updated

School of Computer & Systems Sciences

Master of Computer Applications (M.C.A)

Course Structure

A student shall have to earn a minimum of 110 credits at the end of III year in order to be eligible for the award of MCA degree

Semester I

S.No.	Course Name	L-T-P	Credits
1	Digital Logic	3-0-2	4
2	Discrete Mathematics	4-0-0	4
3	Programming using C	4-0-0	4
4	Numerical Computing	3-0-2	4
5	C Programming Laboratory	0-0-4	2

Semester II

S.No.	Course Name	L-T-P	Credits
1	Microprocessors	3-0-2	4
2	Data Structures	4-0-0	4
3	Formal Language & Automata Theory	4-0-0	4
4	Database Management Systems	3-0-2	4
5	Probability & Statistics	3-0-2	4
6	Data Structures Laboratory	0-0-4	2

Semester III

S.No.	Course Name	L-T-P	Credits
1	Object Oriented Programming	4-0-0	4
2	Computer Networks	3-0-2	4
3	Operating System	3-0-2	4
4	Design & Analysis of Algorithms	3-0-2	4
5	Computer Architecture	3-0-2	4
6	Object Oriented Programming Laboratory	0-0-4	2

Semester IV

S.No.	Course Name	L-T-P	Credits
1	Software Engineering	3-0-2	4
2	Artificial Intelligence	3-0-2	4
3	Computer Graphics	3-0-2	4
4	Web based programming	2-0-4	4
5	Elective I	3-0-2	4

Semester V

S.No.	Course Name	L-T-P	Credits
1	Principles of Compiler Design	3-0-2	4
2	Parallel & Distributed Systems	3-0-2	4
3	Elective II	3-0-2	4
4	Elective III	3-0-2	4
5	Elective IV	3-0-2	4

Semester VI

S.No.	Course Name	L-T-P	Credits
1	Major project		8

List of Optional Courses for Elective I – IV

1. Algorithmic Graph Theory
2. Data Mining and Knowledge Discovery
3. Advanced Algorithms
4. Big Data Management
5. Distributed Databases
6. Cloud Computing
7. Digital Image Processing
8. Computer Vision
9. Information Security
10. Evolutionary Computation
11. Networks Programming
12. Information Theory
13. Object Oriented Analysis And Design
14. Optimization Techniques
15. Machine Learning
16. VLSI Design
17. Modeling and Simulation
18. Internet and Web Technology
19. Multimedia Systems
20. Natural Language Processing
21. Pattern Classifications
22. Software Testing
23. Wireless Communication and Mobile Computing

School of Computer and Systems Sciences

Master of Computer Applications (M.C.A)

Syllabus

SEMESTER I (All compulsory)

1. Digital Logic (CS-101) **(3-0-2)**

Introduction: Analog and Digital system, Active and Passive components, Number system, Binary codes, Digital Integrated Circuits: Introduction to Bipolar transistor characteristics, RTL, DTL, I^2L, TTL, ECL, MOS, CMOS, Logic Families Design: Logic gates, Boolean Algebra, K-map, Map simplification Combinational Circuit Design: Half Adder, full adder, Decoders, Encoders, Magnitude comparator, Multiplexer, Read only memory, PLAs, Sequential Circuit Design: Flip-Flops, Registers, Shift Registers, Counters, Processor Logic Design: Arithmetic Circuit, Logic circuit, Accumulator, Status Register

References:

1. Moris Mano, Digital Logic and Computer Design, Fundamentals, PHI, 2004.
2. T.L.Floyd and R.P.Jain, Digital Fundamentals, Pearson Education, 2007.
3. A.P.Malvino, Digital Computer Electronics, Second Edition, TMH.
4. Givone D D, Digital Principles and Design, Tata McGraw- Hill, 2002.

2. Discrete Mathematics (CS-102) **(4-0-0)**

Number System: Decimal Number Systems, Binary Number Systems, Hexadecimal Number Systems, Octal Number Systems, Binary Arithmetic. Propositions and Logical Operations: Notation, Connections, Normal forms, Truth Tables, Equivalence and Implications, Theory of interference for statement calculus, Predicate calculus, Rules of Logic, Mathematical Induction and Quantifiers. Sets, Relations and Diagraphs: Review of set concepts, Relations and digraphs, Properties of relations, Equivalence relations, Computer representation of relations and digraphs, Manipulation of relations, Partially Ordered Sets (Posets). Recurrence Relations: Towers of Hanoi, Iterations, Homogeneous linear equations with constant coefficients, particular solution, difference table, finite order differences, Line in a plane in general position. Groups and Applications: Monoids, semi groups, Product and quotients of algebraic structures, Isomorphism, homomorphism, automorphism, Normal subgroups, Codes and group codes Classification of Languages: Overview of Formal Languages-Representation of regular languages and grammars, finite state machines.

References:

1. J.P.Tremblay and R.Manohar, Discrete Mathematical Structures, Tata McGraw Hill, 2001.
2. Semyour Lipschutz and Varsha Pati, Discrete Mathematics, Second Edition, Schaum's Series, TMH

3. Kolman, Busby and Ross, Discrete Mathematical Structures, Third Edition, Prentice Hall India.
4. C.L. Liu, Elements of Discrete Structures, MacGraw Hill, 1986.
5. K. H. Rosen, Discrete Mathematics and Application, MacGraw Hill, 1999.

3. Programming using C (CS-104) **(4-0-0)**

Introduction to problem solving : Structure of C program, C data types, Storage types, String processing, C operators and expressions, Precedence of operators, Control statements, Loops , Arrays , Pointers, Array and Pointers, Static versus Dynamic Arrays, Unions, Structures, Macros, C preprocessors, Library functions, Functions : defining , accessing, function prototypes, Parameter passing, command line arguments, files handling.

References:

1. B.W. Kernighan, Dennis M. Ritchie , The C Programming Language , PHI/Pearson, 1988
2. Dromey, How to Solve it By Computer, PHI, 2008
3. E Balaguruswamy , C Programming, Tata Mc Graw Hill, 2002
4. Stephen G. Kochan ,Programming in C, Pearson Education, 2005

4. Numerical Computing (CS-103) **(3-0-2)**

Computing Arithmetic, Significant Digits and Numerical Instability, Root finding methods. Bisection, Newton Raphson, Secant and Regula Falsi, methods for multiple roots. System of Linear Algebraic Equations and Eigenvalue problems-Gauss Elimination, LU Decomposition. Jacobi-Gauss-Seidel and SOR methods, Interpolation and Approximation-spline approximation. Linear, quadratic and Cubic, Differentiation and Integration-Richardson's extrapolation, Gauss Quadrature methods, ordinary differential equations-Initial and Boundary Value Problems, introduction to numerical solutions of Partial Differential Equations.

