DEPARTMENT OF COMPUTER & SYSTEM SCIENCES
Siksha-Bhavana, Visva-Bharati, Santiniketan

M.Sc. (Computer Science) Course Structure
(Under Choice Based Credit System)

ODD SEMESTER **EVEN SEMESTER**

Semester-I			**Semester-II**		
Paper Code	**Paper**	**Credits**	**Paper Code**	**Paper**	**Credits**
MCSC-11	Theory of Computation	4	MCSC-21	Design and Analysis of Algorithms	4
MCSC-12	Advanced Data Structures	4	MCSC-22	Compiler Construction	4
MCSC-13	Information and Coding Theory	4	MCSC-23	Distributed Systems	4
MCSC-14	Software Engineering	4	MCSC-24	Advanced Architecture	4
MCSC-15	Artificial Intelligence	4	MCSC-25	Wireless Networks	4
MCSC-16	Software Laboratory	4	MCSC-26	Computing Laboratory	4
Semester-III			**Semester-IV**		
Paper Code	**Paper**	**Credits**	**Paper Code**	**Paper**	**Credits**
MCSE-3X	Elective	4	MCSC-41	Digital Image Processing	4
MCSC-31	Algorithmic Graph Theory	4	MCSC-42	Advanced DBMS	4
MCSC-32	Cryptography and Network Security	4	MCSC-43	Parallel Algorithms	4
MCSC-33	Soft Computing	4	MCSO-4X	Optional-II	4
MCSO-3X	Optional-I	4	MCSO-4X	Optional-III	4
MCSP-31	Project Design	4	MCSP-41	Project Implementation	4

Note: 96 Credits in all.

MCSE-3X	**Elective**	MCSO-4X	**Optional-II & III**
MCSE-31	Bioinformatics	MCSO-41	Advanced Computer Graphics
MCSE-32	GIS and Geospatial Analysis	MCSO-42	Cloud Computing
MCSE-33	Multimedia Systems	MCSO-43	Complex Networks
		MCSO-44	Computational Intelligence
MCSO-3X	**Optional-I**	MCSO-45	Information Retrieval
		MCSO-46	Mobile Broadband Networks
MCSO-31	Natural Language Processing	MCSO-47	Remote Sensing
MCSO-32	Internetworking		
MCSO-33	Pattern Recognition		
MCSO-34	Selected Topics in Advanced Algorithms		

Semester – I

Paper: MCSC-11 (Theory of Computation)

Turing Machines: Turing acceptability and decidability, Computing with Turing Machines, Non-Deterministic Turing machines. Variations of Turing Machines and their equivalence Universal Turing Machines. [9L]
General Grammar, Grammatically Computable functions, Equivalence of grammatically computable functions and Turing computable functions. [7L]
Recursive Function Theory: Primitive recursive functions, Goeldelization, μ-recursive functions, Turing Computability of primitive recursive functions and μ-recursive functions, General Church-Turing Thesis. [9L]
Hierarchy of Formal Languages and Automata: Recursive and Recursively enumerable languages, Context Sensitive Grammar and Linear Bounded Automata, Chomsky's Hierarchy. [8L]
Uncomputability: Halting Problem, Turing enumerability, Unsolvable problems about Turing Machines and μ-recursive functions, Unsolvable problems about Grammars. [12L]

References:

1. Elements of Theory of Computation, Lewis & Papadimitrou, Prentice Hall of India
2. An introduction to formal languages and automata, Peter Linz, Narosa
3. Introduction of Automata Theory, Languages and Computation John E Hopcroft, Rajeev Mowani, Jeffrey D Ullman (Pearson).
4. Theory of Computation, Henne.

Paper: MCSC-12 (Advanced Data Structure)

Hashing: hash functions and tables, collision, overflow, linear probing, hashing with chains. [4L]
Priority queues: leftist trees, min-max heaps, binomial heaps, Fibonacci heaps. [4L]
Multiway Search Tree. [4L]
Balanced search trees: Red-Black, B- trees, B^+-trees – searching, insertion, deletion [6L]
Digital Search Structure: digital search tree, binary tries and patricia, multiway tries – search, insertion, deletion, height of a trie, compressed tries, suffix tree- searching. [14L]
Tries and Internet Packet Forwarding: 1-bit, fixed- and variable- stride tries, IP routing. [12L]

References:

1. Fundamentals of Data Structures in C . E. Horowitz, S. Sahni, and S Anderson-Freed University Press.
2. Introduction to Algorithms. T H Cormen, C E Leiserson, and R L Rivest, Prentice-Hall of India (PHI)
3. Data Structures, Algorithms and Applications in Java. Sartaj Sahni, University Press
4. Advanced Data Structure, Cohen

Paper: MCSC-13 (Information and Coding Theory)

Information Theory Basics: Definition of entropy, relation between uncertainty, information and entropy. [4L]
Information Channels: Shannon's channel coding theorem, redundancy, binary symmetric channel, system entropy, mutual information, Shannon's channel capacity theorem, channel capacity and coding. [6L]
Source-Coding: Shannon's source coding theorem, Uniquely decodable codes, instantaneous codes, Kraft inequality, McMillan's inequality, Lossless and Lossy encoding, Run-Length coding, arithmetic encoding, entropy encoding principles and examples. [10L]
Channel Coding Principles: Discrete Memoryless Channel, error detecting and correcting codes, Hamming distance, M-L Decoding principles. [6L]
Block Codes: Linear block codes, syndrome decoding, Reed-Solomon coding, BCH code, Cyclic code, Golay code. [8L]
Convolution Coding: Code tree and Trellis decoding, Soft and Hard decision Viterbi decoding, Parallel and Serial Concatenated Convolution code, Turbo decoding. [10L]

