KANNUR UNIVERSITY

(Abstract)

M.Sc. Computer Science Programme– under Choice Based Credit Semester System in the Department of IT of the University – Scheme, Syllabus & Pattern of Question Papers Implemented with effect from 2019 Admission – Approved - Orders issued.

ACADEMIC BRANCH

No.Acad/C4/10429/2012 Dated, Civil Station (P.O),26/06/2019

Read:-1.U.O No.Acad/C3/2049/2009, dated 11/10/2010

2.U.O.No.Acad/C3/2049/2009, dated 05/04/2011

3. Resolution of the Syndicate vide item.No.2019.018 dated 31/01/2019

4.U.O.No.Acad/A2/15374/2011 dated 23/05/2019

5.Syllabus of M.Sc.Computer Science Programme submitted by the Head, Department of Information Technology, Mangattuparamba Campus, dated 25/06/2019.

ORDER

1.The Regulations of P.G.Programmes under choice Based Credit Semester System were implemented in the Schools / Departments of the University with effect from 2010 admission as per paper read(1) above and certain modifications were effected to the same vide paper read (2).

2.Meanwhile, on the basis of Proposal, submitted by the Head, Department of Information Technology, Mangattuparamba Campus, the Syndicate of the University vide paper read (3) above, resolved to reinstate the M.Sc Computer Science Programme, at the Mangattuparamba Campus of the University, which was suspended from 2015 academic year onwards.

3.Subsequently, the Head ,Department of Information Technology forwarded the Panel of experts for revising the syllabus of M.Sc.Computer Science Programme w.e.f.2019 admission and the Vice Chancellor approved the same.

4. As per the paper read(4) above, sanction has been accorded by the Vice-Chancellor to restart the M.Sc. Computer Science Programme w.e.f, the academic year 2019 -20 at the Department of Information Technology, Mangattuparamba Campus of the University.

P.T.O

5.Accordingly, the Head, Department of Information Technology vide paper read (5) above, submitted the Scheme ,Syllabus and pattern of Question Papers of the M.Sc.Computer Science Programme for implementation with effect from 2019 Admission in tune with the Regulations of Choice Based Credit Semester System, in the Department/ School of the University.

6.The Vice-Chancellor, after considering the matter in detail, and in exercise of the powers of the Academic Council, conferred under Section 11 (1) of Kannur University Act, 1996 and all other enabling provisions read together with, accorded sanction to implement the Scheme, Syllabus and Pattern of Question papers of M.Sc.Computer Science Programme under Choice Based Credit Semester System, reinstated in the Department of Information Technology, Mangattuparamba Campus of the University w.e.f.2019 admission, subject to reporting to the Academic Council.

7.The Scheme, Syllabus and Pattern of Question Papers of M.Sc.Computer Science Programme implemented in the University Department from 2019 admission are uploaded in the University Website (**www.kannuruniversity.ac.in**)

Orders are issued accordingly.

Sd/-

DEPUTY REGISTRAR (ACADEMIC)
For REGISTRAR

To

The Head, Department of Information Technology
Mangattuparamba Campus

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

Forwarded /By Order

SECTION OFFICER

Copy to:

1. The Examination Branch (through PA to CE)
2. PS to VC/PA to PVC/PA to R
3. DR/AR I(Academic)/ All Sections of Academic Br./PRO/ All Campus Directors/DSS
4. The Computer Programmer (for Uploading in the Website)
5. SF/DF/FC

Kannur University

Department of Information Technology

M. Sc. Computer Science

(Choice Based Credit Semester System)

Course Structure, Syllabus and Scheme

(With Effect from 2019 admission)

Kannur University

Department of Information Technology

MSc. Computer Science

(Choice Based Credit Semester System)

Course Structure, Syllabus and Scheme

(With Effect from 2019 admission)

Semester	Theory	Practical
Semester I	5	2
Semester II	5(1 elective)	2
Semester III	5(2 elective)	2
Semester IV	2(2 elective)	Project/Viva

COURSE STRUCTURE

Semester I

Subject Code	Subject	*Instructional Hrs./week*			Marks			Credit
		L	P	T	ESE	CE	Tot	
MCSC01	Computational Mathematics	4	0	0	60	40	100	3
MCSC02	Digital Signal Processing	3	0	0	60	40	100	3
MCSC03	Principle of Programming & Numerical Methods	4	0	0	60	40	100	4
MCSC04	Advanced Database Management System	4	0	0	60	40	100	4
MCSC05	Digital Design & Computer Organizations	3	0	0	60	40	100	3
MCSC06	Lab –I (Digital Signal Processing)	0	3	2	60	40	100	2
MCSC07	Lab–II (Principle of Programming & Numerical Methods)	0	4	3	60	40	100	2
Total		18	7	5	420	280	700	21

Semester II

Subject Code	Subject	*Instructional Hrs./week*			Marks			Credit
		L	P	T	ESE	CE	Tot	
MCSC08	Advanced Data Structures& Algorithms	4	0	0	60	40	100	4
MCSC09	Theory of Computation	4	0	0	60	40	100	4
MCSC10	Computer Graphics &Visualizations	3	0	1	60	40	100	3
MCSC11	System Software &Advanced Operating Systems	4	0	0	60	40	100	4
MCSE01	Elective – I	3	0	0	60	40	100	3
MCSC12	Lab –III (Advanced Data Structure & Algorithm)	0	4	3	60	40	100	2
MCSC13	Lab IV (Computer graphics)	0	3	1	60	40	100	2
Total		18	7	5	420	280	700	22

Semester III

Subject Code	Subject	*Instructional Hrs./week*			Marks			Credit
		L	P	T	ESE	CE	Tot	
MCSC14	Digital Image Processing	3	0	0	60	40	100	3
MCSC15	Data Communication & Network Administration	4	0	0	60	40	100	4
MCSC16	Principles of Intelligent systems	4	0	0	60	40	100	4
MCSE02	Elective – II	4	0	0	60	40	100	3
MCSE03	Elective – III	3	0	0	60	40	100	3
MCSC17	Lab –V (Digital Image Processing)	0	4	2	60	40	100	2
MCSC18	Lab -VI (Data Communication &Network Administration)	0	3	3	60	40	100	2
Total		18	7	5	420	280	700	21

Semester IV

Subject Code	Subject	*Instructional Hrs./week*			Marks			Credit
		L	P	T	ESE	CE	Tot	
MCSE04	Elective IV	3	0	1	60	40	100	3
MCSE05	Elective V	3	0	1	60	40	100	3
MCSC19	Project& Viva	0	19	3	210	140	350	10
Total		6	19	5	330	220	550	16

ELECTIVES

Subject Code	Subject
MCSEL01	Software Engineering
MCSEL02	Information Retrieval System
MCSEL03	Graph Theory &Combinatorics
MCSEL04	Advanced Java Programming
MCSEL05	Fuzzy Sets & Systems
MCSEL06	Operations Research
MCSEL07	Design & Analysis of Algorithms
MCSEL08	Simulation & Modeling
MCSEL09	Linux System & Network Administration
MCSEL10	Embedded Systems
MCSEL11	Pattern Recognition
MCSEL12	Artificial Intelligence
MCSEL13	Multimedia Database Systems
MCSEL14	Software Project Management

MCSEL15	Quantum Computing
MCSEL16	Cyber Forensics
MCSEL17	Cryptography & Network Security
MCSEL18	Nature Inspired Computing
MCSEL19	Information Storage and Management
MCSEL20	Big Data Analytics
MCSEL21	Time Series Analysis
MCSEL22	Data Mining & Warehousing
MCSEL23	Natural Language Processing
MCSEL24	Advanced Microprocessors & Microcontrollers
MCSEL25	Grid & Cloud Computing
MCSEL26	High Performance Computing
MCSEL27	Data Science
MCSEL28	Medical Image Processing
MCSEL29	Wireless Sensor Networks
MCSEL30	Computer Vision
MCSEL31	Biometric Image Processing
MCSEL32	Research Methodology
MCSEL33	Bio Informatics
MCSEL34	Geographical Information System (GIS)
MCSEL35	Internet of Things (IoT)
MCSEL36	Robotics
MCSEL37	Digital Speech Processing

CORE PAPERS

MCSC01COMPUTATIONAL MATHEMATICS

Unit 1

Mathematical logic: statements and notations, connectives, normal forms, well-formed formulas, implications, satisfiability and tautology, predicate calculus.

Unit 2

Set and relations: sets, subsets, operations on sets, principle of inclusion and exclusion, piano axioms and mathematic inductions, generating functions, recurrence relations. Product sets and partitions, relations, properties of relations, equivalence of relations, manipulation of relations.

Unit 3

Functions, pigeonhole principles, permutation and combinations, combinatorics – simple counting techniques. Partially ordered sets, external elements of possets, lattices.

Unit 4

Elementary Probability Theory, Groups and semi groups:

Unit 5

Graph: definition walks, path, trails, connected graph, regular and bipartite graph, cycles and circuits. Tree and rooted tree, spanning tree, eccentricity of vertex, radius and diameter of graph, central graph, Centre(s) of a tree. Hamiltonian and Eulerian graph, planar graphs.

Reference Books:

1. Rosen, Kenneth H., and Kamala Krithivasan. *Discrete mathematics and its applications: with combinatorics and graph theory*. Tata McGraw-Hill Education, 2012.
2. Tremblay, Jean-Paul, and Rampurkar Manohar. *"Discrete mathematical structures with applications to computer science."* (1987).
3. Truss, John K., and J. K. Truss. *Discrete mathematics for computer scientists*. Reading: Addison-Wesley, 1991.

MCSC02DIGITAL SIGNAL PROCESSING

Unit 1

Signals and Signal Processing - Characterization and classification of Signals, Typical signal processing operations, Typical Signal Processing Applications, Advantage of Digital Signal Processing.

Unit 2

Classification of signals - The concept of frequency in continuous and discrete time signals - Sampling of analog signals – Sampling theorem – Quantization and Coding – Digital to analog conversion .

Unit 3

Time Domain Representation of signals and systems - Discrete time signals, Operations on sequences, Discrete time Systems, Linear Time invariant Discrete Time Systems-convolution sum – correlation of discrete time signals , Z-Transform.

Unit 4

Frequency Analysis of Signals - Frequency Analysis of Continuous Time Signals, Frequency Analysis of Discrete Time Signals, Fourier Transform of discrete time signals –Discrete Fourier Transform (DFT). FFT(Qualitative idea only).

Unit 5

Finite word length effects in digital filters – Fixed point arithmetic – Floating point arithmetic – Block floating point arithmetic – Truncation – Rounding – Quantization error in analog to digital conversion– finite register length effects in IIR & FIR filters Limit cycles.

Reference Books:

1. Proakis, John G. and Dimitris G. Manolakis. *Digital signal processing: principles algorithms and applications*. Pearson Education India, 2001.
2. Roberts, Michael J. *Signals and systems: analysis using transform methods and MATLAB*. McGraw-Hill Higher Education, 2011.
3. Oppenheim, Alan V., and Ronald W. Schafer. *Digital Signal Processing [by] Alan V. Oppenheim [and] Ronald W. Schafer*. Prentice-Hall, 1975.
4. Antoniou, Andreas. *Digital signal processing*. McGraw-Hill, 2016.
5. Rabiner, Lawrence R., Bernard Gold, and C. K. Yuen. *Theory and application of digital signal processing*. Prentice-Hall, 2007.

MCSC03 PRINCIPLES OF PROGRAMMING & NUMERICAL METHODS

Unit 1

The Problem -Solving aspect –algorithms and Flow chart, Programs and Programming Languages-classification - compiler – Interpreter, Loader and Linker - Features of Evolution of C, Structure of a C Program, Compiling a C Program, C Character sets- tokens-Operators-Storage classes-auto, register, static, extern, typedef- Type casting, -Control Statements-, Jumping statements .

Unit 2

Functions, Arrays, Searching and Sorting techniques, String operations, Pointers: arrays and pointers – pointers and strings - array of pointers- pointer to pointer- pointers to functions.

Unit 3

Structure: Structure Initialization- Arrays of Structures-Arrays within Structures, Structures within Structures-Passing Structures to Functions- Union: Definition and Declaration-Accessing a Union Member-Initialization of a Union Variable-File Handling: Defining, opening, reading and writing files, sequential access and random access - C preprocessors, Command line arguments.

Unit 4

Errors and Approximations, Nonlinear equations – Bisection Method, Regular-Falsie Method, Secant Method, Newton-Raphson method, Graeffe'sRoot squaring Method

Numerical Interpolation-Newton's fundamental Formula- Lagrange's interpolation formula-Splin Interpolation.

Unit 5

Eigen values and Eigen vectors, Power method, System of Linear Equation, Cramer's rule, Numerical Differentiation - based on equal interval interpolation, Derivative using Newton's Backward difference Formula-Numerical Integration, Trapezium rule, Simpson's rule, Differential Equation, Taylor series method.

Reference Books:

1. R.G.Dromey , *How to solve it by computer*, Pearson education, fifth edition, 2007.
2. Kernighan,B.W and Ritchie,D.M, "*The C Programming language*", 2ndEdn, Pearson Education, 2006.
3. S. G. Kochan, *Programming in C*, Pearson Edn, 4thEdn, 2014.
4. M T. somasekhara, *Problem Solving with C*, PHI, 2009.
5. Balagurusamy, E. *programming in ANSI C*. Tata McGraw-Hill Education, 2012.
6. Gottfried, Byron S., et al. *Programming in C*. Vol. 2. McGraw-Hill, 1991.

