M. Tech. in Information Technology

(Department of Information Technology)

FULL-TIME

Sl. No.	Subject Code	Name of the Subjects	L	T	P	CP
Semester I						
1.	IT 1001	Discrete Mathematics	3	1	0	04
2.	IT 1002	Advanced Algorithms	3	1	0	04
3.	IT 1003	Distributed Systems	3	1	0	04
4.		Elective-I	3	1	0	04
5.		Elective-II	3	1	0	04
6.	IT 1051	Algorithm Development Lab	0	0	3	02
7.	IT 1052	Modeling and Simulation Lab	0	0	3	02
24					**Total Credit**	
Semester II						
1.	IT 2001	Advanced Networks	3	1	0	04
2.	IT 2002	Information and Coding Theory	3	1	0	04
3.		Elective-III	3	1	0	04
4.		Elective-IV	3	1	0	04
5.		Elective-V	3	1	0	04
6.	IT 2051	Networks Lab & Distributed Systems Lab	0	0	3	02

7.	IT 2052	Seminar (Non-Project)	0	0	2	01
8.	IT 2053	Project-I	0	0	4	01
Total Credit 24						
Semester III						
1.	IT 3051	Project-II				11
2.	IT 3052	Seminar				02
Total Credit 13						
Semester IV						
1.	IT 4051	Project-III				11
2.	IT 4052	Project Seminar-II and Viva Voce				03
Total Credit 14						

TOTAL

CREDIT POINT: 75

LIST OF ELECTIVE SUBJECTS

Sl. No.	Subject Code	Name of the Subjects
1.	IT 9011	Foundations of Cryptography
2.	IT 9012	Information Security and Trust Management
3.	IT 9013	Game Theory and its Applications
4.	IT 9014	Advanced Data Base Management Systems
5.	IT 9015	Soft Computing
6.	IT 9016	Computational Bioinformatics
7.	IT 9017	Simulation and Analysis of Communication Networks
8.	IT 9018	Agent-based Computing
9.	IT 9019	Advanced Software Engineering
10.	IT 9020	Digital Image Processing
11.	IT 9021	Adaptive Signal Processing
12.	IT 9022	Swarm Robotics Design and Simulation
13.	IT 9023	Knowledge Management Applications
14.	IT 9024	Computer-Aided Design and Test for VLSI
15.	IT 9025	Computing for Social Science
16.	IT 9026	Biomedical Signal and Image Processing
17.	IT 9027	Optical Networks
18.	IT 9028	Artificial Intelligence

Syllabus for M.Tech. in Information Technology

Theory Courses:

Compulsory Papers:

Discrete Mathematics (IT-1001)

UNIT I:

Mathematical reasoning; propositions; negation disjunction and conjunction; implication and equivalence; truth tables; predicates; quantifiers; natural deduction; rules of Inference; methods of proofs; use in program proving; resolution principle;

UNIT II:

Set theory; Paradoxes in set theory; inductive definition of sets and proof by induction; Peono postulates; Relations; representation of relations by graphs; properties of relations; equivalence relations and partitions; Partial orderings; Posets; Linear and well-ordered sets;

UNIT III:

Functions; mappings; injection and surjection; composition of functions; inverse functions; special functions; Peono postulates; pigeonhole principle; recursive function theory;

UNIT IV:

Definition and elementary properties of groups, semi groups, monoids, rings, fields, vector spaces and lattices;

UNIT V

Boolean Algebras, morphisms of boolean algebras; basic counting principles, permutations, combinations, recurrence relations and their solutions.

UNIT VI

Graph Theory; elements of graph theory, Euler graph, Hamiltonian path, trees, tree traversals, spanning trees;

UNIT VII

Elementary combinatory; counting techniques; recurrence relation; generating functions;

Reference Books:

1. C.L.Liu, “Elements of Discrete Mathematics”, McGraw-Hill Book Company, 2000.
2. K.H.Rosen, “Discrete Mathematics and applications”, TataMcGraw Hill, 2003.
3. J .L.Mott, A.Kandel, T.P .Baker, Discrete Mathematics for Computer Scientists and Mathematicians, second edition 1986, Prentice Hall of India.
4. W.K.Grassmann and J.P.Trembnlay, Logic and Discrete Mathematics, A Computer Science Perspective. Prentice Hal11996.

Advanced Algorithm (IT-1002)

Asymptotic Notations a quick review,

Probabilistic Analysis and Randomized Algorithms,

Online Algorithms:Ski Rental. River Search Problem. Paging. The k-Server Problem. List Ordering and Move-to-Front.

String Algorithms :Rabin-Karp Fingerprinting Algorithm. Suffix Trees.

Maximum Flows:Augmenting Paths and Push-Relabel Methods. Minimum Cost Flows. Bipartite Matching.

Multi Threaded Algorithms: The Basics of Dynamic Multi Threading, Multi Threaded Matrix Multiplication,

Linear Programming:Formulation of Problems as Linear Programs. Duality. Simplex, Interior Point, and Ellipsoid Algorithms.

Computational Geometry: Line Segment Properties, Convex hull, Voronoi diagrams,

NP Completeness: NP Completeness and Reducibility, NP Completeness proofs for several problems,

Approximation Algorithms: Vertex cover problem, Traveling salesman problem, set-covering problem,

randomization and linear programming, subset sum problem.

