Semester VIII (Fourth year)

Subject wise Detail Syllabus

(Eighth semester onwards)

Undergraduate Degree in Engineering & Technology

Branch/Course:

COMPUTER SCIENCE & ENGINEERING

ARYABHATTA KNOWLEDGE UNIVERSITY
Chanakya National Law University Campus
Mithapur, Patna-800001 www.akubihar.ac.in

Semester –VIII (Fourth year)

SI. No.	Type of course	Code	Course Title	Hours per week			Credits
				Lecture	Tutorial	Practical	
1	Professional Elective Courses	PEC CS 8XX	Elective-IV	3	0	0	3
2	Professional Elective Courses	PEC CS 8XX	Elective-V	3	0	0	3
3	Open Elective courses	OEC-CS 8XX	Open Elective-II	3	0	0	3
4	Project and Seminar	PNS CS 801	Project-III	0	0	12	6
						Total credits	**15**

Professional Elective – 4 8thSem	Queuing Theory and Modeling	Quantum Computing	Transaction Processing System	Advanced Operating Systems	Information Retrieval	Generic Algorithm	Block Chain	Big Data Analytics
Professional Elective – 5 8thSem	Computational Complexity	Computational Geometry	Computational Number Theory	Natural Language Processing	Cloud Computing	Neural Networks and Deep Learning	Bitcoin and Crypto Currencies	Pattern Recognition
Open Elective – 2 8thSem	Low Power Circuits and Systems	Human Computer Interaction	Electronic Design Automation	VLSI System Design	Digital Image Processing	Mobile and Wireless Computing	High Speed Network	
	Fault Tolerant Computing	Embedded Systems	Optimization Techniques	Soft Computing	Simulation and Modeling	High Performance Computing		

Professional Elective – IV

	Advanced Operating Systems	**3L:0T:0P**	**3 Credits**
Pre-requisites	**PCC-CS403**		

Objectives of the course

The objective of this course is to impart necessary and practical knowledge to identify and solve problems in distributed, multiprocessor and database operating systems.

Detail contents

Module 1 **Lecture 6 hrs.**

Introduction to Advance Operating System: Comparative study of OS; LINUX, Linux File System + Measurements, The Log Structured File System, Server less Network File Systems, The Coda File System, AFS, Virtual Memory, Stack/Buffer Overflow, Address Space Layout Randomization (ASLR) User-Level Virtual Memory, Global Network Scheduling, Network Optimization, Extensible Operating Systems, Issues of Security in OS, Cryptographic file systems.

Module 2 **Lecture 6 hrs.**

Distributed Operating Systems: System Architecture Types, Issues in Distributed Operating Systems: Naming, Scalability, Security, Client-Server Model, Process Synchronization, Global Knowledge, etc. RPC, Message Passing. Absence of Global Lock, Absence of Shared Memory, lamport's logical clock, Chandy Lamport's Algorithm, Termination Detection, Distributed Mutual Exclusion, Non Token Based Algorithms, Ricart Agarwala algorithm, Lamport's Algorithm, Generalized Non-Token Based Algorithm, Comparative performance Analysis

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Module 3 **Lecture 6 hrs.**

Synchronization: Clock synchronization, Event ordering, Mutual exclusion, Deadlock, Election algorithms, Desirable features of good global scheduling algorithms, Task assignment approach, Load balancing approach, Load sharing approach, Process management: Process migration, Threads Distributed Deadlock Detection, Centralized/Distributed/Hierarchical control, Path Pushing Algorithm, Edge-Chasing Algorithm, Ho-Ramamoorthy Algorithms.

Module 4 **Lecture 6 hrs.**

Resource Management in Distributed Systems: Distributed File Systems: Mounting, Caching, Bulk Data Transfer, Design Issues, Cache Consistency, Scalability, Log Structured File systems; Distributed Shared Memory: Central-Server Algorithm, Full-Replication Algorithm, etc. Coherence Protocols, Granularity, Page Replacement; Distributed Scheduling: Load, Classification, Load Balancing and Load Sharing, Policies for Transfer, Selection, Location, Information, Stability, Load Balancing Algorithms, Load Sharing Case Studies.