References:

1. San Ling and Chaoping Coding Theory: A first Course, Cambridge University Press, 2004.
2. A Jones J M Jones, Information and Coding Theory, Springer Verlag, 2004.
3. Simon Haykin, Communication Systems, 4th Edn, John Wiley, 2001.
4. Thomas M Cover and Joy A Thomas, Elements of Information Theory John Wiley, 1991.
5. Ranjan Bose, Information theory coding and cryptography, TMH, 2002.
6. E Shannon, "A Mathematical Theory of Communication", Bell Systems Technical Journal, vol.C 27, pp.379-423 and 623-656, July and October, 1948.
7. E Shannon, "Communication Theory of Secrecy Systems", Bell Systems Technical Journal, C vol.28(4), pp. 656-715, 1949

Paper: MCSC-14 (Software Engineering)

Introduction: Program vs. Software Product, Objectives, Challenges, Software Lifecycle, Prototyping. [2L]
Model: Waterfall – Classical and Iterative, Evolutionary and Spiral, Comparative study.
Software Project Management : Project Planning, Effort Estimation: Uncertainties in Effort Estimation, Building Effort Estimation Models, A Bottom-up Estimation Approach, COCOMO Model. [8L]
Project Scheduling and Staffing, Overall Scheduling, Detailed Scheduling, Configuration Management Plan, Quality Plan, Risk Management, Monitoring Plan. [5L]
Software Requirement Analysis and Specification (SRS): Need for SRS, Requirement Process, Problem Analysis: Informal Approach, Dataflow Modelling and Object Oriented Modelling. [8L]
Requirement Specification: Characteristic of an SRS, Components of an SRS, Specification language, Structure of a Requirement Document. Validation and Metrics. [3L]
Software Design Approaches: Function Oriented Software Design and Object oriented Software Design. [4L]

Coding and Testing: Coding, Unit Testing, Black-Box testing, White Box Testing, White Box Testing, Debugging, Program Analysis Tools, Integration Testing, System Testing. [9L]
Software Reliability and Quality Assurance: Software Reliability and Software Quality, Software Quality Management System. [5L]

References:

1. Practitioners Approach to Software Engineering- E.E. Pressman.
2. Integrated Approach to Software Engineering - Pankaj Jalote.
3. Software Engineering – Rajiv Mal.

Paper: MCSC-15 (Artificial Intelligence)

Overview: foundations, scope, problems, and approaches of AI. [1L]
Problem-solving through Search: forward and backward, state-space models, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications. [8L]
Knowledge Representation and Reasoning: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications. [9L]
Variable-based models: Constraints: constraint satisfaction problems, factor graphs, independence, variable elimination, Markov networks, Gibbs sampling, particle filtering, Generative: Markov models, Bayesian networks, HMMs. [10L]
Machine learning: supervised learning, linear models, loss minimization, maximum likelihood, unsupervised learning, reinforcement learning. [10L]
Logic: propositional logic, first-order logic. [4L]
Applications: Language, vision, Robotics. [2L]

References:

1. Artificial Intelligence: A Modern Approach (3rd ed.), Stuart Russell & Peter Norvig, 2010.
2. Artificial Intelligence, Third Edition. Patrick Henry Winston. Addison-Wesley Professional.1992.
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI

Paper: MCSC-16 (Software Laboratory)

Problem solving based on theory papers.

Semester – II

Paper: MCSC-21 (Design and Analysis of Algorithms)

Models of computation, notion of worst, average time complexity. [4L]
Review of basic techniques: Divide and Conquer, Dynamic Programming, Greedy technique including Greedy algorithms on matroid. [6L]
Amortized analysis techniques: Aggregate, Accounting and Potential methods. [3L]
Important data structures: Algorithms for implementation of Dictionary, Mergable Heap. Union-Find algorithms. [7L]
Graph Algorithms: Review of algorithms for BFS, DFS, Connected Components, Biconnected Components , Minimum Spanning Forest, Strongly Connected Components, Single Source and all pair Shortest Paths. [10L]
Matrix multiplication and inversion algorithms. [3L]
Discrete Fourier Transform. [3L]
NP-Completeness: Decision vs optimization problem, formal language framework for decision problems, reducibility, Classes P, NP, NP-Hard, NP-Completeness, Proving NP-completeness of Basic Problems. [8L]

References:

1. Design and Analysis of Algorithms Aho, hopcroft and Ullman; Addison Wesly.
2. Introduction of Algorithms Cormen, Leiserson and Rivest, PHI.
3. Algorithms Design, Klienberg and Tardos, Pearson.

Paper: MCSC-22 (Compiler Construction)

Introduction: Compilers and Translators, Structure of a Compiler, Compiler writing tools, Lexical and syntactic structure of a language.[5L]
Lexical analysis: Finite automata, Regular expression, Lexical analyzer, Lexical analyzer generator. [5L]
Syntax Analysis: Notion of top-down and bottom-up parsing, LL parsing, Operator-precedence parsing, LR parsing (SLR, LALR, and Canonical LR parsing), Syntax Directed Translation, Parser generator. [15L]
Semantic Analysis: Declaration processing, Type checking, Symbol tables. [5L]
Intermediate Code Generation: Run-time environments, translation of language constructs. [5L]
Code Generation: Flow-graphs, Register allocation, Code-generation algorithms. [5L]
Error handling and recovery. [2L]
Code optimization: An introduction to the techniques. [2L]

References:

1. Principles of Compiler Design - Alfred V. Aho, Jeffrey D. Ullman, Sethi.
2. Compiler Design in C - Allen I.Holub, Prentice Hall of India, 1993.
3. Compiler Construction: Principles & Practice, Kenneth C. Louden, Thomson Learning 2003.