References

1. M.K. Jain, SRK Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 2003.
2. S.C. Chopra and Raymond P. Canale, Numerical Methods for Engineers, McGraw-Hill Higher Education, 2005.
3. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI, 2012.
4. E.W. Cheney and D.R. Kincaid, Numerical Analysis, American Mathematical Society, 2010.

5. C Programming Laboratory **(0-0-4)**

1. Simple programs
   - Exchanging values of two variables
   - Summation of First N integers
   - Summation of a set of numbers
   - Series Summation : sin,cosine, exponential series, AP, GP
   - Factorial Computation
   - Sum of digits of a number and reversing the number

- Base Conversion
- Character to number Conversion
- Programs on : arithmetic, logical, relational and bitwise operator

2. Factoring Methods
   - Finding Square root of a number
   - Finding LCM and GCD of a number
   - Testing and generating prime numbers
   - Generating prime factors of a number
   - Raising number to a large power
   - Finding nth Fibonacci number

3. Array Programs
   - Finding Max/Min Second max/min nth max/min of array
   - Partitioning an array wrt an element
   - Finding longest monotone sequence
   - Searching, Sorting, Merging, Intersection of Arrays
   - Array order reversal
   - Removal of duplicates from ordered array
   - Programs on Frequency array, making histogram
   - Matrix Addition, Subtraction, Multiplication, Chain Multiplication

4. String manipulation and Text Search
   - String Manipulation : Search, insertion, deletion, replacement, concatenation, comparison
   - Checking if a string is Palindrome
   - Parsing of tokens, Counting of different types of tokens
   - Morse Code Program
   - Keyword Search, Text and pattern search
   - String manipulation using bitwize operator

5. Recursive Algorithms
   - Factorial, Fibonacci series
   - Tower of Hanoi
   - Linear , Binary Search
   - Recursive Sorting algorithms
   - Series summation

6. Pointer and its applications
   - Programs on 1D and 2D array and pointers
   - Programs on Array , Record , Union and functions
   - Programs using complex declaration of pointers
   - Programs on dynamic memory management

7. Programs on Data Structures

- Program on records and union, array of record and union
- Program on stack and queue
- Program on Linked List

8. Programs on File Management
    - Programs on text and binary files
    - Converting text file to Binary file and vice versa
    - Programs on sequential and random files
    - Copy a file to another
    - Printing contents of file selectively
    - Deleting/Editing contents of a file selectively
    - Comparing two files
    - Application of files on solving practical problems

9. Other Programs
    - Program on converting a number from digit to Words
    - Programs to find difference/no. of days between two dates
    - Programs to find day on a date
    - Program for printing Calendar
    - Program on Complex numbers and operation on complex numbers

SEMESTER II (All compulsory)

1. Microprocessor (CS-113) **(3-0-2)**

Programming the 8085: 8085 Microprocessor, Bus Structure and Timings, Demultiplexing the bus, Addressing Modes and Instruction set, 8085 Interrupts, Programming the 8086: Software Model of 8086, Memory address Space and Data Organization, Segment Registers and Memory Segmentation, Dedicated and General Use of Memory, Addressing Modes, Instruction Set, Interrupt Processing, Minimum/ Maximum Mode, Interfacing Peripherals and Applications: Digital to Analog Converters, Analog to Digital Converters, 8255 PPI, 8279 Keyboard Display Interface, 8253 Programmable Interval Timer, 8259 Programmable Interrupt Controller, 8237 DMA Controller, Introduction to 80186, 80286, 80386 and 80486 Microprocessors, Registers, Memory Management.

References:

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Wiley Eastern Limited, 2002
2. Barry B. Brey, C.R.Sharma, The Intel Microprocessors: Atrchitecture, Programming and Interfacing, Pearson Education, 2005
3. Sunil Mathur, Microprocessor 8086: Architecture, Programming and Interfacing, PHI, 2011
4. Douglas V. Hall, Microprocessor and Interfacing, McGraw Hill Company, 2005.

2. Data Structures (CS-107) (4-0-0)

Introduction to Data Structures, algorithms, pseudocode, time and space complexities; arrays, sparse matrix, stacks, recursion, queues, priority queues, linked lists, Introduction to trees, forest, binary tree, threaded binary tree, traversal techniques, Binary Search Trees, AVL trees, B-trees, B+ trees, Introduction to Graphs, DFS, BFS. Sorting and searching algorithms, hashing.

References:

1. Horowitz Ellis and Sahni Sartaj, Fundamentals of Data Structures, W H Freeman and Co, 1988.
2. Tremblay Jean-Paul and Sorenson Paul G., An Introduction to Data Structures With Applications, Second Edition, McGraw-Hill, Inc.
3. Kruse Robert L., Data Structures and Program Design, Prentice Hall, 2007
4. Gilberg Richard F. and Forouzan Behrouz A., Data Structures: A Pseudocode Approach with C, Cengage Learning, 2004
5. Cormen Thomas H., Introduction to Algorithms, MIT Press, 2009.

3. Formal Languages and Automata Theory (CS-119) (4-0-0)

Regular language Models: Finite state machines (deterministic, non-deterministic), regular languages and regular grammars, properties; Context-free language models: Context-free languages, properties of CFL, Pushdown automata; Turing Machines, limits of algorithmic computation; Grammars, hierarchy of formal languages, properties of models of computation, Computational complexity, complexity class P and NP.

Reference:

1. Linz, Peter, An introduction to Formal Languages and Automata, Narosa Publishing House, 2007.
2. Lewis, H.R., and Papadimitriou, C.H., Elements of Theory of Computation, Pearson Education, 2002.
3. Hofcroft, J.E., and Ullman, J.D., Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, 2008.
4. Krithivasan, Kamala, Introduction to Automata Theory, Languages and Computation, Pearson Education, 2009.
5. Martin, J.C., Introduction to Languages and Theory of Computation, Tata McGraw-Hill Publication, 2007.

3. Database Management Systems (CS-111) (3-0-2)

Database Approach - System Concepts and Architecture, Database Users; Database Design - Entity-Relationship (E-R) Model, Relational Model, Mapping E-R to Relational Model; Languages - Relational Algebra, Tuple and Domain Relational Calculus , SQL; Normalization - Functional and Multivalued Dependency, 1NF to 5NF; Security; Transaction Management - Transaction, ACID properties, Concurrency, Recovery ; Query Optimization - Cost based and Heuristics based. Practical: Design E-R model for a real world, map to relational model, implement using available RDBMS and execute SQL queries.

