

**ADIKAVI NANNAYA UNIVERSITY:RAJAMAHENDRAVARAM**  
**UNIVERSITY COLLEGE OF ENGINEERING**

Department Of Computer Science & Engineering



**Master of Computer Applications(MCA)**

**Course Structure and Scheme of Valuation w.e.f. 2016-17**

**ADIKAVI NANNAYA UNIVERSITY**  
**Master of Computer Applications(MCA)**  
**Course Structure and Scheme of Valuation w.e.f. 2016-17**

**I Semester**

Code	Name of the subject	Periods/week		Max Marks		Total Marks	Credits
		Theory	Practical	External	Internal		
MCA 1.1	Computer Fundamentals and Programming in C	4	-	75	25	100	4
MCA 1.2	Data Structures	4	-	75	25	100	4
MCA 1.3	Discrete Mathematical Structures	4	-	75	25	100	4
MCA 1.4	Computer Organization	4	-	75	25	100	4
MCA 1.5	Management Accountancy	4	-	75	25	100	4
MCA 1.6	C and Data Structures Programming Lab	-	3	50	50	100	2
MCA 1.7	Computer Organization Lab	-	3	50	50	100	2
<b>Total</b>						<b>700</b>	<b>24</b>

## MCA 1.1 Computer Fundamentals and Programming in C

**Instruction:**4 Periods/week

**Time:** 3 Hours

**Credits:**4

**Internal:**25 Marks,

**External:** 75 Marks

**Total:** 100 Marks

---

### Unit-I

**Fundamentals of Computers:** Computers, Computer generations and Classification, Moore's law, Data Representation: Representation of Characters, Integers and Fractions, Algorithms, Flowcharts, Input Units: Keyboard, Mouse, MICR and OMR; Output Units: Flat Panel Display, Printers and Plotters, Programming Languages: Assembly Language, Higher Level Programming Languages, Compiling a High Level Language Program, Some High Level Languages, Need of Operating Systems, Evolution of OS, Functions of OS.

### Unit-II

**Introduction to C Programming:** C Character Set, Identifiers, Keywords, Variables, Constants, Type Conversion, Operators and Expressions, Operator Precedence and Associativity, Basic Input Output Types: Single Character and String, General; Formatted Input and Output, Running a Simple C Program Using gcc, tc++ Compilers.

**Control Structures:** Sequence, Selection Using Simple if, if..else and switch, Iteration using while, do..while and for Statements. Counter Controlled and Sentinel Controlled Repetition, Break and Continue, Unconditional goto, Conditional Operator, null Statement.

### Unit-III

**Functions:** Uses, User Defined and Library Functions, Calling Functions by Value and Reference, Storage Classes, Recursion, Macros vs Functions.

**C Library Functions:** stdio.h, stdlib.h, math.h, string.h, ctype.h, alloc.h, graphics.h.

**Arrays and Strings:** Array Uses and Operations, One and Two Dimensional Arrays, Array of Strings

**Pointers:** Uses of Pointers, Pointer Variables, Dereferencing Pointers, Void Pointers, Pointer Arithmetic, Pointers to Pointers, Pointers and One Dimensional, Two Dimensional Arrays, Pointers and Functions, Array of Pointers, Pointer Constants, Pointers and Strings, Constant Pointers

### Unit-IV

**Structures and Unions:** Declaring and Using Structures, Operations on Structures, Array of Structures, Pointers to Structures, Structures and Functions, Unions, Bitwise Operators, Bit Fields.

**Files:** File Structure, File Handling Functions, Create, Read and Write of Sequential and Random Access Files.

**Dynamic Memory Allocation:** Library Functions for Dynamic Memory Allocation, Dynamic Multi Dimensional Arrays, Self Referential Structures.

**Other Topics:** Conditional Compilation, Command Line Arguments, Comma Operator, Enumeration Constants, Type Qualifiers: const and volatile

### Text Books:

1. Fundamentals of Computers. V Rajaraman, Neeharika Adabala, Fourth Edition PHI
2. Mastering C. K R Venugopal S R Prasad. Tata Mc Graw Hill.
3. C How to Program. Paul Dietel, Harvey Dietel. Sixth Edition. PHI.

### Reference Books:

1. C The Complete Reference. Herbert Schildt, Fourth Edition. Mc Graw Hill.
2. Programming in C. Stephen G Kochan. Third Edition. Sams Publishing.
3. The C Programming Language. Brian W Kernighan, Dennis M Ritchie. Second Edition. Prentice Hall.

## MCA 1.2 Data Structures

**Instruction:4 Periods/week**  
**Internal:25 Marks,**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits:4**  
**Total: 100 Marks**

---

### Unit I

The Stack: Primitive operations – stack as an ADT–Implementing the Stack operations using Arrays and Structures, Queue as Abstract Data Type–Sequential Representation, Types of Queues – Operations – Implementation using Arrays and Structures, Linked List:Operations, Implementation of Stacks, Queues and priority Queues,insertion, deletion and concatenation operations on circular lists, Stacks and Queues as circular lists, doubly linked lists-applications.

### Unit II

Trees: Binary Trees Operations and Applications. Binary Tree Representation: Node Representation–Implicit array Representation–Choice of Representation–Binary Tree Traversal–Threaded Binary Trees and their Traversal- Huffman Algorithm-Representing Lists as Binary Trees–Trees and their Applications.

Binary Search Tree: Insertion in to a Binary Search Tree–Deleting from a Binary Search Tree– Efficiency of Binary Search Tree operation

### Unit III

Sorting: General Background-Exchange sorts-Selection and Tree Sorting-Insertion sorts-Merge and Radix Sort

Searching: Basic Search Techniques- Tree Searching-General Search Trees:B Trees and B<sup>+</sup> Trees.

### Unit IV

Hashing: Open Addressing-deleting items-Binary Tree hashing-Dynamic Hashing and Extendible Hashing-Choosing a hash function

Graphs: Graphs-Linked Representation of Graphs-Graph Traversals: BFS and DFS.

### Text Books:

- 1.Data Structures Using C and C++ Yedidyah Langsam, Moshe J.Augenstein and Aaron M. Tanenbaum, Prentice Hall of India (2ndEdition)
2. Data Structures, Algorithms and Applications with C++, SahaniMc-GrawHill.
3. File Structures – An Object Oriented Approach with C++ by Michael J. Folk, Bill Zoellick and Greg Riccardi,, Pearson

## MCA 1.3 Discrete Mathematical Structures

**Instruction: 4 Periods/week**  
**Internal: 25 Marks,**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### Unit I

**Introduction:** Logic-Propositional Equivalences-Truth tables-Totalogies-Predicates and Quantifiers-Sets-Operations on sets-Sequences and Summations -Growth functions - relations and their properties- n-ary relations and their applications - Representation of relations-Closures of relations-Equivalence relations-Partial Orderings.

### Unit II

**Counting Techniques:** Basics of Counting- Pigeonhole Principle- Combinations and Permutations-Generalized Permutations and Combinations

**Recurrence relations:** Solving Recurrence Relations-Divide and Conquer relations-Inclusion and Exclusion-Applications of Inclusion-Exclusion.

### Unit III

**Graphs:** Introduction to Graphs-Terminology-Relations and Directed Graphs - Representations of Graphs- Isomorphism-Connectivity- Euler and Hamiltonian Paths - Shortest Path problems- Planar Graphs- Graph Coloring-

**Trees:** Introduction to trees- Applications of trees- Traversals-Trees and sorting-Spanning Trees-Minimum Spanning Trees.

### Unit IV

**Boolean Algebra and Models of Computation:** Boolean Functions- Representing Boolean Functions -Logic Gates-Minimizations of Circuits-Languages and Grammars- Finite State Machines with and with no output.

### Text Book:

Discrete mathematics and its applications, Keneth. H. Rosen, Tata McGraw-Hill Publishing Company, New Delhi

### Reference Books:

- 1) Discrete Mathematics for computer scientists & Mathematicians, Joe L. Mott, Abraham Kandel & T. P. Baker, Prentice Hall of India Ltd, New Delhi
- 2) Discrete mathematics, Richard Johnsonbaug, Pearson Education, New Delhi

## MCA 1.4 Computer Organization

**Instruction:4 Periods/week**  
**Internal:25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits:4**  
**Total: 100 Marks**

---

### UNIT-1

#### **Digital Logic Circuits :**

Digital Computers, Logic Gates, Boolean Algebra, Map Simplification, Combinational Circuit, Flip-flops Sequential Circuits.

#### **Digital Components:**

Integrated Circuits, Decoders, Multiplexes, Registers ,Shift Registers, counters, Memory Unit.

### UNIT-2

#### **Data Representation:**

Data Types, Complements, Fixed-point Representation, Floating point Representation

#### **Register Transfer and Micro Operations:**

Register Transfer Language, Register Transfer, Bus and Memory Transfer, Arithmetic Micro Operations, Assembly language Instructions, 8085 Microprocessor Instruction Set Architecture.

### UNIT-3

#### **Basic Computer Organization and Design:**

Instruction Codes, Computer Register, Computer Instructions, Timing and Control, Instruction Cycle memory reference Instructions, Input-Output , Interrupt.

#### **Central Processing Unit:**

Introduction, General Register Organization, Stack Organization, Instruction formats, addressing modes.

### UNIT-4

#### **Input /Output Organization:**

Peripherals Devices, I/O Interface, Asynchronous Data Transfer, Mode of Transfer, Priority Interrupt, Direct memory access, Input – Output Processor(IOP).

#### **Memory Organization:**

Memory Hierarchy, Main memory, Auxiliary Memory, Associate Memory, Cache Memory and Virtual Memory.

#### **Text Books:**

1.Computer System Architecture, M.Morris Mano, Prentice Hall of India Pvt.ltd. Third Edition, Sept. 2008.

#### **Reference Books:\***

1.Computer Architecture and Organization, William Stallings, PHI Pvt. Ltd. Eastern Economy Edition, Sixth Edition, 2003.

2.Computer System Architecture John P. Hayes.

3.Computer Architecture A Quantitative approach 3<sup>rd</sup> Edition John L. Hennessy & David A. Patterson Morgan Kufmann (An Imprint of Elseveir)

## MCA 1.5 Management Accountancy

**Instruction:4 Periods/week**  
**Internal:25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits:4**  
**Total: 100 Marks**

---

### Unit I

Principles Of Accounting: Nature And Scope Of Accounting, Double Entry System Of accounting introduction To Basic Books Of Accounts Of Sole Proprietary Concern, closing of books of accounts and Preparation Of Trial Balance.

Final Accounts: Trading, Profit And Loss Accounts And Balance Sheet Of Sole Proprietary Concern with Normal Closing Entries. (With numerical problems)

### Unit II

Ratio Analysis: Meaning, Advantages, Limitations, Types of Ratio and Their Usefulness. (Theory only) Fund Flow Statement: Meaning Of The Term Fund, Flow Of Fund, Working Capital Cycle, Preparation and Inter-preparation Of Statement.

### Unit III

Costing: Nature, Importance And Basic Principles. Budget and Budgetary Control: Nature And Scope, Importance, Method Of Finalization And Master Budget, Functional Budgets.

Marginal Costing: Nature, Scope, Importance, Construction Of Break Even Chart, Limitations And Uses Of Break Even Chart, Practical Applications Of Marginal Costing. (with numerical problems)

### Unit IV

Introduction To Computerized Accounting System: Coding Logic And Codes Required, Master Files, Transaction Files, Introduction To Documents Used For Data Collection, Processing Of Different Files And Outputs Obtained.

### Text Books:

1. Introduction to Accountancy. T.S. Grewal.
2. Management Accountancy, S.P. Jain.

### Reference Book:

Introduction To Accounting, G. Agarwal.