4. The Theory and Practice of Compiler Writing, Jean-Paul Tremblay and Paul G. Sorrenson, McGraw Hill Book Co.

Paper: MCSC-23 (Distributed Systems)

Introduction, interconnections, distributed system taxonomy, service models, client-server computing, IP and ATM networking, communication models, naming and binding, socket programming: C/Unix, Java, remote procedure calls (RPC), object brokers, RPC case studies: Sun RPC, DCE RPC ,Google Cluster Architecture, Google File System, Microsoft DCOM/ORPC, Java RMI, RPC, protocol buffers. [18L]
Distributed file system design distributed file system case studies: NFS, AFS, Coda, DFS, SMB/CIFS, Google FS (GFS), GmailFS, xFS, logical clocks, vector clocks, clock synchronization. [12L]
Distributed lookup services/hash tables group communication: message ordering and message delivery, IP multicasting, mutual exclusion, election algorithms, distributed shared memory and memory consistency models, fault tolerant, load balancing, and reliability, process migration. [14L]

References:

1. Distributed System, Principle of Paradigm, -Tanenbaum & Steen
2. Distributed Systems: An Algorithmic Approach. Sukumar Ghosh. 2006. CRC Press.

Paper: MCSC-24 (Advanced Architecture)

Introduction: Quantitative Principles of Computer Design. [2L]
Advanced Pipelining and Instruction-Level Parallelism: Basic Pipeline Operations, Data and Control Pipeline Hazards, Instruction-Level Parallelism, Dynamic Instruction Scheduling and Branch Prediction. [8L]
Memory-Hierarchy Design: Cache Design Issues, Performance Evaluation, Virtual Memory Addressing, Memory Protection Mechanisms, Memory coherency techniques. [8L]
Storage Systems: Types of Storage Devices, Buses-Connecting I/O Devices to CPU/Memory, I/O Performance Measures, Reliability, Availability, and RAID, Interfacing to an Operating System. [8L]
Thread Level Parallelism: Multiprocessor Systems and Applications, Centralized Shared-Memory Architectures, Distributed Shared-Memory Architectures, Execution Synchronization, Models of Memory Consistency. [10L]
Data Level Parallelism: Vector Processing, Support for Multimedia Applications, Graphics Processing Units. [8L]

References:

1. Advanced Computer Architecture, Kai Hwang, H. Briggs.
2. Computer Architecture: A Quantitative Approach, 5th Edition, John L. Hennessy and David A. Patterson, Morgan Kaufmann Publishers.

Paper: MCSC-25 (Wireless Networks)

Cellular Mobile Wireless Networks: Description of Cellular System, Evolution of cellular networks, Overview of Layer-1 functionalities. [4L]
GSM Architecture and Protocols: Network Architecture, air interface, multiple access scheme, channel organization, NAS procedures. [6L]
GPRS: Network Architecture, Classes of Operation, TBF procedure for channel assignment, NAS protocols for Session Management, PS-domain Mobility procedures. [4L]
UMTS: Concept of WCDMA, network architecture, channel structure, enhancement of NAS procedures over GSM/GPRS, RBS and Mobility related RRM procedures. [7L]
HSPA over UMTS: HSDPA and HSUPA architecture, HARQ operations, realization of variable data rates over shared channels. [5L]
CS and PS services over cellular networks: Voice call, SMS, Packet call, supplementary services, introduction to AT commands set. [4L]
WLAN: IEEE 802.11x standards, architecture, air interface, authentication, Wi-Fi. [10L]
Ad-Hoc Network Concepts: Mobility and routing issues, MANET, VANET. [6L]

References:

1. Wireless Network Evolution (2G to 3G) , Garg, Pearson Education.
2. Mobile Communications, Jochen Schiller, Pearson.

Paper: MCSC-26 (Computing Laboratory)

Problem solving based on theory papers.

Semester – III

Paper: MCSE-3X (Elective)

Paper: MCSC-31 (Algorithmic Graph Theory)

Cut-sets and Cut-vertices, Connectivity and Separability, 1-lsomorphism and 2-Isomorphism. Planarity, Planarity Testing Algorithms, Coloring, Partitioning, Independent set, Vertex Cover, Matching, Algorithms for Bipartite Matching and General Matching, Graph Enumeration. [14L]
Different Types of Graphs: Intersection Graphs, Circular-arc Graphs, Interval Graphs, Line Graphs of Bipartite Graphs, Perfect Graphs, Permutation graphs, Chordal Graphs, p-Critical Graphs, Comparability Graphs, F-Graphs, Recognizing Triangulated Graphs, MCS Algorithm, PEO Testing Algorithm, Minimum Fill-In Computation, Optimization Algorithms on Triangulated Graphs – Chromatic Number Calculation, Algorithm to Construct G-decomposition, TRO Algorithm. [30L]

References:

1. Perfect Graph Algorithms, Golumbic.
2. Introduction to Graph Theory, Douglas B.West, Pearson Education.
3. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Prentice-Hall India.