References:

1. Elmasri, R., Navathe, S., Fundamentals of Database Systems, Sixth Edition, Pearson Education, 2006.
2. Silberschatz A., Korth H, Sudarshan S., Database System Concepts, Sixth Edition, McGraw-Hill, 2010.

4. Probability and Statistics (CS 105) **(3-0-2)**

Probability-Axioms, Conditional probability, Bayes theorem, Random variables, Discrete RV-Binomial, Geomatric Poisson, Continuous RV-Uniform, Exponential, Gamma, Normal, Expectation, Mean and Variance, Jointly distributed RV's, Co-variance, Sum of RVs, Central Limit theorem, Moment generating functions.
Sample distribution, Inference concerning mean, Statistical inference-Parameter estimation, Maximum likelihood estimation, Hypothesis testing.
Curve fitting, Methods of least squares, Curvilinear multiple regression.

References:

1. Ross, S., A First Course in Probability, Sixth Edition, Pearson Education, 2006.
2. Ross, S., Introduction to Probability Models, Eighth Edition, Elsevier, 2003.
3. Trivedi, K.S., Probability and Statistics with Reliability, Queuing and Computer Science Applications, Second Edition, Wiley, 2002.

5. Data Structures Laboratory **(0-0-4)**

Array Programs : Finding Max/Min Second max/min nth max/min of array, Partitioning an array w.r.t an element, Finding longest monotone sequence Searching, Sorting, Merging, Intersection of Arrays, Array order reversal , Removal of duplicates from ordered array ,Programs on Frequency array, making histogram, Matrix Addition, Subtraction, Multiplication, Chain Multiplication, Sparse Matrices.

Recursion and Programs on recursion specifically on binary tree

Sorting & Searching : Sequential Search, Binary Search, Hashing, Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Heap sort, Merge Sort, Bucket Sort, Radix Sort

Singly Linked List :Basic elementary Operations (Addition , Deletion , Display , Count Nodes etc.), Reversing a Linked List, Merge 2 Linked Lists, Print Common elements, Delete negative nodes, Split a Linked List into 2 parts, Adding and subtracting polynomials

Doubly Linked List :Basic elementary Operations (Addition , Deletion , Display , Count Nodes etc.)

Split doubly Linked List into 2 parts,

Circular Linked List: Basic elementary Operations (Addition , Deletion , Display , Count Nodes etc.)

Stacks :Basic elementary Operations (Push , Pop , Peek , isfull , isempty) using ARRAY , Basic elementary Operations (Push , Pop , Peek , isfull , isempty etc.) using LINKED LIST, Infix to Postfix notation, Evaluate Postfix expression

Queues : Basic elementary Operations (Enqueue , Dequeue , Peek etc.) using ARRAY Basic elementary Operations (Enqueue , Dequeue , Peek etc.) using LINKED LIST,Evaluate Prefix expression, Priority queues

Trees: Binary Tree : Creation, Insertion, Deletion & Traversal, Binary Search Tree :, Creation, Insertion, Deletion, Traverse a BST (Preorder , Postorder , Inorder), Find Predecessor and Successor of given element, Expression Evaluation

Graphs : Representing graph using adjacency matrix, list, BFS,DFS, Check if a graph is connected or not, Finding conneted components, Minimum Spanning tree, Single Source All destination Shortest path, All shortest paths, topological sort

Programs on Structures and Unions, Handling array and linked list of Structure/Union type

Handling Strings in C

Handling files in C

SEMESTER III (All compulsory)

1. Object Oriented Programming (CS-109) (4-0-0)

Concept of Object-Oriented Programming paradigm: Abstraction, Encapsulation, Inheritance, Polymorphism, Classes, Objects, member function, static member function, Data types, Arrays, Memory Allocation for Objects, Storage Management, constructors, destructor, Inheritance: single and multiple inheritances, operator overloading, function overloading, Polymorphism, abstract class, overriding, memory layout of objects; Exception Handling, Template class and function, Packages and Interfaces, Multithreaded programming, , Input/Output; Practical: using Java/C++

References:

1. Bjarne Stroustrup, The C++ Programming Language, Third Edition, Pearson Education
2. Lipman, S. B. C++ Primer, Third Edition. Pearson Education
3. H.M. Deitel, P.J.Deitel, Java : How to Program, Fifth Edition, Prentice Hall Publication.
4. Herbert Schildt, The Java 2: Complete Reference, Fourth edition, TMH.

2. Computer Networks (CS-112) (3-0-2)

Overview of Computer Network, OSI and TCP/IP Reference Models, Guided and Unguided Transmission Media, Analog and Digital communication, Encoding and Modulation, Nyquist

theorem, Shannon's capacity, Switching techniques, multiplexing techniques-TDM, FDM, Framing, Error detection and Error correction – VRC, LRC, CRC, Stop and Wait Protocol, Sliding Window Protocol, Go-back-n ARQ, Selective-Reject ARQ, HDLC, Channel Allocation, ALOHA Systems, CSMA Protocols, Collision Free Protocols, Local Area Networks, Bridges, ATM, Routing: Flooding, Spanning tree, Distance Vector routing, Link state routing, Bellman-Ford and Dijkstra routing algorithms, Congestion control - Leaky Bucket and Token Bucket algorithms , IP Protocol, IP Addressing, ARP, RARP, OSFP, BGP, TCP, UDP, Application Protocols-DHCP, DNS, Telnet, SMPT, Network Security-RSA

References:

1. Andrew S. Tanenbaum, Computer Networks, Fourth Edition, Pearson Education,
2. Behrouz A. Ferouzan, Data Communications and Networking, Second Edition Update, TMH,
3. Alberto Leon-Garcia and Indra Widjaja, Communication Networks, Second Edition, Tata McGraw-Hill,
4. William Stallings, Data and computer Communications, Seventh Edition, Pearson Education

3. Operating Systems (CS-110) (3-0-2)

Introduction to Operating Systems; layered architecture, basic concepts: interrupt architecture, system calls,, Processes and Threads: synchronization and protection; CPU scheduling; Deadlocks; Main memory management including paging and segmentation schemes; Virtual memory management including page replacement algorithms; Storage management including file systems; Case studies of Unix.