Text Books:

- Cormen, Leiserson, Rivest, and Stein.Introduction to Algorithms. 2nd ed. Cambridge, MA:MIT Press, 2001. ISBN: 0262032937.
- Ahuja, Magnanti, and Orlin.Network Flows. Upper Saddle River, NJ: Prentice Hall, 1993. ISBN: 013617549X.
- Motwani and Raghavan.Randomized Algorithms. Cambridge, UK: Cambridge University Press, 1995. ISBN: 0521474655.
- Gusfield, Dan.Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biology. Cambridge, UK: Cambridge University Press, 1997. ISBN: 0521585198.
- Borodin, Allan, and Ran El-Yaniv.Online Computation and Competitive Analysis. Cambridge, UK: Cambridge University Press, 1998. ISBN: 0521563925.
- Tarjan, Robert.Data Structures and Network Algorithms. Philadelphia, PA: Society for Industrial and Applied Mathematics, 1983. ISBN: 0898711878. A classic - no longer up to date, but outstanding writing.
- Berg, Mark de, Marc van Kreveld, Mark Overmars, and Otfried Schwarzkopf.Computational Geometry: Algorithms and Applications. New York, NY: Springer-Verlag, 2000. ISBN: 3540656200.
- Hochbaum, Dorit, ed.Approximation Algorithms for NP-Hard Problems. Boston, MA: PWS Publishing Company, 1997. ISBN: 0534949681.

Distributed Systems (IT-1003)

1. INTRODUCTION

1.1.DEFINITION OF A DISTRIBUTED SYSTEM

1.2.GOALS

- 1.2.1. Making Resources Accessible
- 1.2.2. Distribution Transparency
- 1.2.3. Openness
- 1.2.4. Scalability
- 1.2.5. Pitfalls

1.3.TYPES OF DISTRIBUTED SYSTEMS

- 1.3.1. Distributed Computing Systems
- 1.3.2. Distributed Information Systems
- 1.3.3. Distributed Pervasive Systems

2. ARCHITECTURES

2.1.ARCHITECTURAL STYLES

8.4.1. Basic Reliable-Multicasting Schemes
8.4.2. Scalability in Reliable Multicasting
8.4.3. Atomic Multicast

8.5. DlSTRIBUTED COMMIT
8.5.1. Two-Phase Commit
8.5.2. Three-Phase Commit
8.6. RECOVERY
8.6.1. Introduction
8.6.2. Checkpointing
8.6.3. Message Logging
8.6.4. Recovery-Oriented Computing

Advanced Networks (IT-2001)

Unit 1: Preliminaries:

IPv4 addressing, Classful addressing, Subnetting and supernetting, Classless addressing, Delivery, forwarding and routing of IP packets, Static versus dynamic routing tables, Adaptive window based control in TCP, Slow start and congestion control, Fast retransmit, TCP Reno, Packet loss recovery.

Unit 2: Introduction to Mobile Ad-Hoc Networks (MANET):

Applications, and variations of MNET, Unicast routing in MANET, Flooding for data delivery, Flooding of control packets, Dynamic source routing, Route caching, Route error, Location-aided routing, Geographic distance routing, Routing with guaranteed delivery, Query localization, Broadcast storm problem, Ad-Hoc on-demand distance vector routing, IEEE 802.11.

Unit 3: TCP Performance in MANET:

Impact of different types of errors on TCP performance, Impact of multi-hop wireless paths, Network feedback, Impact of caching, Out-of-order packet delivery, Impact of acknowledgements. Various schemes for improving TCP performance, Link level mechanism, Split connection approach, TCP-aware link layer, Explicit notification, Receiver based discrimination, Sender based discrimination. TCP over satellite, Impact of mobility on TCP performance, Header compression for wireless networks.

Unit 4: Network Performance Analysis and Modeling:

End to end fixed delays, queueing delay analysis, Markovian random delay analysis, M/M/1 queue analysis, the Little's formula, application of queueing theory in network delay analysis. Traffic source modeling, ON/OFF sources representation with peak rate, average rate and average burst duration, formulation of transition probability matrix for On/OFF sources.

Unit 5: Network Calculus:

Fundamentals of Min-plus convolution and network service curves, The Leaky Bucket regulated sources, Determination of minimum bandwidth for bounded delay services, introduction to stochastic QoS, Stochastic delay guaranty and effective bandwidth analysis.

Books and references:

1. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", Prentice Hall; 5th edition.
2. Anurag Kuma, D. Manjunath, Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufmann; 1st edition.
3. Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic (Eds.), "Mobile Ad Hoc Networking", Wiley-IEEE Press; 1st edition.

Information and Coding Theory (IT-2002)

Source coding: Introduction, Mathematical Measure of Information, Average and Mutual Information and Entropy, coding for Discrete less sources, Source coding theorem, fixed length and variable length coding, Kraft inequality, properties of prefix codes. L-7

Shannon-Fano coding, Huffman code, Huffman code applied for pair of symbols, efficiency calculations, Lempel-Ziv codes, arithmetic coding, Rate distortion Theory. L-4

Channels and Channel Capacity: Discrete memoryless channel model, Binary symmetric channels and channel capacity, entropy rate and channel coding theorem, information

capacity theorem, Markov process and sources with memory, L- 4

Error correction codes: Introduction, Basic concepts of linear algebra including group, ring, field, vector space etc.

L-2

Block codes: Introduction, single parity check codes, product codes, repetition codes, hamming codes L-3

Linear Codes: Definition,encoding an decoding of linear codes, generator matrix, error detection and correction, Perfect codes, Hamming codes. L-3

Cyclic codes :Definition, encoding and decoding, cyclic redundancy check L-4

Convolution codes: Encoding convolutional codes, Generator matrices for convolutional codes, Generator polynomials and graphical representation for convolutional codes. The viterbi decoder. L-3

Bose-Chowdhury- Hoquenghem codes: Definition and construction of BCH codes, Decoding SEC and DEC binary BCH codes, Reed Solomon codes. L-3

Trellis coded modulation:Introduction, The concept of coded modulation, Signal mapping and set partitioning, TCM decoder. L-2

References:

1. T. M. Cover and J. A. Thomas, Elements of Information Theory,, John Wiley & Sons, New York, NY, 1991.

2. S. Lin and D. J. Costello, Error Control Coding, Fundamentals and Applications, Prentice Hall, Englewood Cliffs, NJ, 1983.