## **MCA1.6 Data Structures and Programming Lab**

**Instruction:3 Periods/week**  
**Internal:50 Marks**

**Time: 3 Hours**  
**External: 50 Marks**

**Credits:2**  
**Total: 100 Marks**

---

### **Cycle-I :**

Write programs in C to implement the following concepts / solve the problems.

1. Type Conversion
2. Operator Precedence and Associativity
3. Basic and Formatted Input Output
4. Control Structures
5. Counter and Sentinel Controlled Repetition
6. Break and Continue Statements
7. Functions: Call by Value and Reference
8. Storage Classes
9. C Library Functions
10. Array Operations
11. Array of Strings and Pointers
12. Structures and Unions
13. Sequential and Random Access Files
14. Dynamic Memory Allocation
15. Any other concepts

### **Cycle-II**

1. Implementation of ADT Linked list.
2. Implementation of Stack using arrays and Linked Lists
3. Implementation of Queue using arrays and Linked Lists
4. Write Programs to implement Conversion of prefix expression into post-fix form using stacks.
5. Implementation of Binary tree and its Traversals  
a)Preorder b)In order c)Post order.
6. Write a C Programming to implement the Sorting techniques
7. Write a C Programming to implement the Searching techniques
8. Write C Programs to implement B Trees and B+ Trees
9. Implement BFS and DFS in Graphs
10. Write Program to implement hashing techniques.



## MCA 1.7 Computer Organization Lab

**Instruction:3 Periods/week**  
**Internal:50 Marks,**

**Time: 3 Hours**  
**External: 50 Marks**

**Credits:3**  
**Total: 100 Marks**

---

### **CYCLE-I:**Digital Logic Design Experiments

1. TTL Characteristics and TTL IC Gates
2. Multiplexers&Decoders
3. Flip-Flops
4. Counters
5. Shift Registers
6. Binary Adders & Subtractors
7. ALU

Text Book1 : Computer System Architecture, M.Morris Mano, Preintice Hall of India Pvt.Ltd. Third Edition.

### **CYCLE-II:**8085Assembly Language Programming:

1. 8085Assembly Language Programming according to theory course microprocessors using the following trainers:  
Keyboard Monitor of 8085 $\mu$ P Trainer.  
Serial Monitor of 8085  $\mu$ P Trainer with Terminal  
8085 Line Assembler of 8085 $\mu$ P Trainer with PC as Terminal  
8085Cross Assembler using In-Circuit Emulator(ICE)with 8085 $\mu$ P Trainer and PC as Terminal  
Graded Problems are to be used according to the syllabus
2. Pentium class pc architecture familiarization hardware & software parts demonstration.

Text Book2 : Fundamentals of Micro Processor and Micro Controllers by B.RAM B.Ram

**ADIKAVI NANNAYA UNIVERSITY**  
**Master of Computer Applications(MCA)**  
**Course Structure and Scheme of Valuation w.e.f. 2016-17 Admitted Batch**

**II Semester**

Code	Name of the subject	Periods/week		Max Marks		Total Marks	Credits
		Theory	Practical	External	Internal		
MCA 2.1	Probability, Statistics & Queuing Theory	4	-	75	25	100	4
MCA 2.2	Database Management Systems	4	-	75	25	100	4
MCA 2.3	Object Oriented Programming With C++ & JAVA	4	-	75	25	100	4
MCA 2.4	Formal Languages & Automata Theory	4	-	75	25	100	4
MCA 2.5	Information Systems & Organizational Behavior	4	-	75	25	100	4
MCA 2.6	Database Management Systems Lab	-	3	50	50	100	2
MCA 2.7	Object Oriented Programming Lab	-	3	50	50	100	2
<b>Total</b>						<b>700</b>	<b>24</b>

## MCA 2.1 PROBABILITY, STATISTICS & QUEUING THEORY

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I:

**Probability:** Definitions of probability, Addition theorem, Conditional probability, Multiplication theorem, Bayes' Theorem of Probability.

**Random variables and their properties:** Discrete Random Variable, Continuous Random Variable, Probability Distribution, Joint Probability Distributions their Properties, Transformation Variables, Mathematical Expectations, Probability Generating Functions.

### UNIT II:

**Probability Distributions:** Discrete Distributions: Binomial, Poisson and Their Properties; Continuous Distributions: Uniform, Normal, Exponential Distributions and Their Properties.

**Multivariate Analysis:** Correlation, Correlation Coefficient, Rank Correlation, Regression Analysis, Attributes, Coefficient of Association, Chisquare – Test For Goodness Of Fit, Test For Independence.

### UNIT III:

**Estimation:** Sample, Populations, Statistic, Parameter, Sampling Distribution, Standard Error, Un-biasedness, Efficiency, Maximum Likelihood Estimator, Notion & Interval Estimation.

**Testing of Hypothesis:** Formulation of Null hypothesis, critical region, level of significance, power of the test;

### UNIT IV:

**Sample Tests:** Small Sample Tests: Testing equality of means, testing equality of variances, Large Sample tests: Tests based on normal distribution

**Queuing Theory:** Queue description, characteristics of a queuing model, study state solutions of M/M/1: $\infty$  Model, M/M/1 : N Model,

### Text Books:

1. Probability & Statistics for Engineers and Scientists, Walpole, Myers, Myers, Ye. Pearson Education.
2. Probability, Statistics and Random Processes T.Veerarajan Tata McGraw – Hill

### Reference Book:

1. Probability & Statistics with Reliability, Queuing and Computer Applications, Kishor S. Trivedi, Prentice Hall of India, 1999

## MCA 2.2 DATABASE MANAGEMENT SYSTEMS

**Instruction:**4 Periods/week  
**Internal:**25 Marks

**Time:** 3 Hours  
**External:** 75 Marks

**Credits:**4  
**Total:** 100 Marks

---

### UNIT I

**Database and Database Users:** Data models, schemas, and instances, three-schemas architecture and data independence, database languages and interfaces, the database system environment, Centralized and client/server architectures for DBMSs, Classification of database management system.

**Data Modeling Using the Entity-Relationship Model:** Using High—Level Conceptual data model, Entity types, entity sets Attributes and keys, Relationships types, relationship sets, roles and structural constraints, Weak Entity types, ER diagrams Meaning conventions and design issues, Enhance Entity Relationship model,

**Relational data model and relational database constraints:** Relational model constraints and relational schemas, update operations.

### UNIT II

**Relational Algebra and Relational Calculus:** Unary Relational operations, Relational Algebra operations, Binary Relational operation, Additional Relational operation, Examples of Queries in Relational Algebra, Domain Relational Calculus.

**Relational database design by ER and EER Relational Mapping:** Relational database design using ER to Relational Mapping, Mapping EER Model Construct to Relations,

**Schema Definition, Basic Constraints and Queries:** SQL Data definition, Specifying basic constraints in SQL, Schema change Statements in SQL, Basic queries in SQL, More complex SQL queries, INSERT DELETE UPDATE queries in SQL, Views in SQL, Data base stored Procedures,

### UNIT III

**Relational Database Design:** Informal design Guide lines for Relation Schema, Functional Dependences, Normal forms based on Primary keys, General definitions of Second and Third Normal form, BOYCE-CODE Normal form, Algorithm for Relational database schema design, Multi-valued dependencies and fourth Normal forms,

**File Organization and Indexes:** Introduction, Secondary Storage Devices, Buffering Blocks, Placing file records on disk, Operations on Files, Hashing Techniques, Parallelizing Disk Access using RAID Technology, Indexing Structures for files.

### UNIT IV

**Algorithm for query processing and Optimization:** Translating SQL Queries into Relational Algebra, Algorithms for SELECT and JOIN Operations, Algorithms for PROJECT and SET Operations,

**Introduction to Transaction Processing Concepts and Theory:** Introduction to Transaction Process, Transaction and System Concepts, Characterizing Schedules, Concurrency Control Techniques, Database Recovery Concepts, Recovery Techniques.

### Text Book:

1. Fundamentals of Database System , Elmasri, Navathe, Pearson Educaiton.

### References Books:

1. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw-Hill.
2. Database Concepts, Abraham Silberschatz, Henry F Korth, S Sudarshan, McGraw-Hill

## MCA 2.3 OBJECT ORIENTED PROGRAMMING WITH C++ & JAVA

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT-I

**Fundamentals of Object Oriented Programming:** Introduction to Object Oriented Paradigm, Evolution of Programming Paradigms, Benefits of OOP, An Overview of Classes, Objects and Methods, Encapsulation and Data abstraction, Inheritance and Polymorphism

**Basics of C++:** Structure of a C++ Program, Data Types And Sizes, Variable Definition and Initialization, Type conversion, Expressions and Operator Precedence, Scope Resolution Operator, Inline Functions, Function Overloading, Default Arguments, Dynamic Allocation New and Delete Operators, Control Flow Statements: if, if-else, nested if-else, for, while, do.while, break, switch, continue.

### UNIT-II

**Classes & Objects:** Class Specification, Accessing Class Members, Defining Member Functions, Empty Classes, Friend Functions and Friend Classes, Static Data and Member Functions, Constructors and Destructors, Copy Constructor, Constructor Overloading, Copy Constructor, Pointers, Pointers to Objects, this Pointer.

**Inheritance, Polymorphism & Exception handling:** Forms of Inheritance, Inheritance and Member Accessibility, Derived Classes, Syntax of Derived Classes, Abstract Classes, Single, Multilevel, Multiple, Hierarchical, Hybrid Inheritance, Polymorphism, Operator Over loading, Function Over loading , Pointers to Derived Classes, Virtual and Pure Virtual Functions, Function Templates, Class Templates, Introduction to Exception Handling.

### UNIT-III

**Introduction to Java:** Overview of Java language, Constants, Variables & Data types, Decision Making , Branching , Looping, Classes, Objects & Methods, Arrays, Strings and Vectors.

**Managing I/O files in Java:** Introduction, Concept of Streams, Byte & Character Stream Classes, Using Streams & File Classes, File Creation, Reading/Writing Characters & Bytes, Handling Primitive Data Types.

### UNIT-IV

**Interfaces, Packages, Multi-Threading:** Defining, Extending and Implementing Interfaces; Creating, Accessing & Using Packages; Multithreading- Creating, Extending, Stopping, Blocking Threads, Life Cycle of a Thread, Thread Methods, Exceptions, Priority in Threads, Synchronization, Runnable Interface.

**Exception Handling & Applet programming:** Exception Handling-Syntax of Exception Handling Code, Multiple Catch Statements, Finally, Throwing Our Own exceptions, Applets-Introduction, How Applets Differ from Applications, Building Applet Code, Life Cycle, Designing a Webpage, Adding Applet to HTML file, Running the Applet, Passing Parameters to Applets.

### Text Books:

1. Mastering C++ K R Venu Gopal, Raj Kumar, T Ravi Shankar, Tata McGraw Hill
2. Programming with Java-A primer: E. Balagurusamy, PHI

### Reference Books:

1. Object Oriented Programming in C++, Robert Lafore, SAMS
2. Object Oriented Programming Using C++,Ira Pohl, Pearson Education
3. Head First Java, Kathy Sierra & Bert Bates, Second Edition, Oreilly
4. Java: The Complete Reference, Herbert Schildt, Ninth Edition, Oracle Press
5. Java How to Program, Paul Deitel and Harvey Deitel.

## MCA 2.4 FORMAL LANGUAGES & AUTOMATA THEORY

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT-I

**Finite Automata and Regular Expressions:** Basic Concepts of Finite State Systems, Chomsky Hierarchy of Languages, Deterministic and Non-Deterministic Finite Automata, Finite Automata with  $\epsilon$ -moves, Regular Expressions.

**Regular sets & Regular Grammars:** Basic Definitions of Formal Languages and Grammars, Regular Sets and Regular Grammars, Closure Properties of Regular Sets, Pumping Lemma for Regular Sets, Decision Algorithm for Regular Sets, Minimization of Finite Automata.

