

E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

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Accredited by NAAC with 'A' Grade | Accredited by NBA (CSE, EEE, MECH)

NAGAPATTINAM – 611 002



MASTER OF COMPUTER APPLICATIONS

Full Time Curriculum and Syllabus

Second Year – Third Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1701CA301	Resource Management Techniques	2	2	0	3	40	60	100
1702CA302	Data Mining Techniques	3	0	0	3	40	60	100
1702CA303	Object Oriented Analysis and Design	3	0	0	3	40	60	100
1702CA304	Web Programming	3	0	0	3	40	60	100
1703CA001	Service Oriented Architecture	3	0	0	3	40	60	100
Laboratory Course								
1702CA305	Web Programming Laboratory	0	0	4	2	50	50	100
1702CA306	CASE Tools Laboratory	0	0	4	2	50	50	100
1704CA307	Technical Seminar and Report Writing	0	0	2	1	50	50	100
1704CA308	Life Skill III-Aptitude I	0	0	2	1	100	0	100

L – Lecture | T – Tutorial | P – Practical | CA – Continuous Assessment | ES – End Semester

1701CA301	RESOURCE MANAGEMENT TECHNIQUES	L	T	P	C
		2	2	0	3

PREREQUISITE :

1. Mathematical Foundations of Computer Applications
2. Operation Research

COURSE OBJECTIVES:

1. To understand optimization of LPP using simplex and other methods to be applied in the Industrial situations.
2. To understand network analysis of a Project Management and find shortest path of a Project.
3. To understand different types of Inventory Management and apply it to appropriate environments
4. To understand individual and group replacement policy of an existing machines.
5. To understand queue discipline in different situations and solving it optimally.

UNIT I LINEAR MODEL **12 Hours**

The phases of OR study – Formation of an L.P Model- Graphical solution – Simplex algorithm – Artificial variables technique – Duality in LPP. Transportation problems- VAM – MODI technique, Assignment problems.

UNIT II NETWORK MODELS **12 Hours**

Shortest route – minimal spanning tree - maximum flow models – project network- CPM and PERT network- Critical path scheduling.

UNIT III INVENTORY MODEL **12 Hours**

Types of Inventory- EOQ – Deterministic inventory problems – Price breaks - Stochastic inventory problems- selective inventory control techniques.

UNIT IV REPLACEMENT MODELS **12 Hours**

Replacement of items that deteriorate with time – value of money changing with time – not changing with time – optimum replacement policy – individual and group replacement. Sequencing problem: models with n jobs with 2 machines – problem with n jobs with m machines

UNIT V QUEUING THEORY **12 Hours**

Queuing models – queuing systems and structures – notation – parameter – single server and multi-server models – Poisson input – exponential service – constant rate service – infinite population.

TOTAL: 60 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

Non-Linear Models

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- CO1: Able to analyze and apply optimization techniques and solve Industrial Problems.
- CO2: Able to find shortest path of a Project to complete it in a shortest time.
- CO3: Understand and analyze different types of optimum Inventory levels for the practical problems.
- CO4: Conduct replacement analysis and replace the existing machine in the appropriate time optimally.
- CO5: Able to understand various queue disciplines and apply it according to respective environments.

REFERENCES:

1. Frederick.S.Hiller and Gerald.J.Lieberman, “Introduction Operations Research”, TMH (SIE) 8th edition, 2005.
2. J.K.Sharma, “Operations Research Theory and Applications”, Macmillan India .3rd edition 2009.
3. Wayne.L.Winston, “Operations Research Applications and Algorithms”, Thomson learning, 4th edition 2007.
4. Panneerselvam, “Operations Research” Prentice Hall of India, 2006.
5. G Srinivasan, “Operations Research Principles and Applications”, PHI (EEE) 2013.
6. Wagner, “Operations Research”, Prentice Hall of India, 2000

1702CA302

DATA MINING TECHNIQUES

L	T	P	C
3	0	0	3

PREREQUISITE :

Database Management Techniques

COURSE OBJECTIVES:

1. To Understand Data mining principles and techniques and Introduce DM as a cutting edge Business intelligence
2. To expose the students to the concepts of Data warehousing Architecture and Implementation.
3. To know the data mining techniques in details for better organization and retrieval of data
4. To learn to use association rule mining for handling large data
5. To identify Business applications and Trends of Data mining.