3. R. B. Wells, Applied Coding and Information theory for Engineers, PHI, 2004

Theory Courses: Elective Papers:

Foundations of Cryptography (IT-9011)

Introduction:

ISO X.800 standard, Attacks, Requirements,

Number Theory:

Prime number, distribution of primes, congruence relation, Group Z_p^* , Quadratic Residue, Legendery and Jacobi Symbol, Polynomial over GF(2^m) field.

Symmetric Cryptography:

Introduction, AES, Different mode of symmetric encryption

Asymmetric Cryptography:

Introduction,

RSA Encryption: randomize prime generation, Attacks: small exponent, timing, chosen cipher and chosen plaintext attack. OAEP, Factorization problem: Factor-Base method, continuing fraction method, Sevie method.

Rabin's Encryption: Square root problem, CRT.

ElGamal Encryption: Discrete log problem, index calculation method, encryption and decryption.

Stream Cipher: randomness and generation of randomness, LFSR

Key Establishment: Diffie-Hellman protocol, man-in-middle attack, NOMS

Integrity: message temperament, cryptographic Hashing, Birthday paradox, SHA 512

Authentication: soft authentication: password, smart card etc. Data Authentication: MAC, Entity authentication, digital signature.

Books:

1. Handbook of applied Cryptography, A Menezes, P. Oorschot, S. Vanstone, CRC Press
2. Cryptography & Network Security, B. Forouzan, McGrawHill
3. Cryptography & Network Security, W. Stallings, Prentice Hall
4. Cryptography: Theory and Practice, D. Stinaon, CRC Press.

Information Security and Trust Management (IT-9012)

Digital Signature: signature with message appendix and signature with message recovery, RSA, Rabin's and ElGamal signature. Forgery of signature. Undeniable signature, Fail-stop signature.

PKI: Basic structure, X.509 recommendation, Certificate, X.509 certificate, CRL.

X.509 Certificate with extension, certificate path construction and verification. CRL distribution point.

Secret Sharing, threshold secret sharing, distributed key generation, application of distributed key generation.

Zero-knowledge(ZK) proof: interactive ZK proof, non-interactive ZK proof.

Trust and trust calculation in the collaborative and adhoc scenario. Repudiation system. Role base access control, hierarchical access control, cryptographic solution.

Books:

1. Handbook of applied Cryptography, A Menezes, P. Oorschot, S. Vanstone, CRC Press
2. Understanding PKI: Concepts, Standards and Deployment Considerations: C. Adams, S. Lloyd, Addision-Wesley.

References:

1. T. Pedersen: A threshold cryptosystem without a trusted third party, EUROCRYPT-91
2. T. Pedersen: Non-interactive and information-theoretic secure verifiable secret sharing, CRYPTO 91

3. R. Gennaro, S. Jarecki, H. Krawezyk, T. Rabin: Secure distributed key generation for discrete-log based problem, EUROCRYPT 99
4. A. Shamir: How to share a secret, Commun ACM 79

Game Theory and its Applications (IT-9013)

Part I: Noncooperative Game Theory

Introduction to Game Theory
Extensive Form Games
Strategic Form Games
Dominant Strategy Equilibria
Pure Strategy Nash Equilibrium
Mixed Strategy Nash Equilibrium
Rationalizable Strategies
Sperner's Lemma, Fixed Point Theorems, and Existence of Nash Equilibrium
Computation of Nash Equilibrium
Complexity of Computing Nash Equilibrium
Matrix Games (Two Player Zerosum Games)
Bayesian Games
Subgame Perfect Equilibrium
Case Study: Spectrum Allocation in Cognitive Radios based on Non-Cooperative Game Theory, Applications of Non-Cooperative Game Theory in Wireless Network Research.

Part II: Mechanism Design

Introduction to Mechanism Design
Social Choice Functions and Mechanisms
Incentive Compatibility and Revelation Theorem
Properties of Social Choice Functions
Gibbard Satterthwaite Theorem and Arrow Impossibility Theorem
Quasilinear Mechanisms
Vickrey-Clarke-Groves Mechanisms
Bayesian Incentive Compatible Mechanisms
Revenue Equivalence Theorem
Optimal Auctions and Myerson Auction

Case Study: Sponsored Search Auctions, Spectrum Auction

Part III: Cooperative Game Theory

Correlated Strategies and Correlated Equilibrium
The Two Person Bargaining Problem
Coalitional Games
The Core
The Shapley Value
Other Concepts (Stable Sets, Bargaining Sets, Kernel, Nucleolus, Gately Point)

case study: Applications of Cooperative Game Theory in Wireless Network Research.

Part IV: Evolutionary Stable Strategies and Population Games

Evolution

Population Games

Text Books:

- Y. Narahari, Dinesh Garg, Ramasuri Narayanam, Hastagiri Prakash Game Theoretic Problems in Network Economics and Mechanism Design Solutions. Springer Series in Advanced Information and Knowledge Processing (AIKP), London, UK, 2009. (URL:http://www.springer.com/math/applications/book/978-1-84800-937-0)
- Roger B. Myerson. Game Theory: Analysis of Conflict. Harvard University Press, September 1997.
- Andreu Mas-Colell, Michael D. Whinston, and Jerry R. Green. Microeconomic Theory. Oxford University Press, New York, 1995.
- Martin J. Osborne, Ariel Rubinstein. A Course in Game Theory. The MIT Press, August 1994.
- Philip D. Straffin, Jr. Game Theory and Strategy. The Mathematical Association of America, January 1993.
- Ken Binmore, "Fun and Games : A Text On Game Theory", D. C. Heath & Company, 1992.
- Paul Klemperer, Auctions: Theory and Practice, The Toulouse Lectures in

Economics, Princeton University Press, 2004.

