[DRAFT]

Syllabus of Ph.D. Preparatory Course Work (PCW)

in

Computer Science and Application

Under

Choice Based Credit System (CBCS)

Enlightenment to Perfection

Department of Computer Science and Application

University of North Bengal (N.B.U.)

Raja Rammohonpur, P.O.-N.B.U., Dist-Darjeeling,

West Bengal, India, Pin-734013

(2017-18)

Contents

1. A model Scheme of Instruction and Examination

Name of the Course: Ph.D. Preparatory Course Work (PCW) in Computer Science and Application **Course Duration:** One Semester							
Paper Code	**Papers Title**	**Type of Paper**	**Credit**	**Term End Examination**	**Sessional**	**Total Marks**	**Lecture /Tutorial /Practical** L+T+P * (hr/week) **
PCWCSA 11	Research Methodology 1: Research Foundation	Theory	2	40	10	50	2 + 0 + 0
PCWCSA 12L	Research Methodology 2: Computer Applications in Research	Laboratory	2	40	10	50	0 + 0 + 4
PCWCSA 13	Elective: Any one paper to be chosen from the list of electives based on the scholar's research area with the consent of the supervisor	Theory	4	80	20	100	2 + 4 + 0
		Total	8	160	40	200	4 + 4 + 4

* L: Lecture; T: Tutorial; P:Practical/lab

** One Credit shall mean one teaching period of 1(one) hour per week for one semester (of 15 weeks) for theory courses and 2(two) practical / laboratory / field / demonstration hours / week for one semester.

2. Programme Syllabus

2.1. PCWCSA 11: Research Methodology 1: Research Foundation [Credit Assign: 2, FM: 40+10, Teaching Period: 2hr/week]

Introduction- Meaning, purpose, objectives, characteristics, motivation, significance, types of research; approaches, process, methods and methodology used in research; criteria of good research; difference among research in social science, scientific and engineering domains; research methods in general and computer science, engineering, applications and IT in particular.

The Research Problem – Research problems and sub-problems identification, stating, defining, techniques involved in defining problem

Research Planning and Design - Research plan and its components, developing a research plan, meaning, importance and types of research design, characteristics of a good research design

Development of working hypothesis – Concepts, formulation and types of hypotheses, hypotheses testing methods/techniques, correlation and regression, chi-square test, analysis of variance and covariance etc.

Interpretation and Report Writing- Techniques of interpretation - significance, types, steps, checklist/precautions and characteristics of research documentation i.e. reviews, treatise, monographs, abstracts, articles, technical reports, white papers, research papers, thesis etc. - issues and techniques of writing project proposals, paper presentation and soft skills

Ethical issues and Professional Conduct Ethics in general, Professional Ethics, Ethical Issues and their significance those arise from Computer Technology, General Moral Imperatives, Concepts and issues related to plagiarism and Intellectual Property Rights

Quantitative Methods: Data collection and analysis techniques and tools; Sampling – concepts, types, steps and characteristics of sample, measurement and scaling techniques, types of data with sources; Statistics - Probability & Sampling distribution; Estimation, Hypothesis testing & application; Correlation & regression analysis

Literature Review - Importance of literature review in defining a problem, including literature in research proposal, critique, survey & peer review process, identifying gap areas from literature review; Major Research areas, Journals, Publication, Conferences and Status of Research in the field of Computer Science, engineering, Application and IT

References:

1. Research Methodology Methods and Techniques by C. R. Kothari, Wishwa Prakashan Publishers.
2. An introduction to Research Methodology by Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., RBSA Publishers.
3. Research MethodologySinha, S.C. and Dhiman, A.K., Ess Publications. 2 volumes.
4. Research Methods: the concise knowledge base by Trochim, W.M.K., Atomic Dog Publishing.
5. How to Write and Publish a Scienti_c Paper by Day, R.A., Cambridge University Press.
6. Conducting Research Literature Reviews: From the Internet to Paper by Fink, A., Sage Publications
7. Proposal Writing by Coley, S.M. and Scheinberg, C. A., Sage Publications, 1990.
8. Handbook on Intellectual Property Law and Practice by Subbarau NR, S Viswanathan, Printers and Publishing Private Limited
9. Research Methodology by Dalip Kumar Bhattacharyya
10. Research Methodology by C.H. Chaudhary, RBSA Publication
11. Statistical Techniques by S.P. Gupta, Sultan Chand & Sons
12. An Introduction to Multivariate Statistical Analysis by Anderson T. W., Wiley Eastern Pvt., Ltd., New Delhi.
13. WWW(Web Sources)

2.2. PCWCSA 12: Research Methodology 2: Computer Applications in Research

[Credit Assign: 2, FM: 40+10, Teaching Period: 2hr/week]

Introduction: Use of computer in research as a tool; introduction and use of internet and search engines with advanced search tools for data and information collection and repository; getting familiar and using e-resources i.e. open coursewire, online tutorials, eBooks,

eJournals etc., Libraries, INFLIBNET, Shodhganga, ShodhGangotri, N-LIST, UGC-INFONET Digital Library Consortium etc., different academic and research forums, bodies, societies etc.; concept of free and open source software (FOOS)

Spreadsheets and Statistical tools: Introduction to spread-sheet applications i.e. MS Excel, Open office and similar or other advanced tools, features & functions, using formulae & functions, data storing, features for statistical data analysis, generating charts/graphs & other features, GNU octave, ploticus, PSPP, R etc.

Presentation tool: Introduction to presentation tools i.e. MS Powerpoint, Open Office or any other tool, features & functions, creating presentations, customizing presentation.

Thesis writing & Scientific editing tools: Using different text editing and formatting tools i.e. LaTex, MS Office, Scientific Office, LibreOffice Writer , MS-Publisher, Idea Rover, Wunderlis, Mendely, Zotero, Docear, endnote, Evernote, Dropbox, Spotify, Citavi, Docear, ActiveScolar, FocusWriter, WriteMonkey, Celtx, Sigil, Scribus and others alike.

References:

1. LaTeX Beginner's Guide by Stefan Kottwitz
2. Getting Started with LaTeX by David R. Wilkins
3. Making TeX Work by Norman Walsh
4. A Gentle Introduction to TeX by Michael Doob
5. The Computer Science of TeX and LaTeX by Victor Eijkhout
6. LATEX for Beginners: Workbook [Available at http://www.docs.is.ed.ac.uk/skills/documents/3722/3722-2014.pdf]
7. LATEX Tutorials A PRIMER Indian TEX Users Group Trivandrum, India 2003 September Edited by E. Krishnan [Available at https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf]
8. LaTeX Wikibook [available at https://en.wikibooks.org/wiki/LaTeX]
9. WWW

2.3. PCWCSA 13: Elective – 1: Any one paper to be chosen from the list of following electives based on the research interest of the scholar and availability of suitable supervisor:

E01: Adhoc and Sensor Networks
E02: ANN and Pattern Recognition
E03: Artificial Intelligence & Expert Systems
E04: Big Data and Large-Scale Computing
E05: Bioinformatics and Computational Biology
E06: Computer Graphics and Animation
E07: Computer Networks and Distributed Systems
E08: Cloud and Grid Computing
E09: Data Warehousing and Mining
E10: Digital Image Processing
E11: Digital Watermarking and Steganography
E12: Education Technology
E13: GIS and Remote Sensing
E14: High Performance and Scientific Computing
E15: Human-Computer Interaction (HCI)

E16: Information Security and Cyber Forensic
E17: Natural Language Processing
E18: Network Security and Cryptography
E19: Optimization Methods
E20: Soft Computing
E21: Software Engineering
E22: Systems Software and Compiler Optimization
E23: Theory of Computational Fundamentals

Detail Syllabus of the Elective Papers:

E01: Adhoc and Sensor Networks

Introduction to mobile and ad-hoc/sensor networks: Concepts; advantages, unique constraints and challenges; Driving Applications, Wireless Communications/Radio Characteristics, Ad-Hoc wireless networks , network simulators (OPNET, NS2, etc.)
Wireless LAN (WiFi): 802.11 specifications, Medium Access Control Protocol issues; power control, spatial reusability, and QoS.
Bluetooth: specifications, Piconet synchronization and master-slave switch, scatternet formations, interference issues, interoperability with WiFi.
Architecture: typical network architectures, data relaying strategies, aggregation, role of energy in routing decisions, single node architecture: hardware and software components of a sensor node, TinyOS operating system, nesC language.
Media Access Control (MAC) Protocols: MAC layer protocols, classifications of MAC protocols, MAC protocols, issues in designing MAC protocols, contention-based protocols, schedule-based protocols, 802.15.4 standard.
Routing: Cellular and Ad hoc wireless networks, Issues in designing routing protocols, Classification of routing protocols, Issues of MAC layer and Routing, Proactive, Reactive and Hybrid Routing protocols, Multicast Routing, Tree based and Mesh based protocols, Multicast with Quality of Service Provision, Routing protocols, Agent-based routing, random walk, trace routing; TCP over mobile ad hoc networks- IP address acquisition, effects of partitions on TCP, provisions for mobility and fairness.
Quality of Service: Real-time traffic support, Issues and challenges in providing QoS, Classification of QoS Solutions, MAC layer classifications, QoS Aware Routing Protocols, Ticket based and Predictive location based Qos Routing Protocols
Energy Management Ad Hoc Networks: Need for Energy Management, Classification of Energy Management Schemes, Battery Management and Transmission Power Management Schemes, Network Layer and Data Link Layer Solutions, System power Management schemes
Mesh Networks: Necessity for Mesh Networks, MAC enhancements, IEEE 802.11s Architecture, Opportunistic Routing, Self Configuration and Auto Configuration, Capacity Models, Fairness, Heterogeneous Mesh Networks, Vehicular Mesh Networks
Sensor Networks: Introduction, Unique features, Sensor Network architecture, Clock Synchronization- clustering for synchronization, sender-receiver and receiver-receiver synchronization, Error analysis, Node Localization- absolute and relative localization, triangulation, multi-hop localization and error analysis, anchoring, geographic localization, naming and addressing- addressing services, publish-subscribe topologies ; Data Dissemination, Data Gathering, MAC Protocols for sensor Networks, Deployment of ad-hoc/sensor network, Sensor tasking and control, Transport layer and security protocols,

