Harcourt Butler Technological Institute, Kanpur-208002

(An Autonomous Institute Affiliated to U. P. Technical University, Lucknow)

Revised Syllabus

B. Tech. IV Year
Computer Science and Engineering

(Effective from the session 2011-12)

ARTIFICIAL INTELLIGENCE (HCS-702)

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UNIT-I: Introduction
Introduction to Artificial Intelligence, Brief history, Various approaches to AI, Areas of application, Simulation of sophisticated & Intelligent Behavior in different area, Problem solving in games, natural language processing, automated reasoning, and visual perception, Knowledge and its role in AI, Heuristic algorithm versus solution guaranteed algorithms, Introduction to soft computing.

UNIT-II: Searching in State Space
Representing problems in state space, Informed versus uninformed search, Production System Model, Evaluation of the Production System, Depth First Search and Breadth First Search, Heuristics, Heuristic Search Techniques: Hill Climbing, Best First search, A* Algorithm, Branch and Bound, Cryptarithmatic Problem, Means End Analysis, AO* Algorithm, Game Playing: MINMAX Search, Alpha-Beta Pruning, Heuristic Estimation.

UNIT-III: Knowledge Representation and Reasoning
Propositional Logic, First Order Predicate Logic, Graphs, Associative Network, Semantic Networks, Conceptual Dependencies, Frames, Scripts, Horn Clauses, Introductory Examples from PROLOG, Case Grammar Theory, Production Rules Knowledge Base, The Interface System, Forward & Backward Deduction, Inference System in Propositional and Predicate Logic, Reasoning under Uncertainty.

UNIT-IV: Understanding Natural Languages.
Various Approaches of NLP, Parsing techniques, Context free and transformational grammars, Transition nets, Augmented transition nets, Fillmore's grammars, Grammar free analyzers, Sentence generation, and translation, Introduction to Pattern Recognition, Structured Description, Symbolic Description, Machine Perception, Object Identification, Speech Recognition.

UNIT-V: Expert Systems
Architecture of Expert System, Representing and using domain knowledge, Expert System Shell, Explanation System, Knowledge Acquisition System, Case study of Existing Expert Systems like DENDRAL, MYCIN, Development of a small Expert System using programming Languages and tools like LISP, PROLOG, JESS.

Text and Reference Books:

1. N. J. Nilsson, “Artificial Intelligence: A New Synthesis”, Elsevier Publications.
2. Charnick, “Introduction to A.I.”, Addison Wesley.
3. Rich & Knight, “Artificial Intelligence”, McGraw-Hill Publication.
4. Winston, “LISP”, Addison Wesley
5. Marcellous, “Expert System Programming”, PHI
6. Elamie, “Artificial Intelligence”, Academic Press
7. Lioyed, “Foundation of Logic Processing”, Springer Verlag
8. D. W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, PHI.

ADVANCE COMPUTER ARCHITECTURE (HCS-701)

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Unit-I: Introduction
Introduction to parallel computing, need for parallel computing, parallel architectural classification schemes, Flynn’s, Feng’s classification, performance of parallel processors, distributed processing, processor and memory hierarchy, bus, cache & shared memory, introduction to super scalar architectures, quantitative evaluation of performance gain using memory, cache miss/hits.

Unit-II: Multi-core Architectures

Introduction to multi-core architectures, issues involved into writing code for multi-core architectures, development of programs for these architectures, program optimizations techniques, building of some of these techniques in compilers, OpenMP and other message passing libraries, threads, mutex etc.