- Game Theory, An Introduction by E.N.BARON, WILEY, 2008

Classic Papers in Game Theory and Mechanism Design:

- M. Shubik,"On the Scope of Gaming", Management Science, Vol. 18, No. 5, Jan., 1972.
- R.B. Myerson,"NASH Equilibrium and The History of Economic Theory", Journal of Economic Literature 36:1067-1082 (1999).
- M. Shubik, "Game Theory: Economic Applications",International Encyclopedia of the Social Sciences, Macmillan Co. and The Free Press, 1968.
- M. Shubik,"Games of Status", Behavioral Science, Vol. 16, No.2, Mar., 1971.
- M. Shubik,"Game Theory, Complexity, and Simplicity, Part III: Critique and Prospective".
- R.J. Aumann,"Kakutani Fixed point Theorem".
- J.F. Nash,"Non-Cooperative Games", The Annals of Mathematics, Second Series, Volume 54, Issue 2(Sept., 1951),286-295.
- T. Quint and M. Shubik,"A Bound on the number of Nash Equilibria in a Coordinate Game", Cowles Foundation Discussion Paper 1095.
- J.F. Anscombe, R.J. Aumann, "A Definition of Subjective Probability", The Annals of Mathematical Statistics, Vol. 34, No. 1(Mar., 1963), 199-205.
- M.O. Jackson, "Bayesian Implementation", Econometrica, Vol. 59, No. 2(Mar. ,1991), 461-477.
- J. Nash, "The Bargaining Problem", Econometrica, Vol. 18, No. 2, (Apr., 1950), 155-162.
- A.E. Roth, "The Nash Solution and the Utility of Bargaining", Econometrica, Vol. 46, No. 3(May., 1978), 587-594.
- M. Shubik,"Some Simple Games for Teaching and Research, Part 1: Cooperative Games".
- J.F. Nash, "Two-Person Cooperative Games", Econometrica, Vol. 21, No. 1, (Jan., 1953), 128-140.
- H.E. Scarf, "On the Existence of a Cooperative Solution for a General Class of N-Person Games", Journal of Economic Theory, Vol. 3, No. 2, June, 1971.
- G. Debreu and H. Scarf, "A Limit Theorem On The Core of An Economy", International Economic Review, Vol. 4, No. 3, Sept., 1963.
- R.J. Aumann,"The Shapley Value".
- R.J. Aumann,Economic Applications of the Shapley Value.
- W. Vickrey, "Counterspeculation, Auctions, and Competitively Sealed Tenders". Journal of Finance 16, 8-37, 1961.

- E. Clarke, "Multipart Pricing of Public Goods". Public Choice 11, 17-33, 1971.
- T. Groves, "Incentives in Teams", Econometrica, Vol. 41, No. 4(Jul., 1973), 617-631.
- K.J. Arrow and R. Radner, "Allocation of Resources in Large Teams", Econometrica, 1979.
- C d'Aspremont and L A G´erard-Varet. Incentives and incomplete information. Journal of Public Economics, 11, 25-45, 1979.

Advanced Data Base Management Systems (IT-9014)

Syllabus outline

Database normalization

Object oriented database

Query processing and optimization

Transactions and concurrency control

Database recovery

Parallel and distributed DBMS

Data warehousing and Data mining

Books

Avi Silberschatz, Henry F. Korth, S. Sudarshan, *Database System Concepts*, McGraw-Hill, USA.

C. J. Date, *An Introduction to Database Systems*, Addison-Wesley Longman Publishing Co., USA

Principles of database Systems, J.D.Ullman, Galotia Publications.

Soft Computing (IT-9015)

UNIT I:

Introduction to Soft Computing: Hard Computing, Soft Computing, Hybrid Computing, Optimization and Some Traditional Methods.

UNIT II: ARTIFICIAL NEURAL NETWORKS:

History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Applications of Artificial Neural Networks. Competitive learning networks, Kohonen self organizing networks, Hebbian learning; Hopfield networks, Associative Memories, The boltzman machine

UNIT III: FUZZY SETS AND FUZZY LOGIC:

Fuzzy Sets, The Operations of Fuzzy Sets, Fuzzy Relations and Compositions, Fuzzification, Defuzzification, Fuzzy Arithmetic and Fuzzy Measures, Fuzzy Rule Based and Approximate Reasoning, Fuzzy Decision Making.

UNIT IV: GENETIC ALGORITHMS:
Survival of the Fittest, Fitness Computations, Cross-Over, Mutation, Reproduction, Rank Method, Rank space method.

UNIT V:

Hybrid Systems: Integration of Artificial Neural Network, Fuzzy Logic and Genetic Algorithms

References:

1. Timothy J.Ross, "Fuzzy logic with Engineering Applications", McGraw Hill, 1997.
2. Laurence Fausett , "Fundamentals of Neural Networks", Prentice Hall, 1994.
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic ", Prentice Hall, USA 1995.
4. S. Haykin, "Neural networks: a comprehensive foundation", Pearson, 2004
5. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, NY, 1989.

Computational Bioinformatics (IT-9016)

UNIT I:

Introduction to the Concepts of Bioinformatics and Evolutionary Computation:
Introduction, Biology –the science of life, central dogma of molecular biology, gene networks, computation- history and terminology.

UNIT II:

Sequence and Structure Alignments:
Sequence similarity, homology and alignment. Pair wise alignment: scoring model, dynamic programming algorithms, heuristic alignment, and pair wise alignment using Hidden Markov Models. Multiple alignments: scoring model, local alignment gapped and un-gapped global alignment.

