Department of Computer Science & Informatics

# UNIVERSITY OF KOTA, KOTA

## Scheme of Course Based on CBCS

## Master of Computer Application (MCA)- 2017-18

MCA –I Semester

| S. No. | Subject Code | Name of Paper | Credit | Contact Hrs. | | | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L* | T* | P* | | | |
| 1. | MCA 101 | Computer organization & Architecture | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 2. | MCA 102 | Programming in C | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 3. | MCA 103 | Discrete Mathematics | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 4. | MCA 104 | Data Base Management System | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 5. | MCA 105 | Lab on C & DBMS | 9 | 0 | 0 | 12 | 00 | 100 (50+50) | 100 |
| | | Total Credit | 25 | Total Marks | | | | | 500 |

L* = Lecture T*= Tutorial P*= Practical

MCA - II Semester

| S. No. | Subject Code | Name of Paper | Credit | Contact Hrs. | | | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L* | T* | P* | | | |
| 1. | MCA 201 | Data Structures | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 2. | MCA 202 | Computer Oriented Numerical Methods | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 3. | MCA 203 | Data Communication & Networking | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 4. | MCA 204 | Object Oriented Modeling & Programming | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 5. | MCA 205 | lab based on Data structure lab with C++ & CONM Lab | 9 | 0 | 0 | 12 | 00 | 100 (50+50) | 100 |
| | | Total Credit | 25 | Total Marks | | | | | 500 |

L* = Lecture T*= Tutorial P*= Practical

## MCA - III Semester

| S. No. | Subject Code | Name of Paper | Credit | Contact Hrs. | | | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L* | T* | P* | | | |
| 1. | MCA 301 | Information and Network Security System | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 2. | MCA 302 | Programming with JAVA | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 3. | MCA 303 | Theory of Computation | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 4. | MCA 304 | Design and Analysis of Algorithms | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 5. | MCA 305 | Lab on JAVA & Design and Analysis of Algorithms | 9 | 0 | 0 | 12 | 00 | 100 (50+50) | 100 |
| | | Total Credit | 25 | Total Marks | | | | | 500 |

L* = Lecture T*= Tutorial P*= Practical

## MCA - IV Semester

| S. No. | Subject Code | Name of Paper | Credit | Contact Hrs. | | | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L* | T* | P* | | | |
| 1. | MCA 401 | Web Development & .Net Framework | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 2. | MCA 402 | Operating System | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 3. | MCA 403 | Software Engineering | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 4. | MCA 404 | Artificial Intelligence | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 5. | MCA 405 | Lab on .NET + Operating System + Seminar | 9 | 0 | 0 | 12 | 00 | 100 (50+25+ 25) | 100 |
| | | Total Credit | 25 | Total Marks | | | | | 500 |

L* = Lecture T*= Tutorial P*= Practical

## MCA - V Semester

| S. No. | Subject Code | Name of Paper | Credit | Contact Hrs. | | | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L* | T* | P* | | | |
| 1. | MCA 501 | Modeling & Simulation | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 2. | MCA 502 | Computer Graphics | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 3. | MCA 503 | Elective – I | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 4. | MCA 504 | Elective – II | 4 | 4 | 0 | 0 | 30 | 70 | 100 |
| 5. | MCA 505 | Lab on Computer Graphics and Minor Project | 9 | 0 | 0 | 12 | 00 | 100 (50+50) | 100 |
| | | Total Credit | 25 | Total Marks | | | | | 500 |

L* = Lecture T* = Tutorial P* = Practical

**List of Elective - I**

MCA 503.1: Mobile Computing
MCA 503.2: Image Analysis & Computer Vision
MCA 503.3: Real Time System
MCA 503.4: Embedded System Design
MCA 503.5: System testing

**List of Elective - II**

MCA 504.1: Natural Language Processing
MCA 504.2: Parallel Processing
MCA 504.3: Compiler Design
MCA 504.4: Artificial Neural Network
MCA 504.5: Software Project Management