Unit-III: Multi-threaded Architectures

Parallel computers, Instruction level parallelism (ILP) vs. thread level parallelism (TLP), Performance issues: Brief introduction to cache hierarchy and communication latency, Shared memory multiprocessors, General architectures and the problem of cache coherence, Synchronization primitives: Atomic primitives; locks: TTS, ticket, array; barriers: central and tree; performance implications in shared memory programs; Chip multiprocessors: Why CMP (Moore's law, wire delay); shared L2 vs. tiled CMP; core complexity; power/performance; Snoopy coherence: invalidate vs. update, MSI, MESI, MOESI, MOSI; performance trade-offs; pipelined snoopy bus design; Memory consistency models: SC, PC, TSO, PSO, WO/WC, RC; Chip multiprocessor case studies: Intel Montecito and dual-core, Pentium4, IBM Power4, Sun Niagara

Unit-IV: Compiler Optimization Issues

Introduction to optimization, overview of parallelization; Shared memory programming, introduction to OpenMP; Dataflow analysis, pointer analysis, alias analysis; Data dependence analysis, solving data dependence equations (integer linear programming problem); Loop optimizations; Memory hierarchy issues in code optimization.

Unit-V: Operating System Issues and Applications

Operating System issues for multiprocessing Need for pre-emptive OS; Scheduling Techniques, Usual OS scheduling techniques, Threads, Distributed scheduler, Multiprocessor scheduling, Gang scheduling; Communication between processes, Message boxes, Shared memory; Sharing issues and Synchronization, Sharing memory and other structures, Sharing I/O devices, Distributed Semaphores, monitors, spin-locks, Implementation techniques on multi-cores; OpenMP, MPI and case studies Case studies from Applications: Digital Signal Processing, Image processing, Speech processing.

Text and Reference Books:

1. Kai Hwang," Advance Computer Architecture", TMH
2. Matthew, "Beginning Linux Programming", SPD/WROX
3. Hennessy and Patterson," Computer Architecture: A Quantitative Approach", Elsevier
4. Dezso and Sima, "Advanced Computer Architecture", Pearson
5. Quinn, "Parallel Computing: Theory & Practice", TMH
6. Quinn, "Parallel Programming in C with MPI and Open MP", TMH
7. Open MP Specification and Usage (www.openmp.org)

DATA MINING AND DATA WAREHOUSING (HCS-703)

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Unit-I

Overview, Motivation (for Data Mining),Data Mining-Definition & Functionalities, Data Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Computer and Human inspection), Inconsistent Data, Data Integration and Transformation. **Data Reduction**:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation.

Unit-II

Concept Description:- Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large

Databases. Measuring Central Tendency, Measuring Dispersion of Data, Graph Displays of Basic Statistical class Description, Mining Association Rules in Large Databases, Association rule mining, mining Single-Dimensional Boolean Association rules from Transactional Databases–Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases and Mining Multi-Dimensional Association rules from Relational Databases

Unit-III

Classification and Predictions:

What is Classification & Prediction, Issues regarding Classification and prediction, Decision tree, Bayesian Classification, Classification by Back propagation, Multilayer feed-forward Neural Network, Back propagation Algorithm, Classification methods K-nearest neighbor classifiers, Genetic Algorithm.

Cluster Analysis:

Data types in cluster analysis, Categories of clustering methods, partitioning methods. Hierarchical Clustering- CURE and Chameleon. Density Based Methods-DBSCAN, OPTICS. Grid Based Methods- STING, CLIQUE. Model Based Method –Statistical Approach, Neural Network approach, Outlier Analysis

Unit-IV

Data Warehousing: Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3-Tier Architecture, Data Marting.

Unit-V

Aggregation, Historical information, Query Facility, OLAP function and Tools, OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse.

Text and Reference Books:

1. M. H. Dunham, ”Data Mining: Introductory and Advanced Topics”, Pearson Education
2. Jiawei Han, Micheline Kamber, ”Data Mining Concepts & Techniques”, Elsevier
3. Sam Anahory, Dennis Murray, “Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems, 1/e “ Pearson Education
4. Mallach, ”Data Warehousing System”, McGraw –Hill

DISTRIBUTED DATABASE MANAGEMENT SYSTEM (HCS-704)

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Unit-I: Introduction

Architecture of distributed systems: A detailed review of distributed system architecture (network operating system, distributed operating systems, etc.) will be presented leading to distributed database systems. This will then be categorized into (a) federated database systems, (b) Multi-database systems, and (c) Client/Server systems. **Advanced transaction model**: For managing data processing on distributed platform the conventional transaction model needs some improvements. Discussion of some advanced transaction models suitable for different types of distributed database systems.