### UNIT-II

**Context Free Grammars and Languages:** Context Free Grammars and Languages, Derivation Trees, simplification of Context Free Grammars, Normal Forms, Pumping Lemma for CFL, Closure properties of CFL's.

**Push down Automata:** Informal Description, Definitions, Push-Down Automata and Context free Languages, Parsing and Push-Down Automata.

### UNIT-III

**Turing Machines:** The Definition of Turing Machine, Design and Techniques for Construction of Turing Machines, Combining Turing Machines.

**Universal Turing Machines and Undecidability:** Universal Turing Machines. The Halting Problem, Decidable & Undecidable Problems - Post Correspondence Problem.

### UNIT-IV

**The Propositional calculus:** The Propositional Calculus : Introduction – Syntax of the Propositional Calculus – Truth-Assignments – Validity and Satisfiability – Equivalence and Normal Forms – resolution in Propositional Calculus.

**The Predicate calculus:** Syntax of the Predicate Calculus – Structures and Satisfiability – Equivalence – Un-solvability and NP-Completeness.

#### Text books:

1. Introduction to Automata Theory, Languages and Computations – J.E. Hopcroft, & J.D. Ullman , Pearson Education Asia.
2. Elements of The Theory Of Computation, Harry R Lewis, Cristos h. Papadimitriou, Pearson Education / Prentice-Hall of India Private Limited.

#### Reference books:

1. Introduction to languages and theory of computation – John C. Martin (MGH)
2. Theory of Computation, KLP Mishra and N. Chandra Sekhar, IV th Edition, PHI
3. Introduction to Theory of Computation – Michael Sipser (Thomson Nrools/Cole)

## MCA 2.5 INFORMATION SYSTEMS & ORGANIZATIONAL BEHAVIOUR

**Instruction: 3 Periods/week**

**Time: 3 Hours**

**Credits: 4**

**Internal: 25 Marks**

**External: 75 Marks**

**Total: 100 Marks**

---

### UNIT I

**Organization Structure:** Features of Good Organization Structures, Designing of Organization Structure, Types of Organization Structures-Functional, Product, Geographic and Matrix Organization Structures

### UNIT II

**Motivation:** Nature and importance of motivation, Theories of motivation – Maslow's, Herzberg's and Mc Gregor's X and Y Theories of Motivation. **Leadership:** Meaning and definition, Importance of Leadership, Leadership styles, **Communication:** Process of Communication, Importance, Forms of Communication and Barriers in Communication.

### UNIT III

**Group Dynamics:** Types of Groups, Stages of Group Development, Group Behavior and Group Performance Factors. **Organizational Conflicts:** Reasons for Conflicts, Consequences of Conflicts in Organizations, Types of Conflict, Strategies for Managing Conflicts, Organizational Climate and Culture.

### UNIT IV

**Management Information System:** Nature and Scope, Characteristics and Functions. Classification of MIS - Transaction Processing System, Management Information System, Decision Support System, Executive Support System, Office Automation System and Business Expert System.

### Text Books:

1. Elements of Organizational Behavior, Robbins, 7<sup>th</sup> Edition, Pearson Education
2. Management Information Systems – D.P.Goyal, Macmillan Publishers India Ltd.

### Reference Books:

1. Organizational Behaviour – L.M.Prasad, Sultan Chand and sons
2. Management Information Systems - L.M.Prasad, Usha Prasad , Sultan Chand and sons
3. Management Information Systems – Kanter Jerma , PHI

## MCA 2.6: DATABASE MANAGEMENT SYSTEMS LAB

**Practical: 3 Periods /week**

**Time: 3 Hours**

**Credits: 2**

**Internal: 50 Marks**

**External: 50 Marks**

**Total: 100 Marks**

---

### SQL

- 1) Simple queries to understand DDL, DML and DCL commands
- 2) Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
- 3) Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSET, Constraints.
- 4) Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
- 5) Queries using Conversion functions like (to\_char, to\_number and to\_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions like (Sysdate, next\_day, add\_months, last\_day, months\_between, least, greatest, trunc, round, to\_char, to\_date)

### PL/SQL

- 1) Simple programs to understand PL/SQL
- 2) Write a PL/SQL program to demonstrate exception-handling
- 3) Demonstrate the working of COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
- 4) Develop a program that includes the features NESTED IF, CASE and CASE expression.
- 5) Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT -IN Exceptions, USE defined Exceptions, RAISE-APPLICATION ERROR.
- 6) Programs using CURSORS
- 7) Programs development using creation of procedures and functions.
- 8) Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers

### Text Books:

1. Oracle Database 11g, Jason Price, Oracle Press
2. Oracle PL/SQL for Dummies, Michael Rosenblum, Paul Dorsey, Wiley Publications.



## MCA 2.7 OBJECT ORIENTED PROGRAMMING LAB

**Instruction: 3 Periods/week**

**Time: 3 Hours**

**Credits: 2**

**Internal: 50 Marks**

**External: 50 Marks**

**Total: 100 Marks**

---

### **LIST OF EXPERIMENTS WITH C++:**

1. Simple programs to understand basic object oriented concepts using C++.
2. Program performing complex number addition using friend functions.
3. Program to demonstrate function overloading.
4. Program to perform string operations by over loading operators.
5. Program on constructor overloading and copy constructor
6. Programs to understand different types of inheritance.
7. Program on virtual functions.
8. Program to handle exception handling
9. Generic program with function templates
10. Generic program with class templates.

### **LIST OF EXPERIMENTS WITH JAVA:**

1. Simple Programs to understand basic object oriented concepts using Java.
2. Write a Java program for sorting a given list of names in ascending order.
3. Write a Java program to implement file operations.
4. Write a Java program that displays the number of characters, lines and words in a text file.
5. Write a Java program for defining, extending and implementing interfaces.
6. Write a Java program for creating, accessing & using packages.
7. Write a Java program to demonstrate threads execution in Java.
8. Write a Java program to implement Exception Handling in Java.
9. Write a Java program to implement calculator using applets.
10. Write a Java program to implement database operations using JDBC.

### **Text Books:**

1. Mastering C++ K R Venu Gopal, Raj Kumar, T Ravi Shankar, Tata McGraw Hill
2. Object Oriented Programming in C++, Robert Lafore, SAMS
3. Object Oriented Programming Using C++, Ira Pohl, Pearson Education
4. Programming with Java-A primer: E. Balagurusamy, PHI
5. Java: The Complete Reference, Herbert Schildt, Ninth Edition, Oracle Press
6. Java How to Program, Paul Deitel and Harvey Deitel.

**ADIKAVI NANNAYA UNIVERSITY**  
**Master of Computer Applications (MCA)**  
**Course Structure and Scheme of Valuation w.e.f. 2016-17**

**III Semester**

Code	Name of the subject	Periods/week		Max Marks		Total Marks	Credits
		Theory	Lab	External	Internal		
MCA 3.1	Computer Networks	4	-	75	25	100	4
MCA 3.2	Artificial Intelligence and Expert Systems	4	-	75	25	100	4
MCA 3.3	Design and Analysis of Algorithms	4	-	75	25	100	4
MCA 3.4	Operating Systems	4	-	75	25	100	4
MCA 3.5	Web Technologies	4	-	75	25	100	4
MCA 3.6	Operating Systems Lab	-	3	50	50	100	2
MCA 3.7	Web Technologies Lab	-	3	50	50	100	2
<b>Total</b>						<b>700</b>	<b>24</b>

## MCA 3.1 COMPUTER NETWORKS

**Instruction:4 Periods/week**

**Time: 3 Hours**

**Credits:4**

**Internal:25 Marks**

**External: 75 Marks**

**Total: 100 Marks**

---

### UNIT I

**Introduction to Computer Networks:** Introduction, Network Hardware, Network Software, Reference Models, Data Communication Services & Network Examples, Internet Based Applications.

**Data Communications:** Transmission Media, Wireless Transmission, Multiplexing, Switching, Transmission in ISDN, Broad Band ISDN, ATM Networks

### UNIT II

Data Link Control, Error Detection & Correction, Sliding Window Protocols, LANs & MANs: IEEE Standards for LANs & MANs-IEEE Standards 802.2, 802.3, 802.4, 802.5, 802.6, High Speed LANs.

**Design Issues in Networks:** Routing Algorithms, Congestion Control Algorithms, Network Layer in the Internet, IP Protocol, IP Address, Subnets, and Internetworking.

### UNIT III

**Internet Transport Protocols:** Transport Service, Elements of Transport Protocols, TCP and UDP Protocols, Quality of Service Model, Best Effort Model, Network Performance Issues.

Over View of DNS, SNMP, Electronic Mail, FTP, TFTP, BOOTP, HTTP Protocols, World Wide Web, Firewalls.

### UNIT IV

**Network Devices:** Over View of Repeaters, Bridges, Routers, Gateways, Multiprotocol Routers, Brouters, Hubs, Switches, Modems, Channel Service Unit CSU, Data Service Units DSU, NIC, Wireless Access Points, Transceivers, Firewalls, Proxies.

Overview of Cellular Networks, Ad-hoc Networks, Mobile Ad-hoc Networks, Sensor Networks

### Text Books:

1. Computer Networks, Andrews S Tanenbaum, Edition 5, PHI, ISBN: -81-203-1165-5
2. Data Communications and Networking, Behrouz A Forouzan, Tata McGraw-Hill Co Ltd, Second Edition

### Reference Books:

1. Computer networks, Mayank Dave, Cengage.
2. Computer Networks, A System Approach, 5<sup>th</sup>ed, Larry L Peterson and Bruce S Davie, Elsevier.
3. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition,Pearson Education.
4. Understanding Communications and Networks, 3rd Edition, W.A. Shay, Thomson.

## MCA 3.2 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

**Instruction: 4 Periods/week**

**Time: 3 Hours**

**Credits: 4**

**Internal: 25 Marks**

**External: 75 Marks**

**Total: 100 Marks**

---

### UNIT I

What is AI, The Foundations of AI, The History of AI, Agents and Environments, The Concept of Rationality, The Nature of Environments, The Structure of Agents, Problem Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies: Breadth First, Depth First, Depth Limited; Informed Search Strategies: Greedy Best First, A\* Algorithms

### UNIT II

Heuristic Functions, Local-Search Algorithms and Optimization Problems: Hill Climbing, Simulated Annealing, Genetic Algorithms; Constraint Satisfaction Problems, Backtracking Search For CSPs, Games, Optimal Decisions in Games  
Knowledge Based Agents, The Wumpus World, Logic, Propositional Logic, Reasoning Patterns in Propositional Logic, Syntax and Semantics of First Order Logic, Using First Order Logic, Inference in First-Order Logic: Unification, Resolution.

### UNIT III

Acting Under Uncertainty, Basic Probability Notation, The Axioms of Probability, Inference Using Full Joint Distribution, Independence, Bayes Rule and Its Use, Other Approaches To Uncertain Reasoning: Dempster Shafer Theory, Fuzzy Sets and Fuzzy Logic  
Combining Beliefs Under Uncertainty, The Basis of Utility Theory, Utility Functions, Multi Attribute Utility Functions, Decision Theoretic Expert Systems

### UNIT IV

Expert System, Concepts and Characteristics, Applications and Domains of Expert System, Elements Of an Expert System, Stages in the Development of an Expert System, Semantic Nets, Frames  
Speech Recognition, Forms of Learning, Inductive Learning, Learning Decision Trees, Single Layer Feed Forward, Multi Layer Feed Forward Neural Networks.

### Text Books:

1. Artificial Intelligence: A Modern Approach. Stuart Russell, Peter Norvig, Pearson Education 2<sup>nd</sup> Edition.
2. Expert Systems : Principles and Programming. Joseph C Giarratano, Gary D Riley Thomson Publication, 4<sup>th</sup> Edition.