**Note:** Student have to elect one elective paper from each list**.**

## MCA – VI Semester

| S. No. | Subject Code | Name of Paper | Credit | Contact Hrs. | | | Internal Marks | External Marks | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L* | T* | P* | | | |
| 1. | MCA 601 | Reading Elective | 4 | 0 | 0 | 0 | 0 | 100 | 100 |
| 3. | MCA 602 | Major Project | 16 | 0 | 0 | 0 | 0 | 200 | 400 |
| | | Total Credit | 20 | Total Marks | | | | | 500 |

L* = Lecture T* = Tutorial P* = Practical

**List of Reading Electives**

MCA 601.1: E- Commerce
MCA 601.2: Enterprise Resource Planning
MCA 601.3: Client Server Computing
MCA 601.4: Cloud Computing

**Note:** The lab credits will be calculated by multiplying 3/4 to the weekly hrs. assigned for lab. For Example if 12 hrs. are assigned for lab weekly then credits will be calculated as 12 * 3/4 = 9 credits.

**Distribution of Marks (I to VI Semester)**

Minor Project [50] Break-up

| | |
|---|---|
| SRS (Document + Presentation) | 10 |
| SDS (Document + Presentation) | 10 |
| Mid-term demo of Project | 5 |
| Project Report | 10 |
| Viva-Voce + final Presentation | 15 |
| **Total Marks** | **50** |

Internal Marks [30] Break-up

| | |
|---|---|
| Class Test – I | 15 |
| Presentation/ Case-Study/ Group Activity/ Class Test/ Lab work | 15 |
| **Total Marks** | **30** |

Seminar [25] Break-up

| | | |
|---|---|---|
| 1. | Article Submission (Based on Latest developments in the field of Computer Science ) | 10 |
| 2. | Presentation (Based on Article submitted) | 10 |
| 3. | Viva-Voce | 5 |
| | Total Marks | 25 |

Reading Elective (MCA-VI Sem.) [100] Break-up

| | | |
|---|---|---|
| 4. | *Theory Exam | 30 |
| 5. | Article (Based on Reading Elective) | 30 |
| 6. | Presentation (Based on recent developments in the field of Reading Elective) | 40 |
| | Total Marks | 100 |

* will be conducted at time of final major project submission.

Major Project (MCA-VI Sem.) [400] Marks Break-up

1. Marks of internal Assessment can be distributed as follows:-

| | | |
|---|---|---|
| 1. | Project Performa sent by the student | 40 |
| 2. | Mid-term & end evaluation from project guide | 40 |
| 3. | Synopsis of the project | 70 |
| | Total | 150 |

2. Marks of University Exam can be distributed as follows:-

| | | |
|---|---|---|
| 1. | Dissertation & Project | 100 |

| | | |
|---|---|---|
| 2. | Project Report | 100 |
| 3. | Viva-Voce | 50 |
| | Total | 250 |

Total Marks of MCA VI Semester = 100 (Reading Elective) + 150 (Internal) + 250 (External)

| **Total Marks:** | MCA I Semester | MCA II Semester | MCA III Semester | MCA IV Semester | MCA V Semester | MCA VI Semester |
|---|---|---|---|---|---|---|
| | 500 | 500 | 500 | 500 | 500 | 500 |
| **Total Maximum Marks: 3000** | | | | | | |

## Important Notes:

**1.** A student**,** who remains absent (defaulter) or fails or want to improve the marks in the internal assessment, may be permitted to appear in the desired paper(s) (only on time) in the same semester with the permission of the concerned Head of Department. A defaulter / improvement fee of rupees 250/- per paper shall be charged from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD who may permit the candidate to appear in the internal assessment after depositing the defaulter/improvement fee. A record of such candidates shall be kept in the Department.

## Passing Rules:

**2.** Minimum Pass Marks and Rules regarding Determination of Result are recommended as follows:

(i) The candidate shall be declared as pass in a semester examination. If he/she secures at least 40% marks in each theory paper separately in external & internal examination and 50% marks in each practical paper and at least 50% marks in project/dissertation with 50% aggregate marks in that semester.