References:

1. A. Silberschatz, P. Galvin and G. Gagne, Operating System Concepts, Ninth Edition, John Wiley & Sons, 2012
2. William Stallings, Operating Systems: Internals and Design Principles, Seventh Edition, Pearson Education.
3. A.S.Godbole and A. Kahate, Operating Systems, Third Edition, TMH.
4. Andrew S. Tanenbaum and Herbert Bos, Modern Operating Systems, Prentice Hall.

4. Design and Analysis of Algorithms (CS-115) (3-0-2)

Growth of Functions, Summations, Recurrences, Design Techniques: Divide and conquer, Dynamic programming, Greedy algorithms, Backtracking, Branch and Bound, Graph Algorithms: Elementary graph algorithms, Single source shortest paths, All-pairs shortest paths, Maximum Flow, P and NP class problems, NP-completeness and reducibility, NP-completeness proofs, NP-complete problems, Polynomials and the Fast Fourier transform, Number-theoretic Algorithms, String matching, Algorithms for Parallel computers, Approximation algorithms etc.

References:

1. T Cormen, C Leisersson, R Rivest, C Stein, Introduction to Algorithms, PHI, 2003.

2. V. Aho, J. Hopcraft, J. Ulmann, The Design and Analysis of Computer Algorithms, Pearson Education, 2000.
3. E Horowitz, S Sahni, S Rajasekaran, Fundamentals of Computer Algorithms, Galgotia Publishers, 2010.
4. S. Basse, A. V. Gelder, Computer Algorithms: Introduction to Design and Analysis, Pearson Education Asia Pvt. Ltd., 2009.

5. Computer Architecture (CS-106) **(3-0-2)**

Data Representation, Data Types, Binary Codes and Error Detection Codes, Register Transfer language, Arithmetic, logic and Shift Microoperations. Computer Registers, Instruction Codes, Timing and Control. Computer Arithmetic- Number Representation, Addition, Subtraction, Multiplication and Division Algorithms. General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, RISC Computer, CISC Computer. Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing. Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, DMA, Serial Communication. Memory Hierarchy, Main Memory, Auxillary Memory, Associative Memory, Cache Memory, Virtual Memory. Microprogrammed Control- Control Memory, Address Sequencing, Design of Control Unit.

References:

1. Morris Mano, Computer System Architecture Pearson Education, 2012
2. David A. Patterson, John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Morgan Kaufmann, 2009
3. William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson Education, 2007
4. Behrooz Parhami Computer Architectures: From Microprocessors to Supercomputers, Oxford, 2005.

6. Object Oriented Programming Laboratory **(0-0-4)**

1. Create a class for complex number to perform the arithmetic and I/O operation, program to show the performance of prefix and postfix unary operators,
2. Define a class for storing, evaluating and printing simple arithmetic expressions consisting of integer constants and the operators +, -, * and / using a linked list of nodes as the representation or using a character string as the representation.
3. Write a template class Matrix which provides a number of common functions and with the template parameter of the data type T. Construct a matrix of order M x N dynamically using parameterized constructor. Overload + to add of two matrices , Overload for B = k*B; k - Scalar multiplication, Overload == Equality of matrix -checks the dimensions then check all elements of both matrices. If dimension of both matrices are same and elements of both matrices are same, return true else return false, Overload << operator to show matrix.

4. Program to show the role of virtual base class.
5. Program to show the position of virtual pointer(vptr) and virtual table(vtab) of the given objects.
6. Overload new and delete operators for variable size of memory allocation and removal
7. Write a template class Array in C++, which supports arrays that are similar to C arrays, but can dynamically shrink and grow as necessary. As with a C array, the access time for an Array indexed element is constant and is independent of the array size.
8. Write a program that demonstrates the concept of rethrowing an exception and restrict a function to throw only certain specified exceptions.
9. A file contains a list of telephone object. The class telephone has two data members: name and number. Write a function to insert an object at specified position without using temporary file Write a function to delete an object from file without using temporary file.

SEMESTER IV (All compulsory)

1. Software Engineering (CS-118) **(3-0-2)**

Introduction, Software Product and Process, Software Process Models, Requirements Engineering, Requirements Analysis –Data Flow Diagram, Requirement Specification, Requirement Validation; Design- Concepts, Coupling, Cohesion, Mapping Requirements to Design, User Interface Design, Structure Charts, Coding Principles, Coding Standards and Guidelines, Software Testing Techniques and Strategies, Software Debugging, Software Project Metrics and Estimation Techniques – Empirical, Heuristic and Analytical Techniques, Software Quality Assurance, CASE Tools.

References:

1. Pressman, R., Software Engineering – A Practitioner's approach, Sixth Edition, McGraw-Hill International Edition.
2. Sommerville, I., Software Engineering, Sixth Edition, Pearson Education.
3. Ghezzi, C., Jazayeri, M., Mandrioli, D., Fundamentals of Software Engineering, Second Edition, Pearson Education.
4. Jalote, P., An Integrated Approach to Software Engineering, Second Edition, Narosa Publishing House.

2. Artificial Intelligence (CS-120) **(3-0-2)**

Overview of AI; Problem solving; Various search strategies; Game playing; Minmax, Alpha-Beta pruning; Logic programming; Inference mechanisms; Knowledge representation: logic, rules, semantics, frames; Conceptual dependency; Uncertain knowledge and reasoning; Expert systems; NLP; Learning; Process planning and robotics; Intelligent agents.

References:

1. Rich and Knight, Artificial Intelligence, Tata McGraw-Hill, 2001.
2. Russell and Norvig, Artificial Intelligence: A Modern Approach, Third Edition, Prentice Hall.

3. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers, Inc., 1998.
4. P.H. Winston, Artificial Intelligence, Addison-Wesley Publishing Company, 1992

3. Computer Graphics (CS-116) (3-0-2)

Input devices, Video display devices, Area filling algorithms with irregular boundaries, Cohen-Sutherland and Cyrus-Beck line clipping algorithms, Basic 2-dimensional and 3-dimensional geometric transformations, Homogeneous coordinate system, Parallel projection, Isometric projection and its construction, Perspective projection, Hidden surface elimination algorithms, Basic illumination models, Gouraud and Phong surface rendering models, Representation of curves and surfaces.

References:

1. J.D. Foley, A. Van Dam, J.F. Hughes and S.K. Feiner, Computer Graphics: Principles and Practice, Second Edition, Addison Wesley
2. D. Hearn and P. M. Baker, Computer Graphics, Second Edition, Prentice Hall of India.
3. Rogers, Procedural Elements of Computer Graphics, Second Edition, TMG
4. Rogers and Adams, Mathematical Elements of Computer Graphics, Second Edition, TMG

4. Web Based Programming (CS-114) (2-0-4)

World wide web- Introduction, Client server model, Web servers, Browsers Interface, Browser Architecture, caching in web browser, CGI Interface, Hypertext- HTML, DHTML, HTTP;Scripting language: JSP, ASP.Web Programming – Java language, Java swing, Java beans, Applets, Servlets, RMI, JAVA Utilities.