Location discovery, Quality of Sensor Networks, Evolving Standards, Other Issues, Recent trends in Infrastructure less Networks

Sensor Network Platforms and Tools: Berkley Motes, Sensor network programming challenges, Embedded Operating System, Simulators

Applications of Ad-Hoc/Sensor Network and Future Directions: Ultra wide band radio communication, Wireless fidelity systems

References:

1. C. Siva Ram Murthy And B.S.Manoj, Ad Hoc Wireless Networks – Architectures And Protocols, Pearson Education, 2004
2. Feng Zhao And Leonidas Guibas, Wireless Sensor Networks, Morgan Kaufman Publishers, 2004.
3. C. K. Toh, Adhoc Mobile Wireless Networks, Pearson Education, 2002.
4. Thomas Krag And Sebastin Buettrich, Wireless Mesh Networking,,, O,,Reilly Publishers, 2007
5. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, WILEY
6. Carlos de Morais Cordeiro and Dharma Prakash Agrawal, "Ad Hoc and Sensor Networks : Theory and Applications", Second Edition, World Scientific Publishers, 2011
7. Prasant Mohapatra and Sriramamurtyhy, "Ad Hoc Networks: Technologies and Protocols", Springer International Edition, 2009
8. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks', A John Wiley & Sons Inc. Publication, 2007

E02: ANN and Pattern Recognition

Fundamentals of AI: Definitions, foundations of AI, Brief History of Artificial Intelligence, solving Problems by Searching, Informed Search and Exploration, constraint Satisfaction Problems**,** Adversarial Search**,** Knowledge Representation, different branches and application domainsof AI

Introduction to ANN : Introduction- Features, structure and working of Biological Neural Network, Trends in Computing Comparison of BNN and ANN; Basics of Artificial Neural Networks- History of neural network research, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture; Backpropagation networks (BPN) - Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, backpropagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning; Activation & Synaptic Dynamics - Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks; Neural Network Classifier - Single and Multilayer Perceptron, Back Propagation Learning , Hopfield Network, Fuzzy Neural Network; Unsupervised Classification- Clustering, Hierarchical , clustering , Graph Based Method , Sum of Squared Error Technique, Iterative Optimization

Pattern Recognition: Feature extraction and Pattern Representation , Concept of Supervised and Unsupervised Classification , Application Areas; Statistical Pattern Recognition - Bayes Decision Theory , Minimum Error and Minimum Risk Classifiers; Discriminant Function and Decision Boundary, Normal Density , Discriminant Function for Discrete Features, Parameter Estimation; Dimensionality Problem- Dimension and accuracy , Computational Complexity , Dimensionality Reduction ,Fisher Linear Discriminant , Multiple Discriminant

Analysis; Nonparametric Pattern Classification - Density Estimation , Nearest Neighbour Rule , Fuzzy Classification; Linear Discriminant Functions- Separability , Two Category and Multi Category Classification, Linear Discriminators , Perceptron Criterion , Relaxation Procedure , Minimum Square Error Criterion , Widrow-Hoff Procedure, Ho-Kashyap Procedure , Kesler's Construction; Time Varying Pattern Recognition - First Order Hidden Markov Model, Evaluation , Decoding, Learning

Basic functional units of ANN for pattern recognition tasks: Basic feed forward, Basic feedback and basic competitive learning neural network, Pattern association, pattern classification and pattern mapping tasks; Feedforward neural networks – - Linear responsibility X-OR problem and solution. - Analysis of pattern mapping networks summary of basic gradient search methods; Feed back neural networks Pattern storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning

Competitive learning neural networks: Components of CL network pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network.

Applications of ANN: Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation

References:

1. Artificial Intelligence A Modern Approach, Second Edition By Stuart Russell, Peter Norving., Prentice Hall of India Private Limited New Delhi-110001,(2003).
2. Artificial Intelligence (second edition) by E. Rich & K. Knight, (McGraw Hill, 1991)
3. Introduction to Artificial Intelligence by D. W. Patterson, (Prentice Hall, 1990)
4. B. Yegnanarayana - Artificial neural network PHI Publication
5. S. Raj sekaran, Vijayalakshmi Pari - Neural networks, Fuzzy logic and Genetic Algorithms
6. Kevin L. Priddy, Paul E. Keller – Artificial neural networks: An Introduction - SPIE Press, 2005
7. Mohammad H. Hassoun – Fundamentals of artificial neural networks - MIT Press ,1995
8. Nelson Morgan – Artificial neural network: Electronic Implementations – IEEE Press, 1990

E03: Artificial Intelligence & Expert Systems

Scope of AI: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques-search knowledge, abstraction.

Problem solving: State space search- Production systems; Search space control-Depth first search, breadth first search, heuristic search – Hill climbing, best first search, branch and bound; Minimax search- Alpha-Beta cutoffs.

Knowledge Representation: Predicate Logic- Skolemizing queries, Unification, Modus pones. Resolution, dependency directed backtracking.

Rule Based Systems- Forward reasoning, Conflict resolution, Backward reasoning- Use of no backtrack.

Structured Knowledge Representations: Semantic Net: slots, Frames.

Handling uncertainty: Probabilistic reasoning, Use of certainty factors, Fuzzy logic.
Learning: Concept of learning, learning automation, genetic algorithm, learning by induction, neural nets-back propagation.
Expert Systems: Need and justification for expert systems, Knowledge acquisition
Case studies: MYCIN, RI.

References:

1. Nilsson, N. J., Principles of AI, Narosa publishing House, 1990
2. Patterson, D. W., Introduction to AI and Expert Systems, PHI, 1992
3. Peter Jackson, Introduction to Expert Systems, Addison Wesley Publishing Company, M.A., 1992
4. Rich. E., and knight, K., Artificial Intelligence, 2nd Ed., TMH, 1992
5. Schalkoff, R.J., Artificial Intelligence – An Engineering Approch, McGraw Hill International Edition, Singapore, 1992
6. Sasikumar, M. Ramani, S., Rule Based Expert System, Narosa Publishing House, 1994

E04: Big Data and Large-Scale Computing

Introduction: Introduction to Big Data with applications, Technologies for handling big data, Hadoop overview- MapReduce and HDFS, Hadoop ecosystem- Mahout, Giraph, Pig, Hive, HBase, Sqoop, Spark; Apache Spark overview
Hadoop Fundamentals: Hadoop architecture and HDFS – Hadoop Distributed File System, The MapReduce paradigm, Anatomy of a MapReduce program , Working with (key, value) pairs, Streaming in Hadoop
Data Storage, Importing and Exporting Data: ingress and egress, Understanding HDFS and HBase, Sqoop to import/export from/to MySQL; Importing/Exporting data between HDFS and MongoDB; ingress/egrees between HBase and HDFS; Data serialization
Working with Hive and Pig: Hive basics and Hive query language (HiveQL), Data analytics with Hive, Working with user-defined functions (UDFs), Combining Pig with scripts, Combining (sorted and skewed) data with Pig, Sorting data with Pig
Hadoop Use Cases: How Hadoop is used in the real world, Recognizing Hadoop problems, Example use-cases in search, ad targeting, churn analysis, etc.
Big Data ML with Mahout – Classification: Mahout's machine learning themes, Classification, Data as vector, Choosing an algorithm, Classifier evaluation API, Deploying a classifier in large systems, Case study I: Click prediction, Case study II: Spam classifier
Big Data ML with Mahout- Clustering and Recommenders: Clustering algorithms in Mahout o k-means, fuzzy k-means, Topic modeling by LDA, Clustering on a Hadoop cluster, Case studies, Recommenders, User, item, and content-based recommendations, Recommendations with Hadoop
Apache Spark Fundamentals: Stack: Spark Core, SQL, Streaming, GraphX, MLlib, Programming with Resilient Distributed Datasets (RDDs), Spark SQL, Introduction to data analysis with Scala and Spark
Temporal, Geospatial, Text Data Analysis with Spark: Spark Streaming, Working with temporal and geospatial data in Spark, Parsing text, TF-IDF, SVD, querying and scoring, relevance
Analyzing Networks with GraphX: Constructing co-occurance network, Understanding network structure, Computing graph statistics
Big Data ML with MLlib: k-means Clustering, Decision Trees and Random Forests , Recommenders

Spark MLlib Use Cases: Recommending music, Predicting forest cover, Network traffic anomaly detection

References:

1. Hadoop in Practice, Manning Publications Co. Alex Holmes
2. Hadoop in Action, Manning Publications Co. Chuck Lam
3. Mahout in Action, Manning Publications Co. Sean Owen, Robin Anil, Ted Dunning, Ellen Friedman
4. Learning Spark, O'Reilly Holden Karau, Andy Konwinski, Patrick Wendell, and Matei Zaharia
5. Advanced Analytics with Spark, O'Reilly Sandy Ryza, Uri Laserson, Sean Owen & Josh Wills

E05: Bioinformatics and Computational Biology

Introduction and Basics: basics of molecular biology, DNA, RNA, proteins; transcription, translation, regulation; genome organization; cellular organization, metabolism, regulatory pathways; tree of life, phylogeny; cloning, DNA and protein sequencing, genome mapping, PCR, mutagenesis; in-vivo / in-vitro / in-silico; biological models and formalisms; phylogenetic trees