(ii) A candidate declared as fail/absent in one or more papers at any odd semester examination shall be permitted to take admission in the next higher semester (even semester) of the same academic session.

(iii) A candidate may be promoted in the next academic session (odd semester) if he/she has cleared collectively at least 50 % of the paper of both semester of previous academic session with 50 % of the aggregate marks. The candidate who does not fulfill the above condition will remain as an ex-student and will reappear in the due paper along with next odd/even semester exams.

(iv) If any student who is provisionally admitted in higher odd semester but could not secure prescribed minimum marks in previous semester will be treated as ex-student and his/her admission fee will be carry forwarded to the next odd semester of forthcoming academic session.

(v) If a candidate, who is declared as pass, wishes to improve his/her performance in the theory papers of previous semester. He/she may re-appear only one time in these papers in next odd/even semester examinations.

(vi) Candidate shall not be permitted to re-appear or improve the marks obtained in the external examination of practical/dissertation in any condition.

(vii) If the number of paper prescribed in a semester examination is an odd number. It shall be increased by one for the purpose of reckoning 50% of the papers for considering the student pass/fail.

(viii) A candidate may be given only two additional chances for passing the semester thus maximum tenure for completing the two years' postgraduate course will be limited to four years, for three years postgraduate programme up to five years.

**3.** Classification of Successful Candidates after Last Semester Examination is recommended as follows:

| **Description of Marks Obtained** | **Division / Result** |
|---|---|
| • 80% and above marks in a paper | Distinction in that paper |
| • A candidate who has secured aggregate 60% and above marks | First Division |
| • A candidate who has secured aggregate 50% and above but less than 60% marks | Second Division |

**Fee Refund** : As per University Rules.

# Semester - I

## COMPUTER ORGANIZATION AND ARCHITECTURE (MCA- 101)

**Unit-1**

Brief introduction to computer organization, representation of data, bits and bytes, Number system (binary, octal, decimal, hexadecimal), Representation of integers, real numbers, positive and negative numbers. Binary arithmetic, Simple concepts and theorems of Boolean Algebra. Representation of characters: BCD, ASCII, EBCDIC Codes, Self Complementary Codes, Error Detecting and Error correcting codes (Parity, Gray& Hamming Codes).

**Unit-II**

Logic Gates and Boolean Algebra, Basics of logic families, Karnaugh Map, Combinational Circuit Design: Adder, subtractor, Encoder, Decoder, Multiplexer, Demultiplexer, Magnitude Comparator. Sequential Circuits, Flip-Flops, Shift Registers, Asynchronous and Synchronous Counters.

**Unit-III**

CPU Organization: Design of ALU, design of shifter and accumulator, Status Register, Processor unit, Control unit organization. Micro instruction format, Hardwired and micro-programmed control.

**Unit-IV**

Data bus and address bus, stack organization, various registers, instruction formats, addressing techniques. I/O Organization – Simple I/O devices and their properties, device interfacing, DMA interface, program & interrupt control transfer.

**Unit-V**

Semiconductor Memories: Types of Memories, Sequential and Random Access Memory (RAM, ROM, PROM, EPROM), Storage location and address, fixed and variable word length storage, Cache Memory, bubble memory, Secondary Memory devices and their characteristics. Development of Indian super computer 'PARAM': History, Characteristics, Strengths, weakness and basic architecture.

**Text/Reference Books**


1. Digital Principles and Applications by Malvino C.P., Leach D.P.; Tata Mc- Graw Hill, 1985.
2. Digital Computer Fundamentals, Bartee, Thomas C., 1991, 6th Edition, McGraw Hill.
3. Computer System Architecture, Mano, M.M., Prentice Hall, 1988.
4. Computer Architecture and Organization, Hayes John P., Mc-Graw Hill 1988 (International Edition)
5. Nicholas Carter and Raj Kamal, Schaum Series "Computer Architecture and Organization" 2nd Ed. 2010.