UNIT III:

Protein Folding:
Introduction to protein, Protein Structure Prediction, Protein folding, Motif finding: motif models, finding occurrence of known sites, discovering new sites. Gene Finding: predicting reading frames, maximal dependence decomposition. Analysis of DNA microarray data using hierarchical clustering, model-based clustering, expectation-maximization clustering, Bayesian model selection

Reference:

1. G. B. Fogel and D. W. Corne, "Evolutionary Computation in Bioinformatices", Morgan Kaufmann Publishers, 2003.
2. A. R. Leach, "Molecular Modeling: Principles and Applications", Second edition, Pearson, 2010.
3. O. Bosu and S. K. Thukral, "Bioinformatics: Database, Tools and Algorithms", Oxford Higher Education, 2009.

Simulation and Analysis of Communication Networks (IT-9017)

Unit 1 :

Modelling traffic sources – ON/OFF sources and their transition probability matrix, leaky bucket regulated sources, super position of ON-OFF sources. Long range dependence and self similarity, pareto traffic source simulator using trace files.

Unit 2 :

Delays, throughput and goodput of networks and flows. Queing theory and application – open queueing networks and closed queueing, application of queueing in data-networks.

Unit 3:

Deterministic network calculus – min-plus convolution and service curves, effective bandwidth for guaranteed delay services, WFQ scheduling. The RSVP protocol and DiffServ protocols implementation**.**

Unit 4:

Stochastic network calculus – effective bandwidth calculation for bounded delay with a probability of relaxation, using effective bandwidth with regulated sources, RSVP and DiffServ under stochastic QOS guaranty.

Unit 5:

The TCP dynamics- modelling of TCP dynamics, PFTK model. Modelling TCP with fixed point approach. Extension to other variants of TCP.

Agent-based Computing (IT-9018)

1. Intelligent Agents
    - 1.1 Environments
    - 1.2 Intelligent Agents
    - 1.3 Agents and Objects
    - 1.4 Agents and Expert Systems
    - 1.5 Agents as Intentional Systems
    - 1.6 Abstract Architectures for Intelligent Agents
    - 1.7 How to Tell an Agent What to Do
    - 1.8 Synthesizing Agents
2. Deductive Reasoning Agents
    - 2.1 Agents as Theorem Provers
    - 2.2 Agent-Oriented Programming
    - 2.3 Concurrent MetateM
3. Practical Reasoning Agents
    - 3.1 Practical Reasoning Equals Deliberation Plus Means-Ends Reasoning
    - 3.2 Means-Ends Reasoning
    - 3.3 Implementing a Practical Reasoning Agent
    - 3.4 HOMER: an Agent That Plans
    - 3.5 The Procedural Reasoning System
4. Reactive and Hybrid Agents

- 9.4 Mobile Agents

10. Applications
    - 10.1 Agents for Workflow and Business Process Management
    - 10.2 Agents for Distributed Sensing
    - 10.3 Agents for Information Retrieval and Management
    - 10.4 Agents for Electronic Commerce
    - 10.5 Agents for Human-Computer Interfaces
    - 10.6 Agents for Virtual Environments
    - 10.7 Agents for Social Simulation
    - 10.8 Agents for X
11. Logics for Multiagent Systems
    - 11.1 Why Modal Logic?
    - 11.2 Possible-Worlds Semantics for Modal Logics
    - 11.3 Normal Modal Logics
    - 11.4 Epistemic Logic for Multiagent Systems
    - 11.5 Pro-attitudes: Goals and Desires
    - 11.6 Common and Distributed knowledge
    - 11.7 Integrated Theories of Agency
    - 11.8 Formal Methods in Agent-Oriented Software Engineering
        - 11.8.1 Formal methods in specification
        - 11.8.2 Formal methods in implementation
        - 11.8.3 Verification

Advanced Software Engineering (IT-9019)

An advanced study of applied software product development issues that include:

Software feasibility study, Software requirements specifications & analysis, software quality factors and assurance, system and software design methodologies (DFD, ERD, Data dictionary), structured analysis and design. Overview of object –oriented concepts & function-oriented design, concept of project management, role of metrics and measurement, software reuse, language, tool, and hardware selection, software project planning models (e.g., COCOMO, etc.), cost estimation and software economics, productivity management, risk management, coding tools software implementation and testing.

Books:

1. Ian Sommeriele, “Software Engineering” , Addison Wesley.
2. C.Easteal and G.Davis, Software Engineering Analysis and Design, Tata McGraw Hill.
3. Pressman, Software Engineering –A Practitioner’s Approach.
4. Richard Fairley ,Software Engineeering Concepts ,Tata Mcgraw Hill.
5. Pankaj Jalote , An Integrated Approach to Software engineering, Narosa Publication.