MCSC04 ADVANCED DATABASE MANAGMENT SYSTEM

Unit 1

Introduction: Database System Applications, Database Systems versus File Systems, View of Data, Data Models, Schemas, and Instances, DDL, DML, Data Dictionary, Data Integration, Database Access Method, Database Languages, Database Users and Administrators, Database System Structure, Application Architectures, Advantages of Using a DBMS.

Unit 2

The Relational model: Data modeling using Entity Relationship (ER), ER Diagram, Entity sets, attributes and keys, Relationships, Relationship types, Weak Entity. Types, Specialization and generalization. Relational model concepts, Relational model constraints.

Unit 3

Database Design: Functional dependencies. Basic definitions, Functional dependencies. First, Second, Third and Fourth Normal Forms, Boyce Codd normal form, Basics of SQL, DDL,DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, aggregate functions.

Unit 4

SQL: Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, join, Exist, Any, All, joined relations. Integrity and security: domain constraints, referential integrity, assertion, triggers, authorization in SQL. Views: Introduction to views, data independence, security, updates on views, comparison between tables and views.

Unit 5

Emerging database technologies and applications: Mobile databases, Multimedia databases, Geographic Information Systems. Basics of NoSql Database: BASE transactions and eventual consistency- Properties of NOSQL databases. Key-Value data-stores – Column Stores- Document data-stores - Architecture of Dynamo DB, Big Table, HBase, Cassandra and Mongo DB, Graph Database.

Reference Books:

1. Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan. *Database system concepts*. Vol. 4. New York: McGraw-Hill, 1997.
2. Ramakrishnan and Gehrke, *Database Management Systems*, 3rd Edn, McGraw Hill, 2003.
3. A Leon & M Leon, *Database Management Systems* , Leon Vikas – 2003.
4. Elmasri and Navathe, *Fundementals of Database systems*, 5thEdition ,Pearson 2009.
5. O'Reilly, *Practical PostgreSQL* ,Shroff Publishers(SPD) 2002.
6. C J Date, *An Introduction to Database systems,* Pearson, 2004.
7. Cornell, Morris, Mob, *Database Systems*, Cenage, Learning, 2013.

8. Gruber, Martin. *Understanding SQL*. SYBEX Inc., 1990.
9. Ian Robinson, Jim Webber, Emil Eifrem, *Graph databases*- , O'Reilly, 2013.
10.Manoj V, *comparative study of NOSQL Document, Column store databases and evaluation of Cassandra*, International Journal of Database Management Systems (IJDMS) Vol.6, No.4, August 2014.
11. Fowler, Adam. *NoSQL for dummies*. John Wiley & Sons, 2015.
12. Møller, Anders, and Michael I. Schwartzbach. *An introduction to XML and Web technologies*. Pearson Education, 2006.

MCSC05 DIGITAL DESIGN & COMPUTER ORGANIZATIONS

Unit 1

Number systems and arithmetic operations, Different Binary codes, Gates, Boolean algebra & Laws, Combinational Circuits: Sum of product, Product of sum, simplification by Boolean methods, K-Map Simplification- up to six variables. Tabular method.

Unit 2

Decoders, Multiplexer, De-multiplexer, Encoder, Binary Adders, Subtractors, Magnitude comparator, ROM, PLA, PAL, Logic families: General Characteristics, RTL, DTL, TTL, I2L, ECL, NMOS, PMOS, CMOS, CMOS, Transmission Gate Circuits. DAC and ADC.

Unit 3

Sequential circuits: Flip-flops, Analysis of Clocked Sequential Circuits, State Reduction and assignments, FF excitation tables, Design procedure Registers : shift registers, SISO, SIPO,.PISO, PIPO, Universal Shift Registers, Ripple Counters, Synchronous counters, Ring counter, Shift Counter, Up-down counters.

Unit 4

Basic structure: Basic operational concepts, Instruction set Architecture: Memory locations and addresses, memory operations, instructions and instruction sequencing, addressing modes, RISC vs. CISC, Interrupts, and Memory system.

Unit 5

I/O organization: Bus, , Interface circuits, interconnection standards (USB, PCI, Firewire, SCSI, SATA). Basic Processing Unit: : Fundamental concepts, Instruction execution, Hardwired control , micro programmed control –Pipelining: : basic concepts, pipeline organization- Parallel processing: Parallel processing: Hardware multithreading, Vector processing, Shared memory multiprocessors.

Reference Books:

1. M. Moris Mano, *Digital Design* – PHI 2001.
2. Hamacher, V. Carl, et al. *Computer organization and embedded systems*. New York, NY: McGraw-Hill, 2012.
3. Ronald J. Tocci, Neal S. Widmer and GrigoryL. Moss, *Digital Systems- Principles and applications*, Pearson, 2009.
4. John . M. Yarbrough , *Digital Logic Applications and Design* ,Thomson -2002 .
5. Malvino A P and Leach D P, *Digital Principles and applications*, Tata Mc-Graw Hill,1991.
6. Stallings, William. *Computer organization and architecture: designing for performance*. Pearson Education India, 2003.
7. John P. Hayes, *Computer Architecture and Organization*, Third Edn, Tata McGraw Hill,2002.
8. M. Morris Mano, Computer System Architecture, PHI 2003.

MCSC08ADVANCED DATA STRUCTURES & ALGORITHMS

Unit 1

Abstract Data Types (ADT), Algorithm analysis, asymptotic notations. Arrays – representation. Sparse matrix representation with arrays – operations (multiplication) Linked list – Singly linked list (SLL) – basic operations, search, merge, reverse, concatenate, Circular SLL – basic operations, Queue with circular LL, LL with header/trailer nodes. STACK with SLL & header node, Doubly Linked List – basic .Polynomials with SLL – addition and evaluation. Sparse Matrix with LL – operation (add). Recursive functions – recursive to iterative - analysis of recursive functions, Applications of stack and queues.

Unit 2

Non-linear data structures – tree and binary tree– –function to create binary tree - non-recursive tree traversal, operations with binary tree 9merge, split, copy, print level-by-level). Threaded binary tree (TBT) – inorder threaded BT and function for inorder traversal of Inorder TBT. Binary search tree – create - add/delete nodes – search. Applications of trees.AVL trees –basic concepts, insertion and deletion operations.

Unit 3

B- trees- basic concepts, insertion and deletion operations, red black trees- basic concepts, insertion and deletion operations. Splay trees - basic concepts only. Trie – basic concept only. Hashing - Hashing functions - Collision Resolution Techniques - Separate chaining - Open addressing – Multiple hashing.Graph - Definitions – Representation of graph.

Unit 4

Algorithms - Divide and Conquer –selection, Merge Sort, Quick sort. Sort algorithms – heap, shell, radix. Comparison of sort algorithms. Implementation of priority queue.

Unit 5

Greedy algorithm – Knap sack, Prim's and Kruskal'salgorithm.Dynamic programming – 0/1 knap sack, all-pairs shortest, single source shortest. Backtracking – Sum of Subset Problem. Parallel algorithms (basic concepts only)Lower bound theory – Np – Hard and Np – Complete problems (basic concepts only).

Reference Books:

1. Horowitz, Ellis, Sartaj Sahni, and Dinesh Mehta. "*Fundamentals of data structures in C++,* 2008."
2. Horowitz, Sahni. " *Fundamentals of Computer Algorithms*." 1998.
3. Weiss, Mark A. *Data structures & algorithm analysis in C++*. Pearson Education, 2012.
4. Langsam, Yedidyah, Moshe Augenstein, and Aaron M. Tenenbaum. *Data Structures using C and C++*. Vol. 2. New Jersey: Prentice Hall, 1996.
5. Levitin, Anany. *Introduction To Design And Analysis Of Algorithms, 2/E*. Pearson Education India, 2008.
6. Hopcroft, John E., and Jeffrey D. Ullman. *Data structures and algorithms*. 1983.

MCSC09 THEORY OF COMPUTATION

Unit 1

Introduction to the Theory of computation and Finite Automata: Mathematical preliminaries and notation, Proof techniques, Three basic concepts: languages, grammar & automata. Some applications.

Finite automata: Deterministic Finite Acceptors, Nondeterministic Finite Acceptors, Equivalence of deterministic and nondeterministic finite acceptors, Reduction of the number of states in finite automata.

Unit 2

Regular Languages and Regular grammars: Regular expressions, connection between regular expressions and regular languages , regular grammars.

Properties of Regular Languages: closure properties of regular languages, identifying non regular language.

Context-free grammars &languages Context-free grammars, parsing and ambiguity.

Unit 3

Simplifications of Context free Grammars and Normal forms: methods of transforming grammars, two important normal forms.

Pushdown automata for context-free languagesNon deterministic pushdown automata, PDA and Context-free languages, deterministic pushdown automata and deterministic context-free languages.

Unit 4

Properties of Context-Free Languages: pumping lemmas for context free languages and linear Languages, closure properties for context-free languages.

Turing machine Standard Turing machine, combining Turing machines for complicated tasks, Turing's thesis

Unit 5

Other models of Turing machine: Minor variations on the Turing machine theme, Turing machine with complex storage, nondeterministic Turing machine, a universal Turing machine, Linear bounded automata.

Limits of Algorithmic computation: Problems that cannot be solved by Turing machines,

Undesirable Problems for Recursively enumerable Languages, The Post Correspondence problem.

Reference Books:

1. Linz, Peter. *An introduction to formal languages and automata*. Jones & Bartlett Learning, 2006.
2. John C Martin, *Introduction to Languages and the Theory of Automata*, McGraw Hill 1997.
3. Mishra, K. L. P., and N. Chandrasekaran. *Theory of Computer Science: Automata, Languages and Computation*. PHI Learning Pvt. Ltd., 2006.
4. Hopcroft, John E., Rajeev Motwani, and Jeffrey D. Ullman. "*Automata theory, languages, and computation.*" *International Edition* 24.2.2 (2006).

MCSC10 COMPUTER GRAPHICS& VISUALIZATION

Unit 1

Overview of Graphics systems: Video display devices, Raster scan systems, Graphic workstations and viewing systems, Input devices, Graphics software, introduction to OpenGL.

Graphics Output Primitives: Coordinate reference frames, Line drawing algorithms (DDA and Bresenham's), OpenGL curve functions, Circle generating algorithms (Midpoint circle), Pixel Addressing and Object geometry fill area primitives, Polygon fill areas.

Unit 2

Attributes of graphics primitives: Color and Gray scale, point attributes, Line attributes, Fill-Area attributes, General Scan-line polygon fill algorithm, Scan-Line fill of convex-polygons, Boundary fill and flood fill algorithms, Antialiasing.

Two-dimensional viewing: 2D viewing pipeline, Clipping window, normalization and viewport Transformation, Clipping algorithms, point clipping, line clipping (Cohen-Sutherland, Nichol-Lee- Nichol), Polygon Fill-area clipping (Sutherland – Hodgeman).

Unit 3

Geometric Transformations: Basic 2D transformation, Matrix representation and Homogeneous Coordinates, Inverse transformations, 2D composite transformations, Reflection and shear, Raster Methods for geometric transformations, Transformations between 2D coordinate systems. 3DGeometric transformations, 3D translation, 3D rotation (coordinate axis rotation, General 3-d rotation, Quaternion methods for 3D rotation), 3D scaling, 3D composite transformations, transformations between 3D coordinate systems.

Unit 4

Three-dimensional viewing : Overview of 3D viewing concepts, 3D viewing pipeline, 3D viewing coordinate parameters, Transformation from world to viewing coordinates, Projection transformations, orthogonal projections (axonometric and isometric, orthogonal projection coordinates, clipping window and orthogonal projection view volume, Normalization transformation), Oblique parallel projections (Cavalier and cabinet projections, Clipping window and Oblique parallel-projection view volume, Oblique parallel projection transformation matrix, normalization transformation), Perspective projections (transformation coordinates, perspective-projection equations, vanishing points, view volume, transformation matrix, symmetric and oblique perspective-projection frustum, Normalized perspective-projection transformation coordinates), 3D clipping algorithms (region codes, point and line clipping, polygon clipping)..

Unit5

3D Object representation: Quadric surfaces, super quadrics, spline representations.

Visible surface detection methods: Classification, Back-face detection, depth-Buffer method, Abuffer method. Wireframe visibility methods.

Illumination models and surface rendering methods: Light sources, Surface lighting effects, Basic illumination models (Ambient light, diffuse reflection, specular reflection and the Phong model), polygon rendering methods (constant intensity surface rendering, Gouraud surface rendering, Phong surface rendering), Ray tracing methods – basic Ray-tracing algorithm.

Reference Books:

1. Hearn, Donald, and M. Pauline Baker. *Computer graphics with OpenGL*. Upper Saddle River, NJ: Pearson Prentice Hall,, 2004.

2. Hill Jr. and Kelly, *Computer Graphics using OpenGL*, 3rdEdn, Pearson,2009.
3. Shreiner, Dave, et al. *OpenGL programming guide: The Official guide to learning OpenGL, version 4.3*. Addison-Wesley, 2013.
4. Foley, James D., et al. *Computer graphics: principles and practice*. Vol. 12110. Addison-Wesley Professional, 1996.