Unit-II: Workflow

It is a unit of business processing. From conventional viewpoint it is a set of tightly linked atomic processing units which requires special concurrency control and commit protocols, Discussion of existing ways of handling workflows.

Unit-III: Query processing and Optimization: On distributed systems a query may be fragmented for processing on multiple nodes, This give rise to the problem of query fragmentation and distribution which must be addressed for improving performance.

Unit-IV: Application distribution: To support parallel and concurrent processing of transactions processing application have to be distributed. This gives rise to application recovery problem. This course will explore new ways of managing application recovery which is more complex than database recovery.
Unit-V: Transaction management, commit protocol and database recovery: These are system related issues. We will discuss commonly used schemes and advanced protocols for managing these activities.
Buffer management: Database maintains their own buffer for processing transactions. We will discuss the buffer architecture and buffer management schemes (replacement, allocation, etc.)

Text and Reference Books:

1. Distributed Systems: Concept and Design. Coulouris, Dollimore, and Kindberg, AW.
2. Distributed Database Principles and Systems. Ceri and Pelagatti. McGraw Hill.
3. Recovery Mechanisms in Database Systems. Kumar and Hsu, Prentice Hall.
4. Concurrency Control and Recovery in Database Systems. Bernstein, Hadzilacos and Goodman, AW.

SERVICE ORIENTED ARCHITECTURE (HCS-705)

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UNIT-I: SOA Fundamentals
Defining SOA, Business Value of SOA, Evolution of SOA, SOA characteristics, concept of a service in SOA, misperceptions about SOA, Basic SOA architecture, infrastructure services, Enterprise Service Bus (ESB), SOA Enterprise Software models, IBM On Demand operating environment
UNIT-II: SOA Planning and Analysis
Stages of the SOA lifecycle, SOA Delivery Strategies, service-oriented analysis, Capture and assess business and IT issues and drivers, determining non-functional requirements (e.g., technical constraints, business constraints, runtime qualities, non-runtime qualities), business centric SOA and its benefits, Service modeling, Basic modeling building blocks, service models for legacy application integration and enterprise integration, Enterprise solution assets(ESA).
UNIT-III: SOA Design
Service-oriented design process, design activities, determine services and tasks based on business process model, choosing appropriate standards, articulate architecture, mapping business processes to technology, designing service integration environment (e.g., ESB, registry), Tools available for appropriate designing.
UNIT-IV: SOA Implementation
Implementing SOA, security implementation, implementation of integration patterns, services enablement, Quality assurance, A brief overview of tools available for SOA Implementation.
UNIT-V: Managing SOA Environment
Distributing service management and monitoring concepts, operational management challenges, Service-level agreement considerations, SOA governance (SLA, roles and responsibilities, policies, critical success factors, and metrics), QoS compliance in SOA governance, role of ESB in SOA governance, impact of changes to services in the SOA lifecycle.

Text and Reference Books:

1. Thomas Erl, “Service-Oriented Architecture: Concepts, Technology, and Design”, Prentice Hall Publication, 2005.

2. Norbert Bieberstein, Sanjay Bose, Marc Fiammante, Keith Jones, Rawn Shah, "Service-Oriented Architecture Compass: Business Value, Planning, and Enterprise Roadmap", IBM Press Publication, 2005.
3. Sandy Carter, "The New Language of Business: SOA & Web 2.0", IBM Press, 2007.
4. Thomas Erl, "Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services", Prentice Hall Publication, 2004.
5. Dave Chappell, "Enterprise Service Bus",O'Reilly Publications, 2004.
6. Sanjiva Weerawarana, Francisco Curbera, Frank Leymann, Tony Storey, Donald F. Ferguson, "Web Services Platform Architecture: SOAP, WSDL, WS-Policy, WS-Addressing, WS-BPEL, WS-Reliable Messaging, and More", Prentice Hall Publication, 2005.
7. Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", Addison Wesley Publication, 2004.