Bioinformatics Basics: introduction, issues and problems, physical mapping of genome, genome structure, interpreting genomic sequence data: sequence alignment, gene finding, structure prediction (rna and proteins), pattern discovery, regulatory pathways and networks, simulations, computational models of evolution, simulations; DNA computing, bioinformatics tools vs. synergistic research; molecular biology tools, genomic information content, major databases in bioinformatics information search and data retrieval- tools for web search, data retrieval tools, data mining of biological databases; genome analysis, genome mapping, physical maps, cloning the entire genome, genome sequencing, Human Genome Project (HGP)

Alignment of Pairs of Sequences - Methods of Sequence Alignments, scoring- intro, basics, details; global vs. local sa; Using Scoring Matrices, Measuring Sequence Detection Efficiency, Methods of Multiple Sequence Alignment, Evaluating Multiple Alignments, Phylogenetic Analysis, Tree Evaluation Tools for Similarity Search and Sequence Alignment – Working with FASTA, BLAST, FASTA and BLAST Algorithms Comparison

RNA and Protein Structure: RNA secondary structure prediction, comparative sequence analysis, equilibrium partition function for secondary structure; prediction of pseudoknots in RNA secondary structure; basics: primary, secondary, tertiary, quartary protein structure; forces that stabilise structure; tertiary structure prediction approaches, energy minimisation with genetic algorithms; secondary structure prediction: simple statisitical methods, chou-fasman rules, computational problems; neural network approaches

Gene Finding and Motif Discovery: gene finding- basic problem; why is it interesting? why is it hard?, open reading frames (watson method), simple pattern search, weight matrix methods (WAM, etc.), signal detection and integration, HMM-based methods, HMM gene identification and prediction – Basis of Gene Prediction, Pattern Recognition, technologies for gene expression analysis (microarrays, SAGE), clustering gene expression data, Gene Expression and Microarrays – Working with DNA Microarrays, Clustering Gene Expression Profiles, Data Sources and Tools for Microarray Analysis, state-of-the-art gene finders (HMMGene, GenScen), Applications of Microarray Technology; evaluating gene finding

algorithms; probabilistic scores, benchmark collections, combining gene finders, inference of regulatory relationships from gene expression data; motif discovery and characterization

Biomolecular Computing: Adleman's experiment; "classical" models for DNA computing, Self-assembly models for DNA computing; Winfree's work, combinatorial and algorithmic problems arising in biomolecular, computation: inverse RNA folding, theory of self-assembly and resource bounded tiling

Protein Classification, Structure Visualization and Proteomics - Protein Structure Visualization, Protein Structure Databases, Protein Structure Alignment, Domain Architecture Databases, Protein Classification Approaches, Protein Identification and Characterization, Primary and Secondary Structure Analysis and Prediction, measures of prediction accuracy, statistical technique (CF and GOR algorithm), neural network (PHD) nearest neighbor method (PREDATOR and NNSSP), consensus methods (JPRED and NPS), Protein tertiary structure prediction: homology modeling, threading and Abs Initio structure prediction, Other issues: CASP, Levinthol paradox and protein folding; Patterns and Fingerprints Search, Methods of 2D Structure Prediction, Protein Prediction from a DNA Sequence, Tools and Techniques in Proteomics, Protein-Protein Interactions, Methods of Gene Family Identification

Computational Methods for Pathways and Systems Biology – Analysis of Pathways, Metabolic Control Analysis, Simulation of Cellular Activities, Biological Markup Languages

Phylogenetic Analysis: Graphs and trees: phylogenetics trees and cladogram, Building phylogenetic trees: similarity and distance table, distance matrix methods, maximum parsimony methods, limitations of phylogenetic algorithms, phylogenetic software, reliability of phylogenetic trees, Evolution of macromolecular sequences: molecular phylogeny, choice of macromolecular sequence, rapidly evolving macromolecular sequences.

References

1. N. Gautham, Bioinformatics: Databases and algorithms, Narosa publishing house, Chennai 2006.
2. P. Shanmughavel Principles of Bioinformatics, , Pointer publishers, Jaipur 2005.
3. David Mount, Bioinformatics: Sequence and Genome Analysis, Second Edition, CBS Publishers 2005.
4. J. Pevzner, Bioinformatics and functional genomics, 2nd edition, John wiley & sons, 2009.
5. S C Rastogi, N Mendiratta, P Rastogi, Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery, Third Edition, PHI Learning Private Limited, 2011
6. Vittal R Srinivas, Bioinformatics A modern Approach, PHI Learning Private Limited, 2009
7. Bryan Bergeron, Bioinformatics Computing PHI Learning Private Limited, 2010
8. Dan E Krane, Michael L Raymer, Fundamental Concepts of Bioinformatics, Pearson Education, 2003
9. T K Attwood, D J Parry Smith, Introduction to Bioinformatics, Pearson Education, 2003.
10. D. Gusfield: Algorithms on Strings, Trees, and Sequences: Computational Science and Computational Biology. Cambridge University Press, 1997.

11. Durbin, Eddy, Krogh, Mitchison: Biological sequence analysis: Probabilistic models of proteins and nucleic acids. Cambridge University Press, 1998.
12. P. Baldi, S. Brunak: Bioinformatics: the machine learning approach. MIT Press, 1998.
13. Garret and Grisham: Biochemistry. Saunders College Publishing, 1995
14. Alberts, Bray, Lewis, Raff, Roberts, Watson: Molecular Biology of the Cell. Garland Publishing, Inc., 1994
15. Benjamin Lewin: Genes V. Oxford University Press, 1994.
16. Griffiths, Miller, Suzuki, Lewontin, Gelbart: An Introduction to Genetic Analysis. Freeman and Company, 1993.
17. Watson, Gilman, Witkowsi, Zoller: Recombinant DNA. Scientific American Books, 1992.
18. Gesteland, Cach, Atkins (Editors): The RNA World. Cold Spring Harbor Laboratory Press, 1999.

E06: Computer Graphics and Animation

Introduction to Computer Graphics: Overview of Computer Graphics, Computer Graphics Application and Software, Description of some graphics devices, Input Devices for Operator Interaction, Active and Passive Graphics Devices, Display Technologies, Storage Tube Graphics Displays, Calligraphic Refresh Graphics Displays, Raster Refresh (Raster-Scan) Graphics Displays, Cathode Ray Tube Basics, Color CRT Raster Scan Basics, Video Basics, The Video Controller, Random-Scan Display Processor, LCD displays

2D Transformations: Transformations and Matrices, Transformation Conventions, 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Translations and Homogeneous Coordinates, Rotation, Reflection, Scaling, Combined Transformation, Transformation of Points, Transformation of The Unit Square, Solid Body Transformations, Rotation About an Arbitrary Point, Reflection through an Arbitrary Line, A Geometric Interpretation of Homogeneous Coordinates, The Window-to-Viewport Transformations

3D Transformations: Introduction, Three-Dimensional Scaling, Three-Dimensional Shearing, Three-Dimensional Rotation, Three-Dimensional Reflection, Three-Dimensional Translation, Multiple Transformation, Rotation about an Arbitrary Axis in Space, Reflection through an Arbitrary Plane, Matrix Representation of 3D Transformations, Composition of 3D Transformations, A_ne and Perspective Geometry, Perspective Transformations, Techniques for Generating Perspective Views, Vanishing Points, the Perspective Geometry and camera models, Orthographic Projections, Axonometric Projections, Oblique Projections, View volumes for projections.

Viewing in 3D: Stages in 3D viewing, Canonical View Volume (CVV), specifying an Arbitrary 3D View, Examples of 3D Viewing, The Mathematics of Planar Geometric Projections, Combined transformation matrices for projections and viewing, Coordinate Systems and matrices, camera model and viewing pyramid, Scan conversion-Lines, circles and Ellipses; Filling polygons and clipping algorithms, Scan Converting Lines, Mid-point criteria, Problems of Aliasing, end-point ordering and clipping lines, Scan Converting Circles, Scan Converting Ellipses, Filling Polygons, edge data structure, Clipping Lines algorithms Cyrus-Beck, Cohen Sutherland and Liang-Barsky, Clipping Polygons, problem with multiple components.

Solid Modeling: Representing Solids, Regularized Boolean Set Operations, Primitive Instancing, Sweep Representations, Spatial-Partitioning Representations, Octree representation, B-Reps, Constructive Solid Geometry, Comparison of Representations
Visible-Surface Determination: Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The z-Buffer Algorithm, Scan-line method, Painters algorithms (depth sorting), Area sub-division method, BSP trees, Visible-Surface Ray Tracing, comparison of the methods
Illumination and Shading: Illumination and Shading Models for Polygons, Reflectance properties of surfaces, Ambient, Specular and Diffuse reflections, Atmospheric attenuation, Phongs model, Gouraud shading, some examples.
Plane Curves and Surfaces: Curve Representation, Nonparametric Curves, Parametric Curves, Parametric Representation of a Circle, Parametric Representation of an Ellipse, Parametric Representation of a Parabola, Parametric Representation of a Hyperbola, A Procedure for using Conic Sections, The General Conic Equation; Representation of Space Curves, Cubic Splines, 25
Bezier Curves, B-spline Curves, B-spline Curve Fit, B-spline Curve Subdivision, Parametric Cubic Curves, Quadric Surfaces. Bezier Surfaces
Graphics Programming using OPENGL: Why OpenGL, Features in OpenGL, OpenGL operations, Abstractions in OpenGL GL, GLU & GLUT, 3D viewing pipeline, viewing matrix specifications, a few examples and demos of OpenGL programs.
Miscellaneous topics: Why Realism? Aliasing and Anti-aliasing, texture bump mapping, Animation concept and methods, methods of controlling animation, soft modeling of objects, image based rendering, Fundamental Difficulties, animation tools

References:

1. J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes, Computer Graphics Principles and Practice, Second Edition in C, Pearson Education, 2003.
2. D. Hearn and M. Pauline Baker, Computer Graphics (C Version), Pearson Education, 2nd Edition, 2004.
3. D. F. Rogers and J. A. Adams, Mathematical Elements for Computer Graphics, 2nd Edition, McGraw-Hill International Edition, 1990.
4. F. S. Hill Jr., Computer Graphics using OpenGL, Pearson Education, 2003.