MCSC11SYSTEM SOFTWARE &ADVANCED OPERATING SYSTEMS

Unit 1

System programming – Assemblers, linkers, loaders and compiler (basic ideas).
Introduction to compilers: Different Phases. Lexical Analysis: role of the lexical analyzer, input buffering, specification of tokens, Recognition of tokens. Syntax Analysis: role of the parser Context free grammar, writing a grammar, Top down parsing, Recursive descent parsing, Predictive parsing.

Unit 2

Bottom Up Parsing, Shift Reduce parsing, Operator precedence parsing, LR parsers (SLR, Canonical and LALR). Syntax-directed translation – Syntax-directed definitions: S-attributed definition, L-attributed definition. Top-down and bottom-up translation, Type checking.

Unit 3

Run time Environment: source language issues, storage organization - Storage organization Schemes, Activation records. Storage allocation strategies (basic concepts only), Parameter Passing mechanisms, .Symbol tables. Intermediate code generation, intermediate languages, declaration and assignment statements. Run time storage management, Runtime storage allocation, basic blocks and flow graphs. Code optimization: Principal sources of optimization.

Unit 4

Distributed Operating Systems- Motivation, types of network based operating system, distributed systems robustness, design issues. Distributed File System- Naming and transparency, remote file access, stateful v/s stateless services, file replication.

Unit 5

Distributed Synchronization—event ordering, mutual exclusion, atomicity, concurrency control, Deadlock handling, election algorithms, reaching agreement. Real Time Systems- Characteristics, features of real time kernels, implementation, real time CPU scheduling. Features of real time linux.

References Books:

1. Galvin, Peter B., Greg Gagne, and Abraham Silberschatz. *Operating system concepts*. John Wiley & Sons, 2003.

2. D.M. Dhamdhere, "*Systems Programming and Operating Systems*", TMH, 2003.
3. 2. A.V. Aho, R. Semi, J.D. Ullman, *"Compilers - Principles, techniques and tools*", Pearson Education, 2003.

4. Dhamdhere, Dhananjay M. *Operating Systems: A Concept-based Approach, 2E*. Tata McGraw-Hill Education, 2006.
5. Kochan, S, G., Wood, P., "*Unix shell programming*", 3rd ed. Pearson Education, 2003.
6. Deitel, Harvey M., Paul J. Deitel, and David R. Choffnes. *Operating systems*. Delhi.: Pearson Education: Dorling Kindersley,, 2004.
7. .A.V. Aho and J.D. Ullman, " *Principles of Compiler Design*", Narosa, 2002.
8. Louden, Kenneth C. "*Compiler Construction: Principles and Practice. 1997*." *PWS. Boston*.
9. Dave and Dave, *Compilers – principles and practice*, pearson, 2012.
10. Appel*, Modern Compiler Implementation in C*, Cambridge , 2012.

MCSC14 DIGITAL IMAGE PROCESSING

Unit 1

Steps in Digital image Processing, Elements of Visual perception, Image Sensing and Acquisition, Image sampling and quantization, Basic pixel relationships,
Basic Intensity Transformation functions – Negatives, Log transforms, Power law transformations, Piecewise Linear Transformation functions.

Unit 2

Histogram processing, Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Filtering in the Frequency domain: DFT of one and two variables, Properties of 2-D DFT, Basics of filtering in the Frequency domain. Image smoothing filters (Ideal Lowpass, Gaussian Low pass), Image sharpening filters (ideal High pass, Gaussian High pass, Laplacian in the Frequency domain. Selective filtering – Notch filters.

Unit 3

Image restoration and reconstruction: Model, noise models, restoration in the presence of noise only – spatial filtering, Periodic noise reduction by frequency domain filtering. Linear, Position – invariant degradation. Color models – RGB and HIS.

Unit 4

Image compression: Fundamentals, Compression methods (Huffman, Arithmetic coding, LZW Coding, run Length coding, Wavelet coding). Digital watermarking.Morphological Image Processing: Erosion and dilation, opening and closing, Hit-or-miss transformation, Morphological algorithms (Boundary extraction, Thinning, thickening, skeletons,pruning).

Unit 5

Image segmentation: Fundamentals, Point and line and edge detection, Thresholding, Region-based thresholding.

Representation and description: Representation – Boundary following and chain codes, skeletons. Boundary descriptors – Simple descriptors, shape numbers.Regional descriptors – simple descriptors.

Reference Books:

1.Gonzalez, Rafael C., and Richard E. Woods. "*Digital image processing [M].*" Publishing house of electronics industry 141.7 (2002).
2. Anil K. Jain, *Fundamentals of Digital image Processing*, Prentice Hall, US Ed., 1989.
3. William K. Pratt, Digital Image Processing: PIKS Scientific Inside, Wiley Interscience, 4th Ed., 2007.
4. Bernd Jahne, *Digital Image Processing*, Springer, 6th Ed., 1997.
5. Sonka, Hlavac, Boyle, *Digital Image Processing and Compurter Vision*, Cengage, 2008.

MCSC15DATA COMMUNICATION & NETWORK ADMINISTRATION

Unit 1

Introduction, Basic concepts- Line configuration, Topology, Transmission mode, Categories of networks, Internetworks, Transmission media - Satellite Communication, Cellular Telephony, Terrestrial Microwave, OSI and TCP/IP models.

Unit 2

Physical layer,: Signals-types, Digital data transmission, Modems, Multiplexing-FDM,TDM,WDM- Switching-Circuit Switching, Packet Switching and Message Switching.
Data link layer: Characteristics, Types of Errors, Error detection –VRC, LRC, CRC, Error Correction- Data compression-Huffman code- Ethernet, CSMA/CD, TOKEN BUS, POLLING,

Unit 3

Network layer: Characteristics- Networking and Internetworking devices- Internet protocols-Forwarding and Routing algorithms, Distance Vector Routing, Link State Routing, The Dijkstra Algorithm. Transport Layer: Characteristics: UDP, TCP, and SCTP, Congestion Control and Quality of Service, Application Layer: FTP, TFTP, Telnet, WWW and HTTP.

Unit 4

Files used in network setup: /etc/sysconfig/network-scripts/ files (parameter files and scripts) Network Management: SNMP, NFS, NIS, HTTP, SMB Protocol and Samba server, DHCP, DNS and Mail services: working of DNS, Host name Resolution Name lookup with DNS,

Reverse Lookup, Domain Name Servers and Zones, DNS database: SOA, NS, MX, A and PTR records, Secondary and primary DNS, POP, MIME, SMTP and POP3.

Unit 5

Inter Process Communication programming: Create a process- fork() system call, Parent and Child Process, Process ID, User and Group ID Half Duplex Unix Pipes, Named Pipes, (First In First Out) ,System V IPC :Message Queues, Semaphores, Shared memory, Sample programs for IPC using Pipes and FIFO; Introduction to Socket Programming: Sockets and Port numbers, socket address structure Byte ordering functions, Address conversion routines, Socket System calls-Client server computing: Architecture.

.

Reference Books:

1. Forouzan, A. Behrouz. *Data communications & networking (sie)*. Tata McGraw-Hill Education, 2007.
2. Tanenbaum, Andrew S. "*Computer Networks Forth Edition*." Vrije Universiteit (2003).
3. Stallings, William. *Data and computer communications*. Pearson Education India, 2007.
4. Nemeth, Evi, et al. *UNIX system administration handbook*. Pearson Education, 2000.
5. Kirch, Olaf, and Terry Dawson. *Linux network administrator's guide*. " O'Reilly Media, Inc.", 2000.
6. W Richard Stevens, *Unix Network Programming*, PHI, 2002.
7. Evi Nemeth ., et al, *Linux Administration Hand Book* , PHI 2003.

MCSC16 PRINCIPLES OF INTELLIGENT SYSTEMS

Unit 1

Introduction to soft Computing Paradigm, Artificial Neural Networks – fundamental concepts, Evolution, Basic models, important terminologies, MP – Neuron, Linear separability, Hebb network. Supervised learning networks – Perceptron network: Theory, Learning rule, Architecture, Training process, Training algorithm for single output class. Back-propagation network: theory, Architecture, Training process, Learning factors, testing.

Unit 2

Associative Memory networks: introduction, Training algorithms for pattern association: Hebb rule, Outer Products rule. Autoassociative Memory Networks: Theory, architecture, training process and algorithm, testing. Unsupervised Learning networks: Kohenen self-Organizing feature maps: Theory, Architecture, Training algorithm. Adaptive Resonance Network – Theory: fundamental architecture, operating principle and algorithm. ART-1: Architecture, training process and algorithm.

Unit 3

Introduction: Fuzzy systems – Historical perspective, Utility and limitations, uncertainty and information, fuzzy sets and membership, Chance vs Fuzziness. Classical sets and Fuzzy sets: Classical set (Operations, properties, mapping to functions). Fuzzy sets (operations, properties, Alternative fuzzy set operations). Classical Relations and Fuzzy relations: Cartesian product, crisp relations (cardinality, operations, properties, composition), Fuzzy relations (cardinality, operations, properties, Fuzzy Cartesian products and composition), Tolerance and equivalence relation, Crisp equivalence and tolerance relations, Fuzzy tolerance and equivalence relations

Unit 4

Properties of membership functions, Fuzzification and Defuzzification: Features of the membership functions, various forms, Fuzzification, Defuzzification to crisp sets, λ-cuts for fuzzy relations, Defuzzification to scalars. Logic and Fuzzy systems: Classical logic, proof, Fuzzy logic, approximate reasoning, other forms of the implication operation. Natural language, Linguistic hedges, Fuzzy rule based systems, Graphical techniques for inference. Development of membership functions: Membership value assignments (intuition, inference, rank ordering)

Unit5

Genetic Algorithms: Fundamentals of genetic algorithm: history, basic concepts, creation of offspring, working principle, Encoding, fitness function, reproduction. Genetic modeling: inheritance operators, cross over, inversion and deletion, Mutation operators, Bit- wise operators used in GA, Generational cycle, convergence, application (any one).

Reference Books:

1. Sivanandan, Deepa, *Principles of Soft Computing*, 2ndEdn, Wiley India,2014.
2. Rajasekharan and Viajayalakshmipai, *Neural Networks, Fuzzy Logic and Genetic Algorithm,* PHI, 2003. (For Unit 5).
3. Yegnanarayana, Bayya. *Artificial neural networks*. PHI Learning Pvt. Ltd., 2009.
4. S Kumar, Satish. *Neural networks: a classroom approach*. Tata McGraw-Hill Education, 2004.
5. Ross, Timothy J. *Fuzzy logic with engineering applications*. Vol. 2. New York: Wiley, 2004.

ELECTIVES

MCSEL01 SOFTWARE ENGINEERING

Unit 1

Software and Software Engineering: The Nature of Software, The Unique Nature of WebApps, Software Engineering, The Software Process, Software Engineering Practice. Process Models: A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models

Unit 2

Understanding Requirements: Requirements Engineering, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Validating Requirements.RequermentsModeling: Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case, Data Modeling Concepts, Class – Based Modeling.

Unit 3

Requirements Modeling: Requirements Modeling Strategies, Flow-Oriented Modeling. Design Concepts: Design within the Context of Software Engineering, The Design Process, Design Concepts. Architectural Design: Software Architecture - What is Architecture?, Why is Architecture Important? Architectural Styles, Architectural Design

Unit 4

Component-Level Design: What is a Component?, Designing Class-Based Components. User Interface Design: The Golden Rules, User Interface Analysis and Design. Software Configuration Management, The SCM Repository, The SCM Process.

Unit 5

Software Testing: A Strategic Approach to Software Testing, Testing Conventional Applications - Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing, Emerging trends in Software Engineering .

Reference Books:

1.Roger S Pressman, *Software Engineering: A Practitioner's Approach*, 7 th Edition, McGraw-Hill International Edition, 2010.
2. Richard Fairey, '*Software Engineering concepts'*, Tata McGraw-Hill,2009.
3. Sommerville, Ian. "*Software engineering 9th Edition*." *ISBN-10* 137035152 ,2011.
4. Jawdekar, Waman S. "*Software Engineering Principles and Practices*." 2004.

MCSEL02 INFORMATION RETRIEVAL SYSTEM

Unit 1

Introduction: Retrieval strategies: vector space model, Probabilistic retrieval strategies: Simple term weights, Non binary independence model, Language models.

Unit 2

Retrieval Utilities: Relevance feedback, clustering, N-grams, Regression analysis, Thesauri.

Unit 3

Semantic networks, parsing Cross –Language: Information Retrieval: Introduction, Crossing the Language barrier.

Unit 4

Efficiency: Inverted Index, Query processing, Signature files, Duplicate document detection.

Unit 5

Integrating structured data and text. A historical progression, Information retrieval as relational application, Semi Structured search using a relational schema. Distributed Information Retrieval: A theoretical Model of Distributed retrieval, web search.

Reference books:

1. David A. Grossman, OphirFrieder, *Information Retrieval – Algorithms and Heuristics*, Springer, 2nd Edition (Distributed by Universal Press), 2004.
2. Gerald J Kowalski, Mark T Maybury,"*Information Storage and Retrieval Systems: Theory and Implementation",* Springer, 2004.
3. SoumenChakrabarti, "*Mining the Web: Discovering Knowledge from Hypertext Data*", Morgan – Kaufmann Publishers, 2002.
4.Christopher D Manning, PrabhakarRaghavan, HinrichSchutze, "*An Introduction to Information Retrieval*" , Cambridge University Press, England, 2009.