Paper: MCSC-32 (Cryptography and Network Security)

Introduction: Basic concepts of confidentiality, integrity, authentication. [2L]
Basic Cryptography: Historical background, transposition/substitution, caesar cipher, introduction to symmetric crypto primitives, asymmetric primitives and hash functions. [10L]
Secret key cryptography: Applications, DES, Message Digests. [4L]
Public Key cryptography: Euclidean algorithm, Euler theorem, Fermat Theoretical functions, multiplicative and additive inverse; RSA algorithm, Elliptic Curve, Knap-Sack algorithms. [6L]
Authentication: PKI, Certification authorities and key distribution centre, digital signatures. [4L]
Hash functions: MD5 message digest algorithm, Secure Hash algorithm, HMAC digital signatures. [4L]
Network Security: Kerberose -X.509 authentication service, E-mail security - PGP, S/MIME, IPSec. [8L]
System level security: Intrusion detection, password management, Viruses and other Malware threats, counter measures, Firewalls, Trusted Systems. [6L]

References:

1. Network Security and Cryptography – William Stallings
2. Computer Security; Art and Science – Matt Bishop, Pearson
3. Cryptography and Network Security – Sebery,

Paper: MCSC-33 (Soft Computing)

Introduction: soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing, Soft computing and conventional AI. [3L]
Neural Networks: Introduction - Biological neuron v/s artificial neuron, Nerve structure and synapse, Artificial Neuron and its model, characteristics and applications of ANN, single layer network, Perceptron training algorithm, Linear separability, Widrow & Hebb's learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN, Introduction to multilayer feed forward networks, different activation functions, Back propagation networks - perceptron model, solution, back propagation learning methods, effect of learning rule co-efficient, back propagation algorithm, factors affecting back propagation training, applications. Hopfield/ Recurrent network - configuration, stability constraints, associative memory, and characteristics, Hopfield v/s Boltzman machine. Adaptive Resonance Theory - Architecture, classifications, Implementation and training.
Associative Memory. [16L]
Fuzzy Logic: Introduction-Fuzzy sets v/s crisp sets, Basic operations on fuzzy sets, Properties of fuzzy sets, Fuzzy relations. Fuzzy systems - fuzzy logic v/s crisp logic, introduction & features of membership functions. Fuzzy rule base systems - fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic. Neuro Fuzzy Modeling - Adaptive networks based fuzzy inference systems, classification and regression trees, data clustering algorithms, rule based structure identification, neuro fuzzy controls. [16L]
Genetic algorithm: Introduction– Survival of the fittest, basic concepts and working principle, encoding, fitness function, reproduction, Genetic modeling - Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional methods. [9L]

References:

1. Neuro Fuzzy and Soft computing - Jang J.S.R., Sun C.T and Mizutami É, Prentice Hall -, New Jersey, 1998
2. Neural Networks – A comprehensive foundation, Simon Haykin, PHI, 1999
3. Fuzzy Logic Engineering Applications - Timothy Ross, J.Ross, McGraw Hill,NewYork,1997.
4. Genetic Algorithms - D. E. Goldberg, Pearson India, 2006

Paper: MCSO-3X (Optional-I)

Paper: MCSP-31 (Project Design)

Paper: MCSE-3X (Elective)

Paper: MCSE-31 (Bioinformatics)

Introduction, branches, aim, scope, research areas. [2L]
The genetic material: nucleotides, orientation, base pairing, central dogma. [5L]
Gene structure: promoter sequence, genetic code, introns and exons. [3L]
Pairwise Alignment: gaps, dynamic programming, Needleman and Wunsch Algorithm, Smith-Waterman algorithm. [6L]
Databases in Bioinformatics: Structures - sequence and molecular file formats, conversion tools, databases, classification schema, retrieval systems. [6L]
Sequence databases: nucleotide sequence databases, secondary nucleotide, protein sequence databases, secondary and specialized protein sequence databases. [10L]
Data Analysis Tools: Introduction to BLAST, PSI-BLAST. [8L]
Data visualization in proteins using RasMol/Chime. [4L]

References:

1. Bioinformatics –Databases, Tools and Algorithms by O Basu and S K Thukral
2. Bioinformatics – Principle and Applications by Z Ghosh and B Ballick
3. Fundamental Concepts of Bioinformatics by D E Krane and M L Raymer
4. Bioinformatics – A Modern Approach by V R Srinivas

Paper: MCSE-32 (GIS and Geospatial Analysis)

Introduction: Definition of GIS, Key Components of GIS, Concept of Map, Geographic and Projected Coordinate Systems, Map Projection, Cartography, Functions and Advantages of GIS. [10L]
Spatial Data Models: Spatial, Thematic and Temporal Dimensions of Geographic Data, Conceptual, Logical , Object-Oriented , Raster and Vector data models. [8L]
Metadata: GIS as RDBMS, Extension of É-R model with spatial concept, Query Processing and Metadata, Data Encoding Methods. [12L]
Geospatial Analysis: Integration and Modelling of Spatial Data, Spatial Query, Spatial storage and indexing, Geospatial Measurements, Overlay Operations, Network Analysis and Surface Analysis. [10L]
Planning, Implementation and Management of GIS. [4L]

References:

1. Principles of Geographical Information Systems, P. A. Burrough and R. A. Mcdonnell, Oxford.
2. Remote Sensing and GIS, Basudeb Bhatta, Oxford.
3. Remote Sensing and Geographical Information Systems, M. Anji Reddy, BSP.
4. Getting Started with Geographic Information Systems, Keith Clarke, PHI.
5. Exploring Geographic Information Systems, Nicholas Chrismas, John Wiley & Sons.
6. An Introduction to Geographical Information Systems, Ian Heywood, Sarah Cornelius, and Steve Carver. Addison-Wesley Longman.
7. Spatial Databases, A Tour – S Shekhar, S Chawla, Pearson.