E07: Computer Networks and Distributed Systems

Computer Networks and the Internet: What is the Internet, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones, Delay and Loss in Packet-Switched Networks, History of Computer Networking and the Internet? Foundation of Networking Protocols: 5-layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing, Equal-Sized Packets Model: ATM - Networking Devices: Multiplexers, Modems and Internet Access Devices, Switching and Routing Devices, Router Structure.
The Link Layer and Local Area Networks: Link Layer: Introduction and Services, Error-Detection and Error-Correction techniques, Multiple Access Protocols, Link Layer Addressing, Ethernet, Interconnections: Hubs and Switches, PPP: The Point-to-Point Protocol, Link Virtualization. Routing and Internetworking: Network–Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost-Path algorithms, Intradomain Routing Protocols, Interdomain Routing Protocols, Congestion Control at Network Layer

Logical Addressing: IPv4 Addresses, IPv6 Addresses. Internet Protocol: Internetworking, IPv4, IPv6,Transition from IPv4 to IPv6 – Multicasting Techniques and Protocols: Basic Definitions and Techniques, Intradomain Multicast Protocols, Interdomain Multicast Protocols, Node-Level Multicast algorithms - Transport and End-to-End Protocols: Transport Layer, Transmission Control Protocol(TCP), User Datagram Protocol (UDP), Mobile Transport Protocols, TCP Congestion Control –Application Layer: Principles of Network Applications, The Web and HTTP, File Transfer: FTP,Electronic Mail in the Internet, Domain Name System (DNS), P2P File Sharing, Socket Programming with TCP and UDP, Building a Simple Web Server

Wireless Networks and Mobile IP: Infrastructure of Wireless Networks, Wireless LAN Technologies, IEEE 802.11 Wireless Standard, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs). Optical Networks and WDM Systems: Overview of Optical Networks, Basic Optical Networking Devices, Large-Scale Optical Switches, Optical Routers, Wavelength Allocation in Networks, Case Study: An All-Optical Switch VPNs, Tunneling and Overlay Networks: Virtual Private Networks (VPNs), Multiprotocol Label Switching (MPLS), Overlay Networks – VoIP and Multimedia Networking: Overview of IP Telephony,VoIP Signaling Protocols, Real-Time Media Transport Protocols, Distributed Multimedia Networking, Stream Control Transmission Protocol - Mobile A-Hoc Networks: Overview of Wireless Ad-Hoc Networks, Routing in Ad-Hoc Networks, Routing Protocols for Ad-Hoc Networks – Wireless Sensor Networks: Sensor Networks and Protocol Structures, Communication Energy Model, Clustering Protocols, Routing Protocols

Distributed Systems: Introduction, Communication mechanisms, Processes and mobile code, Naming, Synchronization, Scalability, Consistency, replication, and caching, Fault tolerance, Security and access controls

References:

1. Computer Networking: A Top-Down Approach Featuring the Internet, *James F. Kurose, Keith* 2. *W.Ross*, Third Edition, Pearson Education, 2007
2. Computer and Communication Networks, *Nader F. Mir*, Pearson Education, 2007
3. Data Communications and Networking, *Behrouz A. Forouzan*, Fourth Edition, Tata McGraw Hill, 2007
4. Guide to Networking Essentials, *Greg Tomsho,Ed Tittel, David Johnson,*Fifth Edition, Thomson.
5. An Engineering Approach to Computer Networking, *S.Keshav*, Pearson Education.
6. Campus Network Design Fundamentals, *Diane Teare, Catherine Paquet*, Pearson Education (CISCO Press)
7. Computer Networks, *Andrew S. Tanenbaum*, Fourth Edition, Prentice Hall.
8. The Internet and Its Protocols, A. Farrel, Elsevier.
9. *Distributed Systems: Concepts and Design*, by George Coulouris, Jean Dollimore, and Tim Kindberg, Addison Wesley, 4th edition, 2005. (CDK)
10. Distributed Systems: Principles and Paradigms, Andrew S. Tanenbaum & Maarten Van Steen, Published by Pearson, ISBN 0-13-239227-5, 2nd edition.

E08: Cloud and Grid Computing

Introduction to Grid Computing: What is a grid? Infrastructure of hardware and software, Main Projects and Applications, The Open Grid Forum, International Grid Trust Federation; Grid Architecture, Overview of Resource Managers, Overview of Grid Systems; Application

Management: Grid Application Description Languages, Application Partitioning, Meta-scheduling, Mapping, Monitoring; Web Services, Grid Portals,

Cloud Computing Overview: What is a cloud, Definition of cloud, Characteristics of cloud, Why use clouds, How clouds are changing, Driving factors towards cloud, Comparing grid with cloud, Public clouds (commercial), Cloud Computing and SOA, Enterprise Cloud drivers and adoption trends, Typical Cloud Enterprise workloads, Cloud service models/types, Cloud deployment models, Cloud ROI models, Cloud reference architectures, Cloud standards, Technology providers vs. Cloud providers vs. Cloud vendors, Planning Cloud transformations

Cloud service delivery: Cloud service, Cloud service model architectures, Infrastructure as a service (IaaS) architecture, Platform as a service (PaaS) architecture, Platform as a service (PaaS), Software as a service (SaaS) architecture, Examples of SaaS applications, Business Process as a Service (BPaaS) Architecture, Trade-off in cost to install versus, Common cloud management platform reference architecture: Architecture overview diagram, Common cloud management platform.

Cloud deployment scenarios: Cloud deployment models, Public clouds, Hybrid clouds, Community, Virtual private clouds, Vertical and special purpose, Migration paths for cloud, Selection criteria for cloud deployment, Case study example: IBM Smart Cloud

Security in cloud computing: Cloud security, Cloud security reference model, How security gets integrated, Cloud security challenges, Understanding security risks, Cloud security approaches: encryption, Digital signature, tokenization/ obfuscation, cloud security alliance standards, cloud security models and related patterns; Virtualization and multitenancy, Internal security breaches, Data corruption or loss, User account and service hijacking, Steps to reduce cloud security breaches, Steps to reduce cloud security breaches; Identity detection, forensics and management, What is SSL? Cloud security in mainstream vendor solutions; Mainstream Cloud security offerings: security assessment, secure Cloud architecture design; Design a secure Cloud architecture to support the deployment of a secure version of the course project application.

References:

1. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011
3. Nikos Antonopoulos, Lee Gillam, Cloud Computing: Principles, Systems and Applications, Springer, 2012
4. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2010
5. M. N. Rao, Cloud Computing, PHI

E09: Data Warehousing and Mining

Introduction to Data Mining: Definition of data mining ,Data Mining functionalities, Classification of data mining systems , Data Mining Applications, Architectures of data mining systems, Data mining class comparison.

Data Mining Algorithms: Concept Description: Definition, Data Generalization and Summarization –Based Characterization, Mining Descriptive Statistical Measures in Large Databases; Mining Association Rules: Association Rule Mining, Market Basket Analysis, Association Rule Classification, The Apriori Algorithm, Mining Multilevel Association Rules, Constraint-Based Association Mining, Sequential mining

Classification and Prediction: What is Classification and Prediction? Data Classification Process, Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification Based on Association Rule Mining, Other Classification Methods Cluster Analysis: What is Cluster Analysis? Types of Data in Cluster Analysis, Categorization of Clustering Methods, Partitioning methods

Introduction to Data Warehousing: Introduction to Decision Support System: DSS Definition, History of DSS, Ingredients of DSS, Data and Model Management, DSS Knowledge base, User Interfaces, The DSS Users, Categories and Classes of DSSs Need for data warehousing, Operational & informational data, Data Warehouse Definition and characteristics, Operational Data Stores

Data warehouse Components: Architectural components, Data Preprocessing: Why Preprocess Data? Data Cleaning Techniques, Data Integration and Transformation, Data Reduction Techniques, Discretization and Concept Hierarchy, Generation for numeric and categorical data, Significant role of metadata, Building a Data warehouse, Benefits of Data Warehousing.

OLAP in the Data Warehouse: A Multidimensional Data Model, Schemas for Multidimensional Databases: Stars, Snowakes, Star join and Fact Constellations Measures, Concept Hierarchies, OLAP Operations in the Multidimensional Data Model, Need for OLAP, OLAP tools , Mining Multimedia Databases, Mining Text Databases, Mining the World Wide Web.

References:

1. Data Mining – Concepts and Techniques - Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, 2nd Edition, 2006.
2. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson education.
3. Data Warehousing in the Real World – Sam Aanhory & Dennis Murray Pearson Edn Asia.
4. Data Warehousing Fundamentals – Paulraj Ponnaiah Wiley student Edition
5. The Data Warehouse Life cycle Tool kit – Ralph Kimball Wiley student edition
6. Building the Data Warehouse By William H Inmon, John Wiley & Sons Inc, 2005.
7. Data Mining Introductory and advanced topics –Margaret H Dunham, Pearson education
8. Data Mining Techniques – Arun K Pujari, University Press.