Module 5 **Lecture 6 hrs.**

Fault Tolerance, Recovery, Protection and Security: Atomic Actions and Commit, Commit Protocols, Voting Protocols, Dynamic Voting, Classification of Failures, Backward and Forward Error Recovery, Synchronous/Asynchronous Checkpoints and Recovery, Recovery in Concurrent Systems, Access Matrix Model, Advanced Models of Protection, Cryptography.

Module 6 **Lecture 6 hrs.**

Multiprocessor and Database Operating Systems: Tightly and Loosely Coupled systems, Interconnect networks, Caching, Hypercube architectures, Threads, Process Synchronization in MP systems, Process Scheduling in MP systems, Requirements of Database OS, Transactions, Conflicts, Serializability Theory, Distributed Database Systems, Concurrency control Algorithms, Lock Based Algorithms, Timestamp Based Algorithms, 2PL.

Module 7 **Lecture 6 hrs.**

Virtualization: Introduction; Simulation, Emulation, Para-Virtualization, Full virtualization; x86 Virtualization: privileged instructions, control sensitive instructions, Trap and Emulate, Binary translation, x86 hardware virtualization vmxon/vmxoff, vmentry, vm exit;, Intel VTd, VMCS, Shadow page tables, EPT/NPT.

Suggested books:

1. Pradeep K. Sinha, "Distributed Operating Systems: Concepts and Design", Wiley.
2. Andrew S. Tanenbaum, "Distributed Operating Systems", Pearson.
3. Mukesh Singhal & Niranjan Shivaratri, "Advanced Concepts in Operating Systems", McGraw Hill Education.

Course Outcomes

Students should be able to:

1. Identify and solve problems in distributed, multiprocessor and database operating systems.
2. Explain the architectural features and solutions for implementing various virtualization features in operating systems. 3. Solve synchronization problems involving distributed and virtualized environments.

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Professional Elective – V

	Computational Geometry	**3L:0T:0P**	**3 Credits**

Objective: To introduce geometric algorithms and to give an exposure to algorithms and data structures for geometric problems.

Detail contents

Module 1 **Lecture 6 hrs.**

Polygon Triangulation: Triangulation Theory, Area of Polygon, Segment intersection, Segment-triangle intersection.

Polygon Partitioning: Monotone Partitioning, Trapezoidalization, Partition into Monotone Mountains, Linear-Time Triangulation, Convex Partitioning.

Module 2 **Lecture 5 hrs.**

Convex Hulls in Two Dimensions: Definitions of Convexity and Convex Hulls, Naive Algorithms for Extreme Points, Gift Wrapping, QuickHull, Graham's Algorithm, Lower Bound, Incremental Algorithm, Divide and Conquer.

Module 3 **Lecture 6 hrs.**

Convex Hulls in Three Dimensions: Polyhedra and data structures, Gift wrapping, Preparata-Hong algorithm, Incremental algorithm, Randomized incremental algorithm.

Module 4 **Lecture 6 hrs.**

Voronoi Diagrams: Definitions and Basic Properties, Delaunay Triangulations, Algorithms, Applications in Detail, Medial Axis, Connection to Convex Hulls, Connection to Arrangements.

Module 5 **Lecture 6 hrs.**

Arrangements: Combinatorics of Arrangements, Incremental Algorithm, Three and Higher Dimensions, Duality, Higher-Order Voronoi, Diagrams, Applications.

Module 6 **Lecture 8 hrs.**

Search and Intersection: Segment-Segment Intersection, Segment- Triangle Intersection, Point in Polygon, Point in Polyhedron, Intersection of Convex Polygons, Intersection of Segments, Intersection of Nonconvex Polygons, Extreme Point of Convex Polygon, Extremal Polytope, Queries, Planar Point Location.

Module 7 **Lecture 5 hrs.**

Motion Planning: Shortest Paths, Moving a Disk, Translating a Convex Polygon, Moving a Ladder, Robot Arm Motion, Separability.