Paper: MCSE-33 (Multimedia Systems)

Overview of digitization and compression techniques: Characteristics of image, audio and video stream, sampling and quantization, PCM, ADPCM and DM techniques, Lossless and lossy compression mechanisms. [10L]
Encoding and file structure of media streams: JPEG, giff images, flac, mp3 audio, H.261 and H.263 video compression schemes, MPEG 1/2/4 video encoding standards, audio-video synchronization. [12L]
Transportation of multimedia streams over internet: Application requirements, QoS parameters, RTP/RTCP protocol basics. [12L]
VoIP fundamentals: Network protocols (H.323, SIP), QoS requirements. [10L]

References:

1. Networked Multimedia Systems: Concepts, Architecture and Design, S V Raghavan and S K Tripathi, Prentice-Hall.
2. Multimedia Communications: Applications Networks, Protocols and Standards; Fred Halsall; Pearson.
3. Fundamentals of Multimedia, Z-N. Li, M.S. Drew, Pearson Prentice Hall.
4. Multimedia Systems, John F. Koegel Buford.
5. Multimedia Systems, Ralf Steinmetz, Klara Nahrstedt.

Paper: MCSO-3X (Optional-I)

Paper: MCSO-31 (Natural Language Processing)

Introduction. [2L]
Words: regular expressions and automata, words and transducers, n-grams, part-of-speech tagging, hidden markov model, maximum entropy model. [10L]
Syntax: formal grammars of English, syntactic parsing, statistical parsing, features and unification, language and complexity. [12L]
Semantics and Pragmatics: The representation of meaning, computational semantics, lexical semantics, computational lexical semantics, computational discourse. [10L]
Applications: machine translation, information extraction, question answering, summarization, sentiment analysis. [10L]

References:

1. Jurafsky and Martin. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Second Edition, McGraw Hill, 2008.
2. Christopher D. Manning & Henrich Schutze. Foundations of Statistical Natural Language Processing, The MIT Press, 2001.
3. James F. Allen. Natural Language Understanding, Pearson Education, 2003.
4. Robert Dale, Hermani Moisi, Harold Somers. Handbook Of Natural Language Processing, Markcel Dekker Inc., 2000.
5. Nitin Indurkhya & Fred J. Damerau. Handbook of Natural Language Processing, Second Edition, CRC Press, 2010.

Paper: MCSO-32 (Internetworking)

Introduction : Protocol layering of internet and functional split. [2L]
Point-to-point protocol : PPP message format, LCP, authentication, IPCP. [3L]
IPv4 : IPv4 addressing, address classes, concept of subnet and subnet mask, classless addressing and supernetting, IPv4 header format and related functions, basic structure of routing table and next hop routing mechanism. [6L]
ICMP : Purpose and different indications, ping and traceroute programs. [2L]
IPv6 Overview : IPv6 Addressing, header format, improvements over Ipv4. [3L]
IP routing : Concept of autonomous system, intra and inter-AS routing, RIP, OSPF, BGP routing protocol. [6L]
Transport Layer: UDP packet format and functionalities, TCP header format and functionalities, acknowledgement mechanism for interactive and bulk data flow, flow control and congestion control mechanisms, TCP variants. [10L]
DNS : Query-response message types and formats, iterative and recursive queries. [4L]
Application Layer Protocols: SMTP, FTP, HTTP, DHCP, Search Engines. [8L]

References:

1. TCP/IP Illustrated (Vol-I), Richard Stevens, PHI.

Paper: MCSO-33 (Pattern Recognition)

Introduction to pattern recognition, Review of Probability Theory - Conditional Probability and Bayes Rule, Review of Linear Algebra - Linear Transformations. [2L]
Bayesian decision theory: Classifiers, Discriminent functions, Decision surfaces, Normal density and discriminent functions, Discrete features. [4L]
Parameter estimation methods: Maximum-Likelihood estimation, Gaussian mixture models, Expectation-maximization method, Bayesian estimation. [4L]
Hidden Markov models for sequential pattern classification: Discrete hidden Markov models, Continuous density hidden Markov models. [4L]
Dimension reduction methods: Fisher discriminant analysis, Principal component analysis. [4L]
Non-parametric techniques for density estimation: Parzen-window method, K-Nearest Neighbour method. [6L]
Linear discriminant function based classifiers: Perceptron, Support vector machines. [2L]
Non-metric methods for pattern classification: Non-numeric data or nominal data, Decision trees. [4L]
Unsupervised learning and clustering: Criterion functions for clustering, Algorithms for clustering - K-means, Hierarchical and other methods, Cluster validation. [6L]
Fuzzy Set-theoretic Pattern Recognition: Usual Fuzzy set theoretic operations –union, intersection etc., Multivalued Logic - Zade Compositional Rule of inference, Fuzzy C-means algorithm, Supervised Classification - Multitvalued Recognition System, Fuzzy set theoretic based feature selection criteria. [8L]

References:

1. Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley, 2001
2. Pattern Recognition, S.Theodoridis and K.Koutroumbas, 4th Ed., Academic Press, 2009
3. Pattern Recognition and Machine Learning, C.M.Bishop, Springer, 2006

4. Fuzzy Set Theroetic Methods for Patern Recognition, S.K. Pal and Dutta Mazumdar, John Willey, 1998.

Paper: MCSO-34 (Selected Topics in Advanced Algorithms)

Approximation Algorithms: Basic concepts, Techniques for designing approximation algorithms: Greedy methods, Recursive greedy method, LP-rounding and extension techniques, Randomized approximation techniques, Methods of designing approximation schemes. [22L]
Hardness of Approximation: Approximation preserving reductions, Classes APX, APX-Hard and APX-Complete. [6L]
Randomized Algorithms: Models, Classification: Monte Carlo and Las Vegas Algorithms. [4L]
Design Paradigms: Foiling Adversary, Fingerprinting, Success Amplification and Random Sampling, Abundance of Witnesses, Optimization and Random Rounding. [12L]

References:

1. The Design of Approximation Algorithms: Williamson and Shmoys, Cambridge University Press.
2. Approximation Algorithms: V V Vazirani, Springer-Verlag.
3. Randomized Algorithms: Motwani and Raghavan, Cambridge University Press.
4. Design and Analysis of Randomized Algorithms: J Hromkovic, Springer.