UNIT I DATA MINING & DATA PREPROCESSING

8 Hours

Introduction to KDD process – Knowledge Discovery from Databases - Need for Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction.

UNIT II ASSOCIATION RULE MINING

10 Hours

Introduction - Data Mining Functionalities - Association Rule Mining –Market Basket Analysis – Mining Frequent Item sets with Candidate Generation –Mining Frequent Item sets without Candidate Generation Mining Various Kinds of Association Rules

UNIT III CLASSIFICATION & PREDICTION

10 Hours

Classification Vs Prediction – Data preparation for Classification and Prediction –Naïve Bayes Classifier– Classification by Decision Tree Introduction –Associative Classification – Support Vector Machines – Prediction: Introduction –Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Model Section

UNIT IV CLUSTERING

9 Hours

Cluster Analysis - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods– Grid-Based Methods –Clustering High- Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

UNIT V OPEN SOURCE DATA MINING TOOLS

8 Hours

Introduction –Rapid Miner-Attributes-Modeling-Design and Analysis process-Visualization

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

Bootstrap

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- CO1: Preprocess the data for mining applications
- CO2: Apply the association rules for mining the data
- CO3: Design and deploy appropriate classification techniques
- CO4: Cluster the high dimensional data for better organization of the data
- CO5: Able to understand the Open Source Mining tools

REFERENCES:

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2011.
2. K.P. Soman, Shyam Diwakar and V. Ajay, “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Easter Economy Edition
4. BERSON, ALEX & SMITH, STEPHEN J, Data Warehousing, Data Mining, and OLAP, TMH Pub..
5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Pearson Education, 2007
6. Marakas George M, “Modern Data Mining, and Visualization”, Pearson Education, 2011
7. www.wideskills.com/data-mining-tutorial/data-mining-techniques

1702CA303

OBJECT ORIENTED ANALYSIS AND DESIGN

L	T	P	C
3	0	0	3

PREREQUISITE :

Software Engineering Methodologies

COURSE OBJECTIVES:

1. To provide a brief, hands-on overview of object-oriented analysis in software process
2. To discuss Case studies based project specifications to develop object-oriented models
3. To identify implementation strategies.
4. To demonstrate and apply basic object oriented techniques to create and modify object oriented analysis and design models.
5. To understand and apply testing techniques for object oriented software

UNIT I INTRODUCTION

9 Hours

An overview – Object basics – Object state and properties – Behavior – Methods – Messages – Information hiding – Class hierarchy – Relationships – Associations – Aggregations- Identity – Dynamic binding – Persistence – Meta classes – Object oriented system development life cycle.

UNIT II METHODOLOGY AND UML

9 Hours

Introduction – Survey – Rumbaugh, Booch, Jacobson methods – Patterns – Frameworks– Unified approach – Unified modeling language – Static and Dynamic models – UML diagrams – Class diagram – Use case diagrams – Dynamic modeling – Model organization – Extensibility.

UNIT III OBJECT ORIENTED ANALYSIS

9 Hours

Identifying Use case – Business object analysis – Use case driven object oriented analysis – Use case model – Documentation – Classification – Identifying object, relationships, attributes, methods – Super-sub class – A part of relationships Identifying attributes and methods – Object responsibility

UNIT IV OBJECT ORIENTED DESIGN

9 Hours

Design process – Axioms – Corollaries – Designing classes – Class visibility – Refining attributes – Methods and protocols – Object storage and object interoperability – Databases – Object relational systems – Designing interface objects – Macro and Micro level processes – The purpose of a view layer interface

UNIT V SOFTWARE QUALITY

9 Hours

Quality assurance – Testing strategies – Object orientation testing – Test cases – Test Plan – Debugging principles – Usability – Satisfaction – Usability testing – Satisfaction testing

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

Plant UML

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- CO1: Understand the basic concepts to identify state & behavior of real world objects
- CO2: Learn the various object oriented methodologies and choose the appropriate one for solving the problem with the help of various case studies
- CO3: Understand the concept of analysis, design & testing to develop a document for the project
- CO4: Implement analysis, design & testing phases in developing a software project
- CO5: Understand the testing strategies and know about automated testing tools

REFERENCES:

1. Craig Larman, Applying UML and Patterns, 2nd Edition, Pearson, 2002.
2. Grady Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling, Language User Guide”, Addison Wesley Long man, 1999.
3. Bernd Bruegge, Allen H. Dutoit, Object Oriented Software Engineering using UML, Patterns and Java, Pearson 2004.
4. Ali Bahrami, “Object Oriented System Development”, McGraw Hill International Edition, 1999.
5. <https://www.pdfdrive.net/download-ooad-tutorial-pdf-version-tutorialspoint-e14526601.html>

1702CA304

WEB PROGRAMMING

L	T	P	C
3	0	0	3

PREREQUISITE:

1. Problem Solving and C Programming
2. Object Oriented Programming

COURSE OBJECTIVES:

1. To understand the concepts and architecture of the World Wide Web.
2. To understand and practice Markup languages
3. To understand and practice embedded dynamic scripting on client side Internet Programming
4. To understand and practice web development techniques on client-side

UNIT I INTRODUCTION TO WWW

9 Hours

Internet Standards – Introduction to WWW – WWW Architecture – SMTP – POP3 – File Transfer Protocol - Overview of HTTP, HTTP request – response — Generation of dynamic web pages.

UNIT II DESIGN MARKUP LANGUAGE (HTML):

9 Hours

Introduction to HTML and HTML5 - Formatting and Fonts –Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – Frames - HTML Forms. Cascading Style Sheet (CSS): The need for CSS, Introduction to CSS – Basic syntax and structure -Inline Styles – Embedding Style Sheets - Linking External Style Sheets – Backgrounds – Manipulating text - Margins and Padding - Positioning using CSS.

UNIT III INTRODUCTION TO JAVASCRIPT

9 Hours

Introduction - Core features - Data types and Variables - Operators, Expressions, and Statements -Functions - Objects - Array, Date and Math related Objects - Document Object Model - Event Handling - Controlling Windows & Frames and Documents - Form handling and validations.

UNIT IV ADVANCED JAVASCRIPT

9 Hours

Browser Management and Media Management – Classes – Constructors – Object-Oriented Techniques in JavaScript – Object constructor and Prototyping - Sub classes and Super classes –JSON - jQuery and AJAX.

UNIT V PHP

9 Hours

Introduction - Setting up the environment (LAMP server) - Programming basics -Print/echo - Variables and constants – Strings and Arrays – Operators, Control structures and looping structures – Functions – Establishing connectivity with MySQL database.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Angular JS
2. Node JS

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- CO1: Acquire knowledge about functionalities of world wide web
- CO2: Explore markup languages features and create interactive web pages using them
- CO3: Learn and design Client side validation using scripting languages
- CO4: Acquire knowledge about Open source JavaScript libraries
- CO5: Able to design front end web page and connect to the back end databases.