Digital Image Processing (IT-9020)

Unit 1: Introduction to Digital Image Processing

Module 1: Introduction to Digital Image Processing & and Applications L-1

Module 2: Image digitization and sampling L-1

Module 3: Quantization L-1

Module 4: Matrix representation of digital image and Pixel relationships, L-2

Unit 2: Image Geometry and spatial Transformations

Module 1: Basic Transformations L-1

Module 2: Camera model and Image Geometry L-1

Module 3: Camera calibration and stereo imaging L-1

Module 4: Interpolation and resampling L-3

Unit 3: Image Transformations:

Module 1: Fourier Transform L-2

Module 2: Discrete cosine Transform L-1

Module 3: K-L Transform L-1

Unit 4: Image Enhancement

Module 1: Grey level transformation: Image negatives, Log transformations, Power-law transformations, Piecewise-linear transformations. L-1

Module 2: Histogram Processing L-2

Module 3: Basics of spatial filtering: Smoothing spatial filters sharpening spatial filters. L-2

Module 4: Image enhancement in Frequency domain: Frequency domain smoothing filters, Sharpening filters, Homo-Morphic filtering. L-2

Unit 5: Image restoration:

Module 1: Degradation and noise model, Estimation of degradation function. L-2

Module 2: Inverse filtering, MMSE (Wiener) filtering. L-2

Module 3: Constraints least square filtering, Geometric Mean filters. L-1

Unit 6: Color image processing:

Module 1: Color Models L-1

Module 2: Pseudo color image Processing L-1

Module 3: Color Transformations L-1

Unit 7: Image segmentation

Module 1: Detection of discontinuities L-1

Module 2: Edge linking and boundary detection L-1

Module 3: Thresholding L-1

Module 4: Region-based segmentation L-1

Unit 8: Morphological Image Processing:

Module 1: Basic concept of set theories, Logical operation involving Binary images. L-1

Module 2: Dilation, erosion, Opening and closing L-1

Module 3: Hit-or-Miss Transformation and some morphological Algorithms L-1

Unit 9: Object description and representation:

Module 1: Chain codes, Signatures, Boundary segments, Skeletons L-2

Module 2: Boundary descriptors L-1

Module 3: Regional descriptors L-1

References:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 2/e**,** PHI

1. **2.** A. K. Jain, Fundamentals of digital image processing**,** Prentice Hall of India, 2010

Adaptive Signal Processing (IT-9021)

Introduction to Adaptive Filters.

1. Adaptive filter structures, issues and examples.
2. Applications of adaptive filters.

    a. Channel equalization, active noise control.
    b. Echo cancellation, beamforming

Discrete time stochastic processes.

1. Re-visiting probability and random variables.
2. Discrete time random processes.
3. Power spectral density - properties.
4. Autocorrelation and covariance structures of discrete time random processes.
5. Eigen-analysis of autocorrelation matrices.

Wiener filter, search methods and the LMS algorithm.

1. Wiener FIR filter (real case).
2. Steepest descent search and the LMS algorithm.
3. Extension of optimal filtering to complex valued input.
4. The Complex LMS algorithm.

Convergence and Stability Analyses.

1. Convergence analysis of the LMS algorithm.
2. Learning curve and mean square error behavior.
3. Weight error correlation matrix.
4. Dynamics of the steady state mean square error (mse).
5. Misadjustment and stability of excess mse.

Variants of the LMS Algorithm.

1. The sign-LMS and the normalized LMS algorithm.
2. Block LMS.
3. Review of circular convolution.
4. Overlap and save method, circular correlation.
5. FFT based implementation of the block LMS Algorithm.

Vector space framework for optimal filtering.

1. Axioms of a vector space, examples, subspace.
2. Linear independence, basis, dimension, direct sum of subspaces.
3. Linear transformation, examples.
4. Range space and null space, rank and nullity of a linear operator.
5. Inner product space, orthogonality, Gram-Schmidt orthogonalization.
6. Orthogonal projection, orthogonal decomposition of subspaces.
7. Vector space of random variables, optimal filtering as an orthogonal projection computation problem.

The lattice filter and estimator.

1. Forward and backward linear prediction, signal subspace decomposition using forward and backward predictions.
2. Order updating the prediction errors and prediction error variances, basic lattice section.
3. Reflection coefficients, properties, updating predictor coefficients.
4. Lattice filter as a joint process estimator.
5. AR modeling and lattice filters.
6. Gradient adaptive lattice.

RLS lattice filter.

1. Least square (LS) estimation, pseudo-inverse of a data matrix, optimality of LS estimation.
2. Vector space framework for LS estimation.
3. Time and order updating of an orthogonal projection operator.

4. Order updating prediction errors and prediction error power.
5. Time updating PARCOR coefficients.

References:

1. "Adaptive Filter Theory" by S. Haykin, Prentice Hall, Englewood Cliffs, NJ, 1991 (end Ed.).

   "Adaptive Filters: Theory and Applications", by B. Farhang-Boroujeny, John Wiley and Sons, 1999.

Swarm Robotics Design and Simulation (IT-9022)

Chapter 1: An Introduction to Robotics
1.1 Introduction
1.1.1 What are robots?
1.1.2 Robotic Paradigm
1.1.3 Overview of three paradigms
1.1.4 Intelligent robots
1.1.5 Swarm robots
1.1.6 A Brief History of Robotics
1.1.7 Distributed Algorithms: An Overview
Chapter 2: Swarm Robotics
2.1 Introduction
2.1.1 Swarm Intelligence
2.1.2 Autonomous agents
2.2 Swarm Behaviours: Social Insect Motivation and Inspiration
2.2.1 Models
2.2.2 Agents
2.2.3 Self-organization
2.2.4 Swarm intelligence
2.2.5 Emergence
2.2.6 Stigmergy
2.2.7 Algorithms
2.2.7.1 Ant colony optimization
2.2.7.2 Self-propelled particles
2.3 Particle swarm optimization
2.4 Biological swarming
2.5 Insects
2.5.1 Ants

11.1.2 Firebird Kit

Chapter 12: Case Study on Coverage

12.1 Player/stage software simulator
12.1.1 Installation
12.1.2 Writing and executing a program
12.1.3 Troubleshooting
12.1.4 Example programs and their analysis
12.1.5 Data sets

Knowledge Management Applications (IT-9023)

1. **Principles**

Knowledge Management Systems.

Overview of Knowledge Management (KM), Distinguishing data, information and knowledge, Data-Knowledge pyramid, implicit and explicit knowledge, knowledge worker, Understanding knowledge generation in organizations; managing tacit and explicit knowledge, KM cycle and stages .