CRYPTOGRAPHY AND NETWORK SECURITY (HCS-706)

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Unit-I

Introduction to security attacks, services and mechanism, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques-substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers. Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation.

Unit-II

Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.

Unit-III

Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA). Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

Unit-IV

Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.

Unit-V

IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

Text and Reference Books:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.
2. Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag.
3. Bruce Schiener, "Applied Cryptography".

MOBILE COMPUTING (HCS-707)

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UNIT - I

Introduction to Network Technologies and Cellular Communications: HIPERLAN: Protocol architecture, physical layer, Channel access control sub-layer, MAC sub-layer, Information bases and networking WLAN: Infrared vs. radio transmission, Infrastructure and ad hoc networks, IEEE 802.11. Bluetooth: User scenarios, Physical layer, MAC layer, Networking, Security, Link management GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services. Mobile Computing (MC): Introduction to MC, novel applications, limitations, and architecture

UNIT - II

(Wireless) Medium Access Control: Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.

Mobile Network Layer: Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).

UNIT - III

Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

UNIT – IV

Database Issues: Hoarding techniques, caching invalidation mechanisms, client server computing with adaptation, power-aware and context-aware computing, transactional models, query processing, recovery, and quality of service issues. Data Dissemination: Communications asymmetry, classification of new data delivery mechanisms, push-based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques.

UNIT – V

Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs. Protocols and Tools: Wireless Application Protocol-WAP. (Introduction, protocol architecture, and treatment of protocols of all layers), Bluetooth (User scenarios, physical layer, MAC layer, networking, security, link management) and J2ME**.**

Text and Reference Book:

1. Jochen Schiller, “Mobile Communications", Addison-Wesley. (Chapters 4, 7, 9, 10, 11), second edition, 2004.
2. Stojmenovic and Cacute, “Handbook of Wireless Networks and Mobile Computing", Wiley, 2002, ISBN 0471419028. (Chapters 11, 15, 17, 26 and 27)
3. Reza Behravanfar, “Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", ISBN: 0521817331, Cambridge University Press, October 2004

BIOINFORMATICS (HCS-704)

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Unit-I: Introduction

Bioinformatics objectives and overviews, Interdisciplinary nature of Bioinformatics, Data integration, Data analysis, Major Bioinformatics databases and tools, Metadata: Summary & reference systems, finding new type of data online.

Molecular Biology and Bioinformatics: Systems approach in biology, Central dogma of molecular biology, problems in molecular approach and the bioinformatics approach, Overview of the bioinformatics applications.

Unit-II: The Information Molecules and Information Flow

Basic chemistry of nucleic acids, Structure of DNA, Structure of RNA, DNA Replication, -Transcription, -Translation, Genes- the functional elements in DNA, Analyzing DNA, DNA sequencing. Proteins: Amino acids, Protein structure, Secondary, Tertiary and Quaternary structure, Protein folding and function, Nucleic acid-Protein interaction.

Unit-III: Perl

Perl Basics, Perl applications for bioinformatics- Bioperl, Linux Operating System, Understanding and Using Biological Databases, Java clients, CORBA, Introduction to biostatics.

Unit-IV: Nucleotide sequence data Genome, Genomic sequencing, expressed sequence tags, gene expression, transcription factor binding sites and single nucleotide polymorphism. Computational representations of molecular biological data storage techniques: databases (flat, relational and object oriented), and controlled vocabularies, general data retrieval techniques: indices, Boolean search, fuzzy search and neighboring, application to biological data warehouses.

Unit-V: Biological data types and their special requirements: sequences, macromolecular structures, chemical compounds, generic variability and its connection to clinical data. Representation of patterns and relationships: alignments, regular expressions, hierarchies and graphical models.

