Scheme and Syllabus
Of
Master of Technology
(Computer Science & Engineering)

Maharaja Ranjit Singh State
Technical University, Bathinda
(Established by Govt. of Punjab vide Punjab Act No. 5 of 2015 and Section 2(f) of UGC)
Maharaja Ranjit Singh State Technical University

Study Scheme
M.Tech Computer Science And Engineering

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LIST OF ELECTIVES

ELECTIVE-I

CS-508 Natural Language Processing
CS-510 Artificial Intelligence
CS-512 Object Oriented Analysis And Design Using UML

ELECTIVE-II

CS-514 Software Engineering Methodologies
CS-516 Embedded System
CS-518 Neural Networks and Fuzzy Logics

ELECTIVE-III

CS-515 Optimization Techniques
CS-517 Parallel Computing
CS-519 Fundamental Concepts of Bioinformatics
CS-521 VLSI Design

ELECTIVE-IV

CS-520 Quantitative Techniques
CS-522 Robotics
CS-524 Object Oriented Programming With Visual Basics, NET
CS-526 Business Information System

Fundamental issues in software design: Goodness of design, cohesions, coupling. Function-oriented design: structured analysis and design. Overview of object –oriented concepts.


Unit testing. Black box and white box testing. Integration and system testing. Software quality and reliability.

SEI CMM and ISO 9001. PSP and Six Sigma. Clean room technique.

Software maintenance issues and techniques. Software reuse. Client-Server software development.

Reference:

1. Ian Sommeriele, “Software Engineering”, Addison We sley.
Introduction:
Overview of computer networks, seven-layer architecture, TCP/IP suite of protocols, etc.

MAC protocols for high-speed LANS, MANS and wireless LANs. (For Example, FDDI, DQDB, HIPPI, Gigabit Ethernet, Wireless Ethernet, etc.)

Fast access technologies (For Example, ADSL, Cable Modem, etc.)


IP Multicasting, Multicast routing protocols, address assignments, session discovery, etc.

TCP extension for high-speed networks, transaction-oriented applications. Other new options in TCP.

Network security at various layers. Secure-HTTP, SSL, ESP, Authentication header, key distribution protocols,. Digital signatures, digