ST. MARY'S COLLEGE (AUTONOMOUS)

Re-accredited with A+ Grade by NAAC

Thoothukudi – 628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

Syllabus

M.Sc. Computer Science

School of Computing Sciences

Outcome Based Curriculum

(w.e.f. 2021)

Preamble

M.Sc. Computer Science program helps students to master their computer skills in programming and in managing databases and networks. The students are made globally competent and innovative.

Vision

To empower young women to be technologically adept and encourage them to build their careers in the innovative field of computing

Mission

To provide learning ambience with professional training to create and apply knowledge of computer science in various fields.

To impart necessary skills to develop innovative products and moral values to find solution to real life problems.

Programme Outcome:

PO.No.	**At the end of the M.Sc. Program, the students will be able to**
PO-1	Obtain in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods in Science.
PO-2	Understand their subject areas more clearly and develop skills to critically reflect upon the theory they learn.
PO-3	Adopt the scientific methods and hypothesis testing in designing and execution of experiments.
PO-4	Think critically, work independently and focus in research oriented activities.
PO- 5	Inculcate an ability to engage in life-long learning to improve professional competency.
PO-6	Extend and understand the impact of science on society.
PO-7	Apply their professional ability for entrepreneurship and self-employment.
PO-8	Understand and commit to professional ethics and social responsibility.

Program Specific Outcome:

PSO. No.	Students of M.Sc. Computer Science will be able to	PO addressed
PSO-1	Program efficiently with computer languages using simplified logic.	**PO-3**
PSO-2	Understand the use of Mathematics in Computer Science, in designing and programming.	**PO-3**
PSO-3	Design and use algorithms for solving various problems and also design a computer machine with scalable software solution.	**PO-2**
PSO-4	Acquire adequate skills to apply the concepts of distributed management system and standard data mining techniques used in the industry.	**PO-6**
PSO-5	Understand finite automata, non-deterministic finite automata, regular set and regular expression, applications of finite automata, regular and context-free grammar.	**PO-1**
PSO -6	Learn and apply the concepts of Artificial Intelligence which is essentially important while working with Neural networks and Machine learning.	**PO-2**
PSO -7	Identify the human behavior in organization and handle network related problems by studying data communication problems and network security courses.	**PO-7**
PSO- 8	Understand the working of microprocessor and IoT concepts to develop user friendly projects and further the advancement in research.	**PO-7**

Course Structure (w.e.f.2021)

SEMESTER – I

Subject	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core I	21PCSC11	Design and Analysis of Algorithms	5	4	40	60	100
Core II	21PCSC12	Digital Image processing using MATLAB	5	4	40	60	100
Core III	21PCSC13	Mathematical Foundations for Computer Science	4	4	40	60	100
Core IV	21PCSC14	Compiler Design	4	4	40	60	100
Elective I	21PCSE11/ 21PCSE12	A. Advanced computer Architecture/ B. Cryptography & Network Security	4	4	40	60	100
Core Practical I	21PCSCR1	Design and analysis of algorithm Lab	4	2	40	60	100
Core Practical II	21PCSCR2	Digital Image processing using MATLAB Lab	4	2	40	60	100
			30	**24**			**700**

SEMESTER – II

Subject	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core V	21PCSC21	J2EE	5	4	40	60	100
Core VI	21PCSC22	Data Mining & R Programming	5	4	40	60	100
Core VII	21PCSC23	DDBMS	4	4	40	60	100
Core VIII	21PCSC24	Single Board Computers and IoT	4	4	40	60	100
Elective II	21PCSE21/ 21PCSE22	A. Advanced Computer Networks / B. Soft Computing	4	4	40	60	100
Core Practical III	21PCSCR3	J2EE Lab	4	2	40	60	100
Core Practical IV	21PCSCR4	Data Mining Lab (R Lab)	4	2	40	60	100
			30	**24+2**			**800**

SEMESTER –III

Subject	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core IX	21PCSC31	Software Testing	4	4	40	60	100
Core X	21PCSC32	Cloud Computing & Big Data	4	4	40	60	100
Core XI	21PCSC33	Data Science using Python	4	4	40	60	100
Core XII	21PCSC34	Research Methodology	4	4	40	60	100
Elective III	21PCSE31/ 21PCSE32	A.Organizational Behaviour / B. Object Oriented Software Engineering	4	4	40	60	100
Core Practical V	21PCSCR5	Python Lab	4	2	40	60	100
Project	21PCSCR6	Mini Project	6	4	40	60	100
Self-study Course/ MOOC/ Internship	21PCSSS1/ 21PCSM31/ 21PCSI31	Course for Competitive Exams		+2		100	100
			30	**26+2**			**800**

SEMESTER – IV

Subject	Course Code	Course Title	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Project	21PCSP41	Project work	30	16	100	100	200
			30	**16**			**200**

Master of Science (Computer Science)

Components	No. of Courses	No. of. Hours	Total Credits	Extra Credits
Core	12	52	48	
Practical	5	20	10	
Elective	3	12	12	
Project	2	36	20	
MOOC	1			+2
Self-Study Course/MOOC/ Internship	1			+2
		120	**90**	**+4**

SEMESTER –I			
CORE I	**DESIGN AND ANALYSIS OF ALGORITHMS**		
Course Code:21PCSC11	**Hrs/week:5**	**Hrs/Semester:75**	**Credits:4**

Objectives:

- To be technologically adept, innovative and be able to develop new algorithms.
- To understand the course of the algorithm, its features and complexity
- To compare different algorithms for the same problem.

Course Outcomes:

CO.No.	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Analyze the running time and space complexity of algorithms using asymptotic analysis.	1,3	An
CO-2	Understand different tree traversals, graph traversals and spanning tress.	1,3	Un
CO-3	Apply divide and conquer to binary search, quick sort, merge sort.	3	Ap
CO-4	Apply greedy method to knapsack problem, prims, kruskal algorithms.	3	Ap
CO-5	Apply dynamic programming to optimal binary search trees,0/1 knapsack problem, etc.	3	Ap
CO-6	Apply Backtracking ton-queen problem, sum of subsets problem, graph coloring etc.	3	Ap
CO-7	Apply branch and bound to Travelling sales person problem, 0/1 knapsack problem.	3	Ap
CO-8	Classify the notions of P, NP, NP-complete, and NP-hard	3	An

SEMESTER –I			
CORE I	**DESIGN AND ANALYSIS OF ALGORITHMS**		
Course Code:21PCSC11	**Hrs/week:5**	**Hrs/Semester:75**	**Credits:4**

UNIT- I: Introduction

Introduction – Performance Analysis - Divide and conquer Method: Binary Search, Finding Maximum and Minimum, Merge Sort and Quick Sort.

UNIT - II: Greedy Methods

Greedy Methods: Knapsack Problem, Minimum Cost Spanning Trees, Optimal Storage on Tapes and Single Source Shortest Path Problem-**Net Exam Related Problems**.

UNIT - III : Dynamic Programming & Basic Traversal and Search Techniques

Dynamic Programming: Multistage Graphs, 0/1 knapsack and Traveling Salesman Problem. Basic Traversal and Search Techniques: Techniques for Binary Tree,
Techniques for Graphs: Depth First Search and Breadth First Search - Connected Components and Spanning Tree-**Net Exam Related Problems**

UNIT - IV : Backtracking

Backtracking: 8 Queens Problems, Sum of Subsets, Graph Colouring, Hamiltonian Cycle and Knapsack Problem.

UNIT - V: Branch- and- Bound

Branch and Bound: Least Cost Search. Bounding: FIFO Branch and Bound and LC Branch and Bound.0/1 Knapsack Problem, Travelling Salesman Problem.

Text Book

1. E.Horowitz, S.Sahni and Sanguthevarrajasekaran. *Fundamentals of Computer Algorithms*, 2nd edition, Universities Press, 2008.

Reference Books:

1. S. K. Basu. Design *Methods and Analysis of Algorithms*. PHI, 2005.
2. Goodman and S. T. Hedetniem. *Introduction to the Design and Analysis of Algorithms*. MGH, 1977.
3. A.V. Aho, J.D. Ullman and J.E.Hospcraft. *The Design and Analysis of Computer Algorithms*, Pearson Education.

SEMESTER I			
CORE II	**DIGITAL IMAGE PROCESSING USING MATLAB**		
Course Code: 21PCSC12	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

Objectives:

- To interpret images mathematically and process them for the extraction of data using MATLAB.
- To familiarize students with image enhancement and restoration techniques.
- To introduce the concepts of image processing and basic analytical methods to be used in image processing.

Course Outcomes:

CO. No.	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Develop programming skills and techniques to solve mathematical problem.	1	Ap
CO-2	Learn graphic features of MATLAB and they are able to use this feature effectively in the various applications	1	Ap
CO-3	Distinguish the need for image transforms different types of image transforms and their properties.	2,3	An
CO-4	Learn different techniques employed for the enhancement of images.	3	Un
CO-5	Analyze images in the frequency domain using various transforms.	3	An
CO-6	Interpret Image compression, segmentation and representation standards	3	An
CO-7	Choose image filtering in various applications	2	Ap
CO-8	Analyze different causes for image degradation and overview of image restoration techniques.	3	An

SEMESTER I			
CORE II	**DIGITAL IMAGE PROCESSING USING MATLAB**		
Course Code: 21PCSC12	**Hrs/Week: 5**	**Hrs/Sem: 75**	**Credits: 4**

UNIT- I: Matlab

Introduction: MATLAB Environment - Types of files - Search - Constants , Variables and Expressions - Vectors and Matrices - Polynomials - Input / Output statements-MATLAB graphics-Control Structures - Writing Programs and functions.
(Text Book 1 - Chapter 1, 2, 3, 4, 5, 6, 7, 8)

UNIT- II: Introduction & Image Enhancement

Introduction – steps in image processing, Image acquisition, representation, sampling and quantization, relationship between pixels. – color models – basics of color image processing.

Image enhancement in spatial domain – some basic gray level transformations – histogram processing – enhancement using arithmetic, logic operations – basics of spatial filtering and smoothing.

UNIT-III: Intensity Transformations And Spatial Filtering& Frequency Domain Processing

Intensity Transformation Functions- Histogram Processing and Function Plotting- Spatial Filtering- Image Processing Toolbox Standard Spatial Filters

The 2-DDiscrete Fourier Transform- Computing andVisualizing the 2-D DFT in MATLAB-Filtering in the Frequency Domain- Obtaining Frequency Domain Filters from Spatial Filters - Generating Filters Directly in the Frequency Domain- Sharpening Frequency Domain Fillers.

UNIT -IV: Image Restoration & Color Image Processing

A Model of the Image Degradation/Restoration Process - Noise Models - Restoration in the Presence of Noise Only-Spatial Filtering- Periodic Noise Reduction by Frequency Domain Filtering-Modeling the Degradation Function **-**Direct Inverse Filtering -Wiener Filtering

Color Image Representation in MATLAB- Converting to Other Color Spaces -The Basics of Color Image Processing Color Transformations**.**

UNIT -V: Image Compression & Image Segmentation

Coding Redundancy -Huffman Codes - Huffman Encoding - Huffman Decoding -Interpixel Redundancy -Psychovisual Redundancy- JPEG Compression.

Point, Line, and Edge Detection- Thresholding- Region-Based Segmentation.
(Text Book 2 - Chapter 2, 3, 4, 5, 6, 8, 10)

Text Books:

1. Rajkumar Bansal, Ashok Kumar Goel and Manoj Kumar Sharma. *MATLAB and its Applications in Engineering*. Pearsons Publications, 2016.
2. Rafael C. Gonzalez. *Digital Image Processing using MATLAB*. 2nd Edition, 2010.

Reference Books:

1**.** R.C. Gonzalez and R.E.Woods. *Digital Image Processing*, 3rd Edition, Pearson Education.

SEMESTER – I			
CORE III MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE			
Course Code : 21PCSC13	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Objectives:

- To understand and apply the class of functions which transform a finite set into another finite set which relates to input output functions in computer science.
- Apply the concept of two dimensional random variables to correlation, regression and Central limit theorem
- Analyze whether given graphs are isomorphic and apply different algorithms to find the shortest path.

Course Outcomes:

CO. No.	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Test the complementary relationship of skewness with measures of central tendency and dispersion in describing a set of data.	2	An
CO-2	Apply 'moments' as a convenient and unifying method for summarizing several descriptive statistical measures.	2	Ap
CO-3	Analyze the strength and direction of a linear relationship between two variables using Correlation.	2	An
CO-4	Demonstrate how much a dependent variable changes based on adjustments to an independent variable using regression.	2	Ap
CO-5	Discover the logical operations and predicate calculus needed for computing skill.	2	An
CO-6	Understand the application of various type of graphs in real life problem.	2	Un
CO-7	Apply abstract concepts of graph theory in modeling and solving non-trivial problems in different field of study.	2	Ap
CO-8	Apply theories and concepts to test and validate intuition and independent mathematical thinking in problem solving.	2	Ap

SEMESTER – I			
CORE III MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE			
Course Code : 21PCSC13	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

UNIT - I: Statistics

Moments-Skewness and kurtosis-Curve Fitting-Method of least squares-fitting lines-parabolic, exponential & logarithmic curves

UNIT - II: Correlation & Regression

Correlation & regression –Scatter diagram- Karl Pearson's coefficient of correlation- lines of regression coefficient - rank correlation.

UNIT - III: Mathematical Logic

Mathematical Logic: Propositions and Predicate logic - Truth table - Propositional Equivalence- Normal forms - Predicate and Quantifiers-Rules of Inference.

UNIT – IV: Graph Theory

Graph Theory: Introduction – Paths and Circuits: Isomorphism – Sub graphs – Walks, Paths, Circuits Connected Graphs, Disconnected Graphs and Components – Euler Graphs – Operations on Graph – Hamiltonian Paths and Circuits - Trees and Fundamental Circuits: Trees – Some properties of Trees – Distance and Centers in a Tree – Rooted and Binary Trees – Spanning Trees – Fundamental Circuits – Finding all Spanning Trees of a Graph – Spanning Tress in a weighted Graph

UNIT – V: Graph Theory

Cut-Sets and Cut-Vertices: Cut-Sets – Properties of Cut-Sets – All Cut-Sets in a Graph – Fundamental Circuits and Cut-Sets – Connectivity and Separability – Combinational vs geometric graphs – Planer graphs – Different representation of a planer graph – Matrix: Incidence, Submatrices, Circuit – Matchings – Coloring – The four color problem - Directed graphs – Types of directed graphs – Digraphs and binary relations – Directed paths and connectedness – Euler graphs.

Text Books:

1. Dr.M.K.Venkatraman, Dr. N. Sridharan and N.Chandrasekaran. *Discrete Mathematics*. 2012
2. S. Arumugam and A. Issac. *Statistics*. New Gamma publishing House. Palayamkottai, 2011.
3. NarsinghDeo. *Graph Theory with Application to Engineering and Computer Science*. Prentice-Hall of India Pvt.Ltd, 2003.

Reference Books:

1. Tremblay and Manohar. *Discrete Mathematical Structures with applications to Computer Science*, Tata McGraw Hill.
2. Kenneth H.Rosen. *Discrete Mathematics and Its Applications*, Tata McGraw Hill, 4th Edition, 2002.
3. A.Tamilarasi and A.M.Natarajan. *Discrete Mathematics and its Application.* Khanna Publishers, 2nd Edition 2005.
4. Bondy, J. A. and Murty, U.S.R. *Graph Theory with Applications.* North Holland Publication, 2008.

SEMESTER –I			
CORE IV	**COMPILER DESIGN**		
Course Code:21PCSC14	**Hrs/week:4**	**Hrs/Semester:60**	**Credits:4**

Objectives:

- To learn the process of translating a modern high-level language to executable code.
- To identify the methods and strategies of parsing techniques.
- To generate intermediate code, and to design syntax directed translation scheme and apply code optimization techniques.

Course Outcomes:

CO. No	Upon Completion of this course, students will be able to	PSO addressed	CL
CO-1	Understand the basic principles of compiler in high level programming language	1,5	Un
CO-2	Represent language tokens using regular expressions, finite automata	5	An
CO-3	Apply parsing techniques and able to write Context Free Grammars for various languages	5	Ap
CO-4	Apply the knowledge of intermediate code generation to build efficient systems	5	Ap
CO-5	Develop the knowledge on Run-time Environment	5	Ap
CO-6	Understand the need of intermediate representation for the generation of target code	5	Ap
CO-7	Design code generator and apply code optimization techniques	5	Ap
CO-8	Apply optimization techniques to intermediate code and generate machine code for high level language program	5	Ap

SEMESTER –I			
CORE IV	**COMPILER DESIGN**		
Course Code:21PCSC14	**Hrs/week:4**	**Hrs/Semester:60**	**Credits:4**

UNIT – I: Lexical Analysis

Structure of a compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens –Finite Automata – Regular Expressions to Automata – Minimizing the number of states of a DFA.

UNIT – II: Syntax Analysis

Introduction – Context-free Grammars – Writing a Grammar – Top-Down Parsing – Bottom-Up parsing – LR Parsing – Ambiguous Grammar – Parser Generators

UNIT – III: Intermediate Code Generation

Syntax Directed Definitions - Evaluation Orders for Syntax Directed Definitions - Variants of Syntax trees – Three-Address Code – Types and Declarations – Translation of Expressions – Type Checking

UNIT – IV: Run Time Environments and Code Generation

Storage Organization – Stack Allocation of Space - Access to Nonlocal Data on the Stack - Issues in the Design of a Code Generator – Target Language – Address in the Target Language - A Simple Code Generator

UNIT – V: Code Optimization

Basic Blocks and Flow Graphs - Optimization of Basic Blocks - Peephole Optimization - Machine-Independent Optimizations: Introduction to Data-Flow Analysis

Text Book:

1. Alfred V. Aho, Monica S. Lam, RaviSethi and Jeffery D.Ullman. *Compilers: Principles, Techniques and Tools*. Pearson, 2nd Edition, 2014.

Reference Books:

1. J.P. Tremblay and P.G. Sorrenson. *The Theory and Practice of Compiler Writing*. McGraw Hill, 1985.
2. David Galles. *Modern Compiler Design.* Pearson Education Asia, 2007.
3. Steven S. Muchnick. *Advanced Compiler Design & Implementation*. Morgan Kaufmann Pulishers, 2000.

