DEPARTMENT OF INFORMATION TECHNOLOGY

IT900 Advanced Database Management Systems **4**

Basic concepts and terminology, software architecture for data sharing, federated database management system,designing distributed databases, distributed transactions, client server architecture, multimedia databases, object oriented DBMS, query Processing & optimization.

Tamer Ozsu, Patrick Valduring: Principles of Distributed Database systems,
PHI Ceri S, Pelagatti S: Distributed Databases: Principles and Systems, McGraw Hill.
Thomas Connolly & Carolyn Begg, Database systems: A Practical Approach to Design, Implementation and Management, 3/e, Pearson Education, 2003. (Chapters 19 & 20)
Patrick O'Weil & Elizebeth O'Weil, Database Principles, Programming & Performance, Harcourt India Pvt. Ltd., 2/e,2002(Chapters 8, 9 & 10)

IT901 Distributed Computing Systems **4**

Introduction Computer Networks and Multi-processor systems, Evolution of modern operating systems, Design Goals, transparencies and fundamental issues in Distributed systems, Temporal ordering of events, Global state detection, Physical clocks, Mutual Exclusion Algorithms, Interprocess Communication, Deadlocks in distributed systems, Load balancing techniques, Distributed databases

Shivarathi & Shingal, Advanced Operating Systems
Randy Chow, Distributed Operating Systems and Algorithms
George Couloris et al, Distributed Systems - concepts and design, Pearson Education, 2002
A.S. Tanenbaum and M.V. Steen, Distributed Systems - Principles and Paradigms, Pearson Education 2003.
Wolfgang Emmerich, Engineering Distributed Objects, Wiley, 2000.
Gerald Tel, Introduction to Distributed Algorithms, 2/e, Cambridge, 2004.

IT902 Advanced Software Engineering **4**

Managing software projects : Project management concepts, Project metrics, Project planning, Project scheduling and tracking; Quality, Configuration management, Technical metrics and formal methods; Object oriented software engineering; Reuse, Reengineering, Client/Server software engineering, CASE.

Roger S Pressman, Software Engineering - A Practitioner's Approach,
McGraw-Hill Ian Sommerville, Software Engineering, Addison Wesley.
Joel Henry, Software Project Management, Pearson Education, 2003.
Kenneth R. Bainey, Integrated IT Project Management: A Model-Centric Approach, Allied Publishers, 2004.
Mario E. Moreira, Software Configuration Management Hand Book, Allied Publishers, 2004.
Len Bass, Paul Clements, and Rick Kazman, Software Architecture in Practice, Addison-Wesley, 1998.
William J. Brown, Raphael C. Malveau, Hays W. "Skip" McCormick III and Thomas J.Mowbray Wiley. AntiPatterns: Refactoring Software, Architectures, and Projects in Crisis, 1998.

IT903 Design and Analysis of Algorithms **4**

Fundamentals of Algorithmic Problem Solving, Fundamental data Structures, Fundamentals of the Analysis of Algorithm Efficiency, Brute Force, Divide -and-Conquer, Decrease and Conquer, Transform and Conquer, Space and Time Tradeoffs, Dynamic Programming, Greedy Technique, Limitations of Algorithm Power. Coping with the Limitations of Algorithm Power.

Anany Levitin, Introduction to The Design And Analysis Of Algorithms, Pearson Education, 2003.
T.H. Cormen, C.E. Leiserson, R.L. Rivest, Introduction to Algorithms, McGraw Hill, 1994.
Dan Gusfield, Algorithms on Strings, trees and Sequences, Cambridge, 2005.
Sara Baase, Computer Algorithms: Introduction to Design and Analysis, Addison Wesley, 1998.
Michael T Goodrich & Roberto Tamassia, Algorithm Design: Foundations, Analysis & Internet Examples, John Wiley, 2002.

IT904 Advanced Operating Systems **4**

An overview of operating system functions, Distributed operating systems, Protection and security, Multiprocessor operating systems, Database operating systems, Concurrency control, Object oriented operating systems and its
characteristics, Case studies of OS such as UNIX OS, Netware OS, Windows etc, *Mukesh*

Singhal Niranjan, Shivorothri G: Advanced concepts in Operating Systems
Andrew S Tenanbaum: Distributed Operating systems
Doreen L Galli, Distributed Operating System- Concepts and Practice, Prentice-Hall, 2000.
A. Silberschatz, Applied Operating System Concepts, Wiley, 2000.
Lubemir F. Bic & Alan C. Shaw, Operating Systems Principles, Pearson Education, 2003

IT905 Data Warehousing and Data Mining **4**

Data Warehousing, Data Mining, Association Rules, Classification, Clustering, Decision Trees, Other Techniques for Data Mining, Web Mining, Searching Techniques

Jiawei Han, Micheline Kamber: Data Mining: Concepts and Techniques, Harcourt India Pvt. 2001.
Arun Poojary K., Data Mining Concepts, Hyderabad Press, 2001.
George M. Marakas, Modern Data Warehousing, Mining & Visualization, Pearson Education, 2003.
Margaret H. Dunham, Datamining: Introductory & Advanced Concepts, Pearson Education, 2003.

IT906 Genetic Algorithms **4**

Population based search techniques, Introduction to Genetic algorithms, Mathematical foundations, Computer implementation of genetic algorithms, Advanced operators and techniques in genetic algorithm search, Industrial application of genetic algorithms.