E10: Digital Image Processing

Fundamentals of Image Processing: Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels and distance measurement, connectivity, Image Geometry, Photographic film, Light, Brightness adaption and discrimination, Perspective Projection, Spatial Domain Filtering, Grayscale and Color fundamentals, color models (RGB, CMY, HIS), formulation, color complements, color slicing, tone and color corrections, image file formats

Image Filtering: *Spatial Domain Filtering*- Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian; *Frequency domain Filtering*- Hotelling Transform, Fourier Transforms and properties, FFT, Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering, Inverse filtering, Least squares filtering. Recursive filtering

Image Compression: Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Hufiman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation; Wavelet based Image Compression- Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking; Fidelity criterion- MSE, PSNR, Compression ratio,

Image Restoration: Basic Framework and models, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.

Morphological Image Processing: Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

Image Segmentation: Definition, Detection of Discontinuities, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Iterative and Multivariable thresholding, Otsu's method, Moving averages, Boundary detection based techniques; Characteristics of segmentation, Pixel based, Region based and histogram based segmentation methods, segmentation by sub region aggregation, split and merge technique, Watershed segmentation, Use of motion in segmentation (spatial domain technique only),

Image Enhancement: *Spatial Domain Methods*- Arithmetic and Analytical operations, pixel or point operations, size operations) Smoothing filters Mean, Median, Mode filters. Low pass filters, high pass filters, sharpening filters; *Frequency Domain Method*- Design of Low Pass, High Pass, Edge enhancement, Sharpening filters in frequency domain, Bufier Worth Filter, Homomorphic filters in frequency domain and spatial domain.

Application: Different application domains of digital image processing i.e. steganography, medical image processing, GIS etc.

References:

1. Gonslaez, et.a1, "Digital Image Processing", Addison Wesley, Reading, M.A., 1990
2. Anil K Jain; Fundamentals of Digital Image Processing
3. Rafael C Gonzalez, Richard E Woods; Digital Image Processing, Pearson Education
4. Rafael C Gonzalez, Richard E Woods, Eddins; Digital Image Processing using MATLAB, Pearson Education
5. B Chanda & D Dutta Majumder; Digital Image Processing and Analysis, PHI

E11: Digital Watermarking and Steganography

Fundamentals of Image Processing: Basics of image Acquisition and Model, Sampling and Quantization, Image Geometry; Light, Brightness adaption and discrimination, Perspective Projection, Grayscale and Color fundamentals, models and formulation, color issues, image file formats; Image Filtering-Spatial Domain and Frequency domain Filtering; Image Compression- Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, different types of Image Compression techniques; Image Restoration- Basic

Framework , models and techniques; Morphological Image Processing- Introduction, different morphological operations on image; Image Segmentation- Introduction, detection of discontinuities; point, line, edge and boundary detection; Edge linking, characteristics of segmentation, different segmentation approaches; Image Enhancement- Spatial and Frequency Domain Methods

Digital Watermarking Fundamentals: Spatial-Domain Watermarking, Substitution Watermarking in the Spatial Domain, Additive Watermarking in the Spatial Domain, Frequency-Domain Watermarking, Substitution Watermarking in the Frequency Domain, Multiplicative Watermarking in the Frequency Domain, Watermarking Based on Vector Quantization, The Rounding Error Problem, The Fragile Watermark, The Block-Based Fragile Watermark, Weaknesses of the Block-Based Fragile Watermark, The Hierarchical Block-Based Fragile Watermark, The Robust Watermark, The Redundant Embedding Approach, The Spread Spectrum Approach;

Watermarking Attacks and Tools - Image Processing Attacks, Attacks by Filtering, Attack by Remodulation, Attack by JPEG Coding Distortion, Attack by JPEG 2000 Compression, Geometric Transformation, Attack by Image Scaling, Attack by Rotation, Attack by Image Clipping, Attack by Linear Transformation, Attack by Bending, Attack by Warping, Attack by Perspective Projection, Attack by Collage, Attack by Template, Cryptographic Attach, Protocol Attacks, Watermarking Tools;

Combinational Digital Watermarking - An Overview of Combinational Watermarking, Watermarking in the Spatial Domain, Watermarking in the Frequency Domain, Experimental Results, Further Encryption of Combination Watermarking, Genetic Algorithm-Based Digital Watermarking, Adjusted-Purpose Digital Watermarking, Robust High-Capacity Digital Watermarking

Introduction to Digital Steganography: Types of Steganography, Technical Steganography, Linguistic Steganography, Digital Steganography, Applications of Steganography, Cover Communication, One-Time Pad Communication, Embedding Security and Imperceptibility, Examples of Steganographic Software, S-Tools, StegoDos, EzStego, Jsteg-Jpeg; **Steganalysis -**An Overview, The Statistical Properties of Images, The Visual Steganalytic System, IQM-Based Steganalytic System, Learning Strategies, Introduction of the Support Vector Machine, Neural Networks, Principle Component Analysis, Frequency-Domain Steganalytic System;

Genetic Algorithm-Based Steganography- An Overview of the GA-Based Breaking Methodology, The Fitness Function, Reproduction, Crossover, Mutation, The GA-based Breaking Algorithm on the SDSS, Generating the Stego-Image on the Visual Steganalytic System, Generating the Stego-Image on the Image Quality, Measure-Based Steganalytic System, The GA-Based Breaking Algorithm on the FDSS, Experimental Results, The GA-Based Breaking Algorithm on the VSS, The GA-Based Breaking Algorithm on the IQM-SDSS, The GA-Based Breaking Algorithm on the JFDSS, Complexity Analysis.

References:

1. Rafael C Gonzalez, Richard E Woods, Eddins; Digital Image Processing using MATLAB, Pearson Education
2. Ingemar Cox, Matthew Miller, Jeffrey Bloom, and Jessica Fridrich . Digital Watermarking and Steganography, 2nd Ed, (The Morgan Kaufmann Series in Multimedia Information and Systems).
3. Frank Y. Shih. Digital Watermarking and Steganography: Fundamentals and Techniques, CRC Press.g

4. Stefan Katzenbeisser, Fabien, and A.P. Petitcolas. Information Hiding Techniques for Steganography and Digital Watermarking, Artech House.
5. Neil F. Johnson; Zoran Duric; Sushil Jajodia. Information Hiding: Steganography and Watermarking – Attacks and Countermeasures, Springer. 5. Gregory Kipper. Investigator's Guide to Steganography, Auerbach Publications.

E12: Education Technology

Technology in Education: Meaning, Evolution, issues and development
E-Learning: Conceptual Frame Work- Pedagogy, Managerial Perspectives, Online Learning, Media Interactivity, E-Learning Framework; Technologies and Applications - Social Networking, Really Simple Syndication, Concept Maps in e-Learning, Learning Management Systems
Traditional Educational Technology/Materials: Cone of Experiences: Direct and Purposeful (Games & Experiments), Contrived Experiences (Three Dimensional, Mock up, Diorama), Dramatized Experiences(Pageant, Socio-Drama), Demonstration Boards (chalkboard, peg board etc.), Field Trips, Exhibits, Still Pictures(drawings, graphs, cartoon, etc.)
Trends in Educational Technology: Projected materials, Audio Materials, Interactive Materials
ICT in Education: Computer, Internet, Multimedia/Hypermedia
Educational Technology in Instructional Planning: Multiple Intelligence, Learning Styles, Blooms Taxonomy
Technology and Student Assessment: Rubrics, Checklist, Blogs, Miscellaneous Special Topics related to topics of Research

References:

1. Teachers Discovering Computers, Integrating Technology in the Classroom, Second Edition by Shelly Cashman Gunter, (ISBN: 0-7895-6492-0).
2. Integrating Educational Technology into Teaching, Student Value Edition (6th Edition), M. D. Roblyer, Aaron H. Doering, Publisher: Pearson; 6 edition (February 25, 2012) ISBN-10: 013289680X, ISBN-13: 978-0132896801.

E13: GIS and Remote Sensing

Introduction to GIS: GIS definition, key components, scope and functions of GIS, benefits, relationship with other disciplines, issues, application areas.
Functional requirements of GIS: GIS components; Cartography –GIS interface; Recent trends and applications of GIS; Open source GIS;
Geographic data: Spatial and non spatial; Data models: Raster and vector; Database Management System (DBMS); Data Structures: Relational, hierarchical and network; Data input: Digitization of maps and imageries; Coordinate transformation; Attribute data generation; Spatial Data Structures - Quad-tree, R-tree- searching, insertions, deletion algorithms, Topology and topological models- 9 Intersection model
Spatial data base fundamentals: Extended ER diagram for spatial entities. Spatial data model, object relational mode, ex. Oracle spatial data model
Spatial data models: ISO 19101 data model, geometry classes, basic element types, SDO-GEOMETRY structure and operations

Spatial Indexing and analysis: Spatial indexing - principles, benefits, index types, implementation in Oracle; Spatial overlay operations, network analysis and proximity analysis; 3D models; TIN, DEM, DTM Query in GIS;
Spatial SQL: (operators and functions) terminology, principles, set based operations, topological operations. Spatial joins. Spatial functions.
Network modelling: motivation, general network concepts, Network data model and metadata, spatial indexes on NM, shortest path and other functions. Directed and undirected networks, Traveling salesperson problem, reachability analysis, spanning tree spatial data infrastructure and
OpenGIS: introduction, components of SDI, Standards
Principles of Remote Sensing: Definition, types and scope of remote sensing; Stages in remote sensing data acquisition; Electromagnetic radiation and electromagnetic spectrum; Black body radiation and radiation laws; Interaction of EMR with atmosphere and Earth's surface features.
Platforms, Sensors and Data Products: Remote sensing platforms; Types & characteristics of sensors: IRS, LANDSAT, SPOT, IKONOS, Quick Bird; Remote sensing data products.
Thermal & Microwave Remote Sensing: Thermal Remote Sensing; Thermal properties of materials: emissivity of materials; thermal inertia of Earth surface features; Thermal data sets: LANDSAT and ASTER; Concept and Principles of microwave remote sensing; Microwave data sets SLAR. LIDAR and SAR; Application of Thermal and Microwave data
Remote Sensing Applications: Remote Sensing Applications in Human Settlement and Urban Analysis, Geosciences, Agriculture, Forestry and Soil, Hydrology & Water Resources Management

References:

1. Geographic Information Systems and Science, Longley, Goodchild, Rhind, Wiley & Sons
2. The Design and Analysis of Spatial Data Structures by Hanan Samet, Addison Wesley
3. Maguire,D.J.; Goodchild, M.F.; Rhind,D.W. 1991.Geographical information System, Longman, London,UK
4. Siddiqui, M.A.; 2006, Introduction to Geographical Information System, Sharda Pustak Bhavan, Allahabad.
5. Fotheringham, S.; Rogerson, P. (ed.), 1994. Spatial analysis and GIS. Taylor and Francis, London, UK
6. Spatial Databases- A Tour by Shekhar Chawla, Upper Saddle River, NJ, USA, Prentice Hall. 4. Pro Oracle Spatial, R. Kothuri & Beinat, E, APRESS, USA
7. Curran,Paul J; 1985, Principles of Remote Sensing,Longman,London.
8. Estes, J.E. and LW Senger, 1974, Remote Sensing techniques for environmental Analysis, Hamilton, Santa Barbara, California.
9. Lillesand, Thomas M. and RW Kiefer, 1987, Remote sensing and Image Interpretation, John Wiley & Sons, New York.
10. Sabins, floyd F,1986, Remote Sensing: Principles and Interpretation, Freeman, New York.
11. Slater,PN,1980,Remote Sensing: Optics and Optical System, Addison-Wesley, Reading

E14: High Performance and Scientific Computing

Introduction: An overview of high performance and scientific computing ; Review of Sequential Computing: *Uniprocessor Architecture*- The CPU, Memory, I/O and Networking, Design Tradeoffs, Single-processor performance, memory hierarchy, and pipelines; *Enhancing Uniprocessor Performance*- Increasing Processor Clock Frequency, Parallelizing ALU Structure, Using Memory Hierarchy, Pipelining, Very Long Instruction Word (VLIW) Processors, Instruction-Level Parallelism (ILP) and Superscalar Processors, Multithreaded Processor, Performance bottlenecks of sequential computing,

Introduction to Parallel Computing: Motivation, What is Parallel Computing and Why to Use? Concurrent, Parallel, Distributed computing, interacting with hardware- Composite Capabilities, How Do Languages and Environments Assist with These Tasks? Applications of Parallel Computing, RAM and PRAM model, PRAM pseudo code, Data vs. Task parallelism,

Parallel Computers Architectures: Overview of parallel system organization, Modifications to the Von-Neumann Model, Memory Barriers, Memory Hierarchy and organization, Different types of memory access-UMA and NUMA, Shared memory, distributed memory and distributed shared memory architectures, Cache Coherence and Memory Consistency, classification of parallel computers, Flynn's Classical Taxonomy, ILP, Multi-threaded architectures and TLP, Pipeline Parallelism, I/O Operations; Overheads-Hardware System Architecture, Costs of Operations; Parallel Architecture Design Tradeoffs and Future Directions, SIMD Processors, Systolic Processors, Cluster Computing, Grid and Cloud Computing, Multicore Systems, GPU computing, Synchronization and Mutual Exclusion; Scalability and Load Balance,

Interconnection Networks: Introduction, Communication between Parallel Processors, Classification of Interconnection Networks by Logical Topologies, Interconnection Network Switch Architecture, Routing Mechanisms for Interconnection Networks,

Performance Analysis and Tuning: Measuring Benefits of Parallel Computing, Performance, Performance MetriIT, Scalability and Scalability MetriIT, Speed up, Amdahl‟s law, Gustafson–Barsis‟s Law, efficiency, Scalability, Granularity, Latency, Bandwidth, Throughput, Cache, false sharing, Performance Analysis Tools- Tau.

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, CharacteristiIT of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, templates, Basic parallel programming techniques-loop splitting, spin locks, contention barriers and row conditions, Variations in splitting, self and indirect scheduling. Data dependency-forward and backward, block scheduling.

Coding and scripting for HPC: Embarrassingly parallel problems, introduction to *nix, shells, make, C/C++, Fortran, to message passing and MPI programming , A brief history of HPC & Numerical and HPC libraries,

References:

1. B. Wilkinson and M. Allen, Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers, 2nd Ed., PHI, 2005
2. Michael J. Quinn. Parallel Programming in C with MPI and OpenMP. TMH, 2004
3. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, Introduction to Parallel Computing, 2nd Ed., Pearson ducatio, 2003
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5. V. Rajaraman And C. Siva Ram Murthy, Parallel Computers – Architecture and Programming
6. Peter S. Pancheo, An Introduction to Parallel Programming, 2011
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9. Kenneth A. Berman and Jerome L. Paul. Algorithms: Sequential, Parallel, and Distributed, Thomson Course Technology, 2005
10. Introduction to High Performance Computing for Scientists and Engineers, G. Hager and G. Wellein, 2010, CRC Press
11. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.
12. A. Silberschatz, P. B. Galvin, G. Gagne, Operating System Concepts, John Wiley.
13. R. E. Bryant and D. R. O'Hallaron, Computer Systems: A Programmer's Perspective, Prentice Hall.

E15: Human-Computer Interaction

Introduction: Introduction to HCI, Humans, Information Process, Computer, Information Process, Differences and Similarities, Need for Interaction, Models, Ergonomics, Style, Context, Paradigms

Design Process: Designing of Interactive Systems, Usability, Paradigm shift, Interaction Design Basics, Design Process, Scenarios, Users Need, Complexity of Design

Design of Interactive Systems: Software Process, Usability Engineering, Issue based Information Systems, Iterative Design, Practices, Design Rules, Maximum Usability, Principles, Standards and Guidelines, Design Patterns, Programming Tools, Windowing Systems, Interaction Tool Kit, User Interface Management System,

Models: Universal Design Principles, Multimodal Systems, User Support, Presentation and Implementation Issues, Types, Requirements, Approaches, Cognitive Model, Hierarchical Model, Linguistic Model, Physical and Device Models, Socio technical Models, Communication and Collaboration Models, Task Models, Task Analysis And Design.

Theories: Dialogue Notations and Design, Dialogue Need, Dialogue Design Notations, Graphical, Textual, Representing Dialogue, Formal Descriptions, Dialogue Analysis, System Models, Interaction Models, Relationship with Dialogue, Formalisms, Formal Notations, Interstitial Behavior, Virtual Reality, Modeling Rich Interaction, Status Event Analysis, Properties, Rich Contexts, Sensor-based Systems, Groupware, Applications, Ubiquitous Computing, Virtual Reality

Experimental Design and Statistical Analysis of HCI: Basic Design Structure, Single Independent Variable, Multiple Independent Variable, Factorial Design, Split-Plot Design, Random Errors, Experimental Procedure, Statistical Analysis, T Tests, Analysis of Variance Test, Regression, Chi-Square Test, Survey, Probabilistic Sampling, Non-Probabilistic Sampling, Developing Survey Questions, Evaluation Techniques, Evaluation Design, Evaluating Implementations, Observational Methods.

References:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human Computer Interaction, 3rd Ed., PHI, 2004

2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in Human Computer Interaction, Wiley, 2010
3. Ben Shneiderman and Catherine Plaisant, Designing the User Interface: Strategies for Effective Human-Computer Interaction, 5th Ed., Addison-Wesley Publishing Co, 2009

E16: Information Security and Cyber Forensic

Information Security Concepts: Introduction, History, Critical Characteristics of Information, Information System and its components, Security Vs. Protection, Need for Security, Information Security Overview, Goals for Security, Securing the Components, Information Security Services, The Security SDLC, Business Needs, Security Threats and Vulnerabilities , Attacks and Types of Attacks, Legal, Ethical and Professional Issues, Balancing Security and Access, NSTISSC Security Model, E-commerce Security, Computer Forensics, Steganography, Security Engineering

Security Threats, vulnerabilities and Scanning: Overview of Security threats, Hacking Techniques, Password Cracking, Insecure Network connections, Malicious Code, Programming Bugs, Cyber crime and Cyber terrorism, Information Warfare and Surveillance, Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet

Network Defense tools: Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System

Web Application Tools: Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities, Curl, OpenSSL and Stunnel, Application Inspection tools, Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools, John the Ripper, L0htcrack, Pwdump, HTC-Hydra

Network and Computer Security: Cryptography, Access Control and Intrusion Detection, Access Control Devices, Physical Security, Security and Personnel, Security issues in wireless

Cyber Security: Introduction, Weak / Strong Passwords and Password Cracking, Web Browsers Security, Email Security: PGP and SMIME, Web Security: web authentication, SSL and SET, Firewall And Utm,

Cyber Forensics: Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks

Cyber Crimes and Law: Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Realms of the Cyber world, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Cyber Law, Indian IT Act, 2000, Information Security Policy, Standards and Practices, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity, SSE-CMM /

COBIT, ISO 17799/BS 7799, ISO 27001, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.