2. **Technologies**

Technologies to Manage Knowledge: Artificial Intelligence, Digital Libraries, Repositories, etc.

Preserving and Applying Human Expertise: Knowledge-Based Systems

Using Past History Explicitly as Knowledge: Case-Based Systems

Knowledge Elicitation: Converting Tacit Knowledge to Explicit

Discovering New Knowledge: Data Mining

Text KM & Text Mining

3. **Systems**

Knowledge Discovery: Systems that Create Knowledge

Knowledge Capture Systems: Systems that Preserve and Formalize Knowledge; Concept Maps, Process Modeling, RSS, Wikis, Delphi Method, etc.

Knowledge Sharing Systems: Systems that Organize and Distribute Knowledge; Ontology Development Systems, Categorization and Classification Tools, XML-Based Tools, etc.

Knowledge Application Systems: Systems that Utilize Knowledge

TEXT BOOK:

1. Elias.M. Award & Hassan M. Ghaziri – "Knowledge Management" Pearson Education 2003.

2. Irma Becerra-Fernandez, Avelino Gonzalez, Rajiv Sabherwal (2004). Knowledge Management Challenges, Solutions, and Technologies (edition with accompanying CD). Prentice Hall. ISBN:0-13-109931-0.

REFERENCES:

1. Guus Schreiber, Hans Akkermans, Anjo Anjewierden, Robert de Hoog, Nigel Shadbolt, Walter Van de Velde and Bob Wielinga, "Knowledge Engineering and Management", Universities Press, 2001.

2. C.W. Holsapple, "Handbooks on Knowledge Management", International Handbooks on Information Systems, Vol 1 and 2, 2003.

Computer-Aided Design and Test for VLSI (IT-9024)

Unit 1: Preliminaries:

Introduction to application specific integrated circuits (ASICs) and electronic design automation (EDA), VLSI design cycle, Design styles. Full custom, Standard-cell, Gate arrays, FPGA, etc.

Unit 2: **Underlying technologies:**

Brief introduction of underlying technologies- nMOS, pMOS, CMOS. Working of MOS transistors. MOS transistor as switch, Logic design in CMOS. Stick diagram. Design rules. Layout editor.

Unit 3: Introduction to VLSI Physical Design:

Basic physical design flow. Overview of basic data structures and algorithms, Graph algorithms for physical design.

Unit 4: Partitioning:

Problem formulation, Classification of partitioning algorithms, Kernighan-Lin algorithm, Fiduccia-Mattheyses algorithm, Ratio cut, Simulated annealing and evolution, Other partitioning algorithms.

Unit 5: Floorplanning and Pin Assignment:

Problem formulation, Design style specific floorplanning problems, Slicing and non-slicing floorplan, Rectangular dualization based floorplanning, Hierarchical tree based methods, Simulated evolution based algorithms, Timing driven floorplanning, General pin assignment, Channel pin assignment, Integrated approach.

Unit 6: Placement:

Problem formulation, Simulated annealing based algorithms, Timber Woolf, Simulated evolution based algorithms, Force directed placement, Partitioning based placement algorithms.

Unit 7: Routing:

Problem formulation, Classification of routing, Global routing, Lee's algorithm, Soukup's algorithm, Hadlock's algorithm, Line-probe algorithms, Steiner tree based algorithms, Hierarchical approach, Detailed routing, Routing models, Channel routing, Switchbox routing, Left-Edge Algorithm, Dogleg router, Symbolic channel router:YACR2, Net merge channel router, Over-the-cell routing, Via minimization, Clock and power routing, Design considerations for the clocking system, Clock skew, Clock routing algorithms, H-tree based algorithms, The MMM algorithm, Exact zero skew algorithm.

Unit 8: Testing:

Functional versus structural testing, Fault modeling, Famous fault models: stuck-at fault model, bidging fault model, path delay fault model, transition fault model. Fault equivalence, Fault dominance, Fault collapsing, Fault detection and redundancy, Fault simulation, Introduction to automatic test pattern generation, D-algorithm, PODEM algorithm, FAN algorithm. Design for testability.

Books and references:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits, A Design Perspective", Prentice Hall; 2nd edition.
2. Naveed A. Sherwani, "Algorithms for VLSI Physical Design Automation", Springer; 3rd edition.
3. Neil H. E. Weste, Kamran Eshraghian, "Principles of CMOS VLSI Design", Addison Wesley; 2nd edition.

4. M. L. Bushnell, V. D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Springer, 2nd edition.
5. Miron Abramovici, Melvin A. Breuer, Arthur D. Friedman, “Digital Systems Testing & Testable Design”, Jaico Publishing House.

Computing for Social Science (IT-9025)

Unit 1 :
Introduction to various facets of social science, need for quantitative modeling, complexity and non-linearity in modelling social dynamics, relating micro models to macro models, foundations of *emergence*.

Unit 2 :
Simulation of emergence through multi-agent system, game theory and mechanism design, expressing social system in the form of multi-agent games, relating domain knowledge to determine strategies and payoffs of the games.

Unit 3 :
Using multi-agent games simulation tools such as Netlogo, designing game of pure strategy and mix strategy, introduction to repetitive games.

Unit 4 :
Learning theories applied to agents, forming mixed strategy from learning, learning strategy from repetitive games, simulation artificial system including learning and emergence.

Unit 5 :
Simulation of artificial communities and societies based on specific contexts, inclusion of impacts of related contexts, complete simulation of the problem including emergence with learning recording results of interests, drawing conclusions.