SEMESTER – I			
ELECTIVE I A- ADVANCED COMPUTER ARCHITECTURE			
Course Code : 21PCSE11	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Objectives:

- To give the students a deep insight on the hardware organisation of a computer system.
- To understand various addressing modes, data storage and memory organisation.
- Learn the computer arithmetic principles and super scalar techniques.

Course Outcomes:

CO. No	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Understand the fundamental of computer structure.	3	Un
CO-2	Perform computer arithmetic operations.	3,2	Ap
CO-3	Apply the concept of cache mapping techniques.	3,1	Ap
CO-4	Correlate the performance of I/O device	3	An
CO-5	Conceptualize instruction level parallelism	3	An
CO-6	Analyze different types of pipeline hazard	3	An
CO-7	Apply various data transfer techniques in digital computer.	3,1	Ap
CO-8	Analyze performance issues in processor and memory design of a digital computer.	5	An

SEMESTER – I			
ELECTIVE I A- ADVANCED COMPUTER ARCHITECTURE			
Course Code : 21PCSE11	Hrs / Week : 4	Hrs / Sem : 60	Credits : 4

UNIT- I: Review of basics and ISA design

CISC vs RISC - Performance measure of a computer: Performance measures, Performance parameters –Measuring the performance –Amdahl's Law and CPU performance. Benchmarks for evaluating the performance.

Design factors - operand and opcode types – Instruction formats and addressing modes –compiler Issues – structure of modern compilers.

UNIT- II: Pipelining

Pipelining: Definition – Basic characteristics of pipelined processing – Functional structure of pipelined computer – pipelined processor design principles - Performance issues- different types of Pipeline hazards.

UNIT- III: Parallelism

Definition and types of parallelisms – Instruction level parallelism – Different typed of dependencies in programs. – Dynamic scheduling –Score boarding– Tomasulo"s approach-Branch prediction. Software Solution to ILP: Super Scalar architecture – static and dynamic scheduling on a super scalar architecture. VLIW architecture

UNIT- IV: Shared Memory Architecture and Memory Organization

Parallel processing Configurations – Flynn's classification – Centralized and distributed memory models. Communication models and memory architectures – Performance metrics for communication mechanisms- challenge- Cache coherence – Directory based cache coherence protocols. Memory hierarchy –strategies of Cache write – cache performance and improvements – Main Memory performance issues –Interleaved memory- Virtual Memory

UNIT- V: Buses and I/O issues

I/O: Storage types, Busses –Bus transactions – I/O device Performance metrics –Queuing theory –Bus Standards –I/O transfer using memory bus -Connecting bus to Cache –**Net Exam Related Problems**

Text Book:

1. K.A.Parthasarathy. *Advanced Computer Architecture*. Thomson Learning, Indian 2nd Edition, 2006.

Reference Books:

1. K. Hwang & F. A. Briggs. *Computer Architecture and Parallel Processing*. TMH, New Delhi 2004.
2. Kai Hwang & Naresh Jotwani. *Advanced Computer Architecture Parallelism, Scalability, Programmability*. McGraw Hill, 2nd Edition,2011
3. D. Sima, T. Fountain & P. Kacsuk. *Advanced Computer Architectures*. Pearson Education.

SEMESTER- I			
ELECTIVE I B- CRYPTOGRAPHY AND NETWORK SECURITY			
Course Code: 21PCSE12	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits :4**

Objectives:

- To make the students to learn the fundamental concepts of cryptography and network security and utilize these techniques in computing system.
- To understand cryptography and network security concepts
- To develop the knowledge in cryptography theories, algorithms and systems

Course Outcomes:

CO. No.	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Understand the fundamental Concepts of various encryption techniques	1,2	Un
CO-2	Demonstrate the process to maintain the Confidentiality, Integrity and Availability of data	7	Ap
CO-3	Distinguish between various algorithms for network security to protect against the threats in the networks	7	An
CO-4	Apply the concept of Public key cryptography	1,7	Ap
CO-5	Analyze solutions for effective key management and distribution	2,7	An
CO-6	Apply and manage to secure a message over insecure channel by various means	7	Ap
CO-7	Identify and apply the functional IP network security to protect against the threats in the networks	7	Ap
CO-8	Explain the configuration of simple firewall architectures	7	Ap

SEMESTER- I			
ELECTIVE I	**B- CRYPTOGRAPHY AND NETWORK SECURITY**		
Course Code: 21PCSE12	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits :4**

UNIT - I: Introduction

Introduction: Information OSI Security Architecture - Security Attacks-Passive Attacks-Active Attacks-Security Services – Authentication-Access Control-Data Confidentiality-DataIntegrity-Nonrepudiation-AvailabilityService-Security Mechanisms-Model for Network security

UNIT - II: Symmetric Ciphers

Classical Encryption Techniques -Symmetric Cipher Model- Substitution Techniques - Transposition Techniques - Block Ciphers and the Data Encryption Standard-Block Cipher Principles - The Data Encryption Standard -Strength of DES- Advanced Encryption Standard - Evaluation Criteria for AES- The AES Cipher

UNIT- III: Asymmetric Ciphers

Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems - The RSA Algorithm- Key Management - Diffie-Hellman Key Exchange- Message Authentication and Hash Functions: Authentication Requirements-Authentication Functions -Message Authentication Codes - Hash Functions

UNIT - IV: Internet Security

IP Security: IP security overview, IP security architecture, Authentication header, Encapsulating security pay load, combining security association, Key management-Web security considerations, Secure socket layer, Secure electronic transaction.

UNIT - V: System Security

System Security: Intruders - Intrusion Detection - Password Management-Malicious software, Viruses and related threats, virus counter measures-Firewalls: Firewall Design Principles-Trusted Systems - Common Criteria for Information Technology Security Evaluation

Text Book:

1. William Stallings. *Cryptography and Network Security Principles and Practices*. 6th Edition, 2013.

References Books:

1. Behrouz A. Ferouzan. *Cryptography & Network Security*, Tata McGraw Hill, 2007.
2. Charlie Kaufman, Radia Perlman and Mike Speciner. *Network Security.* Prentice Hall of India, 2002.

SEMESTER –I			
CORE PRACTICAL-I DESIGN AND ANALYSIS OF ALGORITHMS LAB			
Course Code:21PCSCR1	**Hrs/week: 4**	**Hrs/Semester:60**	**Credits:2**

Using C++ programming write programs for the following:

1. Sorting
2. Graph traversal
3. Prim's Algorithm-Greedy Method
4. N queen problem
5. Knapsack problem
6. Single Source Shortest Path
7. Sum of Subsets
8. Binary Search Tree
9. Graph Coloring
10. BiConnected Components
11. Travelling Salesman Problem

SEMESTER –I			
CORE PRACTICAL-II DIGITAL IMAGE PROCESSING USING MATLAB LAB			
Course Code:21PCSCR2	**Hrs/week:4**	**Hrs/Semester:60**	**Credits:2**

Using MATLAB write programs for the following:

1. Resizing and Rotating Images
2. To extract different attributes of an Image.
3. Image Enhancement- Contrast and Brightness
4. Image Enhancement- Calculate Histogram
5. Blurring and Smoothing
6. Edge Detection
7. Image Sharpening
8. Object Segmentation via Thresholding
9. Noise Filtering
10. Image Negation

SEMESTER – II			
CORE V	**J2EE**		
Course Code : 21PCSC21	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 4**

Objectives:

- To acquire knowledge on the usage of recent platforms in developing web applications.
- Enhancing the student's skills to design and develop interactive, client-side, server-side executable web applications.
- Able to apply the skill learnt for projects.

Course Outcomes:

CO. No.	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Make use of a high-level overview of the J2EE architecture	1	Ap
CO-2	Identify the services and components which comprise the J2EE specification	1	Ap
CO-3	Explain how J2EE technology applications are packaged	1	Ap
CO-4	Acquire the knowledge of EJB and its types	1	An
CO-5	Build server side java application called Servlet to catch form data sent from client and store it on database	1	Cr
CO-6	Build server side java application called JSP to catch form data sent from client, process it and store it on database.	1	Cr
CO-7	Differentiate Servlet and JSP	1	An
CO-8	Understand Struts to develop MVC based web applications that are easy to develop and maintain.	1	Un

SEMESTER – II			
CORE V	**J2EE**		
Course Code : 21PCSC21	**Hrs / Week : 5**	**Hrs / Sem : 75**	**Credits : 4**

UNIT- I: J2EE Introduction

J2EE introduction – J2EE Architecture (J2EE Tiers, Containers,Roles) –J2EE Servers and services –Services of EJB Container – J2EE Technology – Packaging – Web services – Advantages of J2EE Applications

UNIT- II: Enterprise Java Bean Introduction

Enterprise Bean introduction – Benefits of Enterprise Beans - Types of Enterprise Beans – Session Bean – Entity Bean – Message-Driven Bean – The Contents of a Enterprise Bean – The Life Cycles of Enterprise Beans.