Semester – IV

Paper: MCSC-41 (Digital Image Processing)

Fundamentals of Digital Image Processing: Introduction, Steps in Image Processing, Image Acquisition, Storage, Processing, Display and Communicating Interface. [4L]
Digital Image representation: Digital Image representation, sampling and quantization, basic relationship between pixels, Neighbors and Connectivity, Distance Measure. [4L]
Image Transformation: Introduction, Fourier Transform, Discrete Fourier Transform, Properties of Fourier Transform, Fast Fourier Transform (FFT), Inverse of FFT, Walsh Transform, Hadamard Transform. [6L]
Image Enhancement: Introduction, Spatial Domain and Frequency Domain Approaches. [2L]
Spatial Domain Techniques: Negative of an Image, Contrast Stretching, Gray level Slicing, Bit plane Slicing, Histogram and Histogram Equalization, Histogram Specifications, Image subtraction and Image Average. [4L]
Spatial Filtering: Low-pass special filters, High-pass spatial filters, median filters. [3L]
Frequency Domain Technique: Ideal Low-pass Filter, High-pass Filter, Pseudo Color Image.
Image Compression: Introduction, Coding Redundancy, Inter-pixel Redundancy, Psycho-Visual Redundancy, Image Compression Models. [6L]
Image Segmentation: Introduction, Detection of Isolated Points, Line detection, Edge Detection, Edge linking and Boundary Detection, Corner Detection, Region-oriented Segmentation and Segmentation using Threshold. [7L]
Image Restoration: Degradation Model, Degradation Model for Contentious Functions, Discrete Degradation Model, Estimation by Degradation Model, Linear Regression based approach. [3L]
Image Representation and Description: Boundary Representation Using Chain Codes, Boundary Representation Using Line Segments, Boundary Representation Using Signature, Fourier Descriptors, Region Description. [4L]
Texture: Statistical and Structural Approach. [1L]

References:

1. Digital Image Processing – Gonzales and Woods
2. Digital Image Processing – Rosenfield and Kak
3. Digital Image Processing – B Chanda and D Dutta Majumdar
4. Digital Image Processing – A K Jain

Paper: MCSC-42 (Advanced DBMS)

Transactions: concept, state diagram, processing, serial and concurrent processing, scheduling, concurrency control, protocols: graph, locking - two-phase, rigorous two-phase, deadlock. [16L]
Database Recovery: shadow paging, log-based recovery -immediate and deferred. [4L]

Query optimization: query tree, transformation rules, query processing - cost estimation, sorting, natural join operations, nested natural joins, database tuning and denormalization. [5L]
Parallel database: architecture, data partitioning techniques, parallel sort and join operations. [2L]
Distributed database: design issues, distributed transactions processing, 2-phase and 3-phase commit protocols, semijoin-properties, natural join using semijoin. [6L]
Multidatabase and federated database design, Multidimensional data, data cube, concepts of data mart and data warehousing, OLTP and OLAP. [8L]
Temporal and multimedia database. [3L]

References:

1. Database management systems. R. Ramakrishnan and J. Gehrke.
2. Database System Concepts, Abraham Silberschatz, Henry F.Korth, S. Sudarshan, McGraw Hill.
3. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, Pearson.
4. Principles of Distributed Databases. Ozsu and Valdurietz.

Paper: MCSC-43 (Parallel Algorithms)

Introduction: Sequential Algorithms, Sequential Algorithm Vs. Parallel Algorithms, Nature of Parallel Algorithms. Parallel Algorithms with Parallel Computers, Need for Parallel Algorithms, Analyzing an Algorithm: Running time: Counting Steps, Bounds (Lower and Upper), Speedup Ratio, Numbers of Processors, Amdhal's Law, Cost, Other measures, Area, Length, Period, Flynn's Classification of Computer, SISD, SIMD, MISD, MIMD models. [8L]
Parallel Selection: Introduction, Lower bound, rank, Linear Order, Selection, Complexity. Sequential Algorithm, Desirable Properties of Parallel Algorithms, Broadcasting a Datum and Example of Parallel selection algorithm. [6L]
Parallel Merging: Introduction to Parallel Merging, A Network for parallel Merging, Merging on CREW Model: parallel merging and Sequential Merging, Merging on EREW model. [8L]
Parallel Sorting: Introduction, A Network for Sorting, Sorting on a Linear Array, Sorting on the CRCW Model, Sorting CREW Model, Sorting on EREW Model. Case study. [6L]
Parallel Searching: Introduction, Searching a Sorted Sequence, EREW Searching, CREW Searching, CRCW Searching, Searching a random Sequence, searching on SM SIMD Computers, EREW, ERCW, CREW, CRCW. Searching on a Tree, Searching on a Mesh. [6L]
Parallel Matrix Operations: Introduction, Transposition, Matrix-by-Matrix Multiplication, Mesh Network, Cube Network, CRCW. Matrix by Vector Multiplication. [6L]
Parallel Algorithms for Graph Theory: Introduction, Definitions, Computing the Connectivity Matrix, Finding Connected Components, All-pairs of shortest paths, Computing the minimum Spanning Tree. [4L]

References:

1. Parallel Algorithms, Salim G Akl, PHI.
2. Introduction to Parallel Algorithms, S.Quinn, Addison Wesley.
3. Parallel Algorithms, Joseph Jaja.