REFERENCES:

1. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, Fifth Edition, Pearson Education, 2011.
2. Achyut S Godbole and AtulKahate, “Web Technologies”, Second Edition, Tata McGraw Hill, 2012.
3. Thomas A Powell, Fritz Schneider, “JavaScript: The Complete Reference”, Third Edition, Tata McGraw Hill, 2013.
4. David Flanagan, “JavaScript: The Definitive Guide, Sixth Edition”, O'Reilly Media, 2011
5. Steven Holzner, “The Complete Reference - PHP”, Tata McGraw Hill, 2008
6. Mike Mcgrath, “PHP & MySQL in easy Steps”, Tata McGraw Hill, 2012.
7. https://www.cs.uct.ac.za/mit_notes/web_programming.html

1703CA001

SERVICE ORIENTED ARCHITECTURE

L	T	P	C
3	0	0	3

PREREQUISITE:

1. Computer Communication and Networks
2. Cryptography and Network Security

COURSE OBJECTIVES:

1. To learn SOA fundamentals
2. To understand SOAD Design
3. To gain knowledge about SOAP, UDDI and XML to create web services.
4. To study about service composition and to explore Restful services and SOA security
5. To know about the Cloud Computing architecture and services.

UNIT I SOA BASICS

9 Hours

Roots of SOA – Characteristics of SOA - Comparing SOA to client server and distributed internet architectures – Anatomy of SOA - How components in an SOA interrelate -Principles of service Orientation – Service Layers.

UNIT II XML AND WEB SERVICES

9 Hours

XML structure – Elements – Creating Well-formed XML - Name Spaces – Schema Elements, Types, Attributes – XSL Transformations – Parser – Web Services Overview – Architecture.

UNIT III WSDL, SOAP and UDDI

9 Hours

WSDL - Overview Of SOAP – HTTP – XML-RPC – SOAP: Protocol – Message Structure – Intermediaries – Actors – Design Patterns And Faults – SOAP With Attachments – UDDI.

UNIT IV SOA IN J2EE AND .NET

9 Hours

SOA platform basics – SOA support in J2EE – Java API for XML-based web services (JAX-WS) - Java architecture for XML binding (JAXB) – Java API for XML Registries (JAXR) - Java API for XML based RPC (JAX-RPC) – JAX-RS SOA support in .NET – ASP.NET web services

UNIT V CLOUD COMPUTING

9 Hours

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

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

SOAML Diagrams and tools

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- CO1: Known about the basic principles of service oriented architecture , its components and techniques
- CO2: Understand the architecture of web service
- CO3: Design and develop web services using protocol
- CO4: Understand technology underlying the service design
- CO5: Acquire the fundamental knowledge of cloud computing

REFERENCES:

1. Thomas Erl, “Service-Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2006.
2. Heather Williamson, “XML, The Complete Reference”, McGraw Hill Education, 2012.
3. Frank. P. Coyle, “XML, Web Services And The Data Revolution”, Pearson Education, 2002.
4. Sandeep Chatterjee, James Webber, “Developing Enterprise Web Services. An Architect’s Guide”, Pearson Education, 2005.
5. Newcomer, Lomow, “Understanding SOA with Web Services”, Pearson Education, 2005.
6. Dan woods and Thomas Mattern, “Enterprise SOA designing IT for Business Innovation”, O’REILLY, First Edition, 2006.
7. www.soa-manifesto.org.

1702CA305

WEB PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

PREREQUISITE :

Problem Solving and Programming

COURSE OBJECTIVES:

1. To learn web page creation.
2. To understand CSS concepts
3. To understand and practice markup languages
4. To understand and practice embedded dynamic scripting on client side Internet Programming

LIST OF EXPERIMENTS:

1. Create a web page with the following using HTML5
 - (i) To embed an image map in a web page
 - (ii) To fix the hot spots
 - (iii) Show all the related information when the hot spots are clicked
2. Create a web page with all types of Cascading style sheets.
3. Creation of web pages having dynamic contents and validation using Java script
4. Write a JavaScript for Loan Calculation.
5. Develop PHP program using Arrays, control structures, looping structures and Form Handling
6. Using PHP and MySQL, develop a program to accept book information viz. Accession number, title, authors, edition and publisher from a web page and store the information in a database and to search for a book with the title specified by the user and to display the search results with proper headings.
7. Develop and demonstrate a HTML file that includes JavaScript that uses functions for the following problems:
 - (a) Parameter: A string
Output: The position in the string of the left-most vowel
 - (b) Parameter: A number
Output: The number with its digits in the reverse order
8. Designing Quiz Application Personal Information System/ Using JavaScript

TOTAL: 60 HOURS

ADDITIONAL EXPERIMENTS / INNOVATIVE EXPERIMENTS :

1. Application involving applet based GUI, JDBC, Servlet, JSP/PHP, cookies and session tracking.
2. Develop PHP program using Arrays, control structures, looping structures and Form Handling

COURSE OUTCOMES :

On the successful completion of the course, students will be able to

- CO1: Make Web site creation and validation.
- CO2: Explore markup languages features and create interactive web pages using them
- CO3: Acquire knowledge about Open source JavaScript libraries
- CO4: Learn and design Client side validation using scripting languages

REFERENCES :

1. www.W3Schools.com
2. www.tutorialspoint.com
3. http://nptel.ac.in
4. Web programming Lab Manual by EGSPEC

1702CA306

CASE TOOLS LABORATORY

L	T	P	C
0	0	4	2

PREREQUISITE :

Software Engineering

COURSE OBJECTIVES:

1. To understand the software engineering methodologies for project development.
2. To gain knowledge about open source tools for Computer Aided Software Engineering.
3. To develop an efficient software using case tools

LIST OF EXPERIMENTS:

1. Practicing the different types of case tools such as Rational Rose / other Open Source be used for all the phases of Software development life cycle.
2. Data modeling
3. Source code generators
4. Apply the following to typical application problems:
 - (a) Project Planning
 - (b) Software Requirement Analysis
 - (c) Software Design
 - (d) Data Modeling & Implementation
 - (e) Software Estimation
 - (f) Software TestingA possible set of applications may be the following:
 - (a) Library System
 - (b) Student Marks Analyzing System
 - (c) Text Editor.
 - (d) Create a dictionary.
 - (e) Telephone directory.
 - (f) Inventory System.

TOTAL : 60 HOURS

ADDITIONAL EXPERIMENTS / INNOVATIVE EXPERIMENTS :

1. To develop the application by use of different types of case tools such as Rational Rose/other source
2. To develop the School Management System application by use of different types of case tools such as Rational Rose/other source

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Use open source CASE tools to develop software.

CO2: Analyze and design software requirements in an efficient manner.

REFERENCES :

1. <http://nptel.ac.in>
2. <http://Coursera.ac.in>
3. www.W3Schools.com
4. Web programming Lab Manual by EGSPEC

1704CA307

TECHNICAL SEMINAR AND REPORT WRITING

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

1. To help students develop listening skills for academic and professional purposes.
2. To help students acquire the ability to speak effectively in English in real-life situations
3. To inculcate reading habit and to develop effective reading skills.
4. To learn and use client server architecture based applications.
5. To explore server side functionalities of an application.

The goal of this course is to train the students to critically evaluate a well-defined set of research subjects and to summarize the findings concisely in a paper of scientific quality. The paper will be evaluated based on the ability to understand a topic, communicate it and identify the issues. Results from this term paper will be presented to fellow students and a committee of faculty members:

1. Every student selects a topic related to current trends and the same should be approved by the respective committee. This selection should have at least 5 distinct primary sources.
2. Every student must write a short review of the topic and present it to fellow students and faculty (discuss the topic – expose the flaws – analyze the issues) every week.

The faculty should evaluate the short review and award marks with respect to the following.

1. Has the student analyzed – not merely quoted – the most significant portions of the primary sources employed?
2. Has the student offered original and convincing insights?
3. Plagiarism to be checked.
4. Every student should re-submit and present the review article including issues/ comments/conclusions which had arisen during the previous discussion.
5. Every student should submit a final paper as per project specifications along with all short review reports (at least 4 internal reviews) and corresponding evaluation comments.
6. Every student should appear for a final external review exam to defend themselves.