### Reference Books:

1. Elaine Rich and Kevin Knight: Artificial Intelligence , Tata McGraw Hill.
2. Dan W.Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India.
3. David W Rolston: Principles of Artificial Intelligence and Expert System Development, McGraw Hill

## MCA 3.3 DESIGN AND ANALYSIS OF ALGORITHMS

**Instruction: 3 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Introduction:** Fundamentals of algorithmic problem solving, important problem types, fundamental data structures.

**Fundamentals of analysis of algorithms and efficiency:** Analysis framework, Asymptotic Notations and Basic Efficiency classes, Mathematical Analysis of Non-recursive Algorithms, Mathematical Analysis of recursive Algorithms, Empirical Analysis of Algorithms, Algorithm Visualization.

**Brute Force:** Selection Sort and Bubble sort, Sequential Search and Exhaustive Search.

### UNIT II

**Divide-and-Conquer:** Merge Sort, Quick sort, Binary Search, Binary Tree Traversals and Related Properties.

**Decrease-and-Conquer:** Insertion Sort, Depth-First Search and Breadth-First Search-Topological Sorting, Decrease-by-a-Constant-Factor Algorithms, Variable-Size-Decrease Algorithms.

**Transform-and-Conquer:** Presorting, Balanced Search Trees, Heaps and Heap sort, Problem Reduction.

### UNIT III

**Space and Time Tradeoffs:** Sorting by Counting, Hashing, B-Trees.

**Dynamic Programming:** Warshall's and Floyd's Algorithm, Optimal Binary Search Trees, The Knapsack Problem and Memory Functions.

**Greedy Technique:** Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees

### UNIT IV

**Limitations of Algorithm Power:** Lower-Bound Arguments, Decision Trees, P, NP and NP-complete problems.

**Coping with the Limitations of Algorithms Power:** Backtracking, Branch-and-Bound, Approximation Algorithms for NP-hard Problems.

### Text Book:

1. Introduction to Design & Analysis of Algorithms by Anany Levitin, Pearson Education, New Delhi, 2003

### Reference Books:

1. Introduction to Algorithms by Thomas H. Corman, Charles E. Leiserson, Ronald R. Rivest & Clifford Stein, Prentice Hall of India, New Delhi.
2. The Design and Analysis of computer Algorithms, Aho, Hopcroft & Ullman, Pearson Education, New Delhi, 2003
3. Fundamentals of algorithmics, Gilles Brassard & Paul Bratley, Prentice Hall of India, New Delhi

## MCA 3.4 OPERATING SYSTEMS

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Introduction:** Definition of Operating System, Types Of Operating Systems, Operating System Structures, Operating-System Services, System Calls, Virtual Machines, Operating System Design and Implementation,

**Process Management:** Process Concepts, Operations on Processes, Cooperating Processes, Threads, Inter Process Communication, Process Scheduling, Scheduling Algorithms, Multiple -Processor Scheduling. Thread Scheduling.

### UNIT II

**Process Synchronization:** The Critical Section Problem, Semaphores, And Classical Problems of Synchronization, Critical Regions, Monitors, Synchronization examples.

**Deadlocks:** Principles of Deadlocks, System Model, Deadlocks Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance, Detection & Recovery from Deadlocks.

### UNIT III

**Memory Management:** Logical Versus Physical Address, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, Thrashing

**File System Implementation:** Concept of a file, Access Methods, Directory Structure, File System Structure, Allocation Methods, Free Space Management, Directory Management, Device Drivers.

**Mass-storage structure:** overview of Mass-storage structure, Disk structure, disk attachment, disk scheduling, swap-space management.

### UNIT IV

**Protection:** Goals and Principles of Protection, Access matrix implementation, Access control, Revocation of access rights.

**Case study:** LINUX, Windows Operating Systems.

### Text Book:

1. Operating System Principles by Abraham Silberschatz, Peter Galvin, Greg Gagne. Seventh Edition, Wiley Publication

### Reference Books:

1. Operating Systems, William Stallings 5th Edition - PHI
2. Modern Operating Systems, Andrew S.Tanenbaum, , 2<sup>nd</sup> edition, 1995, PHI.
3. Operating Systems - A concept based approach, Dhamdhare, 2<sup>nd</sup> Edition, TMH, 2006.
4. Understanding the Linux Kernel, Daniel P Bovet and Marco Cesati, 3<sup>rd</sup> Edition, Reilly, 2005.

## MCA 3.5 WEB TECHNOLOGIES

**Instruction: 4 Periods/week**

**Time: 3 Hours**

**Credits: 4**

**Internal: 25 Marks**

**External: 75 Marks**

**Total: 100 Marks**

---

### UNIT I

**Networking Protocols and OSI Model:** Protocols in Computer Communications, the OSI Model, OSI Layer Functions

**Internetworking Concepts, Devices, Basics, History and Architecture:** Internet working, Problems in Internetworking, Dealing with Incompatibility Issues, A Virtual Network, Internetworking Devices, Repeaters, Bridges, Routers, Gateways, A Brief History of the Internet, Growth of the Internet, Internet topology, Internal Architecture of an ISP

**TCP/IP Part I** (Introduction to TCP/IP, IP, ARP, RARP, ICMP):TCP/IP Basics, Why IP Addresses?, Logical Addresses,TCP/IP Example The Concept of IP Address, Address Resolution Protocol (ARP), Reverse ARP, Internet Control Message Protocol (ICMP), Datagram, Fragmentation and Reassembly

### UNIT II

**TCP/IP Part II** (TCP, UDP):Basics of TCP, Features of TCP, Relationship between TCP and IP, Ports and Sockets, Connections-Passive Open and Active Open, TCP connections, What Makes TCP Reliable?TCP Packet Format, Persistent TCP Connections, User Datagram Protocol , UDP Packet, Difference between UDP and TCP

**TCP/IP Part III** (DNS, Email, FTP, TFTP): Domain Name System (DNS), Electronic Mail (Email), File Transfer Protocol (FTP), Trivial File Transfer Protocol (TFTP)

**TCP/IP Part IV** (WWW, HTTP, TELNET): A Brief History of WWW, Basics of WWW and Browsing, Locating Information on the Internet, HTML , Web Browser Architecture, Web Pages and Multimedia, Remote Login (TELNET).

**An Introduction to Electronic Commerce:** Aspects of Electronic Commerce, Types of E Commerce, Approaches for Developing E Commerce Solutions, Electronic Procurement, Phases in a Procurement Process, E-Procurement Models, E-Procurement Solutions, Trading Models, Buyer Side Purchasing, Supply Chain Management (SCM) and Customer Relationship Management (CRM)

### UNIT III

**Introduction to Web Technology:** Features Required for Enabling e-commerce, Web pages-Types and Issues, Tiers, The Concept of a Tier, A Concept of Microsoft and Java Technologies, Web Pages,Static Web Pages, Plug-ins, Introduction to Frames and Forms

**Dynamic Web Pages:** Need for Dynamic Web Pages,Magic of Dynamic Web Pages, Overview of Dynamic Web Page Technologies,Overview of Dynamic HTML (DHTML), Common Gateway Interface (CGI), Microsoft's Active Server Pages (ASP), Basics of ASP Technology, ASP Example, Modern Trends in ASP, Java and the Concept of a Virtual Machine, Java Servlets and Java Sever pages(JSP), Java Servlets, Java Sever pages (JSP).

**Active Web pages:**Active Web pages is a Better Solution, Java Applets, Why are Active Web Pages Powerful? When not to use Active Web Pages, Lifecycle of Java Applets, Java Beans, Active X Controls.

### UNIT IV

**Middleware and Component-based E-commerce Architectures:**CORBA, Java Remote Method Invocation (RMI), Microsoft's Distributed Component Object Model

**Electronic Data Interchange (EDI):** An Overview of EDI, the Origins of EDI, Understanding EDI, Data Exchange Standards, EDI Architecture, The Significance of EDI in International Trade, Financial EDI, EDI and the Internet.

**Extensible Markup Language (XML):**Standard Generalized Markup Language (SGML), Basics of XML, XML parsers, The Need for a Standard.

**Wireless Application Protocol (WAP):**Limitations of Mobile Devices, The emergence of WAP, WAP Architecture, The WAP Stack, Concerns about WAP and its Future, Alternatives to WAP.

### Text Book:

Web Technologies : TCP/IP to Internet Application Architectures-TATA McGraw Hill Publications – Achyut S Godbole, Atul Kahate

## MCA 3.6 OPERATING SYSTEMS LAB

**Practical: 3 Periods /week**

**Internal: 50 Marks**

**Time: 3 Hours**

**External: 50 Marks**

**Credits: 2**

**Total: 100 Marks**

---

### List of Experiments:

1. Basic UNIX commands

**Implement the following using Shell Programming**

2. Input number even or odd
3. Count the number of lines in the input text
4. Print the pattern  
\*  
\*\*\*  
\*\*\*\*\*

5. File encryption

**Implement the following using C/C++/JAVA**

6. FCFS CPU scheduling algorithm
7. SJF CPU scheduling algorithm
8. Round Robin CPU scheduling algorithm
9. Priority CPU scheduling algorithm
10. Implement Semaphores
11. Sequential file allocation strategy
12. Indexed file allocation strategy
13. Bankers Algorithm for Dead Lock Avoidance
14. Algorithm for Dead Lock Detection
15. FIFO Page Replacement Algorithm
16. LRU Page Replacement Algorithm
17. LFU Page Replacement Algorithm

### References :

1. Operating System Principles by Abraham Silberschatz, Peter Galvin, Greg Gagne. Seventh Edition, Wiley Publication
2. Understanding the Linux Kernel, Daniel P Bovet and Marco Cesati, 3<sup>rd</sup> Edition, Reilly, 2005.
3. Unix programming, Stevens, Pearson Education.
4. Shell programming, Yashwanth Kanetkar.



## MCA 3.7 WEB TECHNOLOGIES LAB

**Instruction: 3 Periods/week**

**Time: 3 Hours**

**Credits: 2**

**Internal: 50 Marks**

**External: 50 Marks**

**Total: 100 Marks**

---

### List of Experiments:

1. Create web pages for an application demonstrating the working of different features of HTML and DHTML.

2. Demonstrate the use of CSS in organizing the layout of webpages

**Implement at least two Java Script programs to demonstrate the working of**

3. Conditional statements

4. Looping statements.

5. Arrays

6. Functions.

7. Event handling

8. Validation controls.

**Develop simple applications for the following**

9. Exercise client server programming using Java Script, Servlets, ASP, JSP

10. Create a web application with database connectivity and work on different queries for data manipulation.

### References:

1. Web Technologies, Godbole, Kahate, 2<sup>nd</sup> Ed., TMH

2. Internet & World Wide Web How to program, Dietel & Deitel Fourth Edition, PHI

3. Web Programming, building internet applications, 2<sup>nd</sup> Ed., Chris Bates, Wiley Dreamtech

4. The complete Reference HTML and DHTML, Thomas A. Powey

5. Core Servlets and Java Server Pages, Marty Hall Larry Brown, Second Edition

**ADIKAVI NANNAYA UNIVERSITY**  
**Master of Computer Applications(MCA)**  
**Course Structure and Scheme of Valuation w.e.f. 2016-17**

**IV Semester**

Code	Name of the subject	Periods/week		Max Marks		Total Marks	Credits
		Theory	Lab	External	Internal		
MCA 4.1	Information Security and Cryptography	4	-	75	25	100	4
MCA 4.2	Operations Research	4	-	75	25	100	4
MCA 4.3	Elective I	4	-	75	25	100	4
MCA 4.4	Object Oriented Software Engineering	4	-	75	25	100	4
MCA 4.5	Data Warehousing and Data Mining	4	-	75	25	100	4
MCA 4.6	Object Oriented Software Engineering Lab	-	3	50	50	100	2
MCA 4.7	Data Mining Using R Programming Lab	-	3	50	50	100	2
<b>Total</b>						<b>700</b>	<b>24</b>

MCA 4.3 Elective I: 4.3.1 Advanced Data Structures

4.3.2 Computer Graphics

4.3.3 Distributed Systems

## MCA 4.1 INFORMATION SECURITY AND CRYPTOGRAPHY

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Introduction:** The need for security-security approaches-principles of security-Plain Text and Cipher Text-substitution and Transposition Techniques-Encryption and Decryption-Symmetric and Asymmetric Cryptography-Stenography-key range and key size-types of attacks.