UNIT- III: Servlet

Servlet - Servlet Lifecycle - Servlet API -Object model of Servlet framework - Understanding web.xml, servlet tags and directory structure of web application - Generic Servlet and Http Servlet, Servlet Config & Servlet Context - Handling Form data with get and post request - Initializing a servlet - Request Dispatcher, Redirecting Request - Session Management -Filters in servlet -programs in servlet to read all parameters from form, database handling program, reading cookies values.

UNIT- IV: JSP

JSP - What is JSP page? Compare it with servlet - Lifecycle of JSP page - JSP syntax using Directive, Declaration , Expression , Scriplet, Comment - Using JavaBean and Action Tag in JSP - JSP implicit objects - Using JSP standard tag library (JSTL) - Session management - Exception handling - Custom tag - Transferring Control to Another Web Component - Using JDBC in JSP -Programs in JSP -Integrating JSP with JQuery, Bootstrap, Angular JS, JSON.

UNIT- V: Struts

Basic of Struts2 - Understanding MVC architecture - Struts2 framework - Understanding default-stack - comparing struts with other framework - Working with Struts2 Actions - Introducing Struts 2 actions - Packaging your actions - Implementing actions Adding workflow with interceptors - Why intercept requests? - Interceptors in action - Surveying the built-in Struts 2 interceptors - Declaring interceptors - Building your own interceptor Data transfer: OGNL and type conversion - Data transfer and type conversion: common tasks of the web application domain - OGNL and Struts 2 - Built-in type converters - Customizing type conversion Validation framework - RequiredFieldValidator Class - RequiredStringValidator Class - ExpressionValidator Class - Email Validator Class - RegexFieldValidator Class - DateRangeFieldValidator Class Struts.

Text Books:

1. Stephanie Bodoff, Dale Green, Kim Hasse ,Eric Jendrock, Monica Pawlan and Beth Stearns.*J2EE Tutorial*.Addison-Wesley, 2002.
2. Keogh.*J2EE: The Complete Reference*, .McGraw Hill India, 2002.
3. Phil Hanna.*The Complete Reference JSP*. Osborne/McGraw-Hill Publication, 2003.
4. Donald Brown,Chad Michael Davis and ScottStanlick. *Struts 2 in Action*. Manning Publications, 2008.
5. Budi Kurniawan.*Java for Web with Servlets,JSP and EJB: ADeveloper's Guide to J2EE Solutions*.New Riders Publishing.

Reference Books:

1. Bryan Basham , Kathy Sierra and Bert Bates.*Head First Servlets and JSP: Passing the Sun Certified Web Component Developer Exam*.2nd Edition.
2. Jonathan Wetherbee , Massimo Nardone , Chirag Rathod and Raghu Kodali.*Beginning EJB in Java EE 8: Building Applications with Enterprise JavaBeans*. 3rd Edition.

SEMESTER- II			
CORE VI	**DATA MINING & R PROGRAMMING**		
Course Code: 21PCSC22	**Hrs / week :5**	**Hrs / Semester: 75**	**Credits :4**

Objectives:

- Extract patterns of usable data using appropriate algorithms
- To study the basic and advanced concepts in Data Mining Techniques.
- To understand the various algorithms involved in data mining and its applications.

Course outcomes:

CO. No.	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Classify different data mining tasks and the algorithms most appropriate for addressing them.	1,3	An
CO-2	Discover Strengths & Limitations of Data Mining Methods	1,4	An
CO-3	Display interesting patterns from large data, to extract and analyse, make predictions and solve problems	1, 4	An
CO-4	Evaluate models/algorithms with respect to their accuracy	3	Ev
CO-5	Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.	1,4	Ev
CO-6	Develop hypotheses based on the analysis of the results obtained and test them.	1	Ev
CO-7	Learn to Set Up Data for Experiments	1,4	Ap
CO-8	Conceptualize a data mining solution to a practical problem.	1,4	Ap

SEMESTER- II			
CORE VI	**DATA MINING & R PROGRAMMING**		
Course Code: 21PCSC22	**Hrs / week :5**	**Hrs / Semester: 75**	**Credits :4**

UNIT- I: Introduction to Data Mining

Introduction: Basic Data Mining Tasks- Data Mining Versus Knowledge Discovery in Databases. Data Mining Techniques: Introduction-A Statistical Perspective on Data Mining-Similarity Measures- Decision Trees-Neural Networks-Genetic Algorithms

UNIT- II: Classification

Classification: Introduction- Statistical Based Algorithms-Distance Based Algorithms-Decision Tree Based Algorithms-Neural Network Based Algorithms- Rule Based Algorithms-Combining Techniques.

UNIT- III: Clustering

Clustering: Introduction - Similarity and Distance Measures-Outliers Hierarchical Algorithms - Partitional Algorithms.

UNIT- IV: Introduction to R programming

Introduction: Overview and History of R, Getting Help, Data Types, Subsetting, Vectorized Operations, Reading and Writing Data. (5L) Control Structures, Functions, lapply, tapply, split, mapply, apply, Coding Standards. (5L) Scoping Rules, Debugging Tools, Simulation, R Profiler.

UNIT- V: Association rules

Association rules - frequent itemsets - Basic Association Rules-Web Mining-Introduction-Content Mining-Social Network Analysis-HITS and Page rank-Usage Mining

Text Books:

1. Margaret H. Dunham. Data *Mining Introductory and Advanced Topics.* Pearson publications, Ninth Impression, 2002.
2. Roger .D.Peng. R *programming for Data Science*,2015.

Reference Books:

1. K. P. Soman, ShyamDivakar and V. Ajay. *Insight in to Data Mining Theory and Practice.* PHI Learning Pvt. Ltd, 2006.
2. Jiawei Han, MichelineKamber and Jian Pei. *Data Mining Concepts and Techniques.* Morgan Kaufmann Publishers, 3rd Edition.
3. Bing Liu. *Web Data Mining: Exploring Hyperlinks, Contents and Usage Data*.Springer, 2006.

SEMESTER - II			
CORE VII	**DISTRIBUTED DATABASE MANAGEMENT SYSTEM**		
Course Code : 21PCSC23	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Objectives:

- Identify the introductory distributed database concepts and its structures.
- Describe terms related to distributed object database design and management.
- Produce the transaction management and query processing techniques in DDBMS.

Course Outcomes:

CO. No.	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Understand the concept of Distributed DBMS	4	Un
CO-2	Apply various architectures of DDBMS	4	Ap
CO-3	Apply various fragmentation techniques in a given problem	4	Ap
CO-4	Visualize the steps of query processing	4	Ap
CO-5	Finding how optimization techniques are applies to Distributed Database	1,4	An
CO-6	Compare various Query Optimization Algorithms	3	An
CO-7	Identify various approaches to concurrency control in Distributed database	4	An
CO-8	Apply various algorithms and techniques for deadlock and recovery in Distributed database	3,4	Ap

SEMESTER – II			
CORE VII	**DISTRIBUTED DATABASE MANAGEMENT SYSTEM**		
Course Code : 21PCSC23	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

UNIT- I: Introduction to DDBMS

Introduction: Distributed Data Processing, Distributed Database Systems, Promises of DDBSs, Complicating factors - Distributed DBMS Architecture Models- Autonomy, Distribution, Heterogeneity DDBMS Architecture – Client/Server, Peer to peer, MDBS

UNIT- II: Data Distribution Alternatives

Design Alternatives – localized data, distributed data Fragmentation – Vertical, Horizontal (primary & derived), hybrid, general guidelines, correctness rules
Distribution transparency – location, fragmentation, replication - Impact of distribution on user queries.

UNIT- III: Query Processing

Query Processing Problem, Layers of Query Processing Query Processing in Centralized Systems – Parsing & Translation, Optimization, Code generation, Example Query Processing in Distributed Systems – Mapping global query to local.
Optimization of Distributed Queries: Query Optimization, Centralized Query Optimization, Join Ordering Distributed Query Optimization Algorithms.

UNIT- IV: Distributed Transaction Management & Concurrency Control

Transaction concept, ACID property, Objectives of transaction management, Types of transactions, Objectives of Distributed Concurrency Control, Concurrency Control anomalies, Methods of concurrency control, Serializability and recoverability, Distributed Serializability, Enhanced lock based and timestamp-based protocols, Multiple granularity, Multi version schemes, Optimistic Concurrency Control techniques

UNIT- V: Distributed Deadlock & Recovery Deadlock concept, Deadlock in Centralized systems

Deadlock in Distributed Systems – Detection, Prevention, Avoidance, Wait-Die Algorithm, Wound-Wait algorithm Recovery in DBMS - Types of Failure, Methods to control failure, Different techniques of recoverability, Write- Ahead logging Protocol, Advanced recovery techniques- Shadow Paging, Fuzzy checkpoint, ARIES, RAID levels, Two Phase and Three Phase commit protocols.

Text Book:

1. Ozsu. *Principles of Distributed Database Systems*.Pearson Publication, 2020.

Reference Books:

1. Rahimi and Haug. *Distributed Database Mangement Systems*. Wiley publication.
2. A. Silberschatz, H.F. Korth and S. Sudharshan. *Database System Concepts.* New Delhi, Tata McGraw Hill,5th Edition,2006.