Text and Reference Books:

1. O'Reilly, " Developing Bio informatics computer skills", Indian Edition's publication
2. Rastogi, Mendiratta, Rastogi, "Bioinformatics concepts, skills & Applications", CBS Publishers
3. Rashidi, Hooman and Lukas K. Buehler, "Bioinformatics Basic Applications" CRC Press.
4. "Bioinformatics" , Addison Wesley
5. Stephen Misner & Stephen Krawetz, " Bioinformatics- Methods & Protocols"

ARTIFICIAL INTELLIGENCE LAB (HCS-752)

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1. Write a LISP Program to solve the water-jug problem using heuristic function.
2. Create a compound object using Turbo Prolog.
3. Write a Prolog Program to show the advantage and disadvantage of green and red cuts.
4. Write a prolog program to use of BEST-FIRST SEARCH applied to the eight puzzle problem.
5. Implementation of the problem solving strategies: Forward Chaining, Backward Chaining, Problem Reduction.
6. Write a Lisp Program to implement the STEEPEST-ASCENT HILL CLIMBING.
7. Write a Prolog Program to implement COUNTE PROPAGATION NETWORK.
8. Development of a small Expert System using PROLOG/JESS.

DISTRIBUTED SYSTEMS (HCS-801)

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Unit–I

Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges.

System Models: Architectural models, Fundamental Models

Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks, Causal ordering of messages, global state, termination detection.

Distributed Mutual Exclusion: Classification of distributed mutual exclusion, Requirement of mutual exclusion theorem, Token based and non token based algorithms, Performance metric for distributed mutual exclusion algorithms.

Unit–II

Distributed Deadlock Detection: System model, resource vs communication deadlocks, deadlock prevention, avoidance, Detection & resolution, centralized dead lock detection, distributed dead lock detection, Path pushing algorithms, Edge chasing algorithms.

Agreement Protocols: Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system.

Unit–III

Distributed Objects and Remote Invocation: Communication between distributed objects, Remote procedure call, Events and notifications, Java RMI case study.

Security: Overview of security techniques, Cryptographic algorithms, Digital signatures Cryptography pragmatics, Case studies: Needham Schroeder, Kerberos, SSL & Millicent.

Distributed File Systems: File service architecture, Sun Network File System, The Andrew File System, Recent advances.

Unit–IV

Transactions and Concurrency Control: Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control.

Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.

Unit –V

Distributed Algorithms: Introduction to communication protocols, Balanced sliding window protocol, Routing algorithms, Destination based routing, APP problem, Deadlock free Packet switching, Introduction to Wave & traversal algorithms, Election algorithm.

CORBA Case Study: CORBA RMI, CORBA services.

Text and Reference Books:

1. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill
2. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Ed.
3. Gerald Tel, "Distributed Algorithms", Cambridge University Press
4. Nancy A. Lynch, "Distributed Algorithms", Elsevier Publication.

DIGITAL IMAGE PROCESSING (HCS-802)

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UNIT-I:

Introduction and Fundamentals

Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.

Image Enhancement in Spatial Domain

Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

UNIT-II

Image Enhancement in Frequency Domain

Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering.

Image Restoration

A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

UNIT-III

Color Image Processing

Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation.

Morphological Image Processing

Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

UNIT-IV

Registration

Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth

Segmentation

Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

UNIT-V

Feature Extraction

Representation, Topological Attributes, Geometric Attributes

Description

Boundary-based Description, Region-based Description, Relationship.

Object Recognition

Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching

Text and Reference Books:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.
2. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and Sons, NY.

3. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ.

MULTI CORE ARCHITECTURE (HCS-803)

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Unit-I: Multi-core Architectures

Introduction to multi-core architectures, issues involved into writing code for multi-core architectures, Virtual Memory, VM addressing, VA to PA translation, Page fault, TLB-Parallel computers, Instruction level parallelism (ILP) vs. thread level parallelism (TLP), Performance issues, OpenMP and other message passing libraries, threads, mutex etc.