David Goldberg, Genetic Algorithms in Search, Optimization and Machine learning, Addison Wesley International
Charles L Karr and L Michael Freeman, Industrial Applications of Genetic Algorithms, CRC Press

IT907 Advanced Compilers **4**

Review of Compiler structure, overview of advanced architectures, compiler challenges, Data Flow and Control Flow Analyses, Dependences and Transformations, Loop Transformations and its applications, Scheduling concepts: instruction/vector unit, register allocation, compiling for HPF, a few recent advances.

Steven Muchnik, "Advanced Compiler Design Implementation" Elsevier Publications, 2003
Randy Allen and Ken Kennedy, "Optimizing for Compilers for Modern Architectures", Elsevier Press, 2002

IT908 Intelligent Information Systems **4**

Emerging Technologies and applications with latest knowledge applied to customized logic systems, agent based approaches to modeling, and human-based models, multi-mobile agent systems, the product development process, fuzzy logic systems, neural networks, and ambient intelligent environment such as development of information and communication technologies for spatial audio and video information, multimedia data hiding and watermarking algorithms for real world audio and video applications.

Xuan F. Zha, "Artificial Intelligence and Integrated Intelligent Information Systems: Emerging Technologies and Applications", IGI Global, 2006
Jialie Shen, "Intelligent Music Information Systems: Tools and Methodologies", Idea Group Reference Publishers, 2007
Pan, J.-S; Huang, H.-C; Jain, L.C.; Fang, W.-C; "Intelligent Multimedia Data Hiding", Springer, 2007

IT909 Adaptive Blind Signal and Image Processing **4**

Introduction to Blind Signal and Image Processing: Principal Component analysis (PCA), Blind Source Separation (BSS) and Independent Component Analysis (ICA), BSS of Instantaneous and Convolutive Mixtures, Sequential Blind Signal Extraction, Robust BSS/ICA with noisy data; Learning Algorithms for Estimation of Sources; Applications: Audio, Speech, Image and Biomedical Signal Processing.

A.*Cichocki and S. Amari, "Adaptive Blind Signal and Image Processing: Learning Algorithms & Applications", John Wiley, 2002*
Hyvarinen, J. Karhunen, and E. Oja, "Independent Component Analysis", John Wiley, 2001
C S. Roberts and R. Everson, "Independent Components Analysis: Principles and Practice", Cambridge University Press, 2001
A. S. Bregman, "Auditory Scene Analysis", MIT Press, 2nd Edition, 1999 Handbook on Speech
Processing and Speech Communication, Springer, 2007

IT910 Perceptual Audio and Speech Processing **4**

Audio Coding and Human Auditory Perception; Speech Analysis - Short Time Discrete Fourier Transforms, Gamma-tone Filter banks, Sub-band coding and Wavelet Transforms, Audio Processing, Standards for audio compression in multimedia applications - MPEG.

Ben G. and Nelson M., "Speech and Audio Signal Processing: Processing and Perception of Speech & Music", Wiley, 1999
K. Rao et al,, "Introduction to Multimedia Communications: Applications, Middleware, Networking", Wiley
2006 Douglas O'Shaugnessy, "Speech Communication - Human and Machine", IEEE Press, 2000
L R Rabiner, "Digital Processing of Speech Signals", Pearson, 1978
Zi Nian Li, "Fundamentals of Multimedia", Pearson Education, 2003

IT911 Perceptual Image and Video Processing **4**

Picture Coding and Human Visual Perception; Perceptual Video Quality Metrics, Perceptual Coding and Processing of Digital Pictures; Image Transforms - DCT, Hadamard, Haar, KL and Wavelet; Standards for Image Compression - JPEG; Standards for Video Compression - MPEG, H.264.

H. R. Wu and K. R. Rao, "Digital Video Image Quality and Perceptual Coding", CRC Press,
2005 R. C. Gonzalez and R E Woods, "Digital Image Processing", Pearson Education, 2002
W Pratt, "Digital Image Processing", Wiley, 2001
Al Bovik, "Handbook of Image and Video", Academic Press,
2000 Keith Jack, "Video Demystified", LLH, 2001

IT912 Modern Cryptography **4**

Classical Encryption Techniques and their Cryptanalysis : Symmetric cipher models Symmetric-Key Encryption Schemes: Data Encryption Standard and Advanced Encryption Standards, RC4, Attacks on DES, AES. Number Theory: Prime numbers and factoring, modular arithmetic, computations in finite fields, Discrete logarithms. Public-Key (Asymmetric) Cryptography. Hash Functions: Design of Collision-Resistant Hash Functions, Popular Uses of Collision-Resistant Hash Functions, Random Oracle Model. Hash algorithms: MD5, SHA-256.
Message Authentication: Message Authentication Codes Definitions, Constructions of Secure Message Authenticate Codes, Practical Constructions of Message Authentication Codes. Digital Signatures and Applications:.

William Stallings, Cryptography & Network Security, Pearson Education Asia.
2006 Schiner Bruce, Applied Cryptology, John Wiley & Sons, 2001.
Wade Trappe & Lawrence C Washington, Introduction to Cryptography with Coding Theory, Pearson Education, 2006.
Kahate A, Cryptography & Network Security, Tata Mc Graw Hill, 2004.
Charlie Kaufman, Radia Perlman and Mike Speciner, Network Security: Private Communication in a Public World, Prentice Hall of India Private Limited.
Behrouz A. Forouzan, Cryptography and Network Security, Mc Graw Hill.
Jonathan Katz and Lindell, Introduction to Modern Cryptography: Principles and Protocols, Chapman and Hall/CRC.
Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press.
A. Menezes, P. Van Oorschot and S. Vanstone, Handbook of Applied Cryptography, CRC Press, 1996.

IT913 Computer Network Security **4**

Security at the Application Layer: Email architecture, PGP (Pretty Good Privacy), S/MIME. Security at the Transport Layer (SSL and TLS): SSL architecture, Four protocols, SSL message formats, Transport Layer Security, Secure Electronic Transaction. Security at the Network Layer (IPSec) : Two modes, Two Security protocols, Security Association, Security Policy, Internet Key Exchange, ISAKMP. Intruder: Intruder, Intrusion Detection, Password Management. Malicious Software : Viruses and Related Threats, Virus Countermeasures, Distributed Denail of Service Attack. Firewall : Firewall Design Principles, Trusted systems, Common Criteria for Information Technology Security Evaluation. Authentication : Kerberos V4 and V5, X.509 Authentication Service, Public Key Infrastructure. Physical Layer Security:Shannon's perfect secrecy, Secure Communication over Noisy Channel, Channel Coding for Secrecy, Secret Key Agreement from noisy observation, Active attacks, Physical Layer Security and Classical Cryptography.

William Stallings, Cryptography and Network Security, Third Edition.
William Stallings, Network Security Essentials, Third Edition.
Behrouz A. Forouzan, Cryptography and Network Security, McGraw Hill.
Jie Wang, Computer Network Security Theory and Practice, Springer Berlin Heidelberg New York.
William Stallings, Cryptography and Network security Principles and Practice , Fifth Edition.
Kwok T. Fung, Network Security Technologies, Second Edition, Auerbach Publications, A CRC Press Company.

Joseph Migga Kizza, A guide to Computer Network Security, Springer Publications.

IT914 Digital Forensic **4**

Introduction to legal issues, context, and digital forensics; Stages of Forensic: acquisition or imaging of exhibits, analysis and reporting standards. Computer forensics. Network forensics: monitoring and analysis of Computer Networks, Social Network analysis for Online Forensics. Database forensics: forensic study of databases and their metadata. Investigative use of database contents, log files and in-RAM data in order to build a time-line or recover relevant information. Mobile device forensics: recovery of digital evidence or data from a mobile device.

Media Analysis: disk structure, file systems (NTFS, EXT 2/3, HFS), and physical layer issues; Tools for digital forensics.

Analysis Techniques: keyword searches, timelines, hidden data; Application Analysis; Network Analysis; Analysis of Cell phones, PDAs, etc.; Binary Code Analysis; Evidence: collection, preservation, testimony.

Kanellis, Panagiotis, Digital Crime and Forensic Science in Cyberspace, IGI Publishing.
Jones, Andrew, Building a Digital Forensic Laboratory. Butterworth Heinemann, 2008.
Marshell, Angus M., Digital Forensics: Digital Evidence in Criminal Investigation, Wiley Blackwell, 2008.
Philip Craiger, Sujeet Shenoi, Advances in Digital Forensics, Springer, 2007.
Paul Crowley Dave Kleiman, CD and DVD Forensics, Syngress Publishing Inc, 2007.
Chris Prosise, Kevin Mandia, Incident Response & Computer Forensics, McGraw-Hill, 2nd Edition, 2003.

IT915 Special Topics in Computer Networks **4**

Voice Packetization: Quality of Service, Distributed Network Architecture. Packet Transport Technologies: Voice over the Internet Protocol, Voice over ATM, Voice Over Frame Relay, Comparison among other technologies. Broadband Access and Evaluation Networks: Voice over cable, Voice over DSL. Fast access technologies. (For example, ADSL, Cable Modem, etc.) IPv6: Why IPv6, basic protocol, extensions and options, support for QoS, security, etc., neighbour discovery, auto-configuration, routing. Changes to other protocols. Application Programming Interface for IPv6. Mobility in networks. Mobile IP. IP Multicasting. Multicast routing protocols, address assignments, session discovery, etc. TCP extensions for high-speed networks, transaction-oriented applications. Other new options in TCP.

David J. Wright, Voice over Packet Network, Wiley Publisher.
W. R. Stevens, TCP/IP Illustrated, Volume 1: The Protocols, Addison Wesley, 1994.
G. R. Wright, TCP/IP Illustrated, Volume 2: The Implementation, Addison Wesley, 1995.
W. R. Stevens, TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols, Addison Wesley, 1996.
R. Handel, M. N. Huber, and S. Schroeder, ATM Networks: Concepts, Protocols, Applications, Addison Wesley, 1998.
C. E. Perkins, B. Woolf, and S. R. Alpert. Mobile IP: Design Principles and Practices, Addison Wesley, 1997.

IT916 Vehicular Adhoc Networks **4**

Introduction to Vehicular Networks. Vehicular Network Applications and Services. Medium Access Control Protocols for Vehicular Networks. Heterogeneous Wireless Communications for Vehicular Networks. Routing in Vehicular Networks. Routing in Vehicular Networks: A User's Perspective. Data Dissemination in Vehicular Networks .