# Programming in C (MCA- 102)

**Unit I**

Concept of good program, from problems to programs, Introduction to 'C' Language, History of 'C', 'C' character Set, Identifiers and Keywords, Data types, Constants and Variables, declarations, statement, symbolic constants. Operators and expressions, precedence and order evaluating, formatted and unformatted input and output functions. All types of Control Statements.

**Unit-II**

Functions and Program Structure: Basics of functions, parameter passing, recursion, the C-pre-processor, and command line arguments.

**Unit-III**

Pointers and Arrays: concepts of Pointers, pointers and arrays, address arithmetic, pointers and functions, pointer to functions, Concept of dynamic memory allocation.

**Unit-IV**

Structures: Basics, structures and functions, array of structures, pointers to structures, self referential structures, table look up fields, union and typedef.

**Unit-V**

File Structure, Concept of Record, file operations: storing, creating, retrieving, updating, deleting, text and library files, File handling, file pointers, file accessing function, low level I/O, Error handling, command line argument.

**Text/Reference Books**


1. The C Programming Language by Brian W. Kernighan, Dennis M. Ritchie, Prentice Hall Software Series, 2nd Edition.
2. Let us C by Y.Kanetkar, BPB Publications.
3. Mastering C by Vijay Prasad, TMH.
4. Programing with C, Balaguruswamy, Tata McGraw-Hill.
5. How to Solve it by Computers, Dromey, PHI.
6. Schams Dutline of Theory and Problem of Programming with C: Gottfried B.S., TMH.
7. C Project by Kanetkar, BPB Publications,2006.

# Discrete Mathematics (MCA- 103)

## Unit I

Fundamentals: Sets and Subsets, Operations on Sets, Sequences, Properties of Integers, Matrices, Mathematical Structures. Logic & Propositional Logic: Introduction to Logic, Propositional Logic and Predicate Logic, Elements of Propositional Logic - Negation, Conjunction, Disjunction; Truth Table, Tautology, Connectives, Construction of Proposition, Semantics, normal forms, Reasoning with Propositions, Implications, Proof of Identities, Proof of Implications.

## Unit II

Predicate Logic: Well Formed Formula of Predicate Logic, Predicate, Validity, Quantification, Constructing Formulas, Reasoning with Predicate Logic, Quantifiers and Connectives.

## Unit III

Verification**:** Model checking, Linear-time temporal logic, program verification. Induction and Recursion, Recurrence Relations, Proof by Induction. Set and Functions: Sets, relations, functions, operations, and equivalence Relations, relation of partial order, partitions, binary relations, Equivalence relations, growth of functions, Complexity of Algorithms.

## Unit IV

Combinatorics: Permutation, combinations, Binomial theorem, Counting, Pigeon hole principle. Generalized Inclusion-Exclusion Principle (GIEP), Discrete probability.

## Unit V

Trees and Graphs**:** Trees, traversals, spanning trees; graphs – path, connectivity, reachability, cycles and circuits, planar graphs, Euler and Hamilonian graphs, graph traversals, topological sorting, graph coloring.

**Text/References Books**


1. Logic and Discrete Mathematics: A Computer Science Perspective, Winfried Karl Grassmann, Jean-Paul Tremblay, Prentice Hall.
2. Essentials of Discrete Mathematics, David J. Hunter.
3. Element of Discrete Mathematics, C. L. Liu, McGraw-Hill, 2nd Edition, 1985, reprinted 2000.
4. Discrete Mathematical Structures, Bernard Kolman, Robert Busby, Sharon C. Ross, 6/E. Pearson Education.
5. Discrete Mathematics with Graph Theory by Goodaire and Paramenter (www.mhhe.com/math/advmath/rosen/rs/).
6. Discrete Mathematics and its Applications by Kenneth H. Rosen, 5th Edision, McGraw Hill, Inc, 2003.
7. Graph Theory by Narrigh Deo, PHI.

# Database Management System (MCA- 104)

## Unit-I

Introduction: DBMS, Basic DBMS terminology and Data base System versus file System, Data independence architecture of DBMS. Entity Relationship model : Basic Concepts, keys, design issues, E-R diagram, weak entity sets, extended E-R features, reduction of E-R scheme to tables.

## Unit-II

Relational model: structure of relational database relational algebra, tuple relational calculus, domain relational calculus. SQL: Basic structure, set operations, aggregate functions, null values.

## Unit-III

Data Base Design: Functional Dependencies, normal forms, first, second and third normal form, BCNF multivalued dependencies, fourth normal form, join dependencies.

## Unit-IV

Query processing and optimization: Transaction processing concepts, ACID Properties, Concurrency control technique locking techniques, time stamping, Recovery, Integrity and security of database.

## Unit-V

Distributed database system: Fragments of relations, optimization, Distributed Concurrency Control, management of deadlocks and crashes, Database recovery Management.

**Text /Reference books**


1. Data base system and concepts, H. Korth, A. Silbertz, Sudarshan, Fifth Edition, McGraw – Hill.

2. Fundamentals of Database Systems, Elmasari, Navathe, Addison Wesley

3. An Introduction to Database systems, Date C.J, Addison Wesley

4. Database Management System, Majumdar & Bhattachrya, TMH

5. Database Management System, Ramakrishna, Gehkre, McGraw – Hill

6. database management systems, Leon alexis, leon Mathews, “Vikash publication

7. Database system, Rob, coronel, 7th edition, Congage Learning.

# Semester -II

## Data Structures (MCA-201)

**Unit I**

Introduction: structure and problem solving, algorithmic notation, Data Structure, Algorithms and sub algorithms, introduction to algorithm analysis for time and space requirement, rate of growth, basic time and space analysis of an algorithm.

**Unit II**

Primitive and non primitive data structure concept, representation and manipulation of strings, linear data structures and their sequential storage representation, concept and terminology for non primitive data structure, storage structure for arrays, stacks, queues. Operations on arrays, stacks & queues.

**Unit III**

Linear data structures and their linked storage representation: pointers and linked allocation, linked linear list, singly linked list, circularly linked lists, doubly linked list, application of linked linear lists.

**Unit IV**

Non Linear data structure: Trees, types of trees, binary tree, application of trees, Graphs and their representations, applications of graph.

**Unit V**

Sorting and searching: sorting, selection sort, bubble sort, merge sort, tree sort, radix sort, sequential search, binary search, File structure, sequential files, indexed sequential files, direct files.

**Text / Reference Books**


1. An Introduction to Data Structures with Applications, Tremblay & Sorensons, Tata Mcgraw hills publications.
2. Data structure and algorithms, Aho., Alfred V., Pearson Education.
3. Fundamentals of Data structure in C, Horowitz, Ellis, Galgotia publication.
4. Introduction to Data Structure and algorithms with C++ , Rowe, Glenn W., Prentice , Hall
5. Data structures using C and C++ , Langsun , Augenstein , Tenenbaum Aaron M, Prentice Hall

# Computer Oriented Numerical Methods (MCA- 202)

**Unit I**

Computer Arithmetic: Floating point representation of numbers, arithmetic operations with normalized floating point numbers and their consequences. Error in number representation-pitfalls in computing.

**Unit II**

Iterative methods: Bisection, False position, Newton-raphson methods. Discussion of convergence.Polynomial evaluation. Solving polynomial.

**Unit III**

Solution of simultaneous linear equation and ordinary differential equations: Gauss elimination method-pivoting, Conditioned equations, refinements of solutions, Gauss-seidel methods: Acceleration of its native methods.Taylor series and Euler methods, Local and global error analysis, RungeKutta method, Predictor-corrector method, Automatic Error monitoring Stability of solution.

**Unit IV**

Interpolation & Approximation: Polynomial interpolation. Difference regression.Polynomial fitting and curve fitting. Approximation of function by Taylor series and chebyshev polynomials.

**Unit V**

Numerical differentiation and integration : Differentiation formula based on polynomial fit. Pitfalls in differentiation, Trapezoidal, Simpson rules, Gaussian quadrature.