Suggested Books:

1. M. de Berg, M van Kreveld, M. Overmars, O. Schwarzkopf, Computational Geometry: Algorithms and Applications (2nd Edition), Springer - Verlag 2000
2. J. O'Rourke, Computational Geometry in C, 2nd ed., Cambridge Univ. Press, 1998.
3. B. Casselman, Mathematical Illustrations: A Manual of Geometry and PostScript, Springer-Verlag,.

(http://www.math.ubc.ca/~cass/graphics/manual) 2005

4. K. Mulmuley, Computational Geometry: An Introduction Through Randomized Algorithms, Prentice Hall. 1994

Course Outcome:

Upon successful completion of this course, students will be able to:

(i) Analyze randomized algorithms for small domain problems.

(ii) Use line-point duality to develop efficient algorithms.

(iii) Apply geometric techniques to real-world problems in graphics.

(iv) Solve linear programs geometrically.

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Professional Elective – V

	Natural Language Processing	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lecture 6 hrs.**

Sound: Biology of Speech Processing; Place and Manner of Articulation; Word Boundary Detection; Argmax based computations; HMM and Speech Recognition.

Module 2 **Lecture 6 hrs.**

Words and Word Forms: Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.

Module 3 **Lecture 8 hrs.**

Structures: Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents; Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and Attachment Ambiguity resolution.

Module 4 **Lecture 6 hrs.**

Meaning: Lexical Knowledge Networks, Wordnet Theory; Indian Language Wordnets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors; Coreferences.

Module 5 **Lecture 8 hrs.**

Web 2.0 Applications: Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).

Reference Books:

1. Jurafsky, Dan and Martin, James, "Speech and Language Processing", 2nd Edition, Prentice Hall, 2008
2. Manning, Christopher and Heinrich, Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999
3. Allen James, "Natural Language Understanding", 2nd edition, Benjamin Cumming, 1995
4. Charniack, Eugene, "Statistical Language Learning", MIT Press, 1993

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Professional Elective – V

	Cloud Computing	**3L:0T:0P**	**3 Credits**

Objective: This course will cover the study of various cloud services, deployment model, resource provisioning and scheduling algorithms involved in better implementing the cloud-based systems.

Detailed contents

Module 1 **Lecture 4 hrs.**

Introduction: Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, deployment models, and service models.

Module 2 **Lecture 5 hrs.**

Virtualization: Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, virtualization of data centers, and Issues with Multi-tenancy.

Module 3 **Lecture 6 hrs.**

Implementation: Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, SLA management.

Module 4 **Lecture 12 hrs.**

Resource Management: Cloud resource provisioning plan (advance reservation, on demand plan, spot instances), various scheduling and load balancing techniques to improve QoS parameters, Resource Optimization algorithms, task migration and VM migration technique.

Module 5 **Lecture 7 hrs.**

Security: Vulnerability Issues and Security Threats, Application-level Security, Data level Security, and Virtual Machine level Security, Infrastructure Security, and Multi-tenancy Issues.

Module 6 **Lecture 6 hrs.**

Advances: Green Cloud, Mobile Cloud Computing, Fog Computing, Internet of Things

Suggested Books:

1. Cloud Computing Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley Publishers 2011
2. Cloud Computing Bible, Barrie Sosinsky, Wiley Publishers 2010
3. Mastering Cloud computing, Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, McGraw Hill 2013
4. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly 2010 5. Cloud Computing by Shailendra Singh 2018

Course outcomes:

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
3. Identify problems, and explain, analyze, and evaluate various cloud computing solutions
4. Provide the appropriate cloud computing solutions and recommendations according to the applications used.
5. Attempt to generate new ideas and innovations in cloud computing

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Professional Elective – V

	Deep Learning	**3L:0T:0P**	**5 Credits**
Pre-requisites	**Artificial Intelligence**		

Objectives of the course:

This course will provide a basic understanding of deep learning and their applications to solve real world problems. Open source tools will be used to demonstrate different applications.

Detailed contents

Module 1: Introduction **Lecture 4 hrs.**

Brief introduction of big data problem. Overview of linear algebra, probability, numerical computation. Basics of Machine learning/Feature engineering.

Module 2: Basics of Neural networks **Lecture 4 hrs.**

Neural networks, Tools for Deep learning network - Shallow vs Deep network.