Hassnaa Moustafa, Yan Zhang (Ed), Vehicular Networks Techniques, Standards, and Applications, CRC Press.
Hannes Hartenstein, VANET: Vehicular Applications and Inter-Networking Technologies, A John Wiley and Sons, Ltd., Publication.
Radu Popescu-Zeletin, Ilja Radusch, Mihai Adrian Rigani, Vehicular-2-X Communication, Springer publisher.

IT917 Special Topics in Wireless Sensor Networks **4**

Motivation for a Network of Wireless Sensor Nodes. Sensor Network Architecture and Sensor Devices, Physical Layer in Sensor Networks, MAC Layer in Sensor Networks, Higher Layer Issues in Sensor Networks, Time Synchronization in Wireless Sensor Networks. Software Issues in Wireless Sensor Networks. Sensor Networks' Integration. Mobility Aspects in WSN. Medical Applications of Wireless Sensor Networks. Vehicular Sensor Networks: General Aspects

Waltenegus Dargie, Fundamentals of Wireless Sensor Networks Theory and practice, John Wiley =.

Application and Multidisciplinary Aspects of Wireless Sensor Networks Concepts, Integration, and Case Studies, Springer Publisher.
Kaveh Pahlavan and Prashant Krishnamurthy, Networking Fundamentals Wide, Local and Personal Area Communications, John Wiley.

IT918 Performance Analysis of Local Area Networks and Wide Areanetworks 4 Transmission systems : Introduction, Subscriber Loop Design, Unigauge Design for Telephone Customer Loop Plants Signal Multiplexing, Digital Transmission Systems, Optical Fiber Transmission Systems. Switching systems: Centralized Switching, Switching Techniques, Congestion in Space-Division Switching Networks, AND Time-Division Switching Networks, Nonblocking Networks. Modeling of traffic flows, service times and single-server queues: Distribution for Number of Arrivals in a Fixed Time Interval, The Interarrival Time Distribution, The Service Time Distribution, The Residual Service Time Distribution, The Birth and Death Process, Erlang Loss System and Erlang Delay System. Engset loss and delay systems. Local area networks. Polling networks. Token ring networks. Random access networks
Wah Chun Chan, Kluwer, Performance Analysis of Telecommunications and Local Area Networks, Academic Publishers.

IT919 Modelling and Analysis of Networks Protocols 4
Introduction and Overview. Introduction to Queuing Theory. Layered Architectures in Data Networks. Data Link Layer: Examples and Performance Analysis. Network Layer: Flow Control and Congestion Control. Network Layer: Routing Function Transport Layer. Polling and Random Access in Data Networks. Local Area Networks. Introduction to Circuits Switching. Call Processing in Digital Circuit-switching Systems. The Evolution toward Integrated Networks
Mischa Schwartz, Telecommunication Networks: Protocols, Modeling and Analysis, Addison-Wesley

IT920 Packet Forwarding Technologies 4
Basic Functionalities of Routers, Evolution of Router Architecture, Key Components of a Router, Network Processor, IP-Address Lookup and Routing Table, Construction of Optimal Routing Tables, Matching Techniques, Difficulty of the Longest-Prefix Matching Problem, , Multibit Tries. Pipelined Multibit Tries. Efficient Data Structures for Bursty Access Patterns. Caching Technologies: Suez Lookup Algorithm, Host Address Range Cache, Prefix Caching Schemes, Multi-Zone Caches, Hashing Schemes: Binary Search on Hash Tables, Parallel Hashing in Prefix Length, Multiple Hashing Schemes, Using Bloom Filter. TCAM-Based Routing-Table Partitioning, Technologies Forwarding Engine
Weidong Wu, Packet Forwarding Technologies , Auerbach Publications Taylor & Francis Group.

IT921 Computer Network Systems Design 4
Traditional Protocol Processing Systems, Conventional Computer Hardware Architecture, Basic Packet Processing: Algorithms And Data Structures, Packet Processing Functions, Protocol Software On A Conventional Processor, Hardware Architectures For Protocol Processing, Classification And Forwarding, Switching Fabrics, Network Processor Technology The Complexity Of Network Processor Design, Network Processor Architectures, Issues In Scaling A Network Processor, Examples Of Commercial Network Processors, Design Tradeoffs And Consequences ability, Overview Of The Intel Network Processor, Embedded RISC Processor (XScale Core), Packet Processor Hardware (Microengines).
Version Douglas E. Comer. Network Systems Design Using Network Processors (Intel2XXX).

IT922 Topics in Affective Computing 4
Introduction to affective computing; Emotion research from Cyber Psychology & Behaviour: concepts related to 'affective computing' (e.g., emotion, mood, personality, attitude) in ways that facilitate their use in computing; Computational models of human emotion processes (e.g., decision-making models that account for the influence of emotion; predictive models of user emotional state); Studies on cross- cultural, group and cross-language differences in emotional expression; Behavior Generation & User Interaction: Computational models of visual, acoustic and textual emotional expression for synthetic and robotic agents; Models of verbal and nonverbal expression of various forms of affect that facilitate machine implementation; Methods to adapt interaction with technology to the affective state of users; Computational methods for influencing the emotional state of people; New methods for defining and evaluating the usability of affective systems and the role of affect in usability; Methods of emotional profiling and

adaptation in mid- to long-term interaction; Application of affective computing including education, health care, entertainment, customer service, design, vehicle operation, social agents/robotics, affective ambient intelligence, customer experience measurement, multimedia retrieval, surveillance systems, biometrics, music retrieval and generation; Sensing & Analysis: Algorithms and features for the recognition of affective state from face and body gestures; Analysis of text and spoken language for emotion recognition; Analysis of prosody and voice quality of affective speech; Recognition of auditory and visual affect bursts; Recognition of affective state from central (e.g. fMRI, EEG) and peripheral (e.g. GSR) physiological measures; Methods for multi-modal recognition of affective state; Recognition of group emotion.