**Text / Reference Books**

1. Computer Oriented Statistical and Numerical Method, E. Balagurusamy Macmillan India Ltd.
2. Computer Oriented Numerical Methods, R.S. Salaria, Khanna Book Publishing Co. (P) Ltd.
3. Computer Oriented Numerical Method, by P.K. Jain.
4. Computer Oriented Numerical Method, by Rajaraman, PHI

# Data Communication and Computer Networking (MCA- 203)

**Unit-1**

Introduction to computer networks, advantage of networking, network architecture & strategies. Data transmission: concept and terminology (data and signal), Analog and digital data transmission, transmission impairments.

**Unit- II**

Transmission media : guided v/s unguided transmission media, multiplexing ; TDM, FDM, SDM & WDM types of network : LAN (Star Ethernet, BUS), VLAN, MAN ,WAN: Configuration, topology ,network hardware (hub, bridge, switch and router ).

**Unit-III**

Principles and purpose of layered approach, ISO-OSI model, protocols and their standards, protocol architecture, different layers and their functions of OSI model, Introduction to TCP/IP models.

Network switching: circuit switching, packet switching; routing and congestion control.

**Unit- IV**

Network technologies: ATM, Frame relay network, DSL ,cable modem system ,ISDN, SONET/SDH: architecture and functions.

**Unit -V**

Network management: – functions SNMPV1: architecture and models, Internetworking, Concept of DNS, URL and models RMON. Issues related to network reliability and security, SSL, firewalls, encryption / decryption and data compression, concept of cyber laws.

**Text books/ Reference Books**


1. Data and Computer communications, Stallings William Prentice Hall of India, 5th edition.
2. Computer Networks, Tanenlaum, A.S., Andrew S., Tanenbaum, Pretice Hall, 4th Edition.
3. Data Communications & Networking, Forouzon, A. Behrouz, McGraw Hill, 5th edition.
4. Computer Network, "A system approach", peterson & Dovie, Harcoert, 3rd edition, 2005.
5. Computer Networks and Internets, Douglas E. Comer, Pearson/PHI, 4th edition, 2004.

# Object Oriented Modeling and Programming (MCA-204)

**Unit –I**

Introduction to programming with C++, objects and classes, constructors, Destructors, objects as function arguments, friend function, operator and function overloading, concept of inheritance & polymorphism.

**Unit II**

Introduction: concept of object orientation, what is object oriented development, object oriented themes, evidence for usefulness of object oriented development.

**Unit III**

Class Modeling: object and classes concept, links and associations concept, generalization and inheritances, Navigation of class models. Advanced class modeling, association ends, N-array association aggregation, abstract classes, generalization as extension and restriction, multiple inheritance, metadata, reification, constraint, derived data, candidate keys. Static modelling and advance data modelling: Events and states, Transition's and conditions, state diagram, state diagram behaviour, operations, nested state diagrams, nested states, single generalization, concurrency, advanced dynamic modelling concept.

**Unit IV**

Interaction Modeling: use case Model, sequence models, activity models.

Functional Modeling: functional models, DFD, Specifying Operations, constraints, relation of functional to object and dynamic models. Design methodology: OMT as a software engineering methodology, OMT methodology

**Unit V**

Domain Analysis: Analysing the Problem statement, adding operation, iterating the analysis. System Design: Overview of system design, breaking in to sub system, identifying concurrency, allocating subsystems to processors and tasks, management of data stores, handling global resources, handling boundary conditions, setting tradeoff priorities, common architectural frameworks.

**Text / Reference Books**

1. Object Oriented Modeling and design, Rambaugh, Blaha et.al , Pearson Education.
2. Mastering C++, Venugopal , K.R. Tata McGraw – Hills.
3. Let us C++, Kanetkar Yashwant P. , BPB Publications.
4. Object Oriented programming with C++, Balaguruswami E., Tata Mc Graw Hill.
5. An Introduction to OOP and Silvertalk – Addison Wesley, L. Pinson and R. Wiener,.