SEMESTER- II			
CORE VIII	**SINGLE BOARD COMPUTERS AND IOT**		
Course Code: 21PCSC24	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits :4**

Objectives:

- To deliver a deep knowledge of Internet of Things and Single Board Computers.
- To understand the architecture of Single Board Computers and ability on setup Raspberry Pi .
- To recognize the concepts of Internet of Things and its security measures.

Course Outcomes:

CO.No	**Upon Completion of this course, students will be able to**	**PSO addressed**	**CL**
CO-1	Code program and develop applications using single board computers	8	Ap
CO-2	Create a good working setup of Raspberry Pi	8	Cr
CO-3	Understand the concepts of Internet of Things	8	Un
CO-4	Identify andapplying different IoT technologies	8	Ap
CO-5	Inculcate knowledge on communication middleware and Information security in IoT	7,8	Un
CO-6	Analyze basic protocols in wireless sensor network	7	An
CO-7	Implement State of the Art - IoT Architecture	8	Ap
CO-8	Examine the security and privacy issues in IoT	7,8	An

SEMESTER- II			
CORE VIII	**SINGLE BOARD COMPUTERS AND IOT**		
Course Code: 21PCSC24	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits :4**

UNIT - I: Introduction to Single Board Computers

Introduction - history of Single Board Computers - Classification - Comparison - Evolution - Architecture - applications - Overview on Raspberry Pi - GPIO - shields - overview on Beaglebone - features.

UNIT - II: Setting up RASPBERRY Pi

Installing and preparing Raspberry Pi **-** flashing SD Card **-** Booting up - Configuring Pi **-** Troubleshooting **-** Using Command Line interface - Linux commands - configuring network connection- Arduino and Pi- Basic Input and Output

UNIT – III: Introduction to Internet of Things

Internet of Things: Introduction-Definition & Characteristics of IoT-Physical design of IoT and logical design of IoT- IoT Enabling Technologies: WSNs, Cloud Computing, Big Data Analytics, Communication Protocols and Embedded Systems. IoT and M2M: Introduction-M2M-Difference between IoT and M2M Scenario.

UNIT – IV: Internet of Things Concepts

IoT concepts: IoT architectures-Resource management-IoT data management and analytics-Communication protocols-Applications-Programming frameworks for Internet of Things: Overview-Embedded Device Programming Languages-Message passing in Devices-Stream processing in IoT-Introduction-The foundations of stream processing in IoT-Continuous Logic Processing System-Challenges and future directions.

UNIT – V: Security and Privacy in the Internet of Things

Concepts- IoT Security Overview-Security Frameworks for IoT-Privacy in IoT Networks-Obfuscation and Diversification for Securing the Internet of Things: Introduction-Distinguishing Characteristics of IoT-Obfuscation and Diversification Techniques

Text Books:

1. Matt Richardson and Shawn Wallace.*Getting started with Raspberry Pi.* O'ReillyMedia, Inc, 1st edition, 2012.
2. ArshdeepBahga and Vijay Madisetti.*Internet of Things-A Hands-on Approach*. Universities Press Amir (India), 2015.

Reference Books:

1. RajkumarBuyya and VahidDastjerdi. *Internet of Things: Principles and Paradigms.* Cloud Computing and Distributed Systems (Clouds) Laboratory, Manja Soft Pty Ltd., Australia, 2016.
2. Fei Hu. *Security and Privacy in Internet of Things (IoTs): Models, algorithms, and Implementations.* CRC Press, 2016 .
3. Tim Cox. *Raspberry Pi Cookbook for Python Programmers*. 2014.

SEMESTER- II			
ELECTIVE II	**A – ADVANCED COMPUTER NETWORKS**		
Course Code: 21PCSE21	**Hrs / week :4**	**Hrs / Semester: 60**	**Credits :4**

Objectives:

- To understand modern computer networks
- To familiarize routing algorithms
- To detect the technical problems in networking

Course Outcomes:

CO. No.	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Describe the evolution and History of Wireless technology	7	Un
CO-2	Analyse the wireless propagation channels.	7	An
CO-3	Examine the Performance of ARQ Protocols, Ethernet LAN, Token Ring, RIP, TCP and UDP.	7	Ap
CO-4	Identify the networking technologies and associated network standards.	7	An
CO-5	Solve technical problems in ARQ protocols, MAC protocols and Routing Algorithm.	3,7	Ap
CO-6	Construct the route discovery algorithm to determine the shortest path in an internet represented as a weighted graph.	2,7	Ap
CO-7	Design and implement network architecture	7	An
CO-8	Implementation of protocols like TCP, UDP and IP using OPNET and NS-2	7	Ap

SEMESTER- II			
ELECTIVE II	**A – ADVANCED COMPUTER NETWORKS**		
Course Code: 21PCSE21	**Hrs / week :4**	**Hrs / Semester: 60**	**Credits :4**

UNIT- I: Wireless Services and Technical Challenges

Types of Services- Requirements for the services,-Multipath propagation-Spectrum Limitations-Noise and Interference limited systems-Principles of Cellular networks,-Multiple Access Schemes.

UNIT- II: Wireless Propagation Channels

Propagation Mechanisms (Qualitative treatment)- Propagation effects with mobile radio-Channel Classification- Link calculations-Narrowband and Wideband models.

Unit III: Internetworking devices and Data Link Layer

Repeaters – Hubs – Switches – Bridges: Transparent and Source Routing– Routers.Logical Link Control – Error Detection Techniques – ARQ protocols – Framing – HDLC –Point to Point protocol. Medium Access Control – Random access Protocols – Scheduling approaches to MAC.

Unit IV: Local Area Networks& Wide Area Networks and Network Layer:

Ethernet- Token Bus/Ring , FDDI – Virtual LAN ,WAN Technologies – Frame Relay, ATM, Wireless LAN. Internetworking – IP Addressing – Subnetting – IPv4 and IPv6– Routing – Distance Vector and Link State Routing – Routing Protocols.

Unit V:Transport Layer and Application Layer

Connection oriented and Connectionless Service – User Datagram Protocol – Transmission Control Protocol – Congestion Control –Domain Name System – Simple Mail Transfer Protocol – File Transfer Protocol – Hypertext Transfer Protocol .

Text Books:

1. Andreas.F. Molisch. *Wireless Communications.* John Wiley – India, 2006.
2. Alberto Leon-Garcia. *Communication Networks*. Tata McGraw-Hill, 2012.

Reference Books:

1. Simon Haykin and Michael Moher. *Modern Wireless Communications.* Pearson Education, 2007.
2. Rappaport. T.S.*Wireless communications.* Pearson Education, 2003.
3. W. Stallings. *Data and Computer Communications*. Prentice Hall, 2007.
4. Fred Halsall. *Data communications, Computer Networks and Open systems.* Addis Wesley 2006.
5. Behrouz A. Forouzan .*Data Communications and Networking*.McGraw Hill Companies, Inc., 4th Edition ,2007.

SEMESTER- II			
ELECTIVE II	**B - SOFT COMPUTING**		
Course Code: 21PCSE22	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits :4**

Objectives:

- To solve real-world problems by providing approximate results those conventional and analytical models cannot solve.
- To understand the features, advantages and applications of Artificial Intelligence.
- To realize the revolution of artificial intelligence to develop hybrid systems for the industrial problems.

Course Outcomes:

CO. No.	Upon Completion of this course, students will be able to	PSOs Addressed	CL
CO-1	Understand the concepts of Artificial Intelligence and neural networks.	1	Un
CO-2	Categorize different learning algorithms	3	An
CO-3	Analyze the classification taxonomy of NN	3	An
CO-4	Compare different network models	7	An
CO-5	Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.	2	Ap
CO-6	Implement the concepts of fuzzy sets, knowledge representation using fuzzy rules	2	An
CO-7	Identify and define approximate reasoning, fuzzy inference systems, and fuzzy logic	1	An
CO-8	Analyze the genetic algorithms and their applications	3	An

SEMESTER- II			
ELECTIVE II	**B - SOFT COMPUTING**		
Course Code: 21PCSE22	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits :4**

UNIT – I: Neural Networks Fundamentals

Fundamentals of ANN: The Biological Neural Network, Artificial Neural Networks - Building Blocks of ANN and ANN terminologies: Architecture, setting of weights, activation functions-McCulloch-pitts Neuron Model - Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules – Hebbian Learning rule- Perceptron learning rule-Delta Learning Rule.

UNIT – II: Categories of Neural Networks

Models of ANN: Single layer perceptron- Architecture, Algorithm, application procedure. Associative memory Networks: Hopfield Net and BAM - Supervised Learning Networks: Back propagation Network (BPN) and Radial Basis Function Network (RBFN) - UnSupervised Learning Networks : Self Organizing Feature Maps: SOM and LVQ.

UNIT – III: Basic Concepts of Fuzzy Set

Fuzzy Sets, properties and operations - Fuzzy relations, cardinality, operations and properties of fuzzy relations, fuzzy composition

UNIT – IV: Membership Function & FIS

Fuzzy variables - Types of membership functions - fuzzy rules: Takagi and Mamdani - fuzzy inference systems: fuzzification, inference, rule base, defuzzification.

UNIT-V: Genetic Algorithms

Genetic Algorithm (GA): Biological terminology – elements of GA: encoding, types of selection, types of crossover, mutation, reinsertion – a simple genetic algorithm –General Genetic algorithm -The Schema Theorem - Classification of Genetic Algorithm - Applications of Genetic Algorithm.