Picard, R. (2000), "Affective Computing", Cambridge, MA: MIT Press.
Fellous, J-M, and Arbib, M. (2005), "Who Needs Emotions? The Brain Meets the Robot", Oxford University Press.
Minsky, M. (2007), "The Emotion Machine: Commonsense Thinking, Artificial Intelligence & Future of Human Mind", NY, NY: Simon & Schuster.
Lewis, M., Haviland-Jones, J.M., Feldman Barrett, L. (2010), "Handbook of Emotions", Third Edition. NY, NY: The Guilford Press.
Journal Articles from IEEE Transactions on Affective Computing [2010 to Till Date].

IT923 Topics in Big Data Analytics **4**

Introduction to Big Data Analytics, Big Data Analytics Platforms, Big Data Storage and Processing, Big DataAnalytics Algorithms, Linked Big Data Analysis - Graph Computing and Network Science, Big Data Visualization, Big Data Mobile Applications, Large Scale Machine Learning, Big Data Analytics on Specific Processors, Hardware and Cluster Platforms for Big Data Analytics.

Michael Minelli , Michele Chambers, Ambiga Dhiraj [2013], "*Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley CIO.*
David Loshin [2013], "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann.
Mike Barlow [2012], " Real-Time Big Data Analytics: Emerging Architecture", [Kindle Ed.], O'Reilly Media.

IT924 Topics in Bio-Inspired Computing **4**

Life: Life and Information, Logical Mechanisms of Life; Computation: Universal Computation and Computability, Simulations and Realizations; Limitations of Life: Computational Beauty of Nature, Bio-inspired computing, Natural computing, Biology through the lens of computer science; Complex Systems and Artificial Life: Complex Networks, Self-Organization and Emergent Complex Behavior, Cellular Automata, Boolean Networks, Development and Morphogenesis, Open- ended evolution; Evolutionary Algorithms: Evolution and Adaptation, Genetic Algorithms, Genetic Programming, Differential Evolution; Collective Behavior and Swarm Intelligence: Social Insects, Stigmergy and Swarm Intelligence, Competition and Cooperation, Communication and Multi-Agent simulation, Meta-Heuristics: Ant Colony Optimization, Artificial Bee Colony algorithm, Bat-Termite Algorithm Particle Swarm Optimization, Cat Swarm Optimization, Glowworm swarm optimization, Grey-Wolf Optimization, Wolf-pack Optimization, Multi-Swarm Optimization; Immuno-Computing: Artificial immune systems, Distributed Design for Computational Intelligence, Engineering Application.

Nunes de Castro, Leandro [2006], "Fundamentals of Natural Computing: Basic Concepts, Algorithms and Applications", Chapman & Hall.
Floreano, D. and C. Mattiussi [2008], "Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies", MIT Press.
Nunes de Castro, Leandro and Fernando J. Von Zuben [2005], "Recent Developments in Biologically Inspired Computing", MIT Press.
Forbes, N. [2004], "Imitation of Life: How Biology is Inspiring Computing", MIT Press.
Flake, G. W. [1998], "The Computational Beauty of Nature: Computer Explorations of Fractals, Complex Systems and Adaptation", MIT Press.

IT925 Topics in Cloud Computing **4**

Overview of Cloud Computing: Cloud Computing Characteristics (elasticity, multi-tenant, on-demand, ubiquitous access, usage metering, self-service, SLA-monitoring, etc.), Cloud Computing and SOA, Enterprise Cloud drivers and adoption trends, Typical Cloud Enterprise workloads, Cloud service models & types (public, private, hybrid, and community clouds), Cloud deployment models (IaaS, PaaS, SaaS, BPaaS), Cloud ROI models, Cloud reference architectures, Cloud standards (OSDIAPIs, etc.), Technology providers vs. Cloud providers vs. Cloud vendors,

Planning Cloud transformations (suitability assessment, future state definition, financial assessment and platform selection, roadmap definition); Infrastructure as a Service (IaaS): Virtualization-VMware/Xen/KVM virtualization, adaptive virtualization, Cloud Computing & on-demand resource provisioning, Infrastructure services (storage, compute, services management, cloud brokers, etc.), IaaS vendor solutions: Amazon EC2, HP, Microsoft, Savvis, Terremark, Right Scale, Rackspace cloud, IBM, Oracle, Verizon; Platform as a Service (PaaS): Cloud platform services (monitoring/management, application servers, messaging, data management, development and testing, integration, business intelligence, etc.), PaaS vendor solutions: EMC, Google App Engine, HP, IBM, Microsoft Azure, Rackspace, Savvis, Verizon, force.com, VMware vFabric, OpenStack, Eucalyptus, Storage-as-a-Service platforms (Google Storage, ObjectStore S3, Amazon Dynamo, etc.); Software as a Service (SaaS): Cloud application development lifecycle; SaaS platform services (application development, application migration, SaaS implementation, business intelligence - Cloud-based/big data/real time analytics); Quality of Service (QoS) Aware Load Balancing in Large Scale Heterogeneous Cloud Environment and other Recent Trends in Cloud Computing.