Module 3: Feedforward Networks **Lecture 6 hrs.**

Multilayer Perceptron, Gradient, Loss Function, Gradient Descent, Stochastic Gradient Descent (SDD), Backpropagation algorithm, Empirical Risk Minimization, regularization, Gradient based learning - Cost function, learning rate, soft max, sigmoid function, Hidden unit - ReLU, Logistic sigmoid, hyperbolic tangent Architecture design, Heuristics for faster training.

Module 4: Unsupervised learning **Lecture 10 hrs.**

Deep Belief Network, Deep Boltzmann Machine (DBM), Factor analysis, Auto-encoders (standard, sparse, denoising, contractive, etc), Variational Auto-encoders, Adversarial Generative Networks, Auto-encoder, Regularization Optimization for training deep model.

Module 5: Advanced topics **Lecture 10 hrs.**

Convolutional Neural Network (CNN): Architectures, convolution / pooling layers. Recurrent Neural Network (RNN)/ Sequence modeling,: Long Short Term Memory networks (LSTM), GRU, Encoder Decoder architectures Reinforcement learning.

Module 6: Practical applications **Lecture 6 hrs.**

Application of Deep Learning to Computer Vision, Speech Recognition, Natural Language Processing, etc

Suggested books:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", Book in preparation for MIT Press, 2016.
2. Jerome H. Friedman, Robert Tibshirani, and Trevor Hastie, "The elements of statistical learning", Springer Series in Statistics, 2009.
3. Charu C Aggarwal, "Neural Networks and Deep Learning", Springer.

Learning Outcomes

 Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains. Implement deep learning algorithms and solve real-world problems.

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Professional Elective – V

	Bitcoin and Crypto Currencies	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lecture 8 hrs.**

Introduction to Cryptography, Cryptographic Hash Functions, SHA_256, Hash Pointers and Data Structures, Merkle tree.

Module 2 **Lecture 8 hrs.**

Digital Signatures, Elliptic curve group, Elliptic Curve Digital Signature Algorithm (ECDSA). Public Keys as Identities, A Simple Crypto currency.

Module 3 **Lecture 8 hrs.**

Centralization vs. Decentralization, Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work. Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network.

Module 4 **Lecture 8 hrs.**

Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

Module 5 **Lecture 8 hrs.**

Bitcoin Mining, Mining pools, Mining incentives and strategies. Bitcoin and Anonymity: Anonymity Basics, Mixing, Zerocoin and Zerocash.

Reference Book:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, 2016.

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Professional Elective – V

	Pattern Recognition	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lecture 6 hrs.**

Introduction: Importance of pattern recognition, Features, Feature Vectors, and Classifiers, Supervised Versus Unsupervised Pattern Recognition

Module 2 **Lecture 6 hrs.**

Bayes Decision Theory: Discriminant Functions and Services o the Normal Distribution, Bayesian Classification, Estimating Probability Density Functions, Nearest Neighbour Rules Bayesian Networks

Module 3 **Lecture 6 hrs.**

Linear and Nonlinear Classifiers: The Perceptron Algorithm, Least-Squares Methods, Nonlinear Classifiers, Multilayer Perceptron's, Back Propagation Algorithm, Decision Trees, combinations of Classifiers, Boosting

Module 4 **Lecture 6 hrs.**

Feature Selection: Data Pre-processing, ROC Curves, Class Separability Measures, Feature Subset Selection, Bayesian Information Criterion

Module 5 **Lecture 6 hrs.**

Dimensionality Reduction: Basis Vectors , Singular Value Decomposition , Independent Component Analysis , Kernel PCA, Wavelets

Module 6 **Lecture 6 hrs.**

Additional Features And Template Matching: Texture, Shape and Size Characterization, Fractals, Features For Audio, Template Matching Using Dynamic Time Warping and Edit Distance, Context Dependent Classification

Module 7 **Lecture 6 hrs.**

Clustering: Sequential Algorithms , Hierarchical Algorithms ,Functional Optimization-Based Clustering Graph Clustering ,Learning Clustering ,Clustering High Dimensional Data ,Subspace Clustering , Cluster Validity Measure.