Text Books:

1. S. N. Sivanandam, S. Sumathi and S.N. Deepa. *Introduction to Neural Networks using MATLAB 6.0*. Tata McGraw-Hill, New Delhi, 2006.
2. S. N. Sivanandam and S.N. Deepa. *Principles of Soft Computing.* Wiley-India, 2008.

Reference Books:

1. Simon Haykin.*Neural networks A Comprehensive Foundation*. Pearson Prentice Hall,2005
2. S.Rajasekaran and G.A.V.Pai. *Neural Networks, Fuzzy Logic and Genetic Algorithms.* PHI, 2004.
3. S.N.Sivanandam and S.N.Deepa.*Introduction to Genetic Algorithms.* Springer, 2007.
4. Timothy J.Ross.*Fuzzy Logic with Engineering Application.* McGraw Hill, 2000.
5. Davis E.Goldberg.*Genetic Algorithms: Search, Optimization and Machine Learning*. Addison Wesley, N.Y., 2003.

SEMESTER – II			
CORE PRACTICAL III	**J2EE LAB**		
Course Code : 21PCSCR3	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 2**

1. Write a Servlet to display all the headers available from request.
2. Write a Servlet to display parameters available on request
3. Write a Servlet to display all the attributes available from request and context
4. Write a Servlet which displays a message and also displays how many times the message has been displayed (how many times the page has been visited).
5. Assume that the information regarding the marks for all the subjects of a student in the last exam are available in a database, Develop a Servlet which takes the enrollment number of a student as a request parameter and displays the mark sheet for the student
6. Develop a Servlet which looks for cookies for username and password, and forwards to a home.jsp in case the cookies are valid and forwards to login.jsp, in case the cookies are not found or the cookies are not valid.
7. Develop a Servlet to authenticate a user, where the loginid and password are available as request parameters. In case the authentication is successful, it should setup a new session and store the user's information in the session before forwarding to home.jsp, which displays the user's information like full name, address, etc.
8. Write a simple JSP page to display a simple message (It may be a simple html page).
9. Write a JSP page, which uses the include directive to show its header and footer.
10. Create a Java class called Product with the following properties: name, description, price. Create a listener that notifies (through System.out) whenever a user adds a product to a shopping cart (i.e. adds an object to the session object) or removes it again. Hint: check out the class HttpSessionAttributeListener. Make it print the name and price of the object (hint: access the session through the HttpBindingEvent object). Also, let the listener print the total price of all objects saved in the session so far (one way to accomplish this could be to keep a collection of all objects saved to the session – or just their keys – in the listener or an associated class).
11. Create a Servlet filter that logs all access to and from Servlet in an application and prints the following to System.out:
    a. the time the request was received b. the time the response was sent c. how much time it took to process the request d. the URL of the resource requested e. the IP address of the visitor
12. Develop a interest calculation application in which user will provide all FACULTY OF COMPUTER APPLICATIONS information in HTML form and that will be processed by servlet and response will be generated back to the user.
13. Develop an application to demonstrate how the client (browser) can remember the last time it visited a page and displays the duration of time since its last visit. (Hint: use Cookie)
14. Develop an application to keep track of one user across several servlet invocations within the same browser session.

SEMESTER- II			
CORE PRACTICAL IV	**DATA MINING LAB (R LAB)**		
Course Code: 21PCSCR4	**Hrs / week :4**	**Hrs / Semester: 60**	**Credits :2**

Using R programming language write programs for the following concepts:

1. Vectorization
2. Data frames and Matrices.
3. Functions-Calculator Designing
4. Scoping Rules
5. Loop functions
6. Basic statistics and graphics
7. Grammar of data manipulation (dplyr and related tools)
8. Debugging/profiling
9. Subsetting R objects

Semester III			
CORE IX - SOFTWARE TESTING			
Course Code: 21PCSC31	**Hrs / week : 4**	**Hrs / Sem: 60**	**Credits :4**

Objectives:

- To provide basic understanding of the software development life cycle including testing, test planning &design and test team organization.
- To study the various types of test in the life cycle of the software product.
- To build design concepts for system testing and execution

Course Outcomes:

CO. No	Upon Completion of this course, students will be able to	PSO addressed	CL
CO-1	Understand the fundamental concepts and techniques in Software Testing	1	Un
CO-2	Identify and apply the functional and system testing methods in commercial environment	3	Ap
CO-3	Design Test Planning	3	Ap
CO-4	Understand the categories of the system testing methods	3	Un
CO-5	Distinguish between methods of judging test case adequacy and how to design tests that will accomplish the obligations of such methods.	1	An
CO-6	Apply and manage the test process in real-time applications	1	Ap
CO-7	Demonstrate the process of validation and verification Write code to automate test execution and analysis	1	Ap
CO-8	Implement various test processes for quality improvement	1	Ap

Semester III			
CORE IX	**SOFTWARE TESTING**		
Course Code: 21PCSC31	**Hrs / week : 4**	**Hrs / Sem: 60**	**Credits :4**

UNIT- I Basic Concepts, Issues and Techniques

Quality Revolution- Verification and Validation-Failure, Error, Fault, and Defect- Objectives of Testing- Testing Activities-Sources of Information for test Case Selection -White-Box and Black-Box Testing-Test Planning and design-Test Tools and Automation- Test Team Organization and Management.

UNIT - II System Testing

System Integration Testing: System Integration Techniques- Software and Hardware Integration-Test Plan for System Integration-Built- in Testing. Functional Testing:Testing a Function in Context- Boundary Value Analysis- Decision Tables. Acceptance Testing - Selection of Acceptance Criteria-Acceptance Test Plan-Acceptance Test Execution. Software Reliability: Fault and Failure-Factors Influencing Software Reliability- Reliability Models.

UNIT - III System Test Categories

System Test Categories: Taxonomy of System Tests-Command Line Interface Tests, Functionality Tests- GUI Tests-Security Tests-Feature Tests, Robustness Tests- Boundary Value Tests, Power Cycling Tests, Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests. Test Generation from FSM models: State-Oriented Model- Finite-State Machine Transition Tour Method-Testing with State Verification-Test Architectures.

UNIT - IV System Test Design and Execution

System Test Design: Test Design Factors-Requirement Identification-Modeling a Test Design Process-Test Design Preparedness Metrics- Test Case Design Effectiveness. System Test Execution: Modeling Defects- Metrics for Tracking System Test-Metrics for Monitoring Test Execution- Metrics for Monitoring Defect Reports-Defect Causal Analysis-Beta testing-Measuring Test Effectiveness.

UNIT - V Software Quality

Software quality: Five Views of Software Quality-McCall's Quality Factors and Criteria-ISO 9000:2000 Software Quality Standard .Maturity Models: Capability Maturity Model-Test Process Improvement-Testing Maturity Model

Text Book:

1. Kshirasagar.*Software Testing and Quality Assurance, Theory and Practice*. John Wiley & Sons, Inc., Hoboken, New Jersey,2008.

Reference Books:

1. Srinivasan Desikan and Gopalswami Ramesh.*Software Testing: Principles and Practices*. Pearson Education, 1st Edition, 2008.
2. Paul C. Jorgensen.*Software Testing: A Craftman's Approach*., Auerbach Publications, 4th Edition, 2008.

SEMESTER – III			
CORE X	**CLOUD COMPUTING AND BIG DATA**		
Course Code : 21PCSC32	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Objectives:

- To explore the fundamental concepts of big data analytics.
- To analyze the big data using intelligent techniques and the concept of Virtualization.
- Learn to design trusted Cloud Computing system architecture and services.

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO-1	Carrying out the decisions based on data analytics.	4	Ap
CO-2	Analyze the big data analytic techniques for useful business applications.	4	An
CO-3	Identifying the data models in relation to Big Data Storage and Analytics.	4	Re
CO-4	Implementing Big Data applications Using Pig and Hive	4	Ap
CO-5	Plan to work with big data platform	4	Cr
CO-6	Identify the architecture, infrastructure and delivery models of cloud computing.	7	Re
CO-7	Apply suitable virtualization concept.	7	Ap
CO-8	Organize the core issues of cloud computing such as security, privacy and interoperability	7	An

SEMESTER – III			
CORE X	**CLOUD COMPUTING AND BIG DATA**		
Course Code : 21PCSC32	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

UNIT I: Introduction to Big Data

Big data introduction – Characteristics of Big data – Structure of Big data – Evolution of Analytical Scalability – Map Reduce – Cluster Analysis –
Real time analytics platform applications – Case studies for real time Sentiment analysis, Stock market predictions.

UNIT II: Introduction to NoSQL

Introduction to NoSQL – Aggregate data models – HBase – Pig – Grunt - Hive .

UNIT III: Introduction to Cloud Computing

Vision of Cloud computing – Cloud Definition – Characteristics and Benefits – Virtualization – Cloud computing Architecture – Cloud Reference Model, Types of Clouds – Cloud Platforms in Industry.

UNIT IV: Principles of Parallel and Distributed Computing

Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine,
Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim

UNIT V: Security in Cloud Computing

Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data
Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

Text Books:

1. Rajkumar Buyya, Christian Vecchiola and S.Thamarai Selvi. *Mastering Cloud Computing.* TMGH,2013.
2. Kai Hwang, Geoffrey C Fox and Jack G Dongarra.*Distributed and Cloud Computing, From Parallel Processing to the Internet of Things*. Morgan Kaufmann Publishers, 2012.
3. John W.Rittinghouse and James F.Ransome.*Cloud Computing: Implementation, Management, and Security.* CRC Press, 2010.
4. Arshdeep Bahga and Vijay Madisetti.*Big Data Science & Analytics A Hands -On Approach.*2019.

Reference Books:

1. Viktor Mayer-Schonberger and Kenneth Cukier.*Big Data: A Revolution That Will Transform How We Live, Work and Think* .
2. Venkat Ankam .*Big Data Analytics.* 2016.
3. PeteWarden.*Big Data Glossary.* O'Reilly, 2011.
4. Toby Velte, Anthony Velte and Robert Elsenpeter.Cloud *Computing, A Practical Approach.* TMH, 2009.
5. George Reese.*Cloud Application Architectures: Building Applications and Infrastructure in the Cloud.* O'Reilly.
6. Ronald L. Krutz, Russell and Dean Vines.*Cloud Security – A comprehensive Guide to Secure Cloud Computing.* India ,Wiley ,2010.

SEMESTER III			
CORE XI	**DATA SCIENCE USING PYTHON**		
Course Code: 21PCSC33	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits : 4**

Objectives:

- To enable the students to understand the concepts of data science and apply data analysis in various application areas
- To provide comprehensive knowledge of python programming paradigms required for Data Science.
- To perform a wide variety of mathematical operations on arrays using NumPy

Course Outcomes:

CO. No	Upon Completion of this course, students will be able to	PSO Addressed	CL
CO-1	Explore the fundamental concepts of data science	4	An
CO-2	Explain how data is collected, managed and stored for data science	4	Un
CO-3	Visualize and present the inference using various tools	4	Ap
CO-4	Evaluate the data analysis techniques for applications handling large data	4	Ap
CO-5	Implement numerical programming, data handling and visualization through NumPy and Pandas	1	Ap
CO-6	Understand and demonstrate the usage of universal functions and list of Arrays in Python	1	Ap
CO-7	Understand the working of different data types and their related functions	1	Ap
CO-8	Analyze the significance of python program development environment and apply it to solve real world applications	1,3	Un

SEMESTER III			
CORE XI	**DATA SCIENCE USING PYTHON**		
Course Code: 21PCSC33	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits : 4**

UNIT – I: Introduction to Data Science

Introduction: What Is Data Science?- How Does Data Science Relate to Other Fields?- The Relationship between Data Science and Information Science- Data: Introduction- Data Types- Data Collections- Data Pre-processing–Techniques: Introduction – Data analysis and Data analytics- Descriptive Analysis- Diagnostic analytics-predictive analytics- prescriptive analytics- exploratory analysis – mechanistic analysis

UNIT – II: Data Science Tools

Tools for Data Science: UNIX: Introduction- Getting access to UNIX- Connecting to a UNIX server- Basic commands- Editing on UNIX- Redirecting and piping-Python: Introduction-Getting access to Python- Examples- Control structures- statistics essentials

UNIT – III: Introduction to NumPy

Introduction to NumPy: Understanding Data Types in Python- The Basics of NumPy Arrays- Computation on NumPy Arrays: Universal Functions- Aggregations: Min, Max, and Everything in Between- Computation on Arrays: Broadcasting- Comparisons, Masks, and Boolean Logic- Fancy Indexing- Sorting Arrays- Structured Data: NumPy's Structured Arrays

UNIT – IV: Introduction to Pandas

Data Manipulation with Pandas: Installing and using Pandas- Data Indexing and Selection- Operating on Data in Pandas- Handling Missing Data-Hierarchical Indexing-Combining Datasets-

UNIT – V: Data Manipulation with Pandas

Data Manipulation with Pandas: Aggregation and Grouping – Pivot Tables – Vectorized String Operations- Working with Time Series- High performance Pandas: eval( ) and query( )

Text Books:

1. Chirag Shah. *A Hands-on Introduction to Data Science*. Cambridge University Press, 1st Edition 2020.
2. Jake VanderPlas. *Python Data Science Handbook Essential Tools for Working with Data*, O'Reilly Media, Inc., 1st Edition, 2016.

Reference Books:

1. Wes McKinney. *Python for Data Analysis.* O'Reilly Media, Inc., 1st Edition 2012.
2. Luca Massaron and John Paul Mueller. *Python for Data Science for dummies* .John Wiley & Sons, 2019.
3. Davy Cielen, Arno D.B. Meysman and Mohamed Ali. *Introducing Data Science: Big Data, Machine Learning, and More, using Python Tools.* Manning Publications, 2016.

SEMESTER – III			
CORE XII	**RESEARCH METHODOLOGY**		
Course Code : 21PCSC34	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Objectives:

- To achieve outstanding scientific research in various areas of knowledge.
- To encourage distinguished research work through the creation of an attractive and stimulating environment to achieve goals.
- The learner should be able to get a guidelines on how to write, publish, present and review scientific papers.

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	Demonstrate knowledge of research processes	8	An
CO-2	Compare between methodologies and methods used in research work	8	An
CO-3	Understand the fundamental concepts of research problem and research design	8	Un
CO-4	Explain the concepts and procedures of sampling, data collection, analysis and reporting	3	Ap
CO-5	Assess the basic function and working of analytical research tools used in computer science research	3	Re
CO-6	Discuss different methodologies and techniques used in research work	8	An
CO-7	Prepare a research report and examine the plagiarism and its types.	8	Ap
CO-8	Apply the knowledge of teaching methods for its wide applicability.	8	Ap

SEMESTER – III			
CORE XII	**RESEARCH METHODOLOGY**		
Course Code : 21PCSC34	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

UNIT - I: Introduction to Research Methodology

Research Methodology– Introduction - Meaning of research – Objectives of research – Types of Research – Research Approaches – Significance of Research – Research Methods versus Methodology – Research and Scientific Method – Research Process - Criteria of Good Research.

UNIT – II: Defining the Research Problem

Research Problem – Selecting the Problem – Necessity of Defining the Problem – Technique involved in defining a problem – Meaning of Research Design – Features of a good design.

UNIT – III: Sampling Design

Sampling Design - Methods of Data Collection –Research Tools: Introduction – SPSS – MATLAB – LaTeX – NS2 – R tool - Case Study: Presentation by students on their area of research

UNIT – IV: Writing the Research Report, Plagiarism and Ethical Issues in Research and IPR

Report writing and Thesis writing – Citations – Plagiarism – Types of Plagiarism – Tools for detecting Plagiarism – Ethical Issues within the research process – Intellectual Property Rights

UNIT – V: Methodology of Teaching

Methodology of teaching – Objectives for teaching – Structure of teaching – Phases of teaching - Various teaching methods.

Text Book:

1. Kothari, C.R. *Research Methodology: Methods and Techniques.* New Delhi, New Age International, 2nd Edition, 2012.

Reference Books:

1. Janathan Anderson, Berry H. Durston and Millicent Poole. *Thesis and Assignment Writing*. Wiley Eastern Limited, 1992.
2. EhtiramRaza Khan and Huma Anwar. *Research Methods of Computer Science.* University Science Press, 1st Edition, 2016.
3. Dr.Prabhat Pandey and Dr.Meenu Mishra Pandey. *Research Methodology: Tools and Techniques.* Bridge Center, 1st Edition, 2015.

SEMESTER- III			
ELECTIVE I	**A- ORGANIZATIONAL BEHAVIOUR**		
Course Code: 21PCSE31	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits :4**

Objectives:

- To develop a basic understanding of individual behaviour and organisational change.
- To help the students to develop cognizance of the importance of human behaviour.
- To provide the students with the tools to understand and evaluate individual, group and organizational processes.