Kai Hwang, Jack Dongarra, Geoffrey C. Fox [2011], " Distributed and Cloud Computing: From Parallel Processing to Internet of Things", Morgan Kauffmann.

Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi [2013], "Mastering Cloud Computing", Tata McGraw-Hill. Toby Velte, Anthony Velte, Robert C. Elsenpeter [2010], " Cloud Computing: Practical Approach", *McGraw-Hill. Journal Articles from IEEE Transactions on Cloud Computing [2013 to Till Date]*

IT926 Topics in Green Computing 4

Introduction to Green Cloud Computing, Migrating into Cloud, Green IT: An Overview, Green Devices and Hardware, Green Software; Green Data Centers: Data Centers and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics, Data Centre Management Strategies, Green Data Storage: Introduction, Storage Media Power Characteristics, Energy Management for Hard Disks, System-Level Energy Management; Green Networks and Communications: Introduction, Objectives of Green Network Protocols, Green Network Protocols and Standards, Sustainable Information Systems and Green Metrics; Green Cloud Computing and Environmental Sustainability: Energy Usage Model, Features of Clouds Enabling Green Computing, Towards Energy Efficiency of Cloud Computing, Green Cloud Architecture; Energy Adaptive Computing for Ecosystem: Implementing the Data Center Energy Productivity Metric in a High-Performance Computing Data Center, Sustainable Dynamic Application Hosting Across Geographically Distributed Data Centers, Energy Efficient task scheduling and Resources allocation at Data Center using Bio inspired Techniques, Energy Efficient Virtual Machine Provisioning and Migration w.r.t S.L.A agreements; Cloud Computing Tools : Simulators such as CloudSim, iCanCloud, Open Stack, Green Cloud, Open Nebula, Aneka; Recent Trends in Green Computing and IT.

"The Green Computing Book: Tackling Energy Efficiency at Large Scale", Edited by Wu-chun Feng, Chapman & Hall/CRC Computational Science, CRC Press, June 2014.

"Design Technologies for Green and Sustainable Computing Systems", Edited by Partha Pratim Pande, Amlan Ganguly, Krishnendu Chakrabarty, Springer, 2013.

"Harnessing Green IT: Principles and Practices", Edited by San Murugesan, G.R. Gangadharan, Wiley, 2012.

"Cloud Computing: Principles and Paradigms", Edited by Rajkumar Buyya, Jams Broberg, Andrzej Goscinski, Wiley, February 2011.

IT927 Topics in Internet of Things 4

IoT definitions: overview, applications, potential & challenges, and architecture; IoT examples: Case studies, e.g. sensor body-area-network and control of a smart home; Internet of Things: layers, protocols, packets, services, performance parameters of a packet network as well as applications such as web, Peer-to-peer, sensor networks, and multimedia; Mobile Networking: roaming and handoffs, mobile IP, and ad hoc and infrastructure less networks; Real- time networking: soft and real time, quality of service/information, resource reservation and scheduling, and performance measurements; IoT Security; IoT Ethics/Privacy; IoT in Energy/Environment; IoT in Infrastructure: Smart Homes/Cities; IoT in Healthcare.

Vijay Madisetti and Arshdeep Bahga, "Internet of Things: A Hands-On Approach", Published by VPT, 1st Ed., Aug. 2014.

Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", John Wiley & Sons, 2014.

Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press (Taylor & Francis), 2013. Articles from IEEE Internet of Things Journal [2014 to Till Date].

Articles from IEEE Transactions on Emerging Topics in Computing [2013 to Till date].

IT928 Topics in Social Media Analysis **4**

Introduction and Phenomenology of Social Media: Social Information Processing in Social News Aggregation, Influence and correlation in social networks; Social Network Analysis: Networks, Crowds, and Markets: Reasoning about a Highly Connected World, Four Degrees of Separation; Topic Analysis: Probabilistic topic models, Matrix Factorization Techniques For Recommender Systems; Sentiment Analysis and Opinion Mining; Influence and Centrality in Social Networks; Wikipedia Knowledge Extraction; Search Query Logs; Social Ties and Information Diffusion; Social Ties and Link Prediction; Social Spam & Malicious Behavior; Geospatial Social Data Mining; Privacy in a Networked World; Health and Social Media; Politics and Social Media; Predicting Future with Social Media; Emotional Contagion, Friendship Paradox and Detection of Contagions; Crowd Sourcing; Modelling individuals and collective behaviour; Social Multimedia Analysis: Photos, Videos.

Stanley Wasserman, Katherine Faus, "Social Network Analysis: Methods & Applications", Cambridge University Press, 1994.

David Easley and Jon Kleinberg, "Networks, Crowds and Markets", Cambridge University Press, 2010 Christina Prell, "Social Network Analysis: History, Theory and Methodology", SAGE Publications, 2011. John Scott, "Social Network Analysis", SAGE Publications, 3rd Edition, 2013.