MCSEL03 GRAPH THEORY & COMBINATORICS

Unit 1

Introduction to Graphs, definitions, sub graphs, paths and cycles, matrix representation of graphs, Euler tours, Chinese postman problem, planar graphs, Euler's formula, platonic bodies, applications of Kuratowski's theorem, Hamiltonian graphs, graph colouring and chromatic polynomials, map colouring.

Unit 2

Trees, definition and properties, rooted trees, trees and sorting, weighted trees and prefix codes, biconnected components and articulation points. Kruskal's and Prim's algorithms for minimal spanning trees.

Unit 3

Disjkstra's shortest path algorithm, Bellman – Ford algorithm, all-pairs shortest paths, Floyed – Warshall algorithms, the max-flow min-cut theorem, maximum bipartite matching.

Unit 4

Fundamental principles of counting, permutations and combinations, binomial theorem, combinations with repetition, combinatorialnumbers, Principle of inclusion, derangements, arrangements with forbidden positions.

Unit 5

Generating functions, partitions of integers, the exponential generating function, the summation operator.Recurrence relations, first order and second order, nonhomogeneous recurrence relations, method of generating functions.

Reference Books:

1. Grimaldi R.P., ―*Discrete and Combinatorial Mathematics : an applied Introduction*‖, 3e, Addison Wesley, 1994.
2. Corman T. H., Leiserson C. E., Rivest R. L., ―*Introduction to algorithms*:, Prentice Hall India, 1990.
3. Mott, Joe L., Abraham Kandel, and Theodore P. Baker. *Discrete mathematics for computer scientists and mathematicians*. Florida State Univ., 1986.
4. Rosen, Kenneth H., and Kamala Krithivasan. *Discrete mathematics and its applications: with combinatorics and graph theory*. Tata McGraw-Hill Education, 2012.
5. Clark, John, and Derek Allan Holton. *A first look at graph theory*. World Scientific, 1991.

MCSEL04 ADVANCED JAVA PROGRAMMING

Unit 1

Java Servlets: life cycle; http servlets, post, head and other requests; Servlet responses; error handling; security; servlet chaining; thread safety; cookies; session tracking; httpsessionbinding listener; databases and non-html content.

Unit 2

Remote Method Invocation: RMI architecture; RMI object services; defining remote objects; key RMI classes for remote object implementations; stubs and skeletons; accessing remote object as a client; factory classes; dynamically loaded classes; configuring clients and servers for remote class loading; remote object activation, persistent remote references; defining an activatable, remote object, activatable class, implementing an activatable object, registering activatable objects, passing data with the marshalled object; activation groups, registering activation groups, assigning activatable objects to groups; activation daemon. CORBA: architecture, IDL, creating CORBA objects, registering with naming service, finding and using remote objects.

Unit 3

Java Naming and Directory Interface: JNDI Architecture, Context, initial context class, Looking up Object in a context, Listing the children of a context, Creating and destroying the object, binding objects -accessing directory services, modifying directory entries, creating directory entries, searching a directory, Event notification.

Unit 4

Enterprise JavaBeans: EJB roles-ELB client-Object –container-Transaction management implementing a Basic EJB Object- Implementing session Beans, Implementing Entity Beans Deploying an enterprise Java Beans Object- Changes in EJB1.1 specification.

Unit 5

Java Server Pages: JSP basics, directives and declarations, sharing data between JSPs, JSP actions, JSP application development: Generating dynamic content, using scripting elements implicit JSP Objects, Conditional processing- Displaying values using an expression to set an attribute, Declaring variables and Methods Error Handling and Debugging sharing data between JSP pages, Requests, and users passing.

Reference books:

1. David Flanagan,Jim Parley, William Crawford & Kris Magnusson , *Java Enterprise in a nutshell- A desktop Quick reference* -O'REILLY, 2003.
2.Stephen Ausbury and Scott R. Weiner*, Developing Java Enterprise Applications*, Wiley-2001.

3. JaisonHunder& William Crawford, *Java Servlet Programming*, O'REILLY, 2002.
4. Kogent Learning Solutions Inc. --*Web Technologies Black Book: HTML, JavaScript, PHP, Java, JSP, XML and AJAX* ,2013.

MCSEL05 FUZZY SETS & SYSTEMS

Unit 1

Introduction: Fuzzy systems – Historical perspective, Utility and limitations, uncertainty and information, fuzzy sets and membership, Chance vs. Fuzziness. Classical sets and Fuzzy sets: Classical set (Operations, properties, mapping to functions). Fuzzy sets (operations, properties, Alternative fuzzy set operations).

Unit 2

Classical Relations and Fuzzy relations: Cartesian product, crisp relations (cardinality, operations, properties, composition), Fuzzy relations (cardinality, operations, properties, Fuzzy Cartesian products and composition), Tolerance and equivalence relation, Crisp equivalence and tolerance relations, Fuzzy tolerance and equivalence relations, value assignments (Cosine amplitude , Max-min method), other similarity methods, other forms of composition Operation.

Unit 3

Properties of membership functions, Fuzzification and Defuzzification: Features of the -cuts for fuzzyλmembership functions, various forms, Fuzzification, defuzzification to crisp sets, relations, Defuzzification to scalars. Logic and Fuzzy systems: Classical logic, proof, Fuzzy logic, approximate reasoning, other forms of the implication operation. Natural language, Linguistic hedges, Fuzzy rule based systems, Graphical techniques for inference.

Unit 4

Development of membership functions: Membership value assignments (intuition, inference, rank ordering, Neural network, Genetic algorithm, inductive reasoning.) Extension Principle: Crisp functions, mapping and relations, Functions of Fuzzy sets – extension principle, Fuzzy transform, practical considerations.

Unit 5

Fuzzy arithmetic: Interval analysis, Approximate methods of extension – DSW and restricted DSW algorithms. Fuzzy classification: Classification by equivalence relation (crisp and Fuzzy), Cluster analysis, cluster validity, C-means clustering (Hard and Fuzzy), Fuzzy c-means algorithm.

Reference books:

1. Ross, Timothy J. *Fuzzy logic with engineering applications*. Vol. 2. New York: Wiley, 2004.
2. Hajek P, *Metamathematics of Fuzzy Logic*. Kluwer, 1998 .
3. Rajasekharan and Viajayalakshmipai, *Neural Networks, Fuzzy Logic and Genetic Algorithm,* PHI, 2003.

MCSEL06 OPERATIONS RESEARCH

Unit 1

Linear programming: Formulation, Graphical Solution-2 variables, Development of Simplex Method, Artificial Variable Techniques, Big- M method, Two-Phase method, Reversed Simplex method.

Unit 2

Duality in LPP and its formulation, Dual Simplex Method, Bounded variable method, Applications of LPP, Transportation problems, Assignment Problem, Traveling Sales persons problem.

Unit 3

Integer Programming problem (IPP), Cutting Plane algorithm, Branch and bound method of solving IPP, Dynamic programming problems and it's characteristics, Deterministic Dynamic Programming Problem.

Unit 4

Sequencing Problem, Processing n jobs through two machines and their mechanics, Processing n jobs through m machines, Processing 2 jobs through m machines, Project scheduling by PERT / CPM, Difference between PERT / CPM, Constructing the network, Critical path analysis, Float of an activity, Three time estimated for PERT, project cost by CPM.

Unit 5

Stochastic process, Classification of stochastic process, Discrete parameter Markov chains, Continuous Parameter Markov Chains, Birth and Death Processes, Queuing model and it's characteristics, Classification of Queuing Model (M/M/1): FCFS(birth and death model)z//.

Reference Books:

1. Taha, Hamdy A. *Operations research: an introduction*. Macmillan,, 1992.
2. Sharm J.K, *Mathematical Models in Operation Research*, TMGH, 1989.
3. Trivedi, Kishor Shridharbhai. *Probability and statistics with reliability, queuing, and computer science applications*. Vol. 13. Englewood Cliffs: Prentice-hall, 1982.
4. Winston, *Operations Research Applications and Algorithms*, 4thedn, CENGAGE, 2003Sons, 2007.

MCSEL07 DESIGN AND ANALYSIS OF ALGORITHMS

Unit 1

Introduction, recursive algorithms, time and space complexities, randomized algorithms, repeated element, primality testing. Divide and conquer- general method, finding maximum and minimum, merge sort, quick sort, selection, Strassen's matrix multiplication, convex hull algorithm.

Unit 2

Greedy method: general method, knapsack problem, tree vertex splitting, job sequencing with deadlines, optimal storage on tapes.

Unit 3

Dynamic programming: General method, multistage graphs, all pair's shortest paths, DFS, BFS, connected components, biconnected components and DFS.

Unit 4

Back tracking: general method, 8 queens, sum of subsets, graph colouring, Hamilton cycles. Branch and bound: General method, traveling salesperson problem.

Unit 5

Lower bound theory, comparison trees, Oracles and advisory arguments, Lower bounds through reduction, Basic concept soft NP – Hard and NP – Complete problems.

Reference books:

1. Sahni, Sartaj, and Ellis Horowitz. *Fundamentals of computer algorithms*. Computer Science Press, 1978.
2. Aho, Alfred V., and John E. Hopcroft. *The design and analysis of computer algorithms*. Pearson Education India, 1974.
3. Baase and Gelder, *Computer Algorithms Introduction to Design and analysis*, 3rdedn, Pearson, 2000.
4. Levitin, Anany. *Introduction To Design And Analysis Of Algorithms, 2/E*. Pearson Education India, 2008.

MCSEL08 SIMULATION & MODELING

Unit 1

Introduction: simulation, Merits and demerits, Areas of application, System and Environment, Components of System, Discrete and Continuous systems, types of models. Steps in simulation study, Simulation Examples, Concepts in Discrete event simulation, Event scheduling Vs. Time advance algorithms. Manual simulation Using Event Scheduling, List processing. Simulation in Java, Simulation in GPSS.

Unit 2

Statistical Models: Useful statistical model, Discrete distribution, Continuous distribution, Queuing Models: Characteristics of queuing systems, queuing notations, long run measures of performance of queuing systems, Steady state behaviour of Markovian models (M/G/1, M/M/1, M/M/c), Steady state behaviour of finite population models, Network of Queues.

Unit 3

Random Numbers: Roles of random numbers in simulation, pseudo random number generation techniques- there properties, methods of testing PRN sequence. Random Varieties: Generation, Inverse transformation techniques, Acceptance Rejection techniques, direct transformation technique and Convolution method.

Unit 4

Input Modelling: Data collection, identifying the Distribution, parameter estimation, Goodness of fit tests. Input models without data, Multivariate and Time series input models. Verification and Validation of Models: Model building, Verification, and Validation, Verification of simulation models, Calibration and Validation of models.

Unit 5

Output Analysis for a Single Model: Types of simulations with respect to output analysis, stochastic nature of output data, Measure of performance and their estimation, Output analysis of terminating simulators, Output analysis for steady state simulation. Comparison and Evaluation of Alternative System Design: Comparison of two system design, Comparison of several system design, Meta modelling, Optimization via simulation. **Case Studies:** Simulation of manufacturing systems, Simulation of computer systems, Simulation of super market, Simulation of pert network.

Reference books:

1. Jerry Banks. John S. Carson & Barry L. Nelson - *Discrete Event system simulation* , PHI India 2001.
2. Geoffrey Gordon, *System Simulation*, 2nd Edition, Prentice Hall, India, 2002.
3. N.Deo ,*System simulations with Digital computers*, PHI 1979.
4. James A Payne, *Introduction to Simulation: Programming Techniques & Methods of Analysis* MGH, 1988.
5. Sengupta , *System Simulation and Modelling*, Pearson, 2014.

MCSEL09 LINUX SYSTEM &NETWORK ADMINISTRATION

Unit 1

Introduction: Important parts of kernel; Major services in a UNIX system: init, login from terminals, syslog, periodic command execution crown and at; Boot process: The LILO boot process: LILO parameters, /etc/lilo.conf; The GRUB boot process; The /boot directory and files; initrd file and mkinitrd; Run levels: /etc/inittab, start-up script /etc/rc.d/rc.sysinit; System Configuration: The /etc/sysconfig/… files,kernel modules; kernel daemon; /etc/conf. modules and module parameters; /lib/modules/… directory structure and contents.

Unit 2

File system configuration: file system types, /etc/fstabloyout and meaning; Basic user environment: /etc/skel/… and home directories, Window manager configuration file locations; System Security: Host security: tcp_wrappers and /etc/hosts.allowand /etc/hosts. deny, /etc/security, shadow password, file permissions, users groups and umask; Adding and deleting users; System maintenance: Syslogd, klogd and /etc/syslog.conf; Using a remote syslog; The system crontab, dailyscript, tmpwatch and logrotate; Using and managing the system log files; Basic system backup and restore operations; Emergency rescue operations.

Unit 3

TCP / IP Network Configuration: Introduction to TCP / IP network, Protocols, IP address, Hostname, Configuring a Host : setting the host name, assigning IP address, broad cast, net mask and name server address, Editing Host and network files, Interface Configuration: loop back interface, Ethernet interface, The SLIP and PPP interface, Configuring Gateway, Routing through gateway, Network commands: ifconfig, netstat, route. Network applications Configuration: File Transfer Protocol (FTP) and Trivial File Transfer Protocol (TFTP), Network File Systems (NFS) . Network Information System(NIS),Hyper Text Transfer Protocol (HTTP) and Web server, Server Message Block (SMB) Protocol and Samba server, Dynamic Host configuration Protocol (DHCP) Firewalls, Remote booting.