Practical Excercises

1. Write the HTML source code to display the information of students.
2. Write the HTML source code to display the List of courses and classes in form of table.
3. Write the HTML source code to display the registration form of admission using HTML.
4. Write the HTML source code for upload and download information on server.
5. Write the HTML source code for play the video and audio content.
6. Write the JAVA source code for method overloading.
7. Write the JAVA source code for Inheritance.
8. Write the JAVA source code for Multiple Threading.
9. Write the Applet source code for display smiling face.
10. Write the Applet source code to display seven circles where the alternative one is fill with color and second one is blank.
11. Write the JSP program for addition of 1 to n numbers.
12. Write the source code in HTML/Java/JSP/ASP for mini project on any topic of interest.

References:

1. Comer D.E, Computer Networks, Internet and applications, Third Edition, 2004.
2. Crouch, A., Web programming with ASP and COM , Pearson Education, 2002.
3. Duckett J., Beginning Web Programming with HTML, XHTML, and CSS, Wiley Publication, 2011.

SEMESTER V

Compulsory Courses

1. Principles of Compiler Design (CS-148) (3-0-2)

Overview of Compilation: Introduction, Structure of Compiler, Passes, Phases, Compiler Construction tools. Lexical analysis : Finite state machines, regular expression and their role for Lexical analysis, Specification and recognition of tokens , Implementation of Lexical analyzer using NFA, DFA, Lex, LEX Tool, Symbol Table, Syntax Analysis : Formal grammar and their application to Syntax Analysis, Context Free Grammar, Parse trees, Syntax tree and capabilities of CFG, Top down parsing, Bottom up parsing : Yacc automatic parser generator, Semantic Analysis : Attributes of grammar, Symbol Table, Parse tree Abstract Syntax tree, Syntax directed Translation, Syntax directed translation schemes, Overall design of a semantic analyzer Symbol Tables : Symbol table format, organization, Memory allocation, Runtime stack and heap storage allocation, Intermediate code generation : Intermediate code and data structures, Design Issues, Data structure for Intermediate code, Intermediate code generation for data types , statements and Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Object Code Generation and optimization. Practical- Practical on designing lexical analyzer using NFA, DFA , Implementing Top down predictive parser Practical on LEX and Yacc, Generating Intermediate code for simple statements

References:

1. Aho , Ulman, Sethi, Compiler: Principles, Techniques And Tools, Pearson education, 2006.
2. Kenneth C. Louden , Compiler Construction Principles and Practice, PWS Publishing Company, 1997.
3. Thompson Cooper and Linda, Engineering a Compiler-, Elsevier, 2011.
4. John R. Levine, Tony Mason, Doug Brown, lex andyacc , O'reilly, 1992.

2. Parallel and Distributed Systems (CS-117) (3-0-2)

Introduction to Parallel and Distributed Systems, Classification, Various Speedup Laws, Interconnection Network Architecture, Algorithms On Parallel/Distributed Machine, PRAM Model, EREW, ERCW, CREW, CRCW Algorithms, Sorting Networks 0-1 Principle, Bitonic Sorter, Merger, Sorter, Distributed Systems, Interprocess Communication, Message Passing Communication, Distributed Coordination, Physical And Logical Clocks.

References:

1. Kai Hwang, Advanced Computer Architecture: TMH, 2011
2. M.R. Bhujade, Parallel Computing, New Age International Publications, 2011
3. M.J.Quinn, Parallel Computing, Mc-Graw Hill, 2006
4. Thomas H. Cormen, Algorithms, PHI, 2009
5. Andrew S. Tanenbaum Tanenbaum, Distributed System, Pearson Education, 2002

Electives for Semester IV and Semester V

1. Algorithmic Graph Theory (CS-139)

(3-0-2)

Introduction to Graph Theory, Euler Graphs, Introduction: Overview of graph, complexity, NP completeness, Approximation and randomization of graph algorithms, Tour and Traversals, Spanning Tree and Sub graph, Matching, Covering and Coloring, Planar graphs, Flow Problem, Extremal problems and Algebraic graph theory, Perfect graphs, Random Graph, Random graph model, Random Walk, and Markov Chain, Erdos Renyi random graph, Social Networking and link analysis

References:

1. Martin Charles Golumbic,Algorithmic Graph Theory and Perfect Graphs,North – Holland Publishing Company, Amsterdam, Netherlands, 2004.

2. Alan Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, U.K.,1985.

3. Gary Chartrand, Ortrund R.Oellermann, Applied and Algorithmic Graph Theory, McGraw hill Education, Europe, 1993.

4. David Easley and Jon Kleinberg Networks, Crowds, and Markets: Reasoning about a Highly Connected World , Cambridge University Press, 2010.

2. Data Mining and Knowledge Discovery (CS-133)

(3-0-2)

Introduction to Data Mining and knowledge discovery in databases (KDD); Data mining primitives, concepts, tasks and functionalities - concept learning, classification and prediction, association rule mining, clustering and anomaly detection; Data preparation - cleaning, transformation, reduction, discretization; Techniques, approaches and evaluation: Credibility, evaluation and comparison of data mining models; Association rule mining techniques - Apriori, Partition-based, FP-tree, Pincer-search; Supervised (inductive) learning - Decision table, rule, tree; Model tree, Baye's theorem, k-nearest neighbour, Regression, SVM; Unsupervised learning – Clustering Techniques - Partition, k-d tree, Hierarchical, Density, Grid, Advanced Databases: Text, Sequence, Image, etc.

References:

1. J. Han, M. Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2007.

2. I.H. Witten, E. Frank, Data mining: Practical Tools and Techniques with Java Implementations, Morgan Kaufmann, 1999.

3. P-N. Tan, V. Kumar and M. Steinbach: Introduction to Data Mining, Pearson, 2007.
4. D. Hand, H. Mannila, P. Smyth, Principles of Data Mining, Indian reprint, PHI, 2004.