**Number Theory:** Introduction to number theory- Modular Arithmetic, Euclidean algorithm, Euler theorem, Fermat Theorem, Totient Function, Multiplicative and Additive Inverse.

### UNIT II

**Symmetric Key Cryptographic Algorithms:** Algorithm types and modes-overview of symmetric key cryptography-DES-IDEA-Blowfish-AES-Differential and Linear Cryptanalysis.

**Asymmetric Key Cryptographic Algorithms:** Overview of asymmetric key cryptography-RSA algorithm-symmetric and asymmetric key cryptography together-digital signatures.

### UNIT III

**User Authentication Mechanisms:** Introduction-Authentication basics-passwords-authentication tokens-certificate based authentication-biometrics authentication-Hash functions-SHA1.

**System Security:** Intruders, Viruses, Related Threats, Trusted Systems.

### UNIT IV

**Internet Security Protocols:** Basic concepts-SSL-SHTTP-TSP-SET-SSL versus SET- 3D secure protocol-Electronic money-Email security-WAP security-security in GSM.

**Network Security:** Brief Introduction to TCP/IP -Firewalls -IP security-Virtual Private Networks.

### Text Books:

1. Cryptography and Network security, Atul Kahate, Tata McGraw-Hill Pub company Ltd., New Delhi
2. Network Security Essentials Applications and Standards, William Stallings, Pearson Education, New Delhi

### Reference Books:

1. Network Security Private Communication in a public world, Charlie Kaufman, Radia Perlman & Mike Speciner, Prentice Hall of India Private Ltd., New Delhi
2. Network Security: The Complete Reference by Roberta Bragg, Mark Phodes - Ousley, Keith Strass berg Tata McGraw-Hill.

## MCA 4.2 OPERATIONS RESEARCH

**Instruction:** 4 Periods/week  
**Internal:** 25 Marks

**Time:** 3 Hours  
**External:** 75 Marks

**Credits:** 4  
**Total:** 100 Marks

---

### UNIT I

**Overview of Operations Research:** OR models – OR Techniques

**Linear Programming:** Introduction – Graphical solution; Graphical sensitivity analysis- The standard form of linear programming problems – Basic feasible solutions- unrestricted variables – simplex algorithm – artificial variables – Big M and two phase method – Degeneracy - alternative optima – unbounded solutions – infeasible solutions.

### UNIT II

**Dual Problems:** Relation between primal and dual problems – Dual simplex method

**Transportation Model:** Starting solutions, North West corner Rule - lowest cost method, Vogels approximation method – Transportation algorithms – Assignment problem – Hungarian Method.

### UNIT-III

**Network Models :** Definitions – CPM and PERT – Their Algorithms

**Integer Programming :** Branch and Bound Algorithms cutting plan algorithm.

**Dynamic Programming:** Recursive nature of dynamic programming – Forward and Backward Recursion

### UNIT-IV

**Deterministic Inventory Models :** Static EOQ Models – Dynamic EOQ models.

**Game theory:** Two person Zero Sum Games – Mixed strategy games and their Algorithms.

### Text Books:

1. Operations Research – An Introduction, Handy A Taha – Pearson Education .
2. Operations Research Panneer Selvan Prentice Hall of India.

### Reference Books:

1. Operations Research, SD Sharma
2. Operations Research Kanti Swaroop, PK Gupta, Man Mohan – Sultan Chand & Sons Education

## ELECTIVE I: MCA 4.3.1 ADVANCED DATA STRUCTURES

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT-I

**Skip Lists and Hashing:** Dictionaries, Linear List Representation, Skip List Representation-The Ideal Case, Insertion and Deletions, Assigning, The Class SkipNode and SkipList, Complexity, Hash Table Representation-Ideal hashing, Hashing with Linear open addressing, hashing with chains, An application-Text Compression-LZW Compression, Implementation of LZW Compression, LZW Decompression, Implementation of LZW Decompression.

**Lists, Stacks, Queues:** Implementation of the Stack ADT (Abstract Data Type) and the Queue ADT.

**Trees:** The Search Tree ADT- Biary Search Trees, AVL Trees, Splay Trees, Red Black Trees, B-Trees.

### UNIT-II

**Priority Queues:** Introduction, Linked Lists, Heaps-Definitions, Insertion into a Max Heap, Deletion from a Max Heap, Applications-Heap Sort, Machine Scheduling, Huffman Codes.

**Sorting algorithms:** General Background, Efficiency considerations, O Notation, Efficiency of Sorting, Exchange sorts: Bubble sort, quick sort, Insertion sorts: Simple insertion, Shell Sort, Address Calculation Sort, Merge and Radix sorts

**The Disjoint Set Class:** Equivalence Relations, the Dynamic Equivalence Problem, Basic Data Structure, Smart Union Algorithms, Path Compression, Worst Case for Union-by-Rank and Path Compression, an Application.

### UNIT-III

**Graph Algorithms:** Definition, Topological Sort, Shortest-Path Algorithms, Network Flow Problems, Minimum Spanning Tree, Applications of Depth-First Search, Introduction to NP-Completeness.

**Algorithm Design Techniques:** Greedy Algorithms, Divide and Conquer, Dynamic Programming, Randomized Algorithms, Backtracking Algorithms.

### UNIT-IV

**Amortized Analysis:** An Unrelated Puzzle, Binomial Queues, Skew Heaps, Fibonacci Heaps, Splay Trees.

**Advance Data Structures and Implementation:** Top-Down splay Trees, Red-Black Trees, Deterministic Skip Lists, AA-Trees, Treaps, k-d Trees, Pairing Heaps.

### Text Books

1. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education , Second edition
2. Data structures, Algorithms and Applications in C++,S.Sahni, McGraw-Hill international Edition.
3. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and D.Mount, Wiley student edition, John Wiley and Sons.

## ELECTIVE I: MCA 4.3.2 COMPUTER GRAPHICS

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Introduction:** Computer Graphics and their applications, Graphics- Computer Aided Design- Computer Art- Entertainment- Education and Training- Visualization- Image Processing- Graphical User Interfaces; Overview of Graphics systems: Video Display Devices, Raster Scan systems, random scan systems, Graphics monitors and workstations, Input devices, hard copy devices, Graphics software.

**Output primitives :** Points and Lines, Line Drawing Algorithms, Loading the Frame buffer, Line function, Circle Generating Algorithms, Ellipse Generating Algorithms-, Other Curves, Parallel Curve Algorithms, Curve Functions, Pixel Addressing, Filled Area Primitives, Filled Area Functions, Cell Array, Character Generation, Line and Curve Attributes-Color and Grayscale levels Character Attributes, -Area Fill Attributes, Bundled Attributes, Inquiry Functions, Antialiasing.

### UNIT II

**Two Dimensional Geometric Transformations:** Basic Transformations, Matrix Representations, Homogeneous Coordinates, Composite Transformations, Other Transformations, Transformations between Coordinate Systems, Affine Transformations, Transformation Functions, Raster methods for Transformation.

**Two Dimensional Viewing:** The viewing Pipeline, Viewing Coordinate Reference Frame, Window-to-Viewport Coordinate Transformation, Two Dimensional Viewing Functions, Clipping Operations, Point Clipping Line Clipping Polygon Clipping-Curve Clipping Text and Exterior Clipping

### UNIT III

**Structure And Hierarchical Modeling:** Concepts of Structures and Basic models, Editing, Hierarchical Modeling with Structures, GUI and Interactive Input Methods- Windows and Icons, Virtual Reality Environments

**Three Dimensional Concepts and Object representations:** 3D display methods-3D Graphics, Polygon Surfaces, Curved Lines and Surfaces, Quadratic Surfaces, Super Quadrics, Blobby Objects, Spline Representations, Cubic Spline methods, Bezier Curves and Surfaces, BSpline Curves and Surfaces

### UNIT IV

**Three Dimensional Geometric and Modeling Transformations:** Translation-, Rotation, scaling, Other Transformations, Composite Transformations, 3D Transformation Functions, Modeling and Coordinate Transformations

**Three Dimensional Viewing:** Viewing Pipeline-Viewing Coordinates, Projections, General Projection Transformations, Clipping, Hardware Implementations, 3D Viewing

### Text Book:

1. Computer Graphics C Version, Donald Hearn & M. Pauline Baker, Pearson Education, New Delhi, 2004 (Chapters 1 to 12 except 10-9 to 10-22)

### Reference Books:

1. Procedural Elements for Computer Graphics, David F. Rogers, Tata McGraw Hill Book Company, New Delhi, 2003
2. Computer Graphics: Principles & Practice in C, J.D. Foley, S.K. Feiner, A. Van Dam F.H. John Pearson Education, 2004

## ELECTIVE I: MCA 4.3.3 DISTRIBUTED SYSTEMS

**Instruction: 3 Periods/week**

**Time: 3 Hours**

**Credits: 4**

**Internal: 25 Marks**

**External: 75 Marks**

**Total: 100 Marks**

---

### UNIT I

**Introduction to Distributed Systems:** Distributed systems: Goals, Hardware Concepts: Bus Multiprocessor Timesharing Systems, Design Issues: Reliability, Performance, Scalability etc.

### UNIT II

**Communication distributed systems:** ATM Networks: Asynchronous Transfer Mode, The ATM Physical Layer, The ATM Layer, The ATM Adaptation Layer, ATM Switching, Applications of ATM for DS, Client-server model: Clients and Servers, Addressing, Blocking versus Nonblocking Primitives, Buffered versus Unbuffered Primitives, Reliable versus Unreliable Primitives, Implementing the Client-Server Model. Remote procedure call:RPC Operation, RPC semantics in the presence of Failures,Implementation issues.

**Synchronization:** Clock synchronization: Logical Clocks, Physical Clocks, Clock Synchronization Algorithms, Use of Synchronized Clocks, Mutual exclusion:Centralized Algorithm, Distributed Algorithm,Token Ring Algorithm,Comparison of the Three Algorithms, Election Algorithms: The Bully Algorithm, A Ring Algorithm, Atomic Transactions: Introduction, The Transaction Model, Implementation, concurrency Control, Dead locks.

### UNIT III

**Processes and Processors:** Threads: Introduction, Thread Usage, Design Issues for Thread packages, Implementing a Thread Package, Threads and RPC, System models: The Workstation Model, The Processor pool model, A hybrid model, Processor allocation – Scheduling in Distributed Systems, Fault tolerance: Component Faults, System failures, Real time distributed systems: Design Issues, Real Time Communication, Real Time Scheduling.

**Distributed file systems:** Distributed File system design:File Service Interface, Directory Server interface, File System Implementation: File Usage, System Structure, Caching, Replication.

### UNIT IV

**Distributed Shared Memory:**Introduction, Bus based multi processors, Ring based multiprocessors,Switched multiprocessors, Comparison of shared memory Systems, Consistency Models: Strict Consistency, Sequential Consistency, Causal Consistency, PRAM Consistency and Processor Consistency, Weak Consistency, Release Consistency, Entry Consistency, Page based distributed shared memory: Replication, Granularity, Achieving Sequential Consistency, Finding the owner, finding copies, page replacement, Synchronization.