Paper: MCSC-4X (Optional-II)

Paper: MCSC-4X (Optional-III)

Paper: MCSC-44 (Project Implementation)

Paper: MCSO-4X (Optional-II & III)

Paper: MCSO-41 (Advanced Computer Graphics)

Introduction: Transformation, Translation, Rotation, Scaling, Reflection, Shear and Projection. [6L]
Clipping: Three Dimensional Clipping, 3D Midpoint Subdivision algorithm, 3D Cyrus-Beck algorithm, 3D Liang-Barsky algorithm, Polygon Clipping. [10L]
Curves: Plane Curve, Space Curve, Cubic Splines, Hermite Spline, Cubic Bezier Curve, Cubic B-Spline. [10L]
Visible Lines and Visible Surfaces: Introduction, Floating Horizon Algo. , Upper & Lower Horizon, Roberts algorithm, Warnock algorithm, Scan-line Z-buffer algorithm, Ray-Tracing algorithm. [10L]
Rendering: Introduction, Illumination, Gouraud Shading, Phong Shading, Transparency, Shadows, Texture, Radiosity. [8L]

References:

1. Procedural Elements for Computer Graphics, David F. Rogers, Tata Mc-Graw Hill.
2. Mathematical Elements for Computer Graphics, David F. Rogers, J. Alan Adams, TMH.
3. Computer Graphics, Hearn & Baker, PHI.
4. Computer Graphics,Plastock, Schaum Outline Series, TMH.
5. Introduction to Computer Graphics and Multimedia, Anirban Mukhopadhyay, Arup Chattopadhyay, Vikas.

Paper: MCSO-42 (Cloud Computing)

Introduction: Overview of Computing Paradigm, Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, driving factors for adopting cloud computing, Pros and Cons. [6L]
Cloud Computing Architecture: Comparison with traditional computing architecture (client/server), Services provided at various levels, Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models, Deployment Models. [6L]
Service Models: Infrastructure as a Service (IAAS), Virtualization concepts and approaches, Virtual Machines, Resource Virtualization, Virtual Machine(resource) provisioning and manageability, storage as a service, Platform as a Service (PAAS), Cloud Platform and Management, Software as a Service(SaaS). [16L]
Service Management in Cloud computing: Service Level Agreements, Billing and Accounting, Scalability and cloud services, Database issues, Processing issues. [6L]
Cloud Security: Infrastructure security in network, host and application level, Data privacy

and security issues, identity and access management, Access control, authentication. [6L]
Case studies of Open Source clouds. [4L]

References:

1. Cloud Computing (Second Edition)-Dr Kumar Saurabh, Wiley-India.
2. Handbook of Cloud Computing, Borko Furht and Armando Escalante.
3. Cloud Computing - Principles, Systems and Applications, Nick Antonopoulos and Lee Gillam.
4. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej M. Goscinski.

Paper: MCSO-43 (Complex Networks)

Introduction: review of topics in probability and linear algebra, examples of real-world networks and their properties. [4L]
Fundamentals of network theory: Adjacency matrix, weighted graphs, directed graphs, hypergraphs, bipartite graphs, trees, planar graphs, degree, paths, diameter, components, independent paths, connectivity, cut sets, maximum flows and cut sets on weighted graphs, graph Laplacian, random walks. Centrality measures - degree centrality, closeness centrality, betweenness centrality, eigenvector centrality, Katz centrality, hub and authority centrality. Cliques, plexes, cores, clustering coefficient. Similarity measures - cosine similarity, Pearson coefficient, Katz similarity. Assortative and disassortative mixing. Shortest paths and the small-world effect, degree distributions, scale-free and power laws. [10L]
Fundamental network algorithms: degree distributions, clustering coefficients, shortest paths and breadth-first search, betweenness centrality, maximum flows and minimum cuts, spanning trees, independent paths, minimum cut sets. [5L]
Matrix algorithms and graph partitioning: eigenvectors and eigenvector centrality, graph partitioning and community detection/clustering, spectral partitioning. [10L]
Random graphs and network formation: Erdos-Renyi random graphs, tree structure, giant component, fixed degree distributions, configuration model, small-world (Watts-Strogatz) model, exponential random graphs, Markov graphs, network growth, preferential attachment, Barabasi-Albert model, power-law networks. [10L]
Dynamics on networks: Random walks on graphs, diffusion, Epidemics/contagion, mean-field models. [5L]

References:

1. Networks: An Introduction - M. E. J. Newman, Oxford University Press, Oxford, 2010.
2. Complex Graphs and Networks - F. Chung and L. Lu, **CBMS Regional Conference Series in Mathematics, 2006.**
3. Scale-Free Networks - Guido Caldarelli, Oxford University Press, Oxford, 2007.
4. Random Graph Dynamics – R. Durrett, Oxford University Press, Oxford, 2007.

