Harcourt Butler Technological Institute, Kanpur-208002

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

Revised Syllabus

B. Tech. IV Year
Information Technology

(Effective from the session 2011-12)

CRYPTOGRAPHY AND NETWORK SECURITY (HIT-701)

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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".

ARTIFICIAL INTELLIGENCE (HIT-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.

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.

DOT NET & C# (HIT-702)

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Unit-I

The .NET framework: Introduction, Common Language Runtime, Common Type System, Common Language Specification, The Base Class Library, The .NET class library Intermediate language, Just-in- Time compilation, garbage collection, Application installation & Assemblies, Web Services, Unified classes.

Unit-II

C# Basics: Introduction, Data Types, Identifiers, variables & constants, C# statements, Object Oriented Concept, Object and Classes, Arrays and Strings, System Collections, Delegates and Events, Indexes Attributes, versioning.

Unit-III

C# Using Libraries: Namespace-System, Input Output, Multi-Threading, Networking and Sockets, Data Handling, Windows Forms, C# in Web application, Error Handling.

Unit-IV

Advanced Features Using C#: Web Services, Windows services, messaging, Reflection, COM and C#, Localization.

Unit-V

Advanced Features Using C#: Distributed Application in C#, XML and C#, Unsafe Mode, Graphical Device Interface with C#, Case Study (Messenger Application)

Text and Reference Books:

1. Shibi Panikkar and Kumar Sanjeev, "C# with **.**NET Frame Work", Firewall Media.
2. Shildt, "C#**:** The Complete Reference", TMH
3. Jeffrey Richter, "Applied Microsoft .Net Framework Programming", (Microsoft)
4. Fergal Grimes, "Microsoft .Net for Programmers", (SPD)
5. TonyBaer, Jan D. Narkiewicz, Kent Tegels, Chandu Thota, Neil Whitlow, "Understanding the **.**Net Framework", (SPD)
6. Balagurusamy, "Programming with C#", TMH

ERP SYSTEMS (HIT-703)

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Unit-I

Enterprise wide information system, Custom built and packaged approaches, Needs and Evolution of ERP Systems, Common myths and evolving realities, ERP and Related Technologies, Business Process Reengineering and Information Technology, Supply Chain Management, Relevance to Data Warehousing, Data Mining and OLAP, ERP Drivers, Decision support system.

Unit-II

ERP Domain, ERP Benefits classification, Present global and Indian market scenario, milestones and pitfalls, Forecast, Market players and profiles, Evaluation criterion for ERP

product, ERP Life Cycle: Adoption decision, Acquisition, Implementation, Use & Maintenance, Evolution and Retirement phases, ERP Modules.

Unit- III

Framework for evaluating ERP acquisition, Analytical Hierarchy Processes (AHP), Applications of AHP in evaluating ERP, Selection of Weights, Role of consultants, vendors and users in ERP implementation; Implementation vendors evaluation criterion, ERP Implementation approaches and methodology, ERP implementation strategies, ERP Customization, ERP-A manufacturing Perspective.

Unit- IV

Critical success and failure factors for implementation, Model for improving ERP effectiveness, ROI of ERP implementation, Hidden costs, ERP success inhibitors and accelerators, Management concern for ERP success, Strategic Grid: Useful guidelines for ERP Implementations.

Unit- V

Technologies in ERP Systems and Extended ERP, Case Studies Development and Analysis of ERP Implementations in focusing the various issues discussed in above units through Soft System approaches or qualitative Analysis tools, Learning and Emerging Issues, ERP and E-Commerce.

Text and Reference Books:

1. Lexis Leon, “Enterprise Resource Planning”, TMH
2. Brady, Manu, Wegner, “ Enterprise Resource Planning”, TMH

BIOINFORMATICS (HCS-708)

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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"

CRYPTOGRAPHY & NETWORK SECURITY LAB (HIT-751)

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The following programs should be implemented preferably on '**UNIX'** platform using **'C'** language (for 1-5) and other standard utilities available with '**UNIX'** systems (for 6-8):

1. Implement the encryption and decryption of 8-bit data using 'Simplified DES Algorithm(created by Prof. Edward Schaefer) in 'C'.
2. Implement 'Linear Congruential Algorithm' to generate 5 pseudo-random numbers in 'C'.
3. Implement Rabin-Miller Primality Testing Algorithm in 'C'.
4. Implement the Euclid Algorithm to generate the GCD of an array of 10 integers in 'C'.
5. Implement RSA algorithm for encryption and decryption in 'C'.
6. Configure a mail agent to support Digital Certificates, send a mail and verify the correctness of this system using the configured parameters.
7. Configure SSH (Secure Shell) and send/receive a file on this connection to verify the correctness of this system using the configured parameters.
8. Configure a firewall to block the following for 5 minutes and verify the correctness of this system using the configured parameters:
    a. Two neighborhood IP addresses on your LAN
    b. All ICMP requests
    c. TCP SYN Packets

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 deadlock 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

MOBILE COMPUTING (HIT-801)

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Unit – I

Introduction, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.

Unit - II

Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.

Unit – III

Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, file system, disconnected operations.

Unit - IV

Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.

Unit – V

Ad Hoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications.

Text and Reference Books:

1. J. Schiller, Mobile Communications, Addison Wesley.
2. A. Mehrotra , GSM System Engineering.
3. M. V. D. Heijden, M. Taylor, Understanding WAP, Artech House.
4. Charles Perkins, Mobile IP, Addison Wesley.
5. Charles Perkins, Ad hoc Networks, Addison Wesley**.**

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.

SOFT COMPUTING (HIT-802)

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Unit-I: Artificial Neural Networks

Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self organizing networks - Hopfield network.

Unit-II: Fuzzy Systems

Fuzzy sets and Fuzzy reasoning - Fuzzy matrices - Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.

Unit-III: Neuro-Fuzzy Modelling

Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation.

Unit-IV: Genetic Algorithms

Survival of the Fittest - Fitness Computations - Crossover - Mutation - Reproduction - Rank method - Rank space method.

Unit-V: Soft Computing and Conventional AI

AI search algorithm - Predicate calculus - Rules of interference – Semantic networks - Frames - Objects - Hybrid models - Applications.

Text and Reference Books:

1. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall 1998.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill, 1997.
3. Laurene Fausett, "Fundamentals of Neural Networks", Prentice Hall, 1994.
4. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, USA 1995.
5. N. J. Nilsson, "Artificial Intelligence - A New Synthesis", Harcourt Asia Ltd., 1998.
6. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y, 1989.

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.

MOBILE COMPUTING LAB (HIT-851)

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Experiments/Exercises based on simulation, working and performance analysis of various mobile systems are to be done on tools like NS2, NetSIM, GlomoSIM, and MATLAB.

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.