### Text Book:

1. Andrew S.Tanenbaum: Distributed Operating System, Prentice Hall Intl Inc 1995.

### Reference Book:

1. Distributed Systems – Concepts and Design, George Coulouris, Jean Dollimore, Tim Kindberg, Pearson Education.

## MCA 4.4 OBJECT ORIENTED SOFTWARE ENGINEERING

**Instruction: 3 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Introduction to Object Oriented Software Engineering:** Nature of the Software, Types of Software, Software Engineering Activities, Software Quality

**Introduction to Object Orientation:** Data Abstraction, Inheritance & Polymorphism, Reusability in Software Engineering, Examples: Postal Codes, Geometric Points.

**Requirements Engineering:** Domain Analysis, Problem Definition and Scope, Types of Requirements, Techniques for Gathering and Analyzing Requirements, Requirement Documents, Reviewing Requirements, Case Studies: GPS based Automobile Navigation System, Simple Chat Instant Messaging System.

### UNIT II

**Unified Modeling Language & Use Case Modeling:** Introduction to UML, Modeling Concepts, Types of UML Diagrams with Examples; User-Centred Design, Characteristics of Users, Developing Use Case Models Of Systems, Use Case Diagram, Use Case Descriptions, The Basics of User Interface Design, Usability Principles.

**Class Design and Class Diagrams:** Essentials of UML Class Diagrams, Associations And Multiplicity, Generalization, Instance Diagrams, Advanced Features of Class Diagrams, Process of Developing Class Diagrams, Interaction And Behavioural Diagrams: Interaction Diagrams, State Diagrams, Activity Diagrams, Component and Deployment Diagrams.

### UNIT III

**Software Design and Architecture:** Design Process, Principles Leading to Good Design, Techniques for Making Good Design Decisions, Good Design Document, Software Architecture, Architectural Patterns: The Multilayer, Client-Server, Broker, Transaction Processing, Pipe & Filter And MVC Architectural Patterns.

**Design Patterns:** Abstraction-Occurrence, General Hierarchical, Play-Role, Singleton, Observer, Delegation, Adaptor, Façade, Immutable, Read-Only Interface and Proxy Patterns.

### UNIT IV

**Software Testing:** Effective and Efficient Testing, Defects in Ordinary Algorithms, Numerical Algorithms, Timing and Co-ordination, Stress and Unusual Situations, Testing Strategies for Large Systems.

**Software Project Management:** Introduction to Software Project Management, Activities of Software Project Management, Software Engineering Teams, Software Cost Estimation, Project Scheduling, Tracking And Monitoring.

**Software Process Models:** Waterfall Model, The Phased Released Model, The Spiral Model, Evolutionary Model, The Concurrent Engineering Model, Rational Unified Process.

### Text Book:

1. Object Oriented Software Engineering: Practical Software Development using UML and Java. Timothy C Lethbridge & Robert, Langaneire, Mc Graw Hill

### Reference Books:

1. The Unified Modeling Language User Guide. Grady Booch, James Rumbaugh and Ivar Jacobson. Addison-Wesley.
2. Software Engineering: A Practitioner's Approach. Roger S Pressman.
3. Object-Oriented Software Engineering: Using UML, Patterns and Java, Bernd Bruegge and Allen H. Dutoit, 2nd Edition, Pearson Education Asia.



## MCA 4.5 DATA WAREHOUSING AND DATA MINING

**Instruction: 3 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Data Warehouse and OLAP Technology: An overview** Data Warehouse Basic Concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Implementation

**Data Preprocessing:** An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization, From Data Warehousing to Data Mining

### UNIT II

**Introduction to Data Mining:** Motivation and importance, What is Data Mining, Data Mining on what kind of data, What kinds of patterns can be mined, Which technologies are used, Which kinds of applications are targeted, Major issues in Data Mining.

**Getting to know your Data:** Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring data Similarity and Dissimilarity.

### UNIT III

**Concept Description: Characterization and comparison** What is Concept Description, Data Generalization by Attribute-Oriented Induction(AOI), AOI for Data Characterization, Efficient Implementation of AOI, AOI for Class comparisons.

**Mining Frequent Patterns, Associations and Correlations:** Basic Concepts, Frequent Itemset Mining Methods: Apriori method, generating Association Rules, Improving the Efficiency of Apriori, Pattern-Growth Approach for mining Frequent Item sets, Mining Frequent Itemsets using vertical data format, Mining Closed and Max Patterns.

### UNIT IV

**Classification Basic Concepts:** Basic Concepts, Decision Tree Induction: Decision Tree Induction, Attribute Selection Measures, Tree Pruning, Bayes Classification Methods, Classification by Back Propagation, Support Vector Machines.

**Cluster Analysis:** Cluster Analysis, Partitioning Methods, Hierarchical methods, Density based methods-DBSCAN and OPTICS.

### Text Book:

1. Data Mining Concepts and Techniques—Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufman Publications 3<sup>rd</sup> edition.

### Reference Books:

1. Introduction to Data Mining –Pang-Ning Tan, Michael Steinbach, Vipin Kumar
2. Introduction to Data Mining, Adriaan, Addison Wesley Publication
3. Data Mining Techniques, A.K. Pujari, University Press

## MCA 4.6 OBJECT ORIENTED SOFTWARE ENGINEERING LAB

**Practical: 3 Periods /week**

**Internal: 50 Marks**

**Time: 3 Hours**

**External: 50 Marks**

**Credits: 2**

**Total: 100 Marks**

-----

The Unified Modeling Language (UML) is a standard language for specifying, visualizing, constructing and documenting the artifacts of software systems. The primary goal of UML is to provide users a ready-to-use, expressive visual modeling language so that they can develop and exchange meaningful models.

This lab deals with object oriented analysis and design of a software problem using UML concepts and notations. The tool used is Rational Rose Enterprise Edition. Any other open source tool is also recommended.

**Document the Software Project Management and Software Engineering activities for any two of the following projects. Any other project of interest also can be chosen.**

1. Student Result Management System
2. Library Management System
3. Payroll System
4. Bank Loan System
5. Railway Reservation System
6. Automatic Teller Machine
7. Hostel Management System
8. Hospital Management System
9. Online Shopping System
10. Blood Bank Management System
11. GPS
12. Journal Publication System
13. Chatroom Application
14. Social Media Application

**Software Project Management and Software Engineering activities specified below can be customized according to the features of the project.**

- Problem Statement
- Feasibility Study
- Software Requirements Specification Document
- Estimation of Project Metrics
- Entity Relationship Diagram
- Use Case Diagrams
- Class Diagram
- Sequence Diagrams
- Activity Diagrams
- State Chart Diagrams
- Test coverage

### References:

1. The Unified Modeling Language User Guide. Grady Booch, James Rumbaugh and Ivar Jacobson. Addison-Wesley.
2. Object Oriented Software Engineering: Practical Software Development using UML and Java. Timothy C Lethbridge & Robert, Langaneire, Mc Graw Hill

## MCA 4.7 DATA MINING USING R PROGRAMMING LAB

**Instruction: 3 Periods/week**  
**Internal: 50 Marks**

**Time: 3 Hours**  
**External: 50 Marks**

**Credits: 2**  
**Total: 100 Marks**

Students should be aware of usage of few packages and libraries of R. They should also be familiar with few functions used in R for visualization.

1. Implement all basic R commands
2. Interact data through .csv files(Import from and export to .csv files).
3. Get and Clean data using swirl exercises.(Use 'swirl' package, library and install that topic from swirl).
4. Visualize all Statistical measures(Mean,Mode, Median, Range, Inter Quartile Range etc., using Histograms, Boxplots and Scatter Plots).
5. Create a data frame with the following structure.

EMP ID	EMP NAME	SALARY	START DATE
1	Satish	5000	01-11-2013
2	Vani	7500	05-06-2011
3	Ramesh	10000	21-09-1999
4	Praveen	9500	13-09-2005
5	Pallavi	4500	23-10-2000

- a. Extract two column names using column name.
  - b. Extract the first two rows and then all columns.
  - c. Extract 3<sup>rd</sup> and 5<sup>th</sup> row with 2<sup>nd</sup> and 4<sup>th</sup> column.
6. Write R Program using 'apply' group of functions to create and apply normalization function on each of the numeric variables/columns of iris dataset to transform them into
    - i. 0 to 1 range with min-max normalization.
    - ii. a value around 0 with z-score normalization.
  7. Create a data frame with 10 observations and 3 variables and add new rows and columns to it using 'rbind' and 'cbind' function.
  8. Create a function to discretize a numeric variable into 3 quantiles and label them as low, medium, and high. Apply it on each attribute of iris dataset to create a new data frame. 'discrete iris' with Categorical variables and the class label.
  9. Create a simple scatter plot using toothgrowth dataset using 'dplyr' library. Use the same data to indicate distribution densities using boxwhiskers.
  10. Write R program to implement linear and multiple regression on 'mtcars' dataset to estimate the value of 'mpg' variable, with best  $R^2$  and plot the original values in 'green' and predicted values in 'red'.
  11. Write R Programs to implement k-means clustering, k-medoids clustering and density based clustering on iris dataset.
  12. Write a R Program to implement decision trees using 'readingSkills' dataset.
  13. Implement decision trees using 'iris' dataset using package party and 'rpart'.

### References:

1. [www.tutorialspoint.com/r](http://www.tutorialspoint.com/r)
2. [www.r-tutor.com](http://www.r-tutor.com)
3. R and Data Mining: Examples and Case Studies Yanchang Zhao.

**ADIKAVI NANNAYA UNIVERSITY**  
**Master of Computer Applications(MCA)**  
**Course Structure and Scheme of Valuation w.e.f. 2016-17**

**V Semester**

Code	Name of the subject	Periods/week		Max Marks		Total Marks	Credits
		Theory	Lab	External	Internal		
MCA 5.1	Wireless and Adhoc Networks	4	-	75	25	100	4
MCA 5.2	Cyber Security	4	-	75	25	100	4
MCA 5.3	Big Data Analytics	4	-	75	25	100	4
MCA 5.4	Elective II	4	-	75	25	100	4
MCA 5.5	Elective III	4	-	75	25	100	4
MCA 5.6	Advanced Programming: Cyber Security and Data Analytics Lab	-	3	50	50	100	2
MCA 5.7	.NET Lab	-	3	50	50	100	2
<b>Total</b>						<b>700</b>	<b>24</b>

MCA 5.4 Elective II : 5.4.1 Cloud Computing  
5.4.2 Soft Computing  
5.4.3 Mobile Computing

MCA 5.5 Elective III: 5.5.1 Image Processing  
5.5.2 Bio-Informatics  
5.5.3 Software Testing and Quality Assurance

## MCA 5.1 WIRELESS AND ADHOC NETWORKS

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Introduction:** Introduction to Wireless Networks, Various Generations of Wireless Networks, Virtual Private Networks- Wireless Data Services, Common Channel Signaling, Various Networks for Connecting to the Internet, Blue tooth Technology, Wifi-WiMax- Radio Propagation mechanism, Path loss Modeling and Signal Coverage

**Wireless Local Area Networks:** Introduction-WLAN topologies-IEEE 802.11 Standards, MAC Protocols, Comparison of 802.11 a,b,g and n Standards, HIPER LAN , ZigBee 802.15.4, Wireless Local Loop.

### UNIT II

**Wireless Adhoc Networks:** Basics of Wireless Networks, Infrastructured Versus Infrastructureless Networks – Properties of Wireless, Ad hoc Networks, Types of Ad hoc Networks, Challenges in Ad hoc Networks –Applications of Wireless Ad Hoc Networks

**Routing Protocols for Ad hoc Networks:** Introduction-Proactive Routing Protocols- Reactive Routing protocols-Hybrid Routing Protocols-QoS Metrics-Energy impact issues in Routing.