3. Advanced Algorithms (CS-144)

(3-0-2)

Probabilistic Recurrence, Basic Power and Efficiency of Randomization and Approximation, Computation Model and Complexity Classes, Reducibility, Classification of randomized algorithms: Las Vegas and Monte Carlo, Minimum cut algorithm, Bin-Balls Problem, Birthday-Paradox, Coupon-Collector, Stable Marriage Problem, Game Theory, Random variables and Basic inequalities (Markov, Chebyshev), Chernoff Bounds, Martingale Bound, Max-cut, Random Graphs, Markov chains and random walks, Random graph models for real-world networks, social networks, etc. Algorithms for 2-SAT and 3-SAT, Particle Swarm optimization (PSO), Multi-swarm optimization, Ant Colony optimization, Intelligent Water Drops algorithm, Genetic algorithm, Hill-Climbing optimization algorithm

References:

1. Vijay Vazirani, Approximation Algorithms, Springer-Verlag, ISBN: 3-540-65367-8, Published: 2001

2. D. Williamson and D. Shmoys, The Design of Approximation Algorithms, Cambridge University Press, 2011

3. T Cormen, C Leisersson, R Rivest, C Stein, Introduction to Algorithms, PHI, 2003.

4. Rajeev Motwani and Prabhakar Raghavan, Randomized Algorithms, Cambridge University Press, ISBN: 0521474655, 1995

5. Matthew O. Jackson, Social and Economic Networks, Princeton University Press, 2010.

4. Big Data Management (CS-145)

(3-0-2)

Introduction to Big Data; Big Data Architecture: Tradition Information Architecture, Integrated with Big Data Architecture Capabilities: Storage, Management, Database, Processing, Data Integration, Statistical Analysis; Large Scale File System: Distributed File System, MapReduce, HDFS and Hadoop; Data Management Techniques to Store Data Locally and in Cloud Infrastructures; Data Analysis using Statistical Methods and Visualization; Statistics and Computational Predictive Analysis on data; Data-Intensive Computations on Cluster and Cloud Infrastructures using MapReduce; Mining of Big Data; Issues, Challenges and Opportunities in Big Data Management

References:

1. Rajaraman, A., Ullman, J. D., Mining of Massive Datasets, Cambridge University Press, United Kingdom, 2012
2. Berman, J.J., Principles of Big Data: Preparing, Sharing and Analyzing Complex Information, Morgan Kaufmann, 2014
3. Barlow, M., Real-Time Big Data Analytics: Emerging Architecture, O Reilly, 2013
4. Schonberger, V.M. , Kenneth Cukier, K., Big Data, John Murray Publishers, 2013

5. Distributed Databases (CS-135)

(3-0-2)

Overview; Principles; Dimensions: Distribution, Heterogeneity, Autonomy, Distributed Database Architecture: Client-Server, Peer-to-Peer, Federated, Multidatabase; Distributed Database Design and Implementation: Data Fragmentation, Data Replication and Data Allocation Techniques; Distributed Query Processing and Optimization; Distributed Transaction Management, Concurrency Control and Reliability, Distributed Database Interoperability.

References:

1. Ceri, S., Pellagati, G., Distributed Database Principles and Systems, McGraw-Hill International, 1984.
2. Ozsu, M.T., Valduriez, P., Principles of Distributed Database Systems, Second Edition, Pearson Education.

6. Cloud Computing (CS-180)

(3-0-2)

Overview of Distributed Computing: Trends of computing, Introduction to Parallel/distributed computing, Grid Computing, Cloud computing, Introduction to Cloud Computing: What's cloud computing, Properties and Characteristics, Service models, Deployment models. Components of a computing cloud, Different types of clouds: public, private, hybrid, Delivering services from the cloud, Categorizing service types, Comparing vendor cloud products: Amazon, Google, Microsoft and others, Infrastructure as a Service (IaaS): Introduction to IaaS, Resource Virtualization, Server, Storage, Network, Case studies, Platform as a Service (PaaS): Introduction to PaaS, Cloud platforms and Management, Computation, Storage, Case studies, Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS, Case studies, Cloud Issues and Challenges: Cloud provider Lock-in, Security.

References:

1. Kai Hwang, Geoffrey Fox, Jack Dongarra, Distributed and Cloud Computing, Elsevier, 2012.
2. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, Mastering Cloud Computing, TMH, 2013.
3. Dan C. Marinescu, Cloud Computing: Theory and Practice, Elsevier, 2013.
4. Barrie Sosinsky, Cloud Computing Bible, Wiley, 2011.

7. Digital Image Processing (CS-140)

(3-0-2)

Digital Image fundamentals; Image sensing and acquisition; Image sampling and Quantization; Image Enhancement in Spatial Domain; Grey level transformation; Histogram Processing; Image Transforms; Spatial filters; Fourier Transforms and their properties; Fast Fourier Transforms; Image Enhancement in Frequency Domain; Image Segmentation: edge detection, Hough Transform, Region based segmentation; Image Compression.

References:

1. Richard E. Woods, Rafael C. Gonzalez, Digital Image Processing, Third Edition, Pearson Education.
2. Anil K. Jain, Fundamentals of Digital Image Processing, PHI, 1989.

8. Computer Vision (CS-146) **(3-0-2)**

Introduction to vision; Camera models; Camera calibration; Multi-view geometry and reconstruction; Edge/ Feature extraction; Correspondence and tracking; 3D structure/ motion estimation; basics of object recognition.

References:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2011.
2. Richard Hartley and Andrew Zissermann, Multi-view Geometry in Computer Vision, Second Edition, Cambridge University Press.
3. Forsyth and Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2015

9. Information Security (CS-141) **(3-0-2)**

Introduction, Information Security hierarchy, Vulnerability, attack and threat, Security goals, end-end security, Link encryption, Privacy, authentication, Access control, Private key and public-key, Cryptographic Algorithm: DES, RSA, SHA, DH, Physical security, Personal security, Communication Security, Software security, OS security.

References:

1. John M.D.Hunter, An information security Hadbook, Publication Springer 2002.
2. Timothy J. Shinmeall and Jonathan M Spring, Introduction of Information Security, Syngress Elsevier 2011.
3. Mark Merkov, Jim Breithaupty, Information Security: Principal and Practices, Pearson Education 2011.
4. Stinson D., Cryptography, Theory and Practice , CRC Press, Boca Raton, FA 2005.