Paper: MCSO-44 (Computational Intelligence)

Artificial Neural Network: Activation Functions, Artificial Neuron Geometry, Artificial Neuron Learning, Neural Network Types, Feedforward Neural Networks, Functional Link Neural Networks, Product Unit Neural Networks , Simple Recurrent Neural Networks, Time-Delay Neural Networks; Supervised Learning Rules: Unsupervised Learning Neural Networks:, Self-Organizing Feature Maps, Radial Basis Function Networks, Reinforcement Learning. [16L]

Swarm Intelligence, Social Network Structure: The Neighborhood Principle, Particle Swarm Optimization Algorithm, Individual Best, Global Best , Local Best , Fitness Calculation , Convergence, Ant Colony Optimization: The "Invisible Manager" (Stigmergy), The Pheromone , Ant Colonies and Optimization , Ant Colonies and Clustering , Applications of Ant Colony Optimization. [10L]

Fuzzy Systems : Fuzzy Sets , Membership Functions, Fuzzy Operators, Fuzzy Set Characteristics, Linguistics Variables and Hedges , Fuzziness and Probability , Fuzzy Inferencing Systems , Fuzzification, Inferencing , Defuzzification, Fuzzy Controllers , Components of Fuzzy Controllers, Fuzzy Controller Types, Table-Based Controller, Mamdani Fuzzy Controller, Takagi-Sugeno Controller. [12L]

Rough Sets : Concept of Discernibility, Vagueness in Rough Sets, Uncertainty in Rough Sets. [6L]

References:

1. Simon Haykin, Neural Networks A Comprehensive Foundation, Pearson Prentice Hall, second edition, 2005, ISBN 81-7803-300-0.
2. Peter Norvige and Stuart Russell, Artificial intelligence a mordern approach, Prantice Hall, ISBN: 10 0131038052.
3. S. N. Sivanadam and S. N. Deepa, Principles of Soft Computing. Wiley India (p) Ltd, 2007, iSBN: 81-265-1075-7.
4. Christian Blum · Daniel Merkle, Swarm Intelligence Introduction and Applications, Springer, ISBN: 978-3-540-74088-9
5. James Kennedy and Russell C. Eberhart,Swarm Intelligence,M K Publishers ISBN 1-55860-595-9,
6. Marco Dorigo, Thomas Sturtzle.,Ant colony optimization, MIT Press, ISBN 0-262-04219-3.
7. Andries P. Engelbrecht, Computational Intelligence An Introduction, John Wiley & Sons, Ltd, ISBN 0-470-84870-7.

Paper: MCSO-45 (Information Retrieval)

Basics of Information Retrieval: Boolean retrieval; Term vocabulary and postings lists; Dictionaries and tolerant retrieval; Index construction; Index compression; Scoring, term weighting and the vector space model; Computing scores in a complete search system; Evaluation in information retrieval. [10L]

Advanced topics in Information Retrieval: Relevance feedback and query expansion; XML retrieval; Probabilistic information retrieval; Language models for information retrieval. [16L]

Machine Learning in Information Retrieval: Text classification and Naive Bayes; Vector space classification; Support vector machines and machine learning on documents. Association and clustering: Apriori, K-Means, FCM, Hierarchical; Matrix decompositions and latent semantic indexing. [16L]
Web Mining: Web search basics; Web crawling and indexes; Link analysis. [2L]

References:

1. An Introduction to Information Retrieval. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze. Cambridge University Press, 2008.
2. Modern Information Retrieval. R. Baeza-Yates, B. Ribeiro-Neto. Addison-Wesley, 1999.
3. Information Retrieval: Algorithms and Heuristics. D.A. Grossman, O. Frieder. Springer, 2004.
4. Managing Gigabytes. I.H. Witten, A. Moffat, T.C. Bell. Morgan Kaufmann, 1999.
5. Readings in Information Retrieval. K. Sparck Jones, P. Willett. Morgan Kaufmann, 1997.

Paper: MCSO-46 (Mobile Broadband Networks)

Introduction: Overview of mobile broadband standards. [4L]
HSPA/HSPA+ networks : HSDPA and HSUPA operations for Rel6 and Rel7 networks, Continuous Packet Connectivity (CPC) mechanism, impact of handover on HSPA performance, inter-technology handover between HSPA and WLAN. [10L]
LTE/LTE-Advanced networks : System architecture of Evolved Packet System (EPS), concept of OFDMA, E-UTRAN, LTE/LTE-Advanced Radio Resource Management, Mobility and Handover Procedures, Security aspects. [8L]
Mobile WiMax system: Architecture, Radio interface, Mobility issues. [12L]
Data Services: Multimedia streaming through IMS over 3G/4G networks, Multimedia Broadcast/Multicast Service, Location-based services, Concept of Femtocells for localized access. [10L]

References:

1. WCDMA for UMTS, H Holma and A Toskala, John Wiley.
2. WCDMA for UMTS: HSPA Evolution and LTE, H Holma and A Toskala,John Wiley.
3. 4G LTE/LTE-Advanced for Mobile Broadband, Erik Dahlman, Stefan Parkvall, Johan Sk*ö*ld.
4. Wireless Broadband Networks, David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, Kee Chaing Chua, Jon W. Mark.

Paper: MCSO-47 (Remote Sensing)

Introduction: Concept of Remote Sensing, Types of Remote Sensing and Sensor Characteristics. [8L]
Digital Imaging: Sensor, Imaging by different Techniques. [8L]
Microwave Remote Sensing: Passive and Active MRS, Radar Imaging. [8L]

Ground-Truth Data and Global Positioning System: Requirements of GTD, Instruments for Ground Truthing, Parameters of Ground Truthing, Global Navigation Satellite System. [8L]
Data Integration: Multi-approach of Remote Sensing, Integration with Ground Truth, Process of Remote Sensing Data Analysis, Limitations of Remote Sensing Data Analysis, Applications of Remote Sensing. [12L]

References:

1. Remote Sensing and GIS, Basudeb Bhatta, Oxford.
2. Remote Sensing and Geographical Information Systems, M. Anji Reddy, BSP.
3. Remote Sensing of the environment, J. R. Jensen, Pearson.