### UNIT III

**Mobile Ad hoc Networks (MANETs):** Overview, Properties of A MANET, Spectrum of MANET Applications, Routing and Various Routing Algorithms.

**Other Wireless Technologies:** Introduction, IEEE 802.15.4 and Zigbee, General Architecture, Physical Layer, MAC layer, Zigbee, WiMAX and IEEE 802.16, Layers and Architecture, Physical Layer, OFDM Physical layer.

### UNIT IV

**Security in Ad hoc Networks:** Introduction- Security Attacks, Intrusion Detection System, Intrusion Prevention system, Intrusion Response system, Wired Equivalent Privacy (WEP) -A Security Protocol for Wireless Local Area Networks (WLANs), Security in MANETs.

### Text Books:

1. Principles of Wireless Networks , Kaveth Pahlavan, K. Prasanth Krishnamurthy, Pearson Publications, Asia, 2002
2. Mobile Cellular Communications, G.Sasibhusan Rao, Pearson Publications.

### Reference Book:

1. Guide to Wireless Ad hoc Networks: Series: Computer Communications and Networks, Misra, Sudip; Woungang, Isaac; Misra, Subhas Chandra, 2009, Springer

## MCA 5.2 CYBER SECURITY

**Instruction: 4 Periods/week**

**Time: 3 Hours**

**Credits: 4**

**Internal: 25 Marks**

**External: 75 Marks**

**Total: 100 Marks**

---

### UNIT I

**Information Security and Threats:** Information Security, Information Assets, Threats to Information Assets. **Fundamentals of Information Security:** Elements of information security, Principles and concepts – data security, Types of controls.

**Data Leakage:** Introduction – Data Leakage, Organizational Data Classification, Location and Pathways, Content Awareness, Content Analysis Techniques, Data Protection, DLP Limitations, DRM-DLP Conundrum.

### UNIT II

**Cyber Security Introduction:** Cyber Security, Cyber Security policy, Domains of Cyber Security Policy: Laws and Regulations, Enterprise Policy, Technology Operations, Technology Configuration, Strategy Versus Policy.

**Cyber Security Evolution:** Productivity, Internet, e-commerce, Counter Measures, Challenges.

### UNIT III

**Cyber Security Objectives:** Cyber Security Metrics, Security Management Goals, Counting Vulnerabilities, Security Frameworks, Security Policy Objectives.

**Guidance for Decision Makers:** Tone at the Top, Policy as a Project, Cyber Security Management: Arriving at Goals, Cyber Security Documentation.

**Cyber Governance Issues:** Net Neutrality, Internet Names and Numbers, Copyright and Trademarks, Email and Messaging.

### UNIT IV

**Cyber User Issues:** Malvertising, Impersonation, Appropriate Use, Cyber Crime, Geo location, Privacy.

**Cyber Conflict Issues:** Intellectual property Theft, Cyber Espionage, Cyber Sabotage, Cyber Welfare.

**Cyber Management Issues:** Fiduciary Responsibility, Risk Management, Professional Certification, Supply Chain, Security Principles, Research and Development.

**Cyber Infrastructure Issue:** Banking and finance, Health care, Industrial Control systems.

### Text Books:

1. NASSCOM, Handbook of Security Analyst, SSC/Q0901, 2015.
2. Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs, Jeffrey Schmidt, Joseph Weiss Cyber Security Policy Guidebook, John Wiley & Sons 2012.

### Reference Books:

1. Rick Howard, Cyber Security Essentials, Auerbach Publications 2011.
2. Richard A. Clarke, Robert Knake, Cyberwar: The Next Threat to National Security & What to Do About It, Ecco 2010.
3. Dan Shoemaker Cyber security The Essential Body of Knowledge, 1st ed. Cengage Learning 2011.
4. Augustine, Paul T., Cyber Crimes and Legal Issues”, Crecent Publishing Corporation, 2007

## MCA 5.3 BIG DATA ANALYTICS

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Data structures in Java:** Java concepts required for developing Map Reduce Programs: Linked List, Stacks, Queues, Sets, Maps; Generics: Generic classes and Type parameters, Implementing Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization.

**Introduction to Big Data:** Big Data-definition, Characteristics of Big Data (Volume, Variety, Velocity, Veracity, Validity), Importance of Big Data, Patterns for Big Data Development, Data in the Warehouse and Data in Hadoop[Zikopoulos]

### UNIT II

**Introduction to Hadoop:** Hadoop- definition, Understanding distributed systems and Hadoop, Comparing SQL databases and Hadoop, Understanding MapReduce, Counting words with Hadoop—running your first program, History of Hadoop, Starting Hadoop - The building blocks of Hadoop, NameNode, DataNode, Secondary NameNode, JobTracker and Task Tracker

**HDFS:** Components of Hadoop -Working with files in HDFS, Anatomy of a MapReduce program, Reading and writing the Hadoop Distributed File system -The Design of HDFS, HDFS Concepts, The Command-Line Interface, Hadoop Filesystem, The Java Interface, Data Flow, Parallel Copying with distcp, Hadoop Archives.

### UNIT III

**MapReduce Programming:** Writing basic Map Reduce programs - Getting the patent data set, constructing the basic template of a Map Reduce program, Counting things, Adapting for Hadoop's API changes, Streaming in Hadoop.

**MapReduce Advanced Programming:** Advanced MapReduce - Chaining Map Reduce jobs, joining data from different sources.

### UNIT IV

**Graph Representation in MapReduce:** Modeling data and solving problems with graphs, Shortest Path Algorithm, Friends-of-Friends Algorithm, PageRank Algorithm, Bloom Filters.

#### Text Books:

1. Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data by Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, 1st Edition, TMH, 2012.
2. Hadoop in Action by Chuck Lam, MANNING Publishers.
3. Hadoop in Practice by Alex Holmes, MANNING Publishers

#### Reference Books:

1. Hadoop: The Definitive Guide by Tom White, 3<sup>rd</sup> Edition, O'reilly
2. Big Java Fourth Edition Cay Horstmann Wiley, John Wiley & Sons
3. Mining of massive datasets, AnandRajaraman, Jeffrey D Ullman, Wiley Publications.

## ELECTIVE II: MCA 5.4.1 CLOUD COMPUTING

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Cloud Computing Basics** - Cloud Computing Overview, Applications, Intranets and the Cloud, First Movers in the Cloud. The Business Case for Going to the Cloud - Cloud Computing Services, Business Applications, Deleting Your Datacenter, Salesforce.com, Thomson Reuters.

**Organization and Cloud Computing** - When You Can Use Cloud Computing, Benefits, Limitations, Security Concerns, Regulatory Issues, Cloud Computing with the Titans - Google, EMC, NetApp, Microsoft, Amazon, Salesforce.com, IBMPartnerships.

### UNIT II

**Hardware and Infrastructure** - Clients, Security, Network, Services. Accessing the Cloud - Platforms, Web Applications, Web APIs, Web Browsers. Cloud Storage - Overview, Cloud Storage Providers, Standards - Application, Client, Infrastructure, Service.

**Software as a Service** - Overview, Driving Forces, Company Offerings, Industries Software plus Services - Overview, Mobile Device Integration, Providers, Microsoft Online.

### UNIT III

**Developing Applications** - Google, Microsoft, Intuit QuickBase, Cast Iron Cloud, Bungee Connect, Development, Troubleshooting, Application Management.

**Local Clouds and Thin Clients** - Virtualization in Your Organization, Server Solutions, Thin Clients, Case Study: McNeilus Steel.

### UNIT IV

**Migrating to the Cloud** - Cloud Services for Individuals, Cloud Services Aimed at the Mid-Market, Enterprise-Class Cloud Offerings, Migration, Best Practices and the Future of Cloud Computing - Analyze Your Service, Best Practices, How Cloud Computing Might Evolve.

### Text Books:

1. Cloud Computing-A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGrawHill.

### Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
2. Cloud Computing, A Hands on approach, Arshadeep Bahga, Vijay Madiseti, University Press



## ELECTIVE II: MCA 5.4.2 SOFT COMPUTING

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Soft Computing:** Introduction to Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Different Tools and Techniques, Usefulness and Applications.

**Fuzzy Sets and Fuzzy Logic:** Introduction, Fuzzy Sets Versus Crisp Sets, Operations on Fuzzy Sets, Extension Principle, Fuzzy Relations and Relation Equations, Fuzzy Numbers, Linguistic Variables, Fuzzy Logic, Linguistic Hedges, Applications.

### UNIT II

**Interference in fuzzy logic:** fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzifications and Defuzzifications, Fuzzy Controller, Fuzzy Controllers, Fuzzy Pattern Recognition, Fuzzy Image Processing, Fuzzy Database.

**Artificial Neural Network:** Introduction, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, re-current networks. Various learning techniques, perception and convergence rule, Auto-associative and hetro-associative memory , Hebb's Learning, Adaline, Perceptron.

### UNIT III

**Multilayer Feed Forward Network:** Back Propagation Algorithms, Different Issues Regarding Convergence of Multilayer Perceptron, Competitive Learning, Self-Organizing, Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

**Evolutionary and Stochastic Techniques:** Genetic Algorithm (GA), Genetic Representations, (Encoding) Initialization and Selection, Different Operators of GA, Analysis of Selection Operations, Hypothesis of Building Blocks, Schema Theorem and Convergence of Genetic Algorithm, Simulated Annealing and Stochastic Models, Boltzmann Machine, Applications.

### UNIT IV

**Rough Set:** Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables and Applications.

**Hybrid Systems:** Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications

### Text Books:

1. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, S. Rajsekaran and G.A. Vijayalakshmi Pai, Prentice Hall of India.
2. Rough Sets, Z.Pawlak, Kluwer Academic Publisher, 1991.
3. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher, 1997

### Reference Books:

1. Artificial Intelligence and Intelligent Systems, N.P.Padhy, Oxford University Press.
2. Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice Hall PTR.
3. Learning and Soft Computing, V. Kecman, MIT Press, 2001
4. Fuzzy Sets and Fuzzy Logic, Klir & Yuan, PHI, 1997

## ELECTIVE II: MCA 5.4.3 MOBILE COMPUTING

**Instruction: 4 Periods/week**

**Time: 3 Hours**

**Credits: 4**

**Internal: 25 Marks**

**External: 75 Marks**

**Total: 100 Marks**

---

### UNIT-I

**Introduction to Mobile Communications and Computing:** Introduction to cellular concept, Frequency Reuse, Handoff, GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services, Introduction to mobile computing, novel applications, limitations, and architecture.

### UNIT II

**Wireless LANs:** Introduction, Advantages and Disadvantages of WLANs, WLAN Topologies, Introduction to Wireless Local Area Network standard IEEE 802.11, Comparison of IEEE 802.11a, b, g and n standards, Wireless PANs, Hiper LAN, Wireless Local Loop

**Wireless Networking:** Introduction, Various generations of wireless networks, Fixed network transmission hierarchy, Differences in wireless and fixed telephone networks, Traffic routing in wireless networks, WAN link connection technologies, X.25 protocol, Frame Relay, ATM, Virtual private networks, Wireless data services, Common channel signaling, Various networks for connecting to the internet.

### UNIT III

**Database Issues:** Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, file system, disconnected operations.

**Data Dissemination:** Communications asymmetry, classification of new data delivery mechanisms, push-based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques.

### UNIT IV

**Mobile IP and Wireless Application Protocol:** Introduction to Mobile IP, Introduction to Wireless Application Protocol, Application layer.

### Text Books:

1. Gottapu Sasibhushana Rao, "Mobile Cellular Communication", Pearson Education, First Edition, 2013.
2. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002.