10. Evolutionary Computation (CS-147) **(3-0-2)**

Fundamentals and History of Evolutionary Computation, Common Evolutionary Computation Methods: Genetic Algorithms, Genetic Programming; Evolution Strategies, Components of Evolutionary Computation: Framework, Populations, Selection Operators, Genetic Operators; Evolutionary Computation Problem Solving: Search, Optimization, Machine Learning; Evolutionary Computation Theory: Dynamics, Selection, Reproduction, Representation, Fitness Landscapes; Multi-objective Evolutionary Computation

References:

1. De Jong, K.A., Evolutionary Computation – A Unified Approach, Prentice Hall of India, 2006
2. Eiben, A.E., Smith, J.E., Introduction to Evolutionary Computing, Springer-Verlag, 2003

3. Back, T., Fogel, D.B., Michalewicz, Z., Evolutionary Computation 1: Basic Algorithms and Operators, Institute of Physics Publishing (IPS), 2000
4. Back, T., Fogel, D.B., Michalewicz, Z., Evolutionary Computation 2: Advanced Algorithms and Operations, Institute of Physics Publishing (IPS), 2000

11. Networks Programming (CS-142)

(3-0-2)

Introduction to Network Programming: OSI reference model, TCP and UDP connection establishment and Format, Buffer sizes and limitation, standard internet services. Inter Process Communication: fork, wait and exec function. Pipes, FIFOs streams, and shared memory, semaphores and messages queues, Sockets Programming: Socket address format, TCP and UDP sockets – Socket, connect, bind, listen, and accept, concurrent servers and interactive servers. Signals handling: signal, sigaction. signal masking. signal generation: kill, alarm. Interactions of signal and wait, server process termination, I/O Multiplexing and socket options: I/O Models, select function. Threads: threaded servers – thread creation and termination, Remote Procedure calls. Practical: using C in LINUX/UNIX

References:

1. W. Richard Stevens, UNIX Network Programming – The Sockets Networking API, Vol. 1, Third Edition, Pearson Education, 2004
2. W. Richard Stevens, UNIX Network Programming – Interprocess Communications, Vol. 2, Second Edition, Pearson Education, 2004
3. Chris Brown, UNIX Distributed Programming, PHI, 1994
4. T. Chan, UNIX Systems Programming using C++, PHI, 1997
5. M. J. Rochkind, Advanced UNIX Programming, Second Edition, Pearson Education.

12. Information Theory (CS-132)

(3-0-2)

Review of Probability, uncertainty and information. Axioms for the Uncertainty measure, Entropy, Joint Entropy, Conditional Entropy, Mutual Information, Chain Rules, Jensen Inequality, Data Processing Inequality, Asymptotic Equipartition Property, Consequences of AEP, Data Compression: Kraft Inequality, Optimal Codes, Huffman Code, Shannon Fano-Elias Coding, Channel Capacity. Information Capacity theorem, The Shannon limit, Channel Capacity of MIMO System, Noiseless and Noisy Channel, Hamming Code, Information Measures for Continuous Random Variables, Differential Entropy, Relative Entropy and Mutual Information, Gaussian Channel, Rate Distribution Theory, Binary Source, Gaussian Source, Converse to the Rate Distortion Theory, Jaynes Maximum Entropy Principle and its Applications.

References:

1. M. Cover and Joy A. Thomas, Elements of information theory, Wiley, Second Edition 2012.
2. Robert B. Ash, Information Theory, Dover Publication Inc., New York, 1990.

3. S. M. Moser, P. N. Chen, A Student's Guide to Coding and Information Theory, First Edition, Cambridge Univ. Press.
4. Ranjan Bose, Information theory, Coding and Cryptography, Tata McGraw Hill, , 2008.

13. Object Oriented Analysis and Design (CS-136) **(3-0-2)**

Object Oriented Paradigm and Principles; Modeling - Importance, Principles; Analysis Model; Design Model; Conceptual Model of the UML ; Structural Modeling - Classes, Relationships, Interfaces, Types, Roles, Packages, Instance; Structural Diagrams - Class, Object; Behavioral Modeling - Interactions, Use Cases, Activities, State Machines; Behavioural Diagrams - Use Case, Sequence, Collaboration, Activity, Statechart; Architectural Modeling - Component, Deployment and corresponding diagrams. Practical: Using open source UML tool.

References:

1. Booch G., Rumbaugh J. and Jacobson I., Unified Modeling Language User Guide, Pearson Education, Second Edition, 2005
2. Booch G. Object Oriented Analysis and Design with Applications, The Benjamin/Cummings Publishing Company, Third Edition, 2007

14. Optimization Techniques (CS-128) **(3-0-2)**

Mathematical preliminary, Linear programming, Simplex method, Duality in linear programming, Convex optimization and quadratic programming, Least squares optimization, Unconstrained optimization problems, Nonlinear constrained optimization, Problems with equality constraints, Problems with inequality constraints, Application of mathematical programming in machine learning.

References:

1. D.G. Luenberger and Y. Ye, Linear and nonlinear programming, Third Edition, Springer International Edition, 2008
2. A.L. Peressini, F.E. Sullivan and J.J. Uhl, The Mathematics of Nonlinear Programming, Springer Verlag, 1988
3. J. Nocedal and S.J. Wright, Numerical Optimization, Springer Verlag, 1999
4. I. Griva, S. G. Nash and A. Sofer, Linear and Nonlinear Optimization, SIAM, Second Edition, 2009

15. Machine Learning (CS-129) **(3-0-2)**

An overview of Machine learning, Inductive learning: ID3, C4.5,C5; Learning Concepts and rules from Examples; Learning by analogy; Learning from observation and discovery; Learning by experimentation; Learning by training Neural Networks; Genetic Algorithm; Analysis learning; Reinforcement learning ;Applications to KDD.

References:

1. T.M. Mitchell, Machine Learning McGraw-Hill, 1997.

2. Marsland, S., Machine learning: an algorithmic perspective, CRC Press, Taylor and Francis Group, 2015

16. VLSI Design (CS-143)

(3-0-2)

Introduction to CMOS VLSI Design; nMOS and CMOS transistor structures and process technologies, Operation of MOS transistor as a switch, Design and analysis of nMOS and CMOS inverters, common gates, latches and flip-flops, Fabrication of MOS transistors; stick diagrams, design rules and layout, Circuit characterization and performance estimation of MOS circuits. CMOS circuit and logic design. Dynamic MOS structures, Registers, counters and memory realizations using MOS logic, Design structuring; Regular structure circuits, PLAs and FSMs, system timing and clocking issues, scaling. CMOS subsystem design, Low power circuits and systems, System case studies, Design automation of VLSI Systems: basic concepts. Deep Sub-micron Technologies: Some Design Issues.

References:

1. N. H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design: A Systems Perspective, Pearson Education, 2000.
2. J. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A Design Perspective, Prentice Hall of India, 2003
3. M. Sarafzadeh and C. K. Wong, An Introduction to VLSI Physical Design, MCGraw-Hill, 1996.