Unit 4

Domain Name Services (DNS) and Mail services: working of DNS, Host name Resolution Name lookup with DNS, Reverse Lookup, Domain Name Servers and Zones, DNS database: SOA, NS, MX, A and PTR records, Secondary and primary DNS, Zone change notification, root servers, internet root domains, configuring DNS, Using nslookup. Simple Mail Transfer Protocol (SMTP), Post office Protocol (POP) Multipurpose Internet Mail Extension (MIME), SMTP and POP3 command, Mail routing, configuring a mail server.

Unit 5

Inter Process Communication programming : Create a process- fork() system call, Parent and Child Process, Process ID, User and Group ID Half Duplex Unix Pipes, Named Pipes, (First In First Out) , Streams and messages, System V IPC :Message Queues, Semaphores, Shared memory, Sample programs for IPC that uses Pipes, FIFO; Socket Programming: Overview, socket address, Elementary Socket System Calls: socket, socket pair, bind, connect, listen, accept, send, sendto, recv, recvfrom, close, Byte ordering routines, Byte Operations, Address conversion routines, Simple client Programs that uses some reserved ports, Simple Client / Server Program using unreserved ports.

References Books:

1. Evi Nemeth ., et al, *Linux Administration Hand Book* , PHI 2003.
2. Nicholas Wells, L*inux Installation and Administration*, Thomson Vikas 2000.
3. Olaf Kirch& Terry Dawson, *Linux Network Administrators Guide*, O'relly, 2003 .
4. Hunt, *Linux DNS server Administration*, BPB Publication, 2003
5. W Richard *Stevens, Unix Network Programming*, PHI, 2002.

MCSEL10 EMBEDDED SYSTEMS

Unit 1

Introduction to Embedded Systems– Components of embedded system hardware–Software embedded into the system – Embedded Processors - CPU architecture of ARM processor (ARM9) – CPU Bus Organization and Protocol.

Design and Development life cycle model - Embedded system design process – Challenges in Embedded system design.

Unit 2

Serial Communication Standards and Devices - UART, HDLC, SCI and SPI. Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus. Parallel communication standards ISA, PCI and PCI-X Bus.

Unit 3

Real-time operating systems - Services- Goals – Structures -Kernel - Process Management – Memory Management –Device Management – File System Organization. Micro C/OS-II RTOS - System Level Functions – Task Service Functions – Memory Allocation Related Functions – Semaphore Related Functions. Study of other popular Real-time Operating Systems.

Unit 4

Memory devices and systems - memory map – DMA - I/O Devices – Interrupts - ISR – Device drivers for handling ISR – Memory Device Drivers – Device Drivers for on-board bus.

Unit 5

Programming concepts of embedded programming – Features of Embedded C++ and Embedded Java (basics only). Software Implementation, Testing, Validation and debugging, system-on-chip.

Design Examples: Mobile phones, ATM machine, Set top box.

Reference Books:

1. David E. Simon, *An Embedded Software Primer*, Pearson Education Asia, First Indian Reprint 2000.
2. Wayne Wolf, *Computers as Components: Principles of Embedded Computing System Design*, Morgan Kaufman Publishers - Elsevier 3ed, 2008.
3. Frank Vahid and Tony Givargis, *Embedded Systems Design – A Unified Hardware / Software Introduction*, John Wiley, 2002.
4. Iyer - *Embedded Real time Systems*, 1e, McGraw Hill Education New Delhi, 2003.
5. K.V. Shibu, *Introduction to Embedded Systems*, 2e, McGraw Hill Education India, 2016.
6. Lyla B. Das, *Embedded Systems: An Integrated Approach*, 1/e ,Lyla B. Das, Embedded Systems, 2012.
7. Rajkamal, *Embedded Systems Architecture, Programming and Design*, TMH, 2003.
8. Steve Heath, *Embedded Systems Design*, Newnes – Elsevier 2ed, 2002.
9. Tammy Noergaard, *Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers*, Newnes – Elsevier 2ed, 2012.

MCSEL11 PATTERN RECOGNITION

Unit 1

Pattern recognition systems- Definitions, data representation, representations of patterns and classes. Types of pattern recognition systems. Applications of pattern recognition systems. Bayesian decision making and Bayes Classifier for continuous and discrete features.

Unit 2

Min-max and Neymann-Pearson classifiers, Discrminant functions, Decision surfaces.Maximum likelihood estimation and Bayesian parameter estimation. Overview of Nonparametric density estimation- Histogram based approach, classification using Parzen window.

Unit 3

K-nearest neighbor estimation and classification. Classification of clustering algorithm-hierarchical clustering- agglomerative clustering. Partitional clustering- Forgy's algorithm. K-means clustering.

Unit 4

Introduction to feature selection –filter method- sequential forward and backward selection algorithms. Wrappers method and embedded methods. Feature extraction methods- Principal component analysis, fisher linear discriminant analysis, ICA.

Unit 5

Neural network structures for Pattern Recognition – Neural network based Pattern associators – Unsupervised learning in neural Pattern Recognition – Self-organizing networks – Fuzzy logic – Fuzzy pattern classifiers – Pattern classification using Genetic Algorithms.

Reference Books:

1.Duda R.O., and Har P.E., *Pattern Classification and Scene Analysis*, Wiley, New York, 1973.
2. Bishop C.M, *Pattern recognition and machine learning,* Springer, 2nd Edition,2006.
3. Theodoridis .S, Pikrakis .A, Koutroumbas .K, Cavouras .D, *Introduction to Pattern Recognition:AMatlab approach,* Academics Press 2010.

MCSEL12 ARTIFICIAL INTELLIGENCE

Unit 1

Introduction - Overview of AI applications. Introduction to representation and search. The Propositional calculus, Predicate Calculus, Using Inference Rules to produce Predicate Calculus expressions, Application – A Logic based financial advisor.

Unit 2

Introduction to structure and Strategies for State Space search, Graph theory, Strategies for state space search, using the State Space to Represent Reasoning with the Predicate calculus (Sate space description of a logical system, AND/OR Graph). Heuristic Search: introduction, Hill-Climbing and Dynamic Programming, The Best-first Search Algorithm, Admissibility, Monotonicity and informedness, Using Heuristics in Games.

Unit 3

Building Control Algorithm for State space search – Introduction, Production Systems, The blackboard architecture for Problem solving. Knowledge Representation – Issues, History of AI representational schemes, Conceptual Graphs, Alternatives to explicit Representation, Agent based and distributed problem solving.

Unit 4

Strong Method Problem Solving – Introduction, Overview of Expert System Technology, Rule Based Expert system, Model -Based, Case-Based and Hybrid Systems (Introduction to Model based reasoning, Introduction to Case Based Reasoning, Hybrid design), Introduction to Planning. Reasoning in Uncertain Situation – introduction, logic based Adductive Inference. Introduction to PROLOG, Syntax for predicate Calculus programming, ADTs, A production system example.

Unit 5

Machine Learning: Symbol Based – Introduction, Frame –work. The ID3 Decision tree Induction algorithm. Inductive bias and Learnability, Knowledge and Learning, Unsupervised learning, Reinforcement Learning, Machine Learning: Connectionist – Introduction, foundations, Perceptron learning. Machine learning: Social and emergent: Models, The Genetic Algorithm, Artificial Life and Social based Learning.

Reference Books:

1. Luger, George F. *Artificial intelligence: structures and strategies for complex problem solving*. Pearson education, 2005.
2. Rich, Elaine, Kevin Knight, and Shivashankar B. Nair. "*Artificial Intelligence* (3rd)." (1985).
3. Russell, Stuart J., and Peter Norvig. *Artificial intelligence: a modern approach*. Malaysia; Pearson Education Limited,, 2016.
4. D W Patterson, *introduction to Artificial Intelligence and Expert Systems*, PHI, 1990

MCSEL13 MULTIMEDIA DATABASE SYSTEMS

Unit 1

Introduction : Architecture of Multimedia Database Systems ,Performance measure for evaluating Multimedia Database Systems; Multidimensional Data Structures: k-d Trees, Point Quad trees, The MX-Quad trees, R-Trees, comparison of Different Data Structures.

Unit 2

Image Databases : Raw Images, Compressed Image Representations, Image Processing: Segmentation, Similarity-Based Retrieval, Alternative Image DB Paradigms, Representing Image DBs with Relations, Representing Image DBs with R-Trees, Retrieving Images By Spatial Layout, Implementations.

Unit 3

Text/Document Databases: Precision and Recall, Stop Lists, Word Stems, and Frequency Tables, Latent Semantic Indexing, TV-Trees, Other Retrieval Techniques.

Unit 4

Video Databases: Organizing Content of a Single Video, Querying Content of Video Libraries, Video Segmentation, video Standards.

Audio Databases: A General Model of Audio Data, Capturing Audio Content through Discrete Transformation, Indexing Audio Data.

Unit 5

Multimedia Databases : Design and Architecture of a Multimedia Database, Organizing Multimedia Data Based on The Principle of Uniformity, Media Abstractions, Query Languages for Retrieving Multimedia Data, Indexing SMDSs with Enhanced Inverted Indices, Query Relaxation/Expansion.

Reference books:

1. Subrahmanian, V. S. *"Principles of multimedia database systems."* (1998).
2. Shekhar, Shashi, and Sanjay Chawla. *Spatial databases: a tour*. Pearson, 2003.
3. Dunckley, Lynne, and Lynne Dunkley. *Multimedia databases: An object-relational approach*. Reading: Addison-Wesley, 2003.
4. Prabhakaram, *Multimedia Database Systems* ,Springer, 2016

MCSEL14 SOFTWARE PROJECT MANAGEMENT

Unit 1

Software Project and Characteristics, Project Constraints, Project Life Cycle and Process Life Cycle. Factors in Designing a Project Structure, Types of Project Organization Structures, Different Management Styles. Project Enabling Processes and Project Facilitating Processes. Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, Software Project Management activities, SPM Framework, Common problems with software projects.

Unit 2

Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Elements of a Project Plan. Steps to a Well Defined Project Plan. Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Methods of representing WBS, Application of the WBS. Structure of a Software Project Management Plan.

Unit 3

Software project estimation, Software Effort estimation techniques. Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Activity Planning, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts. Project Schedule Management. Ways to Organize Personnel.

Unit 4

Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index(SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Desk checks, Walkthroughs, Code Reviews, Pair Programming.

Unit 5

Concept of Software Quality, Activities of Software: Quality Planning, Quality Assurance, Quality Control, Tools and techniques for Quality Control. Software Quality Attributes, Software Quality Indicators, Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring.

Reference Books:

1. Manish Kumar Jha, *Software Project Management*, DhanpatRai& Co,2014.
2. Hughes, Bob, and Mike Cotterell. *Software project management*. Tata McGraw-Hill Education, 1968.

MCSEL15 QUANTUM COMPUTING

Unit 1

Introduction to Quantum Computation: Quantum bits, Bloch sphere representation of a cubit, multiple cubits.

Unit 2

Background Mathematics and Physics: Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.

Unit 3

Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits.

Unit 4

Quantum Information and Cryptography: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.

Unit 5

Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm,

Shor factorization, Grover search.-Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation.

Reference Books:

1. Nielsen M. A., *Quantum Computation and Quantum Information*, Cambridge University Press.-2002.
2. Benenti G., Casati G. and Strini G., *Principles of Quantum Computation and Information,* Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.-2004.
3. Pittenger A. O., *An Introduction to Quantum Computing Algorithms*-2000.

MCSEL16 CYBER FORENSICS

Unit 1

Computer Forensics Fundamentals: What is Computer Forensics?, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists. Types of Computer Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement - Computer Forensic Technology - Types of Business Computer Forensic Technology Computer Forensics Evidence and Capture: Data Recovery Defined -Data Back-up and Recovery-The Role of Back-up in Data Recovery - The Data- Recovery Solution.

Unit 2

Evidence Collection and Data Seizure: Why Collect Evidence? Collection Options obstacles--Types of Evidence - The Rules of Evidence-Volatile Evidence - General Procedure - Collection and Archiving - Methods of Collection -Artifacts - Collection Steps - Controlling Contamination: The Chain of Custody. Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene – Computer Evidence Processing Steps - Legal Aspects of Collecting and Preserving Computer Forensic Evidence Computer Image Verification and Authentication: Special Needs of Evidential Authentication – Practical Consideration -Practical Implementation .

Unit 3

Computer Forensics analysis and validation: Determining what data to collect and analyse, validating forensic data. Addressing data-hiding techniques, performing remote acquisitions Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honey net project. Processing Crime and Incident Scenes: Identifying digital evidence. Collecting evidence in private sector incident scenes, processing law enforcement crime scenes, preparing

for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case.

Unit 4

Current Computer Forensic tools: evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-Mail Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in email, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools Cell phone and mobile device forensics: Understanding mobile device forensics, understanding acquisition procedures for cell phones arid mobile devices.

Unit 5

Working with Windows and DOS Systems: understanding file systems, exploring Microsoft File Structures. Examining NTH disks. Understanding whole disk encryption, windows registry.NI Microsoft start-up tasks. MS-DOS start-up tasks, virtual machines.