TOTAL : 30 HOURS

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Gain confidence in facing the placement interview.

CO2: Develop effective communication skills (spoken and written).

CO3: Interact with each other and face a wide variety of issues, topics, and situations that they are likely to come across as entry level professionals

1704CA308

LIFE SKILL III - APTITUDE – I

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

1. To brush up problem solving skill and to improve intellectual skill of the students
2. To be able to critically evaluate various real life situations by resorting to Analysis Of key issues and factors
3. To be able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
4. To enhance analytical ability of students
5. To augment logical and critical thinking of Student

UNIT I INTRODUCTION TO NUMBER SYSTEM, BASIC SHORTCUTS OF ADDITION, MULTIPLICATION, DIVISION 6 Hours

Classification of numbers – Types of Numbers - Divisibility rules - Finding the units digit - Finding remainders in divisions involving higher powers - LCM and HCF Models - Fractions and Digits – Square, Square roots – Cube, Cube roots – Shortcuts of addition, multiplication, Division

UNIT II RATIO AND PROPORTION, AVERAGES 6 Hours

Definition of Ratio - Properties of Ratios - Comparison of Ratios - Problems on Ratios - Compound Ratio - Problems on Proportion, Mean proportional and Continued Proportion Definition of Average - Rules of Average - Problems on Average - Problems on Weighted Average - Finding average using assumed mean method

UNIT III PERCENTAGES, PROFIT AND LOSS 6 Hours

Introduction Percentage - Converting a percentage into decimals - Converting a Decimal into a percentage - Percentage equivalent of fractions - Problems on percentages - Problems on Profit and Loss percentage- Relation between Cost Price and Selling price - Discount and Marked Price - Two different articles sold at same Cost Price - Two different articles sold at same Selling Price - Gain% / Loss% on Selling Price.

UNIT IV CODING AND DECODING, DIRECTION SENSE 6 Hours

Coding using same set of letters - Coding using different set of letters - Coding into a number - Problems on R-model - Solving problems by drawing the paths - Finding the net distance travelled - Finding the direction - Problems on clocks - Problems on shadows - Problems on direction sense using symbols and notations.

UNIT V NUMBER AND LETTER SERIES NUMBER AND LETTER ANALOGIES, ODD MAN OUT 6 Hours

Difference series - Product series - Squares series - Cubes series - Alternate series - Combination series - Miscellaneous series - Place values of letters - Definition of Analogy - Problems on number analogy - Problems on letter analogy - Problems on verbal analogy - Problems on number Odd man out - Problems on letter Odd man out - Problems on verbal Odd man out

TOTAL: 30 HOURS

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- CO1: Learners should be able to understand number and solving problems least time using various shortcut
- CO2: Solve problems on averages; compare two quantities using ratio and proportion.
- CO3: Calculate concept of percentages, implement business transactions using profit and loss.
- CO4: Workout concepts of Coding and Decoding, ability to visualize directions and understand the logic behind a sequence.
- CO5: Learners should be able to find a series the logic behind a sequence.

REFERENCES:

1. Arun Sharma, ‘How to Prepare for Quantitative Aptitude for the CAT’, 7th edition, McGraw Hills publication, 2016.
2. Arun Sharma, ‘How to Prepare for Logical Reasoning for CAT’, 4th edition, McGraw Hills publication, 2017.
3. R S Agarwal, ‘A modern approach to Logical reasoning’, revised edition, S.Chand publication, 2017
4. R S Agarwal, ‘Quantitative Aptitude for Competitive Examinations’, revised edition, S.Chand publication, 2017.
5. Rajesh Verma, “Fast Track Objective Arithmetic”, 3rd edition, Arihant publication, 2018.
6. B.S. Sijwalii and InduSijwali, “A New Approach to REASONING Verbal & Non-Verbal”, 2nd edition, Arihant publication, 2014