Course Outcomes:

CO. No	Upon Completion of this course, students will be able to	PSO addressed	CL
CO-1	Analyse the behaviour of individuals and groups in organisations in terms of the key factors that influence organizational behaviour	7	An
CO-2	Evaluate personality types, perception and learning process on human behavior	7	Ap
CO-3	Analyze the importance of Attitudes, Values, Job satisfaction	7	An
CO-4	Describe the key components of Group formation and Group behaviour	7	An
CO-5	Identify different motivational theories and evaluate motivational strategies used in a variety of organizational settings	7	Un
CO-6	Analyze about human stress and the consequences of stress in an organization	7	An
CO-7	Identify the various leadership styles and the role of leaders in a decision making process	7	Un
CO-8	Assess the potential effects of organisational-level factors (structure and culture) on organizational behaviour	7	An

SEMESTER- III			
ELECTIVE I	**A- ORGANIZATIONAL BEHAVIOUR**		
Course Code: 21PCSE31	**Hrs / week :4**	**Hrs / Sem: 60**	**Credits :4**

UNIT – I: Introduction to OB

Introduction: Definition – Key Elements of OB – Nature and Scope of OB – Need for studying Organisational Behaviour – Evolution of OB – Development of OB – Foundations of Individual Behaviour – Personality

UNIT – II: Perception

Perception: Introduction – Perception – Perception Differs from Sensation – Perceptual Process – Factors Affecting Perception – Impression Management – Attitudes: Concept – Formation – Types – Measurements – Change – Values: Concept – Types – Formation – Values and Behaviour – Job Satisfaction: Concept – Determinants – Measuring – Effects – Job Dissatisfaction – Learning

UNIT – III: Motivation

Motivation: Meaning –Nature – Motivation Cycle or Process – Need – Theories - Foundation of Group Behaviour: Definition and Characteristics of Group – Types of Groups – Stages of Group formation – Group Behaviour – Group Decision-Making – Organisational Conflicts

UNIT – IV: Stress Management

Stress Management: Stress – Symptoms of Stress – Measurement of Stress – Causes or Sources of Stress – Consequences of Stress – Communication – Nature and Need for Communication – Process of Communication – Channels of Communication – Communication Networks – Leadership – Power and Politics

UNIT – V: Understanding the Organisational Structure

Organisation: Organisational Structure – Organisational Theory – Organisational Culture – Organisational Development – Organisational Effectiveness – Quality of Working Life

Text Book:

1. S. S. Khanka.*OrganisationalBehaviour.* S. Chand Publishing, 2003.

Reference Books:

1. Stephen P. Robins.*Organisational Behavior.* PHI Learning / Pearson Education, 11th edition, 2008.
2. Aswathappa, K.*OrganisationalBehaviour.* Himalaya Publication, 7th Edition, 2007.
3. Mrs. Amruta S. Oke, Sunil P. Ujagare, Mrs. Gauri M. Kulkarni and Vilas D. Nandavadekar. *Principles & Practice of Management&Organizational Behaviour*.Nirali publication, 2015.
4. Fred Luthans. *Organisational Behavior*.McGraw Hill, 11th Edition, 2001.

SEMESTER – III			
ELECTIVE I	**B - OBJECT ORIENTED SOFTWARE ENGINEERING**		
Course Code : 21PCSE32	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

Objectives:

- To be a professional developer of software products
- To understand different conventions in software modelling
- To perform software testing and validation

Course Outcomes:

CO. No	**Upon Completion of this course, students will be able to**	**PSOs Addressed**	**CL**
CO-1	Design and implement a software system to meet desired needs.	3,6	**Cr**
CO-2	Identify requirements of systems and applications.	3	**An**
CO-3	Use modern software systems and tools.	3	**Ap**
CO-4	Understand different software life cycle concept.	3	**Un**
CO-5	Study and design SRS documents for software projects.	3	**An**
CO-6	Study and model software projects using different modelling techniques.	3	**An**
CO-7	Understand different techniques to map models to code	7	**Un**
CO-8	Discuss about project organisation and communication	7	**Ev**

SEMESTER – III			
ELECTIVE I B - OBJECT ORIENTED SOFTWARE ENGINEERING			
Course Code : 21PCSE32	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 4**

UNIT I: Software Life Cycle Models

Software Life Cycle Models: System concepts – Project Organisation – Life cycle models – Unified Process – Iterative and Incremental – Workflow – Agile Processes-Project Planning and Estimation.

UNIT II: SRS Documentation & UML Diagram

SRS Documentation: Requirements Elicitation – Requirement Documentation – Use Cases – Unified Modeling language-Introduction.

UML Diagram: Class diagrams – Sequence diagrams – Object diagrams – Deployment diagrams – Use case diagrams –State diagrams, Activity diagram, Component diagrams, Case Study, Identifying Classes – Noun Phrase Approach, Common class Pattern Approach, Use- Case Driven Approach, CRC.

UNIT III: Analysis Phase & Design Phase

Analysis Phase: Analysis Object Model (Domain Model)- Analysis Dynamic Models-Non-functional requirements – Analysis Patterns.

Design Phase: System Design Architecture – Design Principles – Design Concepts – Design Patterns – Architectural Styles – Dynamic Object Modeling – Static Object Modeling – Interface Specification – Object Constraint Language.

UNIT IV: Mapping, Testing & Implementation

Mapping: Mapping Design (Models) to Code – Model Transformation – Refactoring – Mapping Associations – Mapping Activities.

Testing & Implementation: Testing – Configuration Management – Maintenance process – System documentation –program evolution dynamics.

UNIT V: Project Organization and Communication & Methodologies

Project Organization and Communication: Introduction: A Rocket Example - An Overview of Projects - Project Organization Concepts - Project Communication Concepts - Organizational Activities.

Methodologies: Introduction: The First Ascent of K2 - Project Environment - Methodology Issues - A Spectrum of Methodologies - Case Studies.

Text Book:

1. Bernd Bruegge, Allen H. Dutoit .*Object-Oriented Software Engineering Using UML, Patterns, and Java,* 3rd Edition ,Pearson.

Reference Books:

1. Bernd Bruegge and Alan H Dutoit. *Object Oriented Software Engineering*. Pearson Education, 2nd edition ,2004.
2. Craig Larman. *Applying UML and Patterns*. Pearson Education, 3rd edition 2005.
3. Stephen Schach.*Software Engineering*. McGraw-Hill, 7th edition 2007.
4. Ivar Jacobson, GrandyBooch and James Rumbaugh. *The Unified Software development Process.* Pearson Education, 1999.

SEMESTER – III			
CORE PRACTICAL V DATA SCIENCE USING PYTHON LAB			
Course Code : 21PCSCR5	**Hrs / Week : 4**	**Hrs / Sem : 60**	**Credits : 2**

1. Given two NumPy arrays as matrices, output the result of multiplying the two matrices and its transpose of a matrix (as a NumPy array).
2. Calculate the difference between the maximum and the minimum values of a given NumPy array along the second axis.
3. Calculate the Average, Variance and Standard Deviation using NumPy.
4. Using a NumPy module create array and check the following:
   - Reshape 3x4 array to 2x2x3 array
   - Sequence of integers from 0 to 30 with steps of 5
   - Join two Arrays.
   - Split two Arrays.
5. Write a NumPy program that allows you to read and convert written data in a file into an array.
6. Create a Data Frame and List the attributes of a Data Frame.
7. Create a Data frame and list the functions that help in selecting the subset of the Data Frame.
8. Write a program to read .CSV file into the Data Frame and then convert it into Pandas Series.
9. Write a Pandas program for Handling Missing Data, i.e. is NaN.
10. Write a program to create data frame for 3 student including name and roll numbers. and add new columns for 5 subjects and 1 column to calculate percentage. It should include random numbers in marks of all subjects.
11. Draw the histogram based on the Production of Wheat in different Years
    Year:2000,2002,2004,2006,2008,2010,2012,2014,2016,2018
    Production:4,6,7,15,24,2,19,5,16,
12. Write Panda function for Data Analysis and Manipulation.

Semester III	
SELF-STUDY COURSE – COURSE ON COMPETITIVE EXAMS	
Course Code: 21PCSSS1	**Credits: 2**

Objectives:

- To provide a platform to the students for building the fundamentals of basic mathematics for competitive examinations preparation strategy
- Establish a framework to help students acquire knowledge and expertise necessary to secure employment opportunities in the government sector

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	Solve real life problems requiring interpretation and comparison of various representations of ratios.	2,6	Ap
CO-2	Distinguish between proportional and non-proportional situations and when appropriate apply proportional reasoning	6	An
CO-3	Solve problems applying probabilistic reasoning to make decisions	2	Ap
CO-4	Evaluate claims based on empirical, theoretical and subjective probabilities	6,4	Re
CO-5	Create and use visual displays of data	4	Cr
CO-6	Solve problems using high speed mental calculations	6	Ap
CO-7	Understand the basic concepts of logical reasoning skills.	1,4	Un
CO-8	Acquire satisfactory competency in use of data analysis	7	Un

Semester III	
SELF-STUDY COURSE – COURSE ON COMPETITIVE EXAMS	
Course Code: 21PCSSS1	**Credits: 2**

UNIT - I

Number System (Including divisibility) – HCF and LCM (Including Factors, Multiples and Prime Factorization)

(Chapter: 1&2, pages 1 – 46)

UNIT - II

Fractions and Decimals – Square and Square roots, Cube and Cube Roots, Indices and Surds.

(Chapter: 3 &4, pages 47 – 94)

UNIT - III

Time, Work and Wages (Including Pipes & Cistern) – Time, Speed and Distance (Including Trains, Boats and Stream, Circular Motion, Races and Games.

(Chapter: 15 & 16, pages 317 - 374)

UNIT - IV

Permutations & combinations and Probability.

(Chapter: 18, pages 391 - 416)

UNIT - V

Set Theory (Including Venn Diagram) – Data Analysis and Data Interpretation (Including Caselet, Table, Line Graph, Bar Graph, Mixed Bar)

(Chapter: 24 & 27, pages 559 – 570, 615 – 648)

Text Book:

1. Er.Deepak Agarwal and Mr.D.P.Gupta:*Rapid Quantitative Aptitude with Shortcuts and Tricks for Competitive Exam*, Disha Publication.

Reference Books:

1. Dr.R.S.Aggarwal: *Quantitative Aptitude for Competitive Examinations*, S.Chand Publication.
2. Rajesh Verma, *Fast Track Objective Arithemetic*, Arihant Publication.