Unit-II: Multi-threaded Architectures

Brief introduction to cache hierarchy - Caches: Addressing a Cache, Cache Hierarchy, States of Cache line, Inclusion policy, TLB access, Memory Op latency, MLP, Memory Wall, communication latency, Shared memory multiprocessors, General architectures and the problem of cache coherence, Synchronization primitives: Atomic primitives; locks: TTS, ticket, array; barriers: central and tree; performance implications in shared memory programs; Chip multiprocessors: Why CMP (Moore's law, wire delay); shared L2 vs. tiled CMP; core complexity; power/performance; Snoopy coherence: invalidate vs. update, MSI, MESI, MOESI, MOSI; performance trade-offs; pipelined snoopy bus design; Memory consistency models: SC, PC, TSO, PSO, WO/WC, RC;

Chip multiprocessor case studies: Intel Montecito and dual-core, Pentium4, IBM Power4, Sun Niagara

Unit-III: Compiler Optimization Issues

Code optimizations: Copy Propagation, dead Code elimination , Loop Optimizations-Loop Unrolling, Induction variable Simplification, Loop Jamming, Loop Unswitching, Techniques to improve detection of parallelism: Scalar Processors, Special locality, Temporal locality, Vector machine, Strip mining, Shared memory model, SIMD architecture, Dopar loop, Dosingle loop.

Unit-IV: Control Flow analysis

Control flow analysis, Flow graph, Loops in Flow graphs, Loop Detection, Approaches to Control Flow Analysis, Reducible Flow Graphs, Node Splitting. Dataflow analysis: Analysis of Structured programs, Reaching definition Analysis, Control Tree based.

Unit-V: Data-Flow Analysis

Data Flow analysis, Interval Analysis, Backward Analysis, Available Expression, Live variable Analysis, Very busy Expression, pointer analysis, alias analysis; Data Dependence Analysis : data Dependence, solving data dependence equations (integer linear programming problem); Data Dependency graph, Basic Block dependence, Data Dependence in loops, iteration space, iteration Vector, Data dependency in parallel loops, Loop optimizations.

Text and Reference Books:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers: Principles, Techniques & Tools”, 2nd Ed, 2006
2. Shameem Akhter and Jason Roberts, Multi-Core Programming, Intel Press, 2006
3. Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependence-based Approach”, Morgan Kaufmann publishers, 2002

EMBEDDED SYSTEMS (HCS-804)

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UNIT-I: Introduction to Embedded Systems

Definition and Classification – Overview of Processors and hardware units in an embedded system – Software embedded into the system – Exemplary Embedded Systems – Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits.

UNIT-II: Devices and Buses for Devices Network

I/O Devices - Device I/O Types and Examples – Synchronous - Iso-synchronous and Asynchronous Communications from Serial Devices - Examples of Internal Serial-Communication Devices - UART and HDLC - Parallel Port Devices - Sophisticated interfacing features in Devices/Ports- Timer and Counting Devices - '12C', 'USB', 'CAN' and advanced I/O Serial high speed buses- ISA, PCI, PCI-X, cPCI and advanced buses.

UNIT-III: Programming Concepts and Embedded Programming in C

Programming in assembly language (ALP) vs. High Level Language - C Program Elements, Macros and functions -Use of Pointers - NULL Pointers - Use of Function Calls – Multiple function calls in a Cyclic Order in the Main Function Pointers – Function Queues and Interrupt Service Routines Queues Pointers – Concepts of 'C' Program compilers – Cross compiler – Optimization of memory codes.

UNIT-IV: Real Time Operating Systems

Timing and clocks in embedded system, Task modeling and management: RTOS Task scheduling models - Handling of task scheduling and latency and deadlines as performance metrics – Co-operative Round Robin Scheduling – Cyclic Scheduling with Time Slicing (Rate Monotonics Co-operative Scheduling) – Preemptive Scheduling Model strategy by a Scheduler – Critical Section Service by a Preemptive Scheduler – Fixed (Static) Real time scheduling of tasks

UNIT-V: Embedded Control

Embedded control and control hierarchy, communication strategies for embedded system: encoding and flow chart. Fault tolerance and formal verification.