17. Modeling and Simulation (CS-127)

(3-0-2)

Advantages and disadvantages of simulation systems, Components of system, Discrete and continuous systems, Examples – Simulation of queuing and network protocols, concepts in discrete-event simulation; Statistical models in simulation; Analysis of simulation data, Verification and validation of simulation models, Output analysis for single model, Simulation of computer systems, Queuing models – long run measures of performance, steady-state behavior, M/M/1, M/M/C/∞/∞, M/M/C/N/∞, M/M/C/K/K; Pseudo random numbers, random variate generation, Inverse transform technique. Deterministic v/s probabilistic systems, Elements of Stochastic process, Markov chains, Markov process, Poisson process, Brownian motion process. Principles of Monte Carlo, Geomatric Brownian motion and generation of sample paths, Black-Scholes model

References:

1. Raj Jain, Art of Computer Systems Performance Analysis, John Wiley and Sons, Inc, 1991.
2. Sheldon M. Ross, Simulation, Fourth Edition., Elsevier 2008,
3. Averill M. Law and W. David Kelton, Simulation Modeling and Analysis, Third Edition, Tata McGraw-Hill, 2003
4. W.J.Stewart, Probability, Markov Chains, Queues and Simulation, Princeton University, 2009.
5. P. Glasserman, Monte Carlo Methods in Financial Engineering, Springer, 2004

18. Internet and Web Technology (CS-130) **(3-0-2)**

Introduction, history of internet and web technology, hardware and software requirements, information casting , servers, web browsers, searching and web casting techniques, bookmarks, cookies, search engines, web crawlers , case study of browsers , internet chat , security issues, programming language for development.

References:

1. Achyut Godbole, Atul Kahate. Web Technology, Second Edition, TMH.
2. Deitel H., Deitel P., Internet and World Wide Web: How to program, Fifth Edition, PHI, 2011.
3. Karl Barksdale, HTML, JavaScript, and Advanced Internet Technologies, Cengage Learning, 2005.

19. Multimedia Systems (CS-134) **(3-0-2)**

Introduction to Multimedia, Fundamental Concepts of Multimedia Data types : Image, Audio, Video and Animation; Compression Technology, Multimedia Communication and delivery, Content management and retrieval, Distributed multimedia Systems.

References:

1. Ze-Nian Li and M. S. Drew, Fundamentals of Multimedia, Pearson Education, 2004.
2. K. R. Rao, Z. S. Bojkovic and Dragorad A. Milovanovi, Multimedia Communication Systems: Techniques, Standards, and Networks, Prentice Hall, 2002.

20. Natural Language Processing (CS-126) **(3-0-2)**

Introduction , Regular Expressions and Automata, Words and Transducers, N-grams, Part-of-Speech Tagging , Hidden Markov and Maximum Entropy Models, Formal Grammars of English, Syntactic Parsing, Statistical Parsing, Features and Unification, Language and Complexity, The Representation of Meaning, Computational Semantics, Lexical Semantics, Computational Lexical Semantics, Computational Discourse, Information Extraction, Question Answering, Sentiment Analysis and Summarization, Dialog and Conversational Agents, Machine Translation. Case studies in the context of various Indian and foreign languages. Emerging trends in NLP.

References:

1. Jurafsky Daniel and Martin James H., Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Prentice Hall, 1999.
2. Manning Christopher D. and Schütze. Hinrich, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
3. Allen James, Natural Language Understanding, Second Edition, Benjamin/Cummings.
4. Jelinek Frederick, Statistical Methods for Speech Recognition, MIT Press, 1997
5. Pang Bo and Lee Lillian, Opinion Mining and Sentiment Analysis, Foundations and Trends in Information Retrieval 2 (1-2), pp. 1–135, 2008.

21. Pattern Classifications (CS-122) **(3-0-2)**

Review of Probability Theory, Conditional Probability and Bayes Rule, Bayesian Decision Theory, Maximum-Likelihood and Bayesian Parameter Estimation, Non-Parametric Techniques, Neural Networks, Optimization by Gradient Descent, Multilayer Neural Networks, Support Vector Machines, Bias and variance, Resampling for estimating statistics, Bagging, Boosting

References:

1. R O Duda, P E Hart, D G Stork, Pattern Classification, Wiley Interscience, 2012
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
3. Fukunaga, Introduction to Statistical Pattern Recognition, Academic Press, 2013
4. S Theodoridis, K Koutroumbas, Pattern Recognition, Academic Press, 2008

22. Software Testing (CS-149) **(3-0-2)**

Foundation - Basic Definitions, Test Cases, Error and Fault Taxonomies, Levels of Testing; Verification and Validation; Static and Dynamic Testing; Functional Testing - Basics, Boundary Value Analysis, Equivalence Class, Decision Table-Based, Cause-Effect Graphs; Structural Testing - Coverage Metrics, Basis Path, Graph Matrix, Loop, Dataflow; Mutation testing; Regression Testing; V-Model; Levels of Testing - Unit, Integration Types, System Types, Object-Oriented Testing - Class, Integration, GUI, System, Practicals- Based on JUnit/NUnit.

References:

1. Jorgensen P.C., Software Testing, A Craftsman's Approach, Third Edition, Auerbach Publications, 2010
2. Chauhan N., Software Testing: Principles and Practices, First Edition, Oxford University Press, 2010

23. Wireless Communication and Mobile Computing (CS-150) **(3-0-2)**

Mobile radio systems-, Paging systems, cordless telephone system, cellular telephone system, Cellular Concept: Frequency reuse, channel assignment, hand off, Interference and cell splitting, sectoring, Improving Coverage and capacity in Cellular systems. Propagation modeling: Outdoor/ Indoor Propagation models, Small scale Multipath propagation- Rayleigh fading, Ricean Fading, Nakagami fading, Shadowing, lognormal shadowing fading model, outage probability, coverage estimation under shadowing, and multipath fading. Wireless Networks 802.11, frequency-hopping, encoding and modulation, MAC Layer Protocol Architecture Multiple access with collision avoidance protocol, Virtual Carrier-Sensing, DCF Protocol, PCF Operation.

References:

1. Rappaport Theodore S., Wireless Communications: Principal and Practice, Pearson Education, 2010.
2. Matthew s. Gast, 802.11 Wireless Networks, O'reilly, 2011
3. Andrea Goldsmith, Wireless Communication, Cambridge University Press, 2005.
4. Jochen Schiller, Mobile Communications, Second Edition, PHI/Pearson Education, 2003.

SEMESTER VI

1. Project Work