References:

1. Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, 2003
2. Matt Bishop, Computer Security Art and Science, Pearson Education, 2002
3. Ron Weber, Information Systems Control and Audit, Pearson Education, 2004
4. Stuart Mc Clure, Joel Scrambray, George Kurtz, Hacking Exposed, TMH, 2003
5. Mike Shema, Anti-Hacker Tool Kit (Indian Edition), TMH
6. Nina Godbole and Sunit Belpure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Publication Wiley
7. Garms, Jess and Daniel Somerfield, Professional Java Security, Wrox. 2001
8. Nelson Phillips and Enfinger Steuart, Computer Forensics and Investigations, Cengage Learning, New Delhi, 2009
9. Kevin Mandia, Chris Prosise, Matt Pepe, Incident Response and Computer Forensics, TMH, 2006
10. Bernadette H Schell, Clemens Martin, Cybercrime, ABC – CLIO Inc, California, 2004
11. Understanding Forensics in IT, NIIT Ltd, 2005

E17: Natural Language Processing

Introduction: Introduction, Machine Learning and NLP, ArgMax Computation,
Tree Adjoining Grammars: Dependency Grammars-Statistical Parsing-Introduction to Semantic Processing Semantic Knowledge Representation, Deep Structure and Logical Form-Compositional Semantic Interpretation-Semantic Grammars-Case Frames and Case Frame based Parsing.
Natural Language Generation: Problems in NL Generation-Basic Generation Techniques Hard Problems in NLP-Speech Understanding and Translation-Discourse Processing.
Lexical Functional Grammar: Active-Passive and Dative Constructions-Wh-movement in QuestionsOverview of LFG-LFG Formalism-Well-formedness Conditions-Handling Wh movement in QuestionsComputational Aspects.
Morphology and Finite State Transducers: Inflectional Morphology-Derivational Morphology-Finite State Morphological Parsing-The Lexicon and Morphotactics Morphological Parsing with Finite State Transducers-Orthographic Rules and Finite-State Transducers-Combining an FST Lexicon and Rules-Lexicon-Free FSTs.
Word Sense Disambiguation: WordNet, Wordnet; Application in Query Expansion, Measures of WordNet Similarity, Resnick's work on WordNet Similarity, Parsing Algorithms, Evidence for Deeper Structure; Top Down Parsing Algorithms, Noun Structure; Top Down Parsing Algorithms, Non-noun Structure and Parsing Algorithms. Probabilistic parsing; Sequence labelling, PCFG,
Probabilistic parsing: Training issues, Arguments and Adjuncts, Probabilistic parsing; inside-outside probabilities.
Speech : Phonetics, Hidden Markov Model, Morphology, Graphical Models for Sequence Labelling in NLP, Consonants (place and manner of articulation) and Vowels.
Forward Backward probability: Viterbi Algorithm, Phonology, Sentiment Analysis and Opinions on the Web, Machine Translation and MT Tools - GIZA++ and Moses, Text Alignment, POS Tagging.

Phonology: ASR, Speech Synthesis, Hidden Markov Model and Viterbi, Precision, Recall , F-score, Map, Semantic Relations; UNL; Towards Dependency Parsing.
Universal Networking Language: Introduction, Semantic Role Extraction, Baum Welch Algorithm; HMM training.

References:

1. Alexander Clark, Chris Fox, and Shalom Lappin (Editors):The Handbook of Computational Linguistics and Natural Language Processing (Blackwell Handbooks in Linguistics).
2. Akshar Bharathi, Vineet Chaitanya, and Rajeev Sangal: Natural Language Processing: A Paninian Perspective. Prentice Hall of India.
3. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
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E18: Network Security and Cryptography

Introduction to Classical Cryptosystems: Introduction, Need and importance of Cryptography, Classical Cryptosystems, Introduction to symmetric and asymmetric cryptography, Cryptanalysis of Classical Cryptosystems, Shannons Theory
Mathematical Foundations: Number Theory, Number Theoretic Results, Factorization-Factoring Algorithms, Quadratic Sieve Factoring Algorithm, Pollard-Rho Method; Modular Arithmetic- Groups, Solving Modular Linear Equations, Chinese Remainder Theorem, Modular Exponentiation, Discrete Logarithm Problem; GCD Computation- Euclids Algorithm, Extended Euclids Algorithm, Probability and Information Theory, The Discrete Logarithm Problem (DLP), Computation of Generators of Primes; Stream Ciphers, Pseudorandom functions.
Symmetric Key Ciphers and Cryptanalysis: Introduction, Symmetric Key Ciphers, Modern Block Ciphers- DES, AES; Linear Cryptanalysis, Differential Cryptanalysis, Other Cryptanalytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers, NIST recommendations.
Hash Functions and MACs: Hash functions, The Merkle Damgard Construction, Message Authentication Codes (MACs)
Asymmetric Key Ciphers and Cryptanalysis: Construction and Cryptanalysis, RSA Cryptosystem, Different Attacks & Remedies on RSA, Semantic Security of RSA, The Discrete Logarithm Problem (DLP), Diffie Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm, Massey-Omura; Construction and Cryptanalysis, Cryptanalysis of DLP
Modern Trends in Asymmetric Key Cryptography: Overview of Modern Cryptography, Elliptic curve theory and Elliptic Curves based cryptography, Security of Elliptic Curves Cryptography, Elliptic Curve Factorization.
Digital Signatures: Introduction, Signature schemes, Authentication Protocols, Digital Signature Standards (DSS), Proxy Signatures

Network Security: Secret Sharing Schemes, Network Protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls
Primality Testing: Primality Testing, Quadratic Residues, Randomized Primality Test & Deterministic Polynomial Time Algorithm

References:

1. Neal Koblitz, A Course in Number Theory and Cryptography, Springer Verlag, New York Inc, 2001
2. William Stallings, Cryptography and Network security: Principles and Practice, Pearson Education, 2002
3. W. Trappe and L. C. Washington, Introduction to Cryptography with Coding Theory, 2nd Ed., Pearson Education 2007
4. R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge University Press, 1995
5. Douglas Stinson, Cryptography Theory and Practice, 2nd Ed., Chapman & Hall/CRC
6. B. A. Forouzan, Cryptography & Network Security, TMH
7. Wenbo Mao, Modern Cryptography, Theory & Practice, Pearson Education.
8. Hofistein, Pipher, Silvermman, An Introduction to Mathematical Cryptography, Springer
9. J. Daemen, V. Rijmen, The Design of Rijndael, Springer.
10. A. Joux,Algorithmic Cryptanalysis, CRC Press
11. S. G. Telang, Number Theory, TMH
12. C. Boyd, A. Mathuria, Protocols for Authentication and Key Establishment, Springer
13. Matt Bishop, Computer Security, Pearson Education

E19: Optimization Methods

Introduction and Basic Concepts: Historical Development; Engineering applications of Optimization; Art of Modeling; Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Classification of optimization problems, Optimization techniques – classical and advanced techniques
Optimization using Calculus: Stationary points; Functions of single and two variables; Global Optimum, Convexity and concavity of functions of one and two variables; Optimization of function of one variable and multiple variables; Gradient vectors; Examples; Optimization of function of multiple variables subject to equality constraints; Lagrangian function; Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values; Kuhn-Tucker Conditions; Examples
Linear Programming and Applications: Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations; Graphical method for two variable optimization problem; Examples; Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems; Revised simplex method; Duality in LP;Primaldual relations; Dual Simplex method; Sensitivity or post optimality analysis; Other algorithms for solving LP problems – Karmarkar's projective scaling method; Applications- Use of software for solving linear optimization problems using graphical and simplex methods; Examples for transportation, assignment, water resources, structural and other optimization problems

Nonlinear programming: Convex sets and convex functions, Kuhn-Tucker conditions. Convex quadratic programming: Wolfe's and Pivot complementary algorithms. Separable programming

Geometric programming: Problems with positive coefficients up to one degree of difficulty, Generalized method for the positive and negative coefficients

Dynamic Programming and Applications: Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality; Recursive equations – Forward and backward recursions Computational procedure in dynamic programming (DP); Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP; Applications- Problem formulation and application in Design of continuous beam and Optimal geometric layout of a truss; Water allocation as a sequential process; Capacity expansion and Reservoir operation

Integer Programming: Integer linear programming; Concept of cutting plane method; Mixed integer programming; Solution algorithms; Examples

Advanced Topics in Optimization: Piecewise linear approximation of a nonlinear function; Multi objective optimization – Weighted and constrained methods; Multi level optimization; Direct and indirect search methods; Evolutionary algorithms for optimization and search; Applications in computer science

References:

1. S.S. Rao,"Engineering Optimization: Theory and Practice", New Age International P)Ltd.,
2. New Delhi, 2000. 2. G. Hadley,"Linear programming", Narosa Publishing House, New Delhi, 1990.
3. H.A. Taha,"Operations Research:An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb,"Optimization for Engineering DesignAlgorithms and Examples",Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. K.Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management",PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7,
6. Ravindran A., Phillips, D.T., Solberg J.J.,. - Operations Research : Principles and Practice, 2nd ed.,2001, John Wiley & Sons.
7. Pant J.C. - Introduction to Optimization techniques(Operations Research), 6th ed., 2005, Jain Brothers, New Delhi.

E20: Soft Computing

Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing; Artificial Intelligence : Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies; Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.

Optimization: Derivative-based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton‟s Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, Random Search, Downhill Simplex Search.

Artificial Neural Networks: Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks.Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory; Propogation Networks-introduction, Counter propagation network, architecture, functioning & its characteristics, Back Propogation Networks -Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications; Hopfield/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations and applications; Hopfield v/s Boltzman machine; Adaptive Resonance Theory: Architecture, classifications, Implementation and training; Associative Memory.

Fuzzy Logic: Basic concepts of crisp and fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion; Fuzzy rule base system-Membership functions, features of membership functions, fuzzy reasoning, interference in fuzzy logic, fuzzy decision making, fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Applications of fuzzy logic, Industrial applications,

Genetic Algorithm(GA): Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, fitness function, reproduction, Genetic modeling: Genetic operators, 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 method

Hybrid Systems: Integration of neural networks, fuzzy logic and genetic algorithms.

References:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, PHI.
2. Siman Haykin, Neural Netowrks, PHI
3. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997
4. Kumar Satish, Neural Networks, TMH
5. J. Yen and R. Langari., Fuzzy Logic, Intelligence, Control and Information, Pearson Education
6. J. S. R. Jang, C. T. Sun and E. Mizutani, Neuro-Fuzzy and Soft Computing, PHI, 2004

E21: Software Engineering

Introduction: Introduction to software engineering, Fundamentals of software engineering principles and pratices,

Software Engineering: A Preview, history of Software Engineering, Software Engineer's Role, Software Lifecycle

Software Lifecycles: Lifecycle Models, Phases and Activities

Software Requirements: Functional and Non-Functional Requirements, IEEE Standard for Software Requirements document

UML 2.0 and the Unified Process: Overview of UML 2.0, The Unified Process

Inception: Use cases, Supplementary specification, Glossary and Vision

Domain Model: System Sequence Diagrams, Domain Model, Contracts for System Operations
Design Patterns: Design patterns
Design Model: Use Case Realization, Class Diagram
Implementation Model: Mapping design to code, Package structures
Design with Layers: Logical Architecture and Software Architecture, Applying UML: Package Diagrams, Design with Layers, N+1Views
Project Planning and Management: Project Planning activities, Manager's responsibilities, IEEE standard for Software Project Management Plans
Formal Specifications: Specification Qualities, Classification of Specification Styles, Descriptive Specifications- Logic and Algebraic Specifications, Operational Specifications- DFD, FSM, Petri Nets, Introduction to Z
Agile software engineering: Agile principles; Key concepts: sprint, backlog, product owner; Agile methods: SCRUM, Lean, Kanban, Agile project management, Documentation
Empirical software engineering: The importance of empirical methods in Software Engineering. Qualitative approaches and quantitative approaches. Experimentation. Surveys. Case studies. Systematic Literature Reviews
Advance Topics: Real-time embedded software, adaptive software, reliability and dependability, real time JAVA, real time UML, formal methods, verification and validation, extreme programming, management issues in software development, software quality assurance, metrics, Aspect-oriented programming, web service and service-oriented architecture (SOA), Model driven Architecture (MDA), software security, software engineering education

References:

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2. C. Ghezzi, M. Jazayeri and D. Mandrioli, Fundamentals of Software Engineering, Prentice Hall, 2003.
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7. Agile estimating and planning - Cohn, Mike, Prentice Hall Professional Technical Reference
8. User stories applied : for agile software development - Cohn, Mike, Addison-Wesley , cop. 2004
9. Software architecture : foundations, theory, and practice - Taylor, Richard N; Medvidovi??, Nenad; Dashofy, Eric M, John Wiley , cop. 2010
10. Ultra-Large-Scale Systems: The Software Challenge of the Future - Northrop, Linda, Carnegie Mellon University , 2006
11. The Agile samurai : how agile masters deliver great software - Rasmusson, Jonathan, The Pragmatic Bookshelf , cop. 2010
12. The Rational unified process : an introduction - Kruchten, Philippe, Addison-Wesley , 2007
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E22: System Software and Compiler Optimization

System Software: Introduction, Definition, Role and Functions, characteristics, types
Assembler: Introduction, functions, features, design of one pass and two pass assemblers;
Macroprocessors: Introduction, functions, features and design;
Loader and Linkers: Basic Concepts of Linkers and Loader Functions, Boot Loaders, Linking Loaders, Linkage Editors, Dynamic Linking
Compiler: Introduction to Compiler, Difierent phases and passes of compiler, Compiler Structure, Analysis-synthesis model of compilation, various phases of a compiler, tool based approach to compiler construction.
Lexical Analysis: Role of Lexical Analyzer, Interface with input, parser and symbol table, Input Buffering, Specification of Tokens, lexeme and patterns; difficulties in lexical analysis; error reporting; Finite state machines and regular expressions and their applications to lexical analysis, regular definition, transition diagrams, Lex., Review of regular languages, design and implementation of a lexical analyzer,
Syntax Analysis: Role of the parser, Formal and context free grammars(CFGs) and their application to syntax analysis, ambiguity, associatively, precedence, Derivation and parse trees, Top Down parsing, LL(1) grammars, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, Shift Reduce Parsing, LR(0) grammars, operator precedence grammars, LR parsing algorithms and LR parsers, Yacc.
Syntax directed translation and Definitions: Syntax directed definitions, Construction of syntax trees, Top down and bottom up approaches, dependency graph, data types, mixed mode expression; subscripted variables, evaluation order and sequencing statement, Inherited and synthesized attributes, bottom up and top down evaluation of attributes, L- and S-attributed definitions.
Type Checking: Type system, type expressions, structural and name equivalence of types, type conversion.
Run Time System Environments: Source Language issues, Storage organization, Storage Allocation strategies, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation, Access to non-local names, Parameter passing mechanism
Intermediate Code Generation: Intermediate languages, Intermediate Graphical representations, Three address code, Implementation of three address statements (Quadruples, Triples, Indirect triples), translation of declarations, assignments, control flow, Boolean expressions and procedure calls, implementational issues.
Code Optimization and generation: Introduction and Issues, Basic blocks and flow graphs, Transformation of basic blocks, DAG representation of basic blocks, code generation from dags, Loops in flow graph, Principle sources of optimization, Peephole optimization, machine dependent and machine independent optimization techniques, Issues in the design of code generator, Register allocation and assignment, code generation, specifications of machine.
Subroutines and functions: parameters called by address, by name and by value, subroutines with side effects.

References:

1. A. V. Aho, R. Sethi and J. D. Ullman, Compilers: Principles, Techniques, and Tools (US edition), Addison Wesley, 1986
2. R. Mak, Writing Compilers and Interpreters, 2nd Ed., John Wiley & Sons, 1996
3. D. Galles, Modern Compiler Design, Pearson Education, 2007
4. S. Chattopadhyay, Compiler Design, PHI, 2005
5. Alfred Aho, Monica S. Lam, Ravi Sethi, Jefirey D Ullman, Compilers Principles, Techniques and Tools, 2nd Ed., Pearson Education Asia, 2009

6. Leland L. Beck, System Software: An Introduction to Systems Programming, 3rd Ed., Addison- Wesley, 1997
7. Allen I. Holub Compiler Design in C, PHI, 2006
8. C. N. Fischer and R. J. LeBlanc, Crafting a compiler with C, Pearson Education.
9. J. P. Bennet, Introduction to Compiler Techniques, Second Edition, TMH, 2003
10. Henk Alblas and Albert Nymeyer, Practice and Principles of Compiler Building with C, PHI, 2001
11. Kenneth C. Louden, Compiler Construction: Principles and Practice, Thomson Learning
12. D. M. Dhamdhere, Systems Programming and Operating Systems, TMH
13. John J. Donovan, Systems Programming, 3rd Ed., 1997, Addison Wesley

E23: Theory of Computational Fundamentals

Theory of Computations: Finite automata and regular languages, context-free languages, turing machines and algorithms, decidability and reducibility, time Complexity and NP-completeness.
Combinatorial algorithms: Set cover, Steiner tree and TSP, Multiway cut, Knapsack, Minimum makespan scheduling, Huffman coding
NP-completeness: Review, Basic NP-complete problems, Novel approaches to NP-complete problems
LP and SDP-based approximation algorithms: Fundamentals of approximation algorithms, LP Duality, Set cover via dual fitting, LP rounding techniques, Sparsest cut, Facility location, Semidefinite programming, Max-cut
Additional topics: Hardness of approximation, Approximation Algorithms based on Algorithmic Game Theory, Heuristic algorithms
Open problems

1. Introduction to Theory of Computation by Michael Sipser
2. Computers and Intractability by M. R. Garey and D. S. Johnson
3. Approximation algorithms by Vijay Vazirani.
4. Introduction to Automata Theory, Languages, and Computation by J. E. Hopcroft, R. Motwani, and J. D. Ullman
5. *Introduction to Algorithms*, by Cormen, Leiserson, Rivest, and Stein
6. *Algorithm Design*, by Kleinberg and Tardos
7. Computational Complexity by C. H. Papadimitriou.

In Computer Science and related discipline. Hence, the syllabus for JEST Theoretical Computer Science Exam majorly focuses on the mathematical aspect of computer science. Elements of Discrete Mathematics. Introduction to Algorithms. An Introduction to Data Structures with Applications. Discrete Mathematical Structures with Applications to Computer Science. Compilers: Principles, Techniques, and Tools.Â The question paper of Theoretical Computer Science will have questions of both types â€“ some requiring short answers and some involving detailed problem-solving. Physics and Mathematics question paper will be based on objective type questions. For Part A: 3 marks will be rewarded for every correct answer and 1 mark will be deducted for every wrong answer. Computer Science, Ph.D.: The doctoral degree in computer science prepares students to undertake fundamental and applied research in computer science, preparing them to apply their studies in the world of academia, governmental policy and/or the industrial sector. The Ph.D. in computer science is available for students of high ability who seek to develop and implement their own research studies.Â This degree features advanced course work and a strong emphasis on student research. The M.S. program provides numerous opportunities for interdisciplinary study. Within this degree, students can concentrate their studies in the following areas: arts, media and engineering, and cybersecurity. Computer Science, MS Catalog Program. Home Â» Courses Â» Electrical Engineering and Computer Science Â» Introduction to Computer Science and Programming Â» Syllabus. Syllabus. Course Home. Syllabus.Â Help students (who may or may not intend to major in computer science) to feel justifiably confident of their ability to write small programs. Map scientific problems into computational frameworks. Position students so that they can compete for jobs by providing competence and confidence in computational problem solving.Â Introduction to Computation and Programming Using Python: With Application to Understanding Data. MIT Press, 2016. ISBN: 9780262529624.