## ELECTIVE III: MCA 5.5.1 IMAGE PROCESSING

**Instruction: 4 Periods/week**

**Time: 3 Hours**

**Credits: 4**

**Internal: 25 Marks**

**External: 75 Marks**

**Total: 100 Marks**

---

### UNIT I

**Fundamentals of Image Processing:** Image Acquisition, Image Model, Sampling, Quantization, Relationship Between Pixels, Distance Measures, Connectivity, Image Geometry, Photographic Film.

**Histogram:** Definition, Decision Of Contrast Basing On Histogram, Operations Basing on Histograms Like Image Stretching, Image Sliding, Image Classification. Definition and Algorithm of Histogram Equalization.

### UNIT II

**Image Transforms:** A Detail Discussion On Fourier Transform, DFT,FFT,

**Image Enhancement:**

- a) Arithmetic and Logical Operations, Pixel or Point Operations, Size Operations,
- b) Smoothing Filters-Mean, Median, Mode Filters – Comparative Study
- c) Edge Enhancement Filters – Directorial Filters, Sobel, Laplacian, Robert, KIRSCH Homogeneity
- d) Low Pass Filters, High Pass Filters, Sharpening Filters. – Comparative Study

### UNIT III

**Image Enhancement:** Design of Low Pass, High Pass, EDGE Enhancement, Smoothing Filters in Frequency Domain. Butter Worth Filter, Homomorphic Filters in Frequency Domain Advantages of Filters in Frequency Domain, Comparative Study of Filters in Frequency, Domain and Spatial Domain.

**Image Compression:** Run Length Encoding, Contour Coding, Huffman Code, Compression Due to Change in Domain, Compression Due to Quantization Compression at the Time of Image Transmission. Brief Discussion on:- Image Compression Standards.

### UNIT IV

**Image Segmentation:** Characteristics of Segmentation, Detection of Discontinuities, Thresholding Pixel Based Segmentation Method. Region Based Segmentation Methods, Segmentation by Pixel Aggregation, Segmentation by Sub Region Aggregation, Histogram Based Segmentation, Spilt and Merge Technique, Motion in Segmentation.

**Morphology:** Dilation, Erosion, Opening, Closing, Hit-And-Miss Transform, Boundary Extraction, Region Filling, Connected Components, Thinning, Thickening, Skeletons, Pruning Extensions to Gray – Scale Images, Application of Morphology in IP

#### **Text Book:**

1. Digital Image Processing, Rafael C. Gonzalez And Richard E. Woods, Addison Wesley

#### **Reference Books:**

1. Fundamentals Of Electronic Image Processing By Arthyr –R – Weeks, Jr.(PHI)
2. Image Processing, Analysis, And Machine Vision By Milan Sonka Vaclan Halava Roger Boyle, Vikas Publishing House.
3. Digital Image Processing, S. Jayaraman, S. Esakkirajan& T. Veera Kumar, TMH
4. Fundamentals of Digital Image Processing, Chris Solomon, Tobi Breckon, Wiley-Blackwell

## ELECTIVE III: MCA 5.5.2 BIO INFORMATICS

**Instruction: 4 Periods/week**  
**Internal: 25 Marks**

**Time: 3 Hours**  
**External: 75 Marks**

**Credits: 4**  
**Total: 100 Marks**

---

### UNIT I

**Introduction:** Definitions, Sequencing, Biological Sequence/Structure, Genome Projects, Pattern Recognition a Prediction, Folding Problem, Sequence Analysis, Homology and Analogy.

**Protein Information Resources:** Biological Databases, Primary Sequence Databases, Protein Sequence Databases, Secondary Databases, Protein Pattern Databases, and Structure Classification Databases.

### UNIT II

**Genome Information Resources:** DNA Sequence Databases, Specialized Genomic Resources.

**DNA Sequence Analysis:** Importance Of DNA Analysis, Gene Structure And DNA Sequences, Features of DNA Sequence Analysis, EST (Expressed Sequence Tag) Searches, Gene Hunting, Profile of a Cell, EST Analysis, Effects Of EST Data on DNA Databases.

### UNIT III

**Pair Wise Alignment Techniques :**Database Searching, Alphabets and Complexity, Algorithm and Programs, Comparing Two Sequences, Sub-Sequences, Identity and Similarity, The Dotplot, Local and Global Similarity, Different Alignment Techniques, Dynamic Programming, Pair Wise Database Searching.

**Multiple Sequence Alignment:** Definition and Goal, The Consensus, Computational Complexity, Manual Methods, Simultaneous Methods, Progressive Methods, Databases of Multiple Alignments And Searching.

### UNIT IV

**Secondary Database Searching:** Importance and Need of Secondary Database Searches, Secondary Database Structure and Building a Sequence Search Protocol.

**Analysis Packages:** Analysis Package Structure, Commercial Databases, Commercial Software, Comprehensive Packages, Packages Specializing in DNA Analysis, Intranet Packages, Internet Packages.

### Text Books:

1. Introduction To Bioinformatics, By T K Attwood & D J Parry-Smith Addison Wesley Longman
2. Bioinformatics- A Beginner's Guide By Jean-Michel Claveriw, Cerdric Notredame, WILEY Dreamlech India Pvt. Ltd

### Reference Books:

1. Introduction To Bioinformatics By M.Lesk Oxford Publishers (Indian Edition)

## ELECTIVE III: MCA 5.5.3 SOFTWARE TESTING AND QUALITY ASSURANCE

**Instruction: 4 Periods/week**

**Time: 3 Hours**

**Credits: 4**

**Internal: 25 Marks**

**External: 75 Marks**

**Total: 100 Marks**

---

### UNIT I

**Basic concepts of quality and testing:** Quality revolution, Software Quality, Role of testing, Verification and validation, Failure, Error, Fault, and Defect, Objectives of testing, What is a Test Case, Expected Outcome, Testing activities, Test Levels, Sources of information for Test Case selection.

**Unit testing:** Unit testing basics, Static Unit testing, Defect prevention, Dynamic unit testing, Mutation Testing, Debugging, Unit testing in extreme programming, Tools for unit testing.

**Control flow testing:** Outline of Control flow testing, Control flow graph and Paths, Path Selection Criteria: All-path coverage criterion, Statement coverage criterion, Branch coverage criterion, Predicate coverage criterion, Generating test input, test data selection.

### UNIT II

**Data flow testing:** General idea, Data flow anomaly, Data flow graph, Data flow terms, Data flow testing criteria.

**Domain testing:** Domain error, Testing for domain errors, Sources of domains, Types of domain errors, ON and OFF points, Test selection criterion.

**Integration testing:** Concept of integration testing, Different types of interfaces and interface errors, System integration techniques: Incremental, Top down, Bottom up, Sandwich and Big Bang, Test plan for system integration, Off-the-shelf component integration.

### UNIT III

**Software Quality Assurance (SQA) :** The uniqueness of SQA, The environments for which SQA methods are developed, what is software, Software errors, faults and failures, classification of the causes of software errors, software quality-definition, SQA - definition and objectives.

**Software quality factors:** Classification of software requirements into software quality factors: Product operation, product revision, Product transition.

**Software quality assurance system:** The SQA system-an SQA architecture: Pre-project components, Software project life cycle components, Infrastructure components, Management SQA components.

### UNIT IV

**CASE tools for software quality:** What is a CASE tool? The contribution of CASE tools software product quality, The contribution of CASE tools to improved project management.

**Software quality metrics:** Objectives of measurement, Classification of quality metrics, Process metrics, Product metrics, Implementation of quality metrics, Limitations of metrics.

#### **Quality management standards:**

The scope of quality management standards, ISO 9001 and ISO 9000-3, Capability maturity models-CMM and CMMI assessment methodology, The Bootstrap methodology, The SPICE project and the ISO/IEC 15504 software process assessments standard.

#### **Text books:**

1. Software Testing and Quality Assurance. Kshirasagar Nail, Priyadarshi Tripathy. John Wiley Publication.
2. Software Quality Assurance: From theory to implementation. Daniel Galin. Pearson Adison Wesley Publication.

**MCA 5.6 ADVANCED PROGRAMMING: CYBER SECURITY AND  
DATA ANALYTICS LAB**

**Practical: 3 Periods /week**  
**Internal: 50 Marks**

**Time: 3 Hours**  
**External: 50 Marks**

**Credits: 2**  
**Total: 100 Marks**

---

**List of Experiments: Cyber Security**

1. Implement encryption and decryption substitution technique using Modified Caesar-Cipher
2. Implement One Time Pad Cipher algorithm
3. Implement Rail Fence transposition technique.
4. Implement RSA algorithm.
5. Calculate the message digest of a text using the MD5/SHA-1 algorithm
6. Generate digital signature using RSA & MD5/SHA-1
7. Experiment using NMAP/ZENMAP
8. Sniff network traffic using tool: Cain and Abel / Wireshark / tcpdump
9. Generate minimum 10 passwords of length 12 characters using openssl command
10. Study and use Snort IDS.

**Note:** A minimum of 5 experiments should be completed related to Cyber Security/Cryptography.

**References:**

1. Cryptography and Network security, Atul Kahate, Tata McGraw-Hill Pub company Ltd., New Delhi
2. NASSCOM, Handbook of Security Analyst, SSC/Q0901, 2015

**List of Experiments: Big Data Analytics**

1. Write a Java Program to implement Linked Lists, Stacks and Queues.
2. Write Java Program that implements Generic Types which collects pair of elements of different types.
3. Write a Java Program that uses object serialization and deserialization.
4. Know about setting up and Installing Hadoop in its three operating modes and implement in Standalone.
5. Implement the following file management tasks in Hadoop: Adding, Retrieving and deleting files.  
Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.
6. Write a Map-Reduce Program to find average of numbers.
7. Implement Matrix Multiplication with Hadoop Map Reduce
8. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

**References:**

1. Big Java Fourth Edition Cay Horstmann Wiley, John Wiley & Sons
2. [www.hadoop.apache.org](http://www.hadoop.apache.org)
3. [www.gist.github.com](http://www.gist.github.com)

## **MCA 5.7 .NET LAB**

**Instruction: 3 Periods/week**  
**Internal: 50 Marks**

**Time: 3 Hours**  
**External: 50 Marks**

**Credits: 2**  
**Total: 100 Marks**

---

### **List of Experiments Using VB.NET and C#.NET**

1. Find whether a number is even or odd
2. Find the sum of the digits of a number
3. Accept a string and convert it to lower case
4. Develop a calculator application
5. Develop timer based quiz
6. Validation of login form
7. Exercise different controls like calendar control, data grid
8. Results processing with Database connectivity

### **List of Experiments Using ASP.NET**

9. Develop simple web applications Using ASP.NET to understand the working of button control, label box, text box, check box, list box, image and other basic controls.
10. Write an ASP.NET application to simulate traffic lights.
11. Develop an ASP.NET application for online store with list of items. When the item is selected, display the image and when the image is selected, price should be displayed.
12. Develop ASP.NET application for validation of a login form
13. Create a simple project of your own using Database connectivity with ASP.NET.

### **References:**

1. Visual Basic .Net for Experienced Programmers Harvey M Deitel
2. Visual Basic .NET The Complete Reference. Jeffrey R Shapiro Tata Mc-Graw Hill
3. Programming in C# by E.Balagurusamy.
4. The Complete Reference ASP.NET by Matthew Macdonald.

**ADIKAVI NANNAYA UNIVERSITY**  
**Master of Computer Applications (MCA)**  
**Course Structure and Scheme of Valuation w.e.f. 2016-17**

**VI Semester**

<b>Code</b>	<b>Name of the subject</b>	<b>Periods/week</b>		<b>Max Marks</b>		<b>Total Marks</b>	<b>Credits</b>
		<b>Theory</b>	<b>Lab</b>	<b>External</b>	<b>Internal</b>		
MCA 6.1	Project Work	-	-	100	100	200	12