Reference Books:

1. Vacca, John R. *Computer Forensics: Computer Crime Scene Investigation (Networking Series)(Networking Series)*. Charles River Media, Inc., 2005.
2. Nelson, Bill, et al. "Computer forensics and investigations." (2004).
3. Britz, Marjie T. *Computer Forensics and Cyber Crime: An Introduction, 2/E*. Pearson Education India, 2009.

MCSEL17 CRYPTOGRAPHY & NETWORK SECURITY

Unit 1

Foundations of Cryptography and security: Ciphers and secret messages, security attacks and services. Mathematical tools for cryptography: substitution techniques, moudular arithmetic, Euclid's algorithm, finite fields, polynomial arithmetic. Design Principles of Block Ciphers: Theory of Block Cipher Design, Feistel cipher network strcture, DES and Triple DES, modes of operation (ECB, CBC, OFB, CFB), strength of DES.

Unit 2

Bock cipher Algorithms: IDEA, CAST, Blowfish, Rijndael(AES). Pseudo Random Numbers and Stream Ciphers: PRN sequence, Linear congenital generators, cryptographic generators, design of stream cipher, RC4, RC5.

Unit 3

Public Key cryptography: Prime numbers and testing for primality, factoring large numbers, discrete logarithms, RSA algorithm. Key management, Diffi-Helman Key exchange, elliptic

curve arithmetic, elliptic curve cryptography, Public key cryptography standards. Hashes and message digests: message authentication and Hash functions, Hash algorithms.

Unit 4

Digital signatures, certificates and standards: DSS, DSA, Public Key Infrastructure, Digital Certificates and basics of PKCS standards. Authentication: Kerberos, X.509, Authentication service. Electronic mail security: Pretty Good Privacy, S/MIME, X.400.

Unit 5

IP and Web security protocols: IP security and virtual private networks, secure soket layer and transport layer security. System security, Computer Virus, Firewall and Intrusion Detection: virus and related threats, virus counter measures, intrusion detection and password management, firewall design principles. Electronic commerce security: electronic payment system, secure electronic transaction, protocols, Cybercash, iKey, Ecash, DigiCash, Smartcard based system.

Reference books:

1. William Stallings, *Cryptography and Network Security*, Pearson 2004.
2. BuceSchneier., *Applied cryptography – protocalls and algorithms*, Springer Verlag 2003.

MCSEL18 NATURE INSPIRED COMPUTING

Unit 1

Natural to Artificial Systems- Biological Inspirations in problem solving- Behavior of Social Insects: Foraging- Division of labor- Task Allocation – Cemetery Organization and Brood Sorting – Nest Building – Cooperative Transport.

Unit 2

Ant Colony Optimization : Ant Behavior – Towards artificial Ants - Ant Colony Optimization – Problem solving using ACO – Extensions of Ant Systems – Applications.

Unit 3

Swarm Intelligence: Introduction to Swarm Intelligence – Working of Swarm Intelligence – Optimization – Particle Swarms – Applications.

Unit 4

Introduction to Genetic algorithms – Population Initialization – Choosing a Fitness Function – Selection – Crossover – Mutation – Reinsertion – Applications of Genetic Algorithms – Evolutionary Algorithms. Other Biological computing Methods – Immune System Algorithms –

Cellular Automata – Linden Meyer Systems – Artificial Neural Networks – Simulated Annealing.

Unit 5

Computing With New Natural Materials: DNA Computing: Motivation, DNA Molecule , Adelman's experiment , Test tube programming language, Universal DNA Computers , PAM Model , Splicing Systems , Lipton's Solution to SAT Problem , Scope of DNA Computing , From Classical to DNA Computing.

Reference books

1. Stephen Olariu and Albert Y.Zomaya, "*Handbook of Bio-Inspired and Algorithms and Applications"*, Chapman and Hall, 2006.
2. Marco Dorrigo, Thomas Stutzle," *Ant Colony Optimization*", PHI,2004.
3. Eric Bonabeau, Marco Dorrigo, Guy Theraulaz, *"Swarm Intelligence: From Natural to Artificial Syatems",* Oxford University Press,2000.
4. Mitchell, Melanie, *"Introduction to Genetic algorithms*",ISBN:0262133164,MIT Press,1996.
5. Leandro Nunes de Castro, " *Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications*", Chapman & Hall/ CRC, Taylor and Francis Group, 2006.
6. Floreano D. and Mattiussi C., *"Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies",* MIT Press, Cambridge, MA, 2008.
7. Leandro Nunes de Castro and Fernando .J, " *Recent Developments in Biological Inspired Computing",* MIT Press,2005.

MCSEL19 INFORMATION STORAGE & MANAGEMENT

Unit 1

Storage Systems: Review the amount of information being created and understand the value of information to a business , Data Centre infrastructure elements and their requirements,role of ILM strategy ,physical and logical components of host, connectivity, and storage , disk drive architecture and performance , concept of RAID and different RAID levels (RAID 0, 1, 3, 5, 0+1/1+0, and Define Intelligent Storage System (ISS) and its components, Implementation of ISS as high-end and midrange storage arrays.

Unit 2

Storage Networking Technologies and Virtualization: implementation of DAS and overview of SCSI ,the architecture, components, and topologies of FC-SAN, NAS, Unified Storage,object based storage system CAS and its application as long-term archiving solution. Overview of emerging technologies such as Cloud storage, Virtual provisioning, FAST.

Virtualization: Server Virtualization (LVM –based virtualization, Memory virtualization, Virtual Machine, and Hypervisor), Network (VLAN and VSAN), Storage (Disk virtualization, RAID, LUN masking, File and block level virtualization, Virtual Provisioning)

Unit 3

Business Continuity:Understand the concept of information availability and its measurement. the causes and consequences of downtime , RTO, and RPO , failure in a storage infrastructure and solutions for its mitigation , backup/recovery purposes and considerations,architecture and different backup/Recovery topologies ,local replication technologies and their operation, remote replication technologies and their operation. Overview of emerging technologies like de duplication, offsite backup**,** Continuous data protectiontechnology (CDP)

Unit 4

Storage Security and Management: Define information security. List the critical security attributes for information systems. Define storage security domains. List and analyze the common threats in each domain. Identify key parameters and components to monitor in a storage infrastructure. List key management activities and examples

Unit 5

Cloud Computing: Define cloud computing. Describe cloud services (SaaS, PaaS, and Iaas). Discuss cloud concerns and implementations.

Reference Books:

1. Somasundaram, G., and A. Ahrivastava. "*EMC education services: information storage and management."* (2009).

2. Barker, Richard, and Paul Massiglia. *Storage area network essentials: a complete guide to understanding and implementing SANs*. Vol. 7. John Wiley & Sons, 2002.

MCSEL20 BIG DATA ANALYTICS

Unit 1

Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis –Nature of Data - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools -Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

Unit 2

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing -

Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – EstimatingMoments – Counting Oneness in a Window – Decaying Window - Real time AnalyticsPlatform(RTAP)Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

Unit 3

History of Hadoop- The Hadoop Distributed File System – Components of Hadoop- Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFSBasics-Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map ReduceJob run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types andFormats- Map Reduce Features.

Unit 4

Setting up a Hadoop Cluster - Cluster specification - Cluster Setup and Installation – Hadoop Configuration-Security in Hadoop - Administering Hadoop – HDFS - Monitoring-Maintenance-Hadoop benchmarks- Hadoopin the cloud.

Unit 5

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services –HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphereBigInsights and Streams. Visualizations - Visual data analysis techniques, interaction techniques;Systems and applications

Reference Books:

1. Michael Berthold, David J. Hand, *Intelligent Data Analysis*, Springer, 2007.
2. Tom White*, Hadoop: The Definitive Guide*, 3rdEdn, O'reily Media, 2012.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, *Understanding BigData:Analytics for Enterprise Class Hadoop and Streaming Data*, McGrawHill Pub, 2012.
4. Anand Rajaraman& Jeffrey D Ullman, *Mining of Massive Datasets*, Cambridge University Pres,2012.
5. Bill Franks, Taming the Big Data Tidal Wave: *Finding Opportunities in Huge Data Streams with Advanced Analytics*, John Wiley & sons, 2012.
6. Glen J. Myyat, *Making Sense of Data*, John Wiley & Sons, 2007.
7. Pete Warden, *Big Data Glossary*, O'Reily, 2011 .
8. Han, Kamber, *Data Mining Concepts and Techniques*, 3rdEdn, Morgan Kauffman, 2012.
9. Da Ruan, Guoquing Chen, Etienne E.Kere, Geert Wets, *Intelligent Data Mining*, Springer,2007.

10.Paul Zikopoulos ,DirkdeRos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , *Harness the Power of Big Data The IBM Big Data Platform*, Tata McGraw Hill Pub,2012.
11. Michael Mineli, Michele Chambers, AmbigaDhiraj, *Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business*, WileyPublications,2013.
12. Zikopoulos, Paul, Chris Eaton, *Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data*, Tata McGraw Hill Pub, 2011.

MCSEL21 TIME SERIES ANALYSIS

Unit1

Stochastic process and its main characteristics: Stochastic process. Time series as a discrete stochastic process.Stationarity.Maincharacteristics of stochastic processes (means, autocovariation and autocorrelation functions).Stationary stochastic processes. Stationarity as the main characteristic of stochastic component of time series. Wold decomposition. Lag operator.

Unit2

Autoregressive-moving average models ARMA (p,q): Moving average models MA(q). Condition of invertability. Autoregressive models AR(p).Yull-Worker equations. Stationarity conditions. Autoregressive-moving average models ARMA(p,q).

Unit 3.

Coefficient estimation in ARMA (p,q) processes. Box-Jenkins' approach: Coefficients estimation in autoregressive models. Coefficient estimation in ARMA (p)processes. Quality of adjustment of time series models. AIC information criterion. BIC information criterion."Portmonto"-statistics. Box-Jenkins methodology to identification of stationary time series models.

Unit4

Forecasting in the framework of Box: Jenkins model-Forecasting, trend and seasonality in Box-Jenkins model.

Unit5

Non-stationary time series: Non-stationary time series. Time series with non-stationary variance. Non-stationary mean. ARIMA (p,d,q) models. The use of Box-Jenkins methodology to determination of order of Integration-The unit root problem. Spurious trends and regressions. Unit root tests (Dickey-Fuller). ADF test and the choice of the number of lags. Other unit root tests.

Reference books:

1. Enders W. *Applied Econometric Time Series*. John Wiley & Sons, Inc., 1995.
2. Mills, T.C. *The Econometric Modelling of Financial Time Series*. Cambridge University Press, 1999
3. Andrew C. Harvey. *Time Series Models.Harvesterwheatsheaf*, 1993.
4. Andrew C. Harvey. *The Econometric Analysis of Time Series*. Philip Allan, 1990.

MCSEL22 DATA MINING AND WAREHOUSING

Unit 1

Introduction to data warehousing- evolution of decision support systems- data warehouse environment- modelling a data warehouse- granularity in the data warehouse- data warehouse life cycle- building a data warehouse- online analytical processing

Unit 2

Data Warehousing Components. Building a Data Warehouse. Mapping the Data Warehousing to a Multiprocessor Architecture. DBMS Schemas for Decision Support. Data Extraction, clean up& Transformation Tools. Metadata.

Unit 3

Introduction to Data Mining. Decision Trees. Neural Networks. Nearest Neighbour& Clustering. Genetic Algorithms. Rule Induction. Selecting & Using the Right Technique.

Unit 4

Data mining – demands potential and major issues- classification of data mining techniques- generalization, summarization and characterization- discovery and analysis of patterns, trends and deviations- mining knowledge in database systems

Unit 5

Data mining models- decision trees- genetic algorithms- neural nets – data mining process- data preparation – defining a study- data cleaning- prediction- enabling data mining through data warehouse- integration of data mining tolls with database systems data mining applications – future trends

Reference Books:

1. Berson, Alex, and Stephen J. Smith. *Data warehousing, data mining, and OLAP*. McGraw-Hill, Inc., 1997.
2. Dorndorf, Ulrich, and Erwin Pesch. "Data Warehouses." *Handbook on Data Management in Information Systems*. Springer, Berlin, Heidelberg, 2003. 387-430.

3. Anahory, Sam, and Dennis Murray. *Data warehousing in the real world: a practical guide for building decision support systems*. Harlow, UK: Addison-Wesley, 1997.
4. Inmon, William H. *Building the data warehouse*. John wiley & sons, 2005.
5. Marakas, George M. *Modern data warehousing, mining, and visualization: core concepts*. Upper Saddle River, NJ: Prentice Hall, 2003.
6.Dunham, Margaret H. *Data mining: Introductory and advanced topics*. Pearson Education India, 2006.

MCSEL23 NATURAL LANGUAGE PROCESSING

Unit 1

Morphology and Finite State transducers, N – grams.

Unit 2

Word classes and part of speech tagging, Context free grammars for English, Parsing with context free grammars.

Unit 3

Features and Unifications, Lexicalized and Probabilistic parsing.

Unit 4

Semantics: Representing meaning, Semantic analysis, Lexical semantics, Word Scene Disambiguation and Information retrieval.

Unit 5

Pragmatics: Discourse, Dialog and Conversational Agents, Natural Language Generation, Machine Translation.

Reference Books:

1.Jurafsky and Martin, *Speech and Language Processing*, Pearson, 2013.
2. Allen, James, *Natural Language Understanding*, Second Edition, Benjamin/Cumming, 1995
3. Charniack, Eugene, *Statistical Language Learning*, MIT Press, 1993.
4. Manning, Christopher D., Christopher D. Manning, and Hinrich Schütze. *Foundations of statistical natural language processing*. MIT press, 1999.
5. Kao, Anne, and Steve R. Poteet, eds. *Natural language processing and text mining*. Springer Science & Business Media, 2007.