Journal Articles from IEEE Transactions on Computational Social Systems, Elsevier Journal of Social Networks and Springer International Journal of Social Network Analysis and Mining.

IT929 Natural Language Processing and Applications **4**

Introduction to NLP, History and Applications; Language Modelling: Grammar based Language Models, Statistical Language Models; Mathematical Foundations of NLP and Information Theory; Word Level Analysis and Collocation, n-grams; Syntactic Analysis: CFGs, Parsing, Treebanks, Semantics: Representing Meaning, Lexical Similarity, Lexemes, WordNets; Semantic Analysis: Word Sense Disambiguation; Sentiment Analysis and opinion mining, Generating and developing sentiment lexicons, learning lexicons, machine learning based techniques, case studies, Text Mining and Document Categorization Techniques; Machine Translation, NL Applications.

Christopher D. Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing" MIT Press, 1999

Daniel Jurafsky and James H. Martin. "Speech and Language Processing: An Introduction to Natural Language Processing", Prentice Hall 2000.

Tanveer Siddiqui and U.S Tiwary, "Natural Language Processing and Information Retrieval", Oxford Press, 2008 James Allen, "Natural Language Understanding". Benjamin/Cummings, 2ed, 1995

Steven Bird. "Natural Language Processing with Python". O'Reilly, 2009

IT930 Deep Learning for Natural Language Processing **4**

Introduction to NLP and Deep Learning, Language Modeling, History and Applications, Basic Text Processing, Simple Word Vector representations: word2vec, GloVe, Advanced word vector representations: language models, softmax, single layer networks, Neural Networks and back-propagation -- for named entity recognition; Gradient checks, overfitting, regularization, activation functions; Recurrent neural networks -- for language modeling and other tasks; GRUs and LSTMs, Recursive neural networks -- for parsing and other applications; Convolutional neural networks -- for sentence classification; Reinforcement Learning and applications, The future of Deep Learning for NLP: Dynamic Memory Networks.

Li Deng and Dong Yu, "Deep Learning Methods and Applications", Microsoft Research, Foundations and Trends Book, 2014

Josh Patterson and Adam Gibson, "Deep Learning: A Practitioner's Approach" 1st Edition, 2016

Christopher D. Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing" MIT Press, 1999

Collobert, Ronan, et al. "Natural language processing (almost) from scratch." Journal of Machine Learning Research 12.Aug (2011): 2493-2537.

IT931 Intelligent Information Retrieval **4**

Introduction, Basics Concepts, IR System Architecture; IR Models and Operations - Preprocessing, Bag of Words, Indexing, Boolean, Term Weighting, Vector-Space Retrieval, Probabilistic Models, Best Match Models, Latent Semantic Indexing, ; Experimental Evaluation of IR Systems; Document Representations; Query Operations and

Languages; Relevance feedback and query expansion; Web Search and Link Analysis: Algorithms and evaluation; Structured Information Retrieval, Multimedia Information Retrieval; Recommender Systems; Information Extraction and Integration; Selected research papers on upcoming trends and open problems.

C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008. Baeza-Yates & Ribeiro-Neto, Modern Information Retrieval, Pearson Education, 2010
Information Retrieval: Algorithms and Heuristics, by D. Grossman and O. Frieder, 2004
Information Retrieval: Implementing and Evaluating Search Engines, by S. Büttcher, C. Clarke, and G. Cormack., 2010 Korfhage Robert R, Information Storage and Retrieval, John Wiley & Sons, Inc, 1997.

IT932 Topics in Multimedia Information Retrieval **4**

Introduction to multimedia information retrieval, Characteristics of MM data; similarity-based retrieval model-retrieval framework; feature engineering for multimedia, feature selection and extraction techniques, Color-based Retrieval: color models; histogram model; indexing and retrieval; relevance feedback; histogram refinement; color cluster technique; Texture-based Retrieval: texture models; statistical models; combined color-texture representation; Shape-based Retrieval: shape matching; contour -based method (Fourier descriptors); region-based method (moment invariants); Audio Retrieval: characteristics of audio data; spectrum analysis; pitch tracking; techniques for audio feature extraction, similarity matching and retrieval; Video Retrieval: Video segmentation in raw and compressed domain; key-frame extraction; video summarization and retrieval techniques; Multimedia Retrieval Framework: multi-attribute query processing; knowledge-based methods, Evaluation metrics for multimedia information systems; benchmarking, Multimedia Retrieval Trends, Applications; Research Problems.

R. Jain, R. Kasturi, B.G. Schunck (1995), Machine Vision, McGraw-Hill.
B. Furht, S.W. Smoliar, H.J. Zhang (1995), Video and Image Processing in Multimedia Systems, Kluwer, Boston. Roberto Raieli, "Multimedia Information Retrieval- Theory and Techniques", Elsevier, 1st Edition, 2013 Mark T Maybury, "Intelligent Multimedia Information Retrieval", AAAI Press, MIT Press
C. D. Manning et al., Introduction to Information Retrieval, Cambridge University Press. 2008.
Baeza-Yates & Ribeiro-Neto, Modern Information Retrieval, Pearson Education,2010

IT933 Visual Computing **4**

Basics, Image formation, capture & representation; Visual feature representation techniques; Visual matching - BoVW, VLAD, RANSAC, Hough Transforms, Optical flow; Neural networks for Visual Computing - MLPs, backpropagation; CNN architectures; CNN Kernel Visualization, Backprop-to-image and Deconvolution Methods, Neural Style Transfer; CNNs for Object Detection, Segmentation, Recognition, Verification; Recurrent Neural Networks (RNNs), Attention models for Image Captioning, Visual QA, Visual Dialog, Transformer Networks; Deep Generative Models - GANs, VAEs; Adversarial AEs, PixelRNNs, NADE, Normalizing Flows, Super-resolution etc; Variants and Applications of Generative Models in Vision, Recent Trends - Zero-shot, One-shot, Few-shot Learning; Self-supervised Learning; Reinforcement Learning in Vision, Applications and research challenges.

Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd edition, Springer Verlag 2021.
Simon Prince, Computer Vision: Models, Learning, and Inference, Cambridge Press, 2012.
David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2nd edition, Pearson, 2012.
Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2016
Yoshua Bengio, Learning Deep Architectures for AI, Technical Reports, 2009
Journal Articles from IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Image Processing, ACM Transactions on Multimedia Computing

IT934 Computational Finance **4**

Geometric Brownian motion, asset price process, Proportional dividend model, Volatility variation, Time-dependent volatility, Martingale. Option Pricing: Feynman-Kac theorem, Black-Scholes model. Local Volatility Models: Black-Scholes implied volatility, Non-parametric local volatility models. Multidimensionality, Change of Measure, Affine Processes. Heston stochastic volatility model. Monte Carlo Simulation: Basics, Stochastic Euler and Milstein schemes, Monte Carlo scheme for the Heston model.

Cornelis W Oosterlee and Lech A Grzelak, "Mathematical Modeling and Computation in Finance",World Scientific Publishing Europe Ltd, 2020
Mario J. Miranda and Paul L. Fackler, Applied Computational Economics and Finance; MIT Press Ltd
Articles from Journals: Mathematical Finance, Applied Mathematical Finance, The Journal of Computational Finance, Journal of Computational Mathematics and Data Science

IT935 Quantum Computing **4**

Introduction to Quantum Computation and Quantum Information: Quantum bits, Hilbert space, Superdence coding, Postulates of Quantum mechanics, Single qubit operations, Multiple Qubit operations, Logic gates and Design of quantum circuits.
Quantum Algorithms: The quantum search algorithm, Quantum search of an unstructured database, Optimality of the search algorithm, Quantum counting algorithm, Simon's Algorithm, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Quantum solutions for NP-Complete problems, Applications of Quantum Computing.

Ciaran Hughes, Joshua Isaacson, Anastasia Perry, Ranbel F. Sun, Jessica Turner "Quantum Computing for the Quantum Curious" Springer Nature, 2021-Computer science
Venkateswaran Kasirajan "Fundamentals of Quantum Computing: Theory and Practice" Springer International Publishing, 2021
Simon Edwards "Quantum Computing for beginners: A Complete beginner's guide to Explain in Easy Way, History, Features, Developments and Applications of New Quantum Computers that will Revolutionize the World Published, 2020
Chris Bernhardt "Quantum Computing for Everyone" MIT Press, 2019 - Computers
Wolfgang Scherer Mathematics of Quantum Computing: An Introduction Springer Nature, 2019.
Giuliano Benenti, Giulio Casati, Davide Rossini, Giuliano Strini "Principles of Quantum Computation and Information: A Comprehensive Textbook" World Scientific Publishing Company Pte. Limited, 2018.
N.David Mermin, Quantum Computer Science, Cambridge University Press, 2007.
Vishal Sahni, "Quantum Computing", Tata McGrawHill, 2007.

IT936 Blockchain Technology **4**

Introduction, Blockchain Architecture and design methods, Consensus protocols, Cryptography Essentials, Security and challenges, Forking, Smart Contracts and DApps, Blockchain Categorization, Blockchain Platforms, Security and Attacks, Infra and Network Analysis, Internet of Blockchains, IoTA, Financial Systems Challenges and Opportunities, Digital ID, Case study: Trade Finance, Supply Chain, On-chain and off-chain Communication.

Gulshan Shrivastava, Dac-Nhuong Le, Kavita Sharma, "Cryptocurrencies and Blockchain Technology Applications", Wiley-Scrivener, 1st edition, 2021
Raj, Pethuru, Saini, Kavita, Surianarayanan, Chellammal, "Blockchain Technology and Applications" , Auerbach Book/CRC Press,2021
Ge Xu, Jianming Zhu, Xianhua Song, Zeguang Lu, " Blockchain Technology and Application", Springer, 2021
P. Kravchenko, B. Skriabin, O. Dubinina,"Blockchain And Decentralized Systems"Volume 3, Distributed Lab, 2020
Joseph J. Bambara, Paul R. Allen, Kedar Iyer, Rene Madsen, Solomon Lederer, Michael Wuehler, "Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions", McGraw-Hill Education, 1st edition, 2018 Dylan Yaga, Peter Mell, Nik Roby, Karen Scarfone , "Blockchain Technology Overview", NIST, 2018
Manav Gupta "Blockchain For Dummies", IBM, 2018.
Andreas M. Antonopoulos, "Mastering Bitcoin", O'Reilly,2nd Edition, 2017.
Melanie Swan, " Blockchain - Blueprint for a new economy", O'Reilly,1st Edition, 2015