Biomedical Signal and Image Processing (IT-9026)

Unit 1: Introduction to Biomedical signal and image processing

Module 1: Bio-engineering measurement system and transducers L-1

Module 2: Analog Signal Processing and sources of noises L-1

Module 3: Analog Filters L-1

Module 4: Basic concepts of Analog-to-digital conversion L-1

Unit 2: Basic Concepts

Module 1: Noise and ensemble averaging L-1

Module 2: Data functions and Transforms L-1

Module 3: Convolution, Correlation and Covariance L-1

Module 4: Sampling theory and finite data considerations L-1

Unit 4: Spectral analysis: classical methods

Module 1: Fourier series analysis and Fourier Transform L-1

Module 2: Discrete time Fourier analysis L-1

Module 3: Truncated Fourier analysis: Data windowing L-1

Module 4: FFT algorithms L-1

Unit 5: Spectral analysis: Modern Techniques

Module 1: Parametric model based methods L-1

Module 2: Non-parametric eigen analysis frequency estimation L-1

Unit 5: Digital Filters

Module 1: The Z Transform L-1

Module 2: Digital transfer function and implementation L-1

Module 3: Design of FIR filters L-2

Module 4: Design of IIR filters L-2

Unit 6: The wavelet Transform

Module 1: The continuous wavelet Transforms, Wavelet time-frequency Characteristics L-1

Module 2: Discrete wavelet transforms L-1

Module 3: Denoising, Discontinuity detection, Feature detection L-2

Unit 6: Advance signal processing

Module 1: Wiener's filters L-1

Module 2: Adaptive filters L-1

Module 3: Phase sensitive detection L-1

Unit 7: Multivariate analysis

Module 1: Principal component analysis L-2

Module 2: Independent component analysis L-1

Unit 8: Image Processing

Module 1: Filtering L-1

Module 2: Transformations L-1

Module 3: Registration L-1

Module 4: Image segmentation L-2

Unit 9: Image reconstruction

Module 1: CT, PET and SPECT, Fan beam Geometry, Radon Transform L-2

Module 2: MRI, Basic principle, Data acquisition, Functional MRI L-3

References:

1. J. L. Semmlow, Biosignal and biomedical image processing**,** , Marcel Dekker Inc., 2004

2. Kayvan Najarian & Robert Splinter, Biomedical Signal And Image Processing, CRC/Taylor & Francis, 2006.

Optical Networks (IT-9027)

Unit 1 :

Introduction to optical transmission, fibre optics and optical receivers. WDM links_multiplexers and demultiplexers. Passive optical components – splitters, couplers and combiners.

Unit 2:

Optical add/drop multiplexers, cross-connects and switches. Introduction to WDM all optical networks, routing and wavelength assignment issues. OCS with traffic grooming.

Unit 3:

Introduction to optical burst switching-assembly schemes, scheduling of channels, routing and QOS issues. State of the art and future scope.

Unit 4:

Introduction to optical packet switching, switch architecture, contention loss, TCP over OPS, contention loss reduction techniques. State of the art and future scope.

Unit 5:

Optical access networks- PON, GPON, LR-PON. DBA for GPON and LR-PON, current practise and future scope.

Artificial Intelligence (IT-9028)

Overview: foundations, scope, problems, and approaches of AI.
Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents, Artificial Intelligence programming techniques
Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.
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.
Planning: planning as search, partial order planning, construction and use of planning graphs
Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, bayesian networks, probabilistic inference, sample applications.
Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.
Machine Learning and Knowledge Acquisition: learning from memorization, examples, explanation, and exploration. learning nearest neighbor, naive Bayes, and decision tree

classifiers, Q-learning for learning action policies, applications, Sample Applications of AI, student project presentations.
Brief Survey of selected additional topics: perception, communication, interaction, and action; multiagent systems.
Book:
Artificial Intelligence: A Modern Approach, 3rd Edition, by Stuart Russell and Peter Norvig.
Sessional Courses:

Algorithm Development Lab (IT-1051)

1. Implementation of Random Number Generation and Randomizing a list of Numbers.
2. Implementation of Hiring Assistant Problem.
3. Implementation of Rabin-Karp and KMP string matching algorithms.
4. Implementation of One of the Algorithms for Maximum flows.
5. Implementation of Multi Threaded Matrix Multiplication.
6. Implementation of simplex algorithms with an example problem.
7. Implementation of Convex hull and Voronoi diagrams.
8. Implementation of Approx vertex cover and TSP.

Text Books:
Cormen, Leiserson, Rivest, and Stein. Introduction to Algorithms. 2nd ed. Cambridge, MA:MIT Press, 2001. ISBN: 0262032937.

Modeling and Simulation Lab (IT-1052)

1. Introduction to MATLAB.
2. Experiments in modelling dynamical system with MATLAB.
3. Experiments in image and signal processing with MATLAB.
4. Experiments in convex optimization.
5. Experiments in soft computing techniques.
6. Event driven simulation.
7. Simulation experiments in NS2.
8. Developing your own event driven simulator.

Networks Lab (IT-2051)

1. Establishing PC to PC Communication.
2. Parallel Communication using 8 bit parallel cable.
3. Serial communication using RS 232C.
4. Ethernet LAN protocol.
5. To create scenario and study the performance of CSMA/CD protocol through simulation.
6. Configuring a FTP server.
7. Configuring telnet.
8. Configuring DHCP.
9. Implementation of distance vector routing algorithm
10. Implementation of Link state routing algorithm
11. Implementation of Data encryption and decryption
12. Transfer of files from PC to PC using Windows / Unix socket processing.

Distributed Systems Lab (IT-2052)

1. Experiment cover:
   - i) Basic Network socket programming
   - ii) Using Remote Procedure call.
   - iii) Using message passing interface.
   - iv) Agent Creation using JADE.
   - v) Agent based remote communication.
   - vi) Agent Migration in distributed environment.