MCSEL24 ADVANCED MICROPROCESSORS & MICROCONTROLLERS

Unit 1

Internal Architecture of 8086,Functional Blocks, Instruction set and 8086 Family Assembly language programming, Assembler directives, Addressing memory and ports, Interrupts and Interrupt service procedures.

Unit 2

80286 Microprocessor and its architecture, Addressing modes-Real address and Protected virtual Address mode, Privilege, Protection , additional instructions in 286, concept of Math coprocessor, Memory Management Unit concepts, Advanced features of 386 Processor and their architecture, Paging, virtual 8086 mode, enhancement in the instruction sets.

Unit 3

Architecture and special features of 486 processor. Overview of the features of Pentium and later processors, architecture – recent trends in microprocessor design. Applications and interfacing of 8086 microprocessor with other peripherals 8251, 8255, 8253, 8257 .

Unit 4

Microcontrollers :Overview of Microcontrollers, Types of microcontrollers, embedded system : Hardware architecture; CPU, Memory, Clock circuitry, Watchdog Timer / Reset circuitry, Chip select, I/O devices, Debug port, Communication interfaces, Power supply units. Software architecture, services provided by an operating system, architecture of embedded operating system, Categories of embedded operating systems. Application software, communication software. Development / Testing tools.

Unit 5

Hardware platforms: Types of hardware platforms; single board computers, PC add-on cards, custom-built hardware platforms. 89C51: architecture, instruction set and programming. AVR micro controller development board, PIC microcontrollers. 16F84 architecture, instruction set and programming.

Reference Books:

1. Hall, Douglas V. *Microprocessors and interfacing: programming and hardware*. McGraw-Hill, Inc., 1986.
2. Ray A.K., Bhurchandi K M, *Advanced Microprocessors and Peripherals-Architecture, programming and interface,* Tata McGraw Hill, 2000
3. Wolf, Marilyn. *Computers as components: principles of embedded computing system design*. Elsevier, 2012.
4. David E. Simon, *An Embedded software Primer*, Pearson Education, 2002.

MCSEL25 GRID &CLOUD COMPUTING

Unit 1

Evolution of Distributed computing: Scalable computing over the Internet – Technologies for network based systems – clusters of cooperative computers – Grid computing Infrastructures – cloud computing – service oriented architecture – Introduction to Grid Architecture and standards – Elements of Grid – Overview of Grid Architecture.

Unit 2

Introduction to Open Grid Services Architecture (OGSA) – Motivation – Functionality Requirements – Practical & Detailed view of OGSA/OGSI – Data intensive grid service models – OGSA services.

Unit 3

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software – Pros and Cons of cloud computing – Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

Unit 4

Open source grid middleware packages – Globus Toolkit (GT4) Architecture , Configuration – Usage of Globus – Main components and Programming model – Introduction to Hadoop Framework – Map reduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Design of Hadoop file system, HDFS concepts, command line and java interface, dataflow of File read & File write.

Unit 5

Trust models for Grid security environment – Authentication and Authorization methods – Grid security infrastructure – Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud, Key privacy issues in the cloud.

References Books:

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, "*Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet*", First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.
2. Jason Venner, "*Pro Hadoop- Build Scalable, Distributed Applications in the Cloud*", A Press, 2009.
3. Tom White, "*HadoopThe Definitive Guide*", First Edition. O"Reilly, 2009.
4. Bart Jacob (Editor), "*Introduction to Grid Computing*", IBM Red Books, Vervante, 2005

5. Foster, Ian, and Carl Kesselman, eds. *The Grid 2: Blueprint for a new computing infrastructure*. Elsevier, 2003.
6. Frederic Magoules and Jie Pan, *"Introduction to Grid Computing*" CRC Press, 2009.
7. Daniel Minoli, "*A Networking Approach to Grid Computing*", John Wiley Publication, 2005.
8. Barry Wilkinson, "*Grid Computing: Techniques and Applications*", Chapman and Hall, CRC, Taylor and Francis Group, 2010.

MCSEL26 HIGH PERFORMANCE COMPUTING

Unit 1

Levels of parallelism (instruction, transaction, task, thread, memory, function)- Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc)- Architectures: N-wide superscalar architectures, multi-core, multi-threaded.

Unit 2

Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in high performance computing architectures: (Examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Microarchitecture and Intel Nehalem microarchitecture- Memory hierarchy and transaction specific memory design- Thread Organization.

Unit 3

Synchronization- Scheduling- Job Allocation-Job Partitioning- Dependency Analysis- Mapping Parallel Algorithms onto Parallel Architectures- Performance Analysis of Parallel Algorithms.

Unit 4

Bandwidth Limitations- Latency Limitations- Latency Hiding/Tolerating Techniques and their limitations- Power-aware Processing Techniques-Power-aware Memory Design- Power-aware Interconnect Design-Software Power Management.

Unit 5

Petascale Computing-Optics in Parallel Computing- Quantum Computers- Recent developments in Nanotechnology and its impact on HPC.

Reference Books:

1. George, Almasi S., and Gottlieb Alan. "Highly Parallel Computing." *The BenjaminlCummings Publiihing Company Inc* (1994).
2. Kai Hwang , *Advanced Computer Architecture: Parallelism, Scalability, Programmability*, McGraw Hill 1993

3. David Culler, Jaswinder Pal Singh, Anoop Gupta, *Parallel Computer Architecture: A hardware/Software Approach*, Morgan Kaufmann, 1999.
4. K. Hwang& Z. Xu, *Scalable Parallel Computing – Technology, Architecture, Programming.,* McGraw Hill 1998.
5. William James Dally and BrianTowles, *Principles and Practices on Interconnection Networks,* Morgan Kauffman 2004.
6. Hubert Nguyen , *GPU Gems 3*, Addison Wesley, 2008, (Chapter 29 to Chapter 41)
7. AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar, *Introduction to Parallel Computing, ,* 2nd edition, Pearson, 2003.
8. David A. Bader (Ed.), Petascale Computing: *Algorithms and Applications*, Chapman & Hall/CRC, 2008.

MCSEL27 DATA SCIENCE

Unit 1

Data science process-roles, stages in data science project-working with data from files-working with relational databases-exploring data –managing datacleaning and sampling for modeling and validation. Introduction to NoSQL.

Unit 2

Choosing and evaluating models-mapping problems to machine learning, evaluating clustering models, validating models-cluster analysis-k-means algorithm, Naive Bayes-Memorization Methods - Linear and logistic regression-unsupervised methods.

Unit 3

Reading and getting data into R- ordered and unordered factors - arrays and matrices lists and data frames - reading data from files - probability distributions - statistical models In R manipulating objects - data distribution.- Python-based data visualization, predication through linear regression, collaborative filtering.

Unit 4

Introduction distributed file system mar reduce. Algorithm using Map Reduce –Matrix –Vector Multiplication by map reduce – Hadoop – Understanding Map Reduce architecture – writing Hadoop Map-Reduce programs-Loading data into HDFS Map-Reduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

Unit 5

Documentation and deployment - producing effective presentations - introduction to graphical analysis – plot() function - display ing multivariate data - matrix plots multiple plots in one window - exporting graph - using graphics parameters. Case studies.

References Books:

1. Nina Zumel, John Mount "*Practical Data Science with R*··.Manning Publications. 2014.
2. Jure Leskovec, AnandRajaraman, Jeffrey D. Ullman, "*Mining of Massive Datasets".* Cambridge University Press, 2014.
3. W. N. Venablcs. D. M. Smith and the R Core Team, "*An Introduction to R*", 2013.
4. Tony Ojeda, Sean Patrick Murphy, BenjarninBengfort. AbhijitDasgupta. "*Practical Data Science Cookbook*", Packt Publishing Limited, 2014.
5. Sameer Madhavan , "*Mastering Python for Data Science*", Packt Publishing Limited, 2015.
6. Nathan Yau, "*Visualize This: The Flowing Data Guide to Design, Visualization and Statistics",* Wiley, 2011.
7. Boris Lublinsky, Kevin T. Smith. AlexcyYakubovich, *"Professional Hadoop Solutions",* Wiley, 2015.

MCSEL28 MEDICAL IMAGE PROCESSING

Unit 1

Image fundamentals and pre-processing**:** Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling andquantization – two dimensional sampling theory, Image quantization, Optimum mean squarequantizer, Image transforms – 2D-DFT and other transforms. Image enhancement – point operation,Histogram modeling, spatial operations, Transform operations.

Unit 2

Basics of medical image sources:Radiology- The electromagnetic spectrum-Computed Tomography-Magnetic Resonance Tomography–ultrasound-nuclear medicine and molecular imaging-other imaging techniques-radiation protectionand dosimetry.

Unit 3

Medical image representation: Pixels and voxels – algebraic image operations - gray scale and color representation- depth-color andlook up tables - image file formats- DICOM- other formats- Analyze 7.5, NifTI and Interfile, Imagequality and the signal to noise ratio- MATLAB based simple operations.

Unit 4

Medical image analysis and classification:Image segmentation- pixel based, edge based, region based segmentation. Image representation andanalysis, Feature extraction and representation, Statistical, Shape, Texture, feature and imageclassification – Statistical, Rule based, Neural Network approaches.

Unit 5

Image registrations and visualization: Rigid body visualization, Principal axis registration, Interactive principal axis registration, Featurebased registration, Elastic deformation based registration, Image visualization – 2D display methods,3D display methods, virtual reality based interactive visualization.

Reference Books:

1.Wolfgang Birkfellner, „*Applied Medical Image Processing – A Basic course*", CRC Press, 2011.
2. AtamP.Dhawan, *"Medical Image Analysis*", Wiley Inter science Publication, NJ, USA 2003.
3.R.C.Gonzalez and R.E.Woods, *"Digital Image Processing*", Second Edition, Pearson Education,2002.
4.Anil. K. Jain, *"Fundamentals of Digital Image Processing*", Pearson education, Indian Reprint 2003.
5.Alfred Horowitz, *"MRI Physics for Radiologists – A Visual Approach",* Second edition SpringerVerlag Network, 1991.
6.KavyanNajarian and Robert Splerstor, "*Biomedical signals and Image processing*",CRC – TaylorandFrancis, New York,2006.
7. John L.Semmlow, *"Biosignal and Biomedical Image Processing Matlab Based applications"* Marcel Dekker Inc.,New York,2004.
8. Jerry L.Prince and JnathanM.Links, *" Medical Imaging Signals and Systems*"- Pearson Education Inc. 2006.

MCSEL29 WIRELESS SENSOR NETWORKS

Unit 1

Introduction: Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile AdhocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks Introduction to Wireless Sensor Networks, Overview, Characteristics, Network Applications, Design Objectives, Technological Background, Wireless Sensor Networks Architecture, Classification, Protocol stack, MAC Protocols. Routing Protocols – Flat – Architectural Protocols – Hierarchical Protocols – Geographic Routing Protocols – QoS Based Protocols. Time Synchronization – Localization and Positioning – Topology Management.

Unit 2

Sensor Node Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC, Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts. Routing protocols: Issues

in designing routing protocols, Classification of routing protocols, Energy-efficient routing, Unicast, Broadcast and multicast, Geographic routing.

Unit 3

Wireless Sensor and Actor Networks – Network Architecture – Sensor Actor Coordination – Actor Actor Coordination. Wireless Multimedia Sensor Networks – Network Architecture. Wireless Underwater Sensor Networks – Network components – Communication Architecture – Basics of Acoustic Propagation. Wireless Underground Sensor Networks – Applications – Network Architecture – Communication.

Unit 4

Data Storage and Manipulation: Data centric and content based routing, storage and retrieval in network, compression technologies for WSN, Data aggregation technique. Applications: Detecting unauthorized activity using a sensor network, WSN for Habitat Monitoring.

Unit 5

The transport layer and QoS in wireless sensor networks, Coverage and deployment, Reliable data transport, Single packet delivery, Block delivery. Congestion control and rate control.

Reference Books:

1. Akyildiz, Ian F., and Mehmet Can Vuran. *Wireless sensor networks*. Vol. 4. John Wiley & Sons, 2010.
2. Siva Ram Murthy C. and Manoj B. S., "*Ad Hoc Wireless Networks: Architectures and Protocols",* 2nd Edn. Pearson Education 2005
3. William Stallings, *"Wireless Communications and Networks*", Prentice Hall, 2004.

MCSEL30 COMPUTER VISION

Unit 1

Introduction: Motivation, Difficulty, Image analysis tasks, Image representations, Image digitization, Image properties, Color images, Cameras.

Unit 2

Data Structures: Levels of image data representation - Traditional image data structures - Hierarchical data structures. Texture: Statistical texture description, Syntactic texture description methods, Hybrid texture description methods, Texture recognition method applications.

Unit 3

Object Recognition: Knowledge representation, Statistical pattern recognition, Neural nets, Syntactic pattern recognition, Recognition as graph matching, Optimization techniques in recognition, Fuzzy systems.

Unit 4

3D vision: 3D vision: Tasks - Basics of projective geometry - Scene construction from multiple views, Uses: Shape from X - Full 3D objects - 3D model based vision - 2D view based 3D representation.