Text Books

1. Pattern recognition, Sergios Theodoridis
2. Pattern classification, second edition, duda, hart and stork ,wiley
3. Pattern recognition, Sergios Theodoridis Konstanti Nos Koutrou M Bas

Reference Books

1. Introduction to Statistical Pattern Recognition, Fukunaga Academic Press
2. Pattern Recognition and Machine learning, C. M. Bishop, Springer
3. Statistical Methods in Bioinformatics, Ewens & Grant, Springer
4. The Elements of Statistical Learning, Hastie, Tibshirani, Friedman, Springer

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Open Elective – II

	VLSI System Design	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lectures 6 hrs.**

Introduction to VLSI design: Moore's Law; Scale of Integration; Types of VLSI Chips; Design principles (Digital VLSI); Design Domains(Y-Chart), Challenges of VLSI design- power, timing area, noise, testability reliability, and yield; CAD tools for VLSI design

Module 2 **Lectures 7 hrs.**

Introduction to VLSI Technology: VLSI Technology - An Overview - Wafer Processing, Oxidation, Epitaxial Deposition, Ion-implantation and Diffusion; The Silicon Gate Process- Basic CMOS Technology; basic n-well CMOS process, p-well CMOS process; Twin tub process, Silicon on insulator; CMOS process enhancement-Interconnect; circuit elements; 3-D CMOS

Module 3 **Lectures 7 hrs.**

Analysis of CMOS logic Circuits: MOSFET as Switch; Recapitulation of MOS; CMOS Inverter, CMOS logic circuits; NAND gate and NOR Gate; Complex logic circuits; Pass transistor logic; CMOS Transmission gate; CMOS full adder

Module 4 **Lectures 4 hrs.**

Advanced Techniques in CMOS logic circuit: Pseudo nMOS; Tri-state; Clocked CMOS; Dynamic CMOS logic- Domino, NORA, Zipper, etc.; Dual rail logic networks

Module 5 **Lectures 2 hrs.**

Memories: Static RAM; SRAM arrays; Dynamic RAMs; ROM arrays; Logic arrays

Module 6 **Lectures 8 hrs.**

Timing issues in VLSI system design: Timing classification- synchronous timing basics, skew and jitter, latch based clocking, self-timed circuit design; self-timed logic; completion signal generation; self-timed signaling–synchronizers and arbiters

Module 7 **Lectures 6 hrs.**

Verilog Hardware Description language: Overview of digital design with Verilog HDL; Hierarchical modeling concepts; Modules and port definitions; Gate level modeling; Data flow modeling; Behavioral modeling; Task & functions; Test bench

Text Books:

1. Neil H. E. Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", 2nd edition, Pearson Education Asia, 2000.
2. John P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley and Sons, Inc., 2002.
3. Samir Palnitkar, "Verilog HDL", 2nd Edition, Pearson Education, 2004.

Reference Books:

1. Eugene D. Fabricius, "Introduction to VLSI Design", TMH International Editions, 1990.
2. Bhasker J., "A Verilog HDL Primer", 2nd Edition, B. S. Publications, 2001.
3. Pucknell, "Basic VLSI Design", Prentice Hall of India Publication, 1995.
4. Wayne Wolf, "Modern VLSI Design System on chip", Pearson Education, 2002.

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Open Elective – II

	Digital Image Processing	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lecture 8 hrs.**

Introduction: Background, Digital Image Representation, Fundamental Steps in Image Processing, Elements of a Digital Image Processing System.

Digital Image Fundamentals: Elements of Visual Perception, a Simple Image Model, Sampling and Quantization, Some Basic Relationships between Pixels, Imagining Geometry.

Module 2 **Lecture 8 hrs.**

Image Transforms: Introduction to the Fourier Transform, The Discrete Fourier Transform, Some Properties of the Two-Dimensional Fourier Transform, Other Separable Image Transforms.

Module 3 **Lecture 8 hrs.**

Image Enhancement: Spatial Domain Methods, Frequency Domain Methods, Some Simple Intensity Transformations, Histogram Processing, Image Subtraction, Image Averaging, Background, Smoothing Filters, Sharpening Filters, Lowpass Filtering, Highpass Filtering, Generation of Spatial Masks from Frequency Domain Specifications.