Text and Reference Books:

1. Steve Heath, Embedded Systems Design, Second Edition-2003, Newnes.
2. David E. Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.
3. Wayne Wolf, Computers as Components; Principles of Embedded Computing System Design – Harcourt India, Morgan Kaufman Publishers, First Indian Reprint 2001.
4. Frank Vahid and Tony Givargis, Embedded Systems Design – A unified Hardware Software Introduction, John Wiley, 2002.
5. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, First reprint Oct. 2003.
6. H.Kopetz, "Real-Time Systems", Kluwer, 1997.
7. R.Gupta, "Co-synthesis of Hardware and Software for Embedded Systems", Kluwer 1995.

REAL TIME SYSTEMS (HCS-805)

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UNIT-I: Introduction

Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and

Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.

UNIT-II: Real Time Scheduling

Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.

UNIT-III: Resources Access Control

Effect of Resource Contention and Resource Access Control (RAC), Nonpreemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority-Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic nPriority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Unit Resources, Controlling Concurrent Accesses to Data Objects.

UNIT-IV: Multiprocessor System Environment

Multiprocessor and Distributed System Model, Multiprocessor Priority-Ceiling Protocol, Schedulability of Fixed-Priority End-to-End Periodic Tasks, Scheduling Algorithms for End-to-End Periodic Tasks, End-to-End Tasks in Heterogeneous Systems, Predictability and Validation of Dynamic Multiprocessor Systems, Scheduling of Tasks with Temporal Distance Constraints.

UNIT-V: Real Time Communication

Model of Real Time Communication, Priority-Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols, Real Time Protocols, Communication in Multicomputer System, An Overview of Real Time Operating Systems.

Text and Reference Books:

1. Real Time Systems by Jane W. S. Liu, Pearson Education Publication.
2. Real-Time Systems: Scheduling, Analysis, and Verification by Prof. Albert M. K. Cheng, John Wiley and Sons Publications.

SOFTWARE PROJECT MANAGEMENT (HCS-806)

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UNIT-I: Introduction and Software Project Planning

Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process.

UNIT-II: Project Organization and Scheduling

Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts.

UNIT-III: Project Monitoring and Control

Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.

UNIT-IV: Software Quality Assurance and Testing

Testing Objectives, Testing Principles, Test Plans, Test Cases, Types of Testing, Levels of Testing, Test Strategies, Program Correctness, Program Verification & validation, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model CMM), SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Cleanroom process.

UNIT-V: Project Management and Project Management Tools

Software Configuration Management: Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control, Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project.

Text and Reference Books:

1. Software Project Management, M. Cotterell, Tata McGraw-Hill Publication.
2. Information Technology Project Management, Kathy Schwalbe, Vikas Pub. House.
3. Software Project Management, S. A. Kelkar, PHI Publication.

SOFTWARE QUALITY ENGINEERING (HCS-807)

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UNIT-I: Introduction

Defining Software Quality, Software Quality Attributes and Specification, Cost of Quality, Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction, and Containment, Overview of Different Types of Software Review, Introduction to Measurement and Inspection Process, Documents and Metrics.

UNIT-II: Software Quality Metrics

Product Quality Metrics: Defect Density, Customer Problems Metric, Customer Satisfaction Metrics, Function Points, In-Process Quality Metrics: Defect Arrival Pattern, Phase-Based Defect Removal Pattern, Defect Removal Effectiveness, Metrics for Software Maintenance: Backlog Management Index, Fix Response Time, Fix Quality, Software Quality Indicators.

UNIT-III: Software Quality Management and Models

Modeling Process, Software Reliability Models: The Rayleigh Model, Exponential Distribution and Software Reliability Growth Models, Software Reliability Allocation Models, Criteria for Model Evaluation, Software Quality Assessment Models: Hierarchical Model of Software Quality Assessment.