Unit 5

Motion Analysis: Differential motion analysis methods, Optical flow, Analysis based on interest points, Detection of specific motion patterns, Video Tracking, Motion models to aid tracking.

Reference Books:

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, "*Image Processing, Analysis and Machine Vision"*, Cengage Learning, New Delhi, 2014.
2. Wesley E. Synder and Hairong Qi, "*Machine Vision*", Cambridge University Press, USA, 2010.
3. Richard Szeliski, "*Computer Vision: Algorithms and Applications*", Springer-Verlag, London, 2011.
4. Rafael C Gonzalez, Richard E Woods, Steven L Eddins, "*Digital Image Processing*", Pearson Education, New Delhi, 2009.

MCSEL31 BIOMETRIC IMAGE PROCESSING

Unit 1

Digital image representation, Fundamental steps in image processing, Elements of digital image processing system, Image sensing and acquisition, Sampling and quantization, Basic relationship between pixels, Transformation technology: Fourier transform - Discrete cosine transform.

Unit 2

Image enhancement: Spatial domain methods: Basic grey level transformations - Histogram equalization - Smoothing spatial filter - Sharpening spatial filters - Laplacian, Frequency domain methods: Smoothing and sharpening filters – Ideal - Butterworth - Gaussian filters. Image Segmentation: Point- Line and edge detection - Thresholding - Global and multiple thresholding, Region splitting and merging, Boundary following.

Unit 3

Morphological image processing: Fundamental concepts and operations, Dilation and Erosion, Compound operations, Morphological filtering, Basic morphological algorithms, Grayscale morphology.

Unit 4

2D and 3D face biometrics: Global face recognition techniques: Principal component analysis - Face recognition using PCA - Linear discriminant analysis - Face recognition using LDA, Local face recognition techniques: Geometric techniques - Elastic graph matching techniques, Hybrid face recognition techniques. 3D Face Image: Acquisition, Pre-processing and normalization, 3D face

Unit 5

Hand and Iris Biometrics: Characterization by minutiae extraction: Histogram equalization, Binarization, Skeletonization, Detection of minutiae, Matching, Performance evaluation, Preprocessing of iris images: Extraction of region of interest - Construction of noise mask – Normalization - Features extraction and encoding - Similarity measures between two iris codes. Fusion in biometrics: Multi-biometrics, Levels of fusion: Sensor level - Feature level - Rank level - Decision level fusion - Score level fusion.

References Books:

1. Rafael C Gonzalez, Richard E Woods and Steven L Eddins, "*Digital Image Processing*", Pearson Education, New Delhi, 2013.
2. Amine Nait Ali and Regis Fournier, *"Signal and Image Processing for Biometrics*", John Wiley and Sons, UK, 2012.
3. Arun A Ross, Karthik Nandakumar and Jain A K, "*Handbook of Multi-biometrics",* Springer, New Delhi 2011.
4. Oge Marques, *"Practical Image and Video Processing using MATLAB*", John Wiley and Sons, New Jersey, 2011.

MCSEL32 RESEARCH METHODOLOGY

Unit 1

Objective and types of research: Motivation and objective- Research methods vs. methodology. Types of research-Descriptive vs. analytical, Applied vs. Fundamental, Quantitative vs. Qualitative. Conceptual vs. Empirical.

Unit 2

Research Problem and Formulation of Research Hypotheses: Defining the Research problem; Management Decision Problem vs Management Research Problem; Problem identification process; Components of the research problem; Formulating the research hypothesis- Types of Research hypothesis; Writing a research proposal- Contents of a research proposal and types of research proposals.

Unit 3

Research Design: Meaning of Research Designs; Nature and Classification of Research Designs; Exploratory Research Designs: Secondary Resource analysis, Case study Method, Expert opinion survey, Focus group discussions; Descriptive Research Designs: Cross-sectional studies and Longitudinal studies; Experimental Designs, Errors affecting Research Design.

Unit 4

Data collection and analysis: Execution of the research-Observation and collection of data-methods of data collection-Sapling methods- Data processing and analysis strategies- Data analysis with statistical packages-Hypothesis-testing- Generalization and interpretation-basic elements of modelling and stimulation.

Unit 5

Reporting and thesis writing- Structure and components of scientific Report- Types of report-Technical report and thesis- Significance-Different steps in preparation -Layout(introduction, Review, Experiments, Results and Discussion, Conclusion and References)- structure and language of typical reports- illustrations and table- Bibliography, referencing and footnotes-Oral presentation- planning- preparation -practice- Making presentation- use of visual aids-importance of effective communication.

Reference Books:

1. GargB.L ,Karadla .R, Agarwal.F and Agarwal G.K, *An Introduction Research Methodology*, RBSA publishers, 2002.
2. Kothari C. R, *Research Methodology : Methods and techniques* ,New Age international 418P, 1990.

3. Sinha,S.C and Dhiman,A.K, *Research Methodology,* ESS ESS Publications,2 Volumes,2002.
4. Trochim .W.M.K, *Research methods: The concise knowledge base*, Atomic Dog pubishing,270P,2006.
5. Wadehra .B.L. *Law relating to patents, trademarks, copyright designs and geographical indications*. Universal Law Publishing, 2000.

MCSEL33 BIO INFORMATICS

Unit I

Introduction to bioinformatics and data generation: bioinformatics and its relation with molecular biology. Examples of related tools(FASTA, BLAST, BLAT, RASMOL), databases(GENBANK, Pubmed, PDB) and software(RASMOL,Ligand Explorer). Data generation; Generation of large scale molecular biology data.(Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray).Applications of Bioinformatics.

Unit 2

Biological Database and its Types:Introduction to data types and Source. Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum) .

Unit 3

Data storage and retrieval and Interoperability: Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighbouringsearch.The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.

Unit 4

Sequence Alignments and Visualization**:** Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm). Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.

Unit 5

Gene Expression and and Representation of patterns and relationship**:** General introduction to Gene expression in prokaryotes and eukaryotes, transcription factors binding sites. SNP, EST, STS. Introduction to Regular Expression, Hierarchies, and Graphical models (including Marcov chain and Bayes notes).Genetic variability and connections to clinical data.

Reference books:

1. Bryan Bergeron, *Bio Informatics Computing* , Prentice Hall, 2003.
2. T.K. Affward, D.J. Parry Smith, *Introduction To Bio Informatics*, Pearson Education, 2001.
3. Pierre Baldi, Soren Brunak, *Bio Informatics – The Machine Learning Approach*, 2nd Edition, First East West Press, 2003.

MCSEL34 GEOGRAPHICAL INFORMATION SYSTEM (GIS)

Unit 1

Introduction to GIS, Defining GIS and Introduction to Spatial data, thematic characteristics ofspatial data, sources of spatial data: census, survey data, air photos, satellite images, field data. Satellite Navigation Systems, Models of the Earth; Geoid and Ellipsoid, Datum and Projections, Spatial and attribute data modelling and Management: Spatial entities - Spatial data structures; Raster and Vector GIS implementation architecture; Desktop GIS, GIS Server, Web GIS applications.

Unit 2

Free and Open Source Software for GIS, Standards and Interoperability, Open Geospatial ConsortiumWeb Map Servers- Web Feature Servers- Metadata standard, XML, Geographic Markup Language.

Unit 3

Customization of GIS Overview- the need and benefit of Customization – programming for GIS applications - the enhancement of GIS functionalities through customization – Automation of redundant processes - Data development/update automation – Discuss various case studies that involve customization.

Unit 4

Spatial databases, creating a spatially-enabled database, GIS objects, building spatial indexes, spatial queries and spatial functions, Building applications with spatial database, GIS Integration with R and Big Data.

Unit 5

Web mapping, Web Mapping Services-Open Layers-Google maps-Yahoo maps and Microsoft map services, Mashups. GeoRSS. Web GIS Implementation: Web Map servers and Data servers Case studies: Design and proto-typing; Potential Application domains; Agriculture, Irrigation, Transportation, Environmental Management, Sales & Marketing.

Reference Books:

1.Heywood.L, Comelius.S and S. Carver ,*An Introduction to Geographical Information Systems,* Dorling Kinderseley (India) Pvt. Ltd, 2006.

2.Burrough P A 2000 P A McDonnell, *Principles of Geographical Information systems*, London: Oxford University Press, 2000

3.Lo.C.P., Yeung. K.W. Albert , *Concepts And Techniques of Geographic Information Systems,* Prentice-Hall of India Pvt ltd, New Delhi , 2002.

4. Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W, *Geographic Information Systems and Science.* Chichester: Wiley. 2nd edition, 2005.

MCSEL35 INTERNET OF THINGS (IOT)

Unit 1

Introduction toIoT: Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology .

Unit 2

IoT Architecture: M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture .

Unit 3

IoT Protocols : Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP– Security.

Unit 4

Building IoT with RASPBERRY PI &ARDUINO :Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device - Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces - Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

Unit 5

Case Studies and Real-World Applications :Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

Reference Books:

1. ArshdeepBahga, Vijay Madisetti, ―*Internet of Things – A hands-on approach*‖, Universities Press, 2015 .
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―*Architecting the Internet of Things*‖, Springer, 2011.
3. Honbo Zhou, ―*The Internet of Things in the Cloud: A Middleware Perspective*‖, CRC Press, 2012.
4. Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "*From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence"*, Elsevier, 2014.
5.Olivier Hersent, David Boswarthick, Omar Elloumi , ―*The Internet of Things – Key applications and Protocols*‖, Wiley, 2012.

MCSEL36 ROBOTICS

Unit 1

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systemsHydraulic, Pneumatic and Electric system.

Unit 2

Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

Unit 3

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

Unit 4

Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions-Robot applications- Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot.

Unit 5

Micro/Nano robotics system overview-Scaling effect-Top down and bottom up approach-Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/Nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nano robot in targeted drug delivery system.

Reference Books:

1. S.R. Deb, *Robotics Technology and flexible automation*, Tata McGraw-Hill Education., 2009
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, AshishDutta, *Industrial Robotics, Technology programming and Applications*, McGraw Hill, 2012
3. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, *Robotics Engineering an Integrated Approach*, Phi Learning., 2009.
4. Francis N. Nagy, AndrasSiegler, *Engineering foundation of Robotic*s, Prentice Hall Inc., 1987.
5. P.A. Janaki Raman, *Robotics and Image Processing an Introduction*, Tata McGraw Hill Publishing company Ltd., 1995.
6. Carl D. Crane and Joseph Duffy, *Kinematic Analysis of Robot manipulators*, Cambridge University press, 2008.
7. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., "*Robotics control, sensing, vision and intelligence*", McGraw Hill Book co, 1987
8. Craig. J. J. *"Introduction to Robotics mechanics and control*", Addison- Wesley, 1999.
9. Ray Asfahl. C., "*Robots and Manufacturing Automation*", John Wiley & Sons Inc.,1985.
10. Bharat Bhushan., "*Springer Handbook of Nanotechnology*", Springer, 2004.
11. Julian W. Gardner., "*Micro sensor MEMS and Smart Devices*", John Wiley & Sons, 2001.

MCSEL37 DIGITAL SPEECH PROCESSING

Unit 1

Introduction to speech recognition: Introduction- the paradigm for speech recognition –history of speech recognition research, the speech signal: speech production mechanism, perception-acoustic phonetic characterization and classification- the speech production process-representing speech in time frequency domains-speech sounds and features. Approaches to automatic speech recognition by machine, speech recognition in adverse environment

Unit 2

Signal Processing and Analysis Methods for Speech Recognition: Introduction- The Bank of Filters Front End Processor- Linear Predictive Coding for Speech Recognition- Vector Quantization, Time domain parameters of speech, methods for extracting the parameters, zero crossing, auto correlation function, pitch estimation.

Unit 3

Pattern Comparisons Techniques: Introduction- Speech Detection- Distortion Measures - Spectral Distortion Measures. Incorporation of Spectral Dynamic Features into Distortion Measures- Time Alignment Normalization. Speech Recognition System Design and Implementation Issues: Introduction, Application of Source Coding Techniques to Recognition-Template Training Methods- Performance Analysis and Recognition Enhancements-Discriminative Methods in Speech Recognition.

Unit 4

Large Vocabulary Continuous Speech Recognition: Introduction, Sub word Speech units, Sub word Unit Models Based On HMMs, training of Sub word Units, Language Models for Large Vocabulary Speech Recognition, Statistical Language Modeling, Perplexity of the Language Model, Overall recognition System Based on Sub word Units, Context-Dependent Sub word Units, Creation of Vocabulary-Independent Units, Semantic Postprocessor for recognition

Unit 5

Task Oriented Applications of Automatic Speech Recognition: Introduction, Speech-Recognizer Performance Scores, Characteristics of Speech- Recognition Applications, Broad Classes of Speech Recognition Applications, Command-and-Control Applications, Projections for Speech recognition. Speaker Verification: Introduction, Acoustic Parameters, Similarity Measures, Text- Dependent Speaker Verification, Text- Independent Speaker Verification, Text- Prompted Speaker Verification, Identification, Verification and the Decision Threshold

Reference Books:

1. Rabiner, Lawrence R., Biing-Hwang Juang, and Janet C. Rutledge. *Fundamentals of speech recognition*. Vol. 14. Englewood Cliffs: PTR Prentice Hall, 1993.

2. L R Rabiner and Schafer , *Digital processing of speech signals*, Prentice hall. 1978.
3. Proakis, John G. *Digital signal processing: principles algorithms and applications*. Pearson Education India, 2001.