Module 4 **Lecture 8 hrs.**

Image Restoring: Degradations Model - Definitions, Degradation Model for Continuous Functions, Diagonalization of Circulant and Block-Circulant Matrices, Circulant Matrices, Block Circulant Matrices, Effects of Diagonalization on the Degradation Model, Algebraic Approach to

Restoration, Unconstrained Restoration, Constrained Restoration, Inverse Filtering – Formulation, Removal of Blur Caused by Uniform Linear Motion, Restoration in the Spatial Domain, Geometric Transformation.

Module 5 **Lecture 8 hrs.**

Image Compression: Fundamentals – Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Fidelity Criteria. Image Compression Models – The Source Encoder and Decoder, The Channel Encoder and Decoder. Elements of Information Theory – Measuring Information, The Information Channel, Fundamental Coding Theorems, Using Information Theory. Error-Free Compression – Variable-Length Coding, Bit-Plane Coding, Lossless Predictive Coding. Lossy Compression – Lossy Predictive Coding, Transform Coding.

Text Book:

1. Rafael. C. Gonzalez & Richard E.Woods.- Digital Image Processing, 2/e Pearson Education, New Delhi - 2006

Reference Books:

1. W.K.Pratt.-Digital Image Processing, 3/e Edn., John Wiley & sons, Inc. 2006
2. M. Sonka et.al Image Processing, Analysis and Machine Vision, 2/e, Thomson, Learning, India Edition, 2007

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Open Elective – II

	Mobile and Wireless Computing	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lecture 8 hrs.**

Introduction to Wireless Networks: Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems.

Module 2 **Lecture 8 hrs.**

MAC: Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems: GSM, DECT, TETRA. UMTS, MT-2000.

Module 3 **Lecture 8 hrs.**

Wireless LAN, Infrared Vs Radio transmission, Infrastructure, Adhoc Network, 802.11, HIPERLAN, Bluetooth, Mobile Network Layer, Mobile IP, Dynamic Host Configuration Protocol.

Module 4 **Lecture 8 hrs.**

Adhoc Networks, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit / Fast recovery, Transmission / Time-out freezing, Selective retransmission, Transaction Oriented TCP.

Module 5 **Lecture 8 hrs.**

Support for Mobility, File Systems, WWW, Wireless Application Protocol.

Text Book: 1. Jochen Schiller, "Mobile Communications", Pearson Education, Asia Publications, 2000.

Reference Books:

1. William Stallings, "Wireless Communication and Networks", PHI/Pearson Education, 2002.
2. KavehPahlavan, PrasanthKrishnamoorthy, "Principles of Wireless Networks", PHI/Pearson Education, 2003.
3. HazysztofWesolowshi, "Mobile Communication Systems", John Wiley and Sons Ltd, 2002.

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Open Elective – II

	High Speed Networks	**3L:0T:0P**	**3 Credits**

Detailed contents

Module 1 **Lecture 8 hrs.**

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL, High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11.

Module 2 **Lecture 8 hrs.**

Queuing Analysis- Queuing Models – Single Server Queues – Effects of Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

Module 3 **Lecture 8 hrs.**

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management - Exponential RTObackoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes –Traffic Management Frame work, Traffic Control – ABR traffic Management.

Module 4 **Lecture 8 hrs.**

Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services.

Module 5 **Lecture 8 hrs.**

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP –Protocol Architecture.

Text Books:

1. William Stallings, "High Speed Networks and Internet", Pearson Education, 2 nd Edition, 2002

2. Warland, Pravin Varaiya, “High performance communication networks”, 2 nd Edition, Jean Harcourt Asia Pvt. Ltd., 2001

Reference Books:

1. IrvanPepelnjk, Jim Guichard, Jeff Apcar, “MPLS and VPN architecture”, CiscoPress, Volume 1 and 2, 2003
2. Abhijit S. Pandya and Ercan Sea, “ATM Technology for Broad Band Telecommunication Networks”, CRC Press, New York, 2004

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