UNIT-IV: Software Quality Assurance

Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software, SQA Techniques, Statistical Quality Assurance, Total Quality Management, Quality Standards and Processes.

UNIT-V: Software Verification, Validation & Testing:

Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-Oriented Analysis & Testing, Static and Dynamic Testing Tools, Characteristics of Modern Testing Tools.

Text and Reference Books:

1. Jeff Tian, Software Quality Engineering (SQE), Wiley-Interscience, 2005; ISBN 0-471-71345-7.
2. Metrics and Models in Software Quality Engineering, Stephen H. Kan, Addison-Wesley (2002), ISBN: 0201729156

SOFTWARE TESTING (HCS-808)

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Unit-I: Introduction
Faults, Errors, and Failures, Basics of software testing, Testing objectives, Principles of testing, Requirements, behavior and correctness, Testing and debugging, Test metrics and measurements, Verification, Validation and Testing, Types of testing, Software Quality and Reliability, Software defect tracking.

Unit-II: White Box and Black Box Testing
White box testing, static testing, static analysis tools, Structural testing: Unit/Code functional testing, Code coverage testing, Code complexity testing, Black Box testing, Requirements based testing, Boundary value analysis, Equivalence partitioning, state/graph based testing, Model based testing and model checking, Differences between white box and Black box testing.

Unit-III: Integration, System, and Acceptance Testing
Top down and Bottom up integration, Bi-directional integration, System integration, Scenario Testing, Defect Bash, Functional versus Non-functional testing, Design/Architecture verification, Deployment testing, Beta testing, Scalability testing, Reliability testing, Stress testing, Acceptance testing: Acceptance criteria, test cases selection and execution,

Unit-IV: Test Selection & Minimization for Regression Testing
Regression testing, Regression test process, Initial Smoke or Sanity test, Selection of regression tests, Execution Trace, Dynamic Slicing, Test Minimization, Tools for regression testing, Ad hoc Testing: Pair testing, Exploratory testing, Iterative testing, Defect seeding.

Unit-V: Test Management and Automation
Test Planning, Management, Execution and Reporting, Software Test Automation: Scope of automation, Design & Architecture for automation, Generic requirements for test tool framework, Test tool selection, Testing in Object Oriented Systems.

Text and Reference Books:

1. S. Desikan and G. Ramesh, “Software Testing: Principles and Practices”, Pearson Education.
2. Aditya P. Mathur, “Fundamentals of Software Testing”, Pearson Education.
3. K. K. Aggarwal and Yogesh Singh, “Software Engineering”, 3rd Edition, New Age International Publication.

DIGITAL IMAGE PROCESSING LAB (HCS-852)

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The following programs should be developed in ‘**C**’ language preferably on ‘**UNIX’** platform. The graphical development environment can be created using some appropriate library like ‘OpenGL’:

1. Implement the spatial image enhancement functions on a bitmap image –
   a) Mirroring (Inversion) (b) Rotation (Clockwise) (c) Enlargement (Double Size)
2. Implement (a) Low Pass Filter (b) High Pass Filter.
3. Implement (a) Arithmetic Mean Filter (b) Geometric Mean Filter.
4. Implement Smoothing and Sharpening of an eight bit color image.
5. Implement (a) Boundary Extraction Algorithm (b) Graham's Scan Algorithm
6. Implement (a) Edge Detection (b) Line Detection.

DISTRIBUTED SYSTEMS LAB (HCS-851)

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The following programs should be developed preferably on '**UNIX'** platform:-

1. Simulate the functioning of Lamport's Logical Clock in 'C'.
2. Simulate the Distributed Mutual Exclusion in 'C'.
3. Implement a Distributed Chat Server using TCP Sockets in 'C'.
4. Implement RPC mechanism for a file transfer across a network in 'C'
5. Implement 'Java RMI' mechanism for accessing methods of remote systems.
6. Simulate Balanced Sliding Window Protocol in 'C'.
7. Implement CORBA mechanism by using 'C++' program at one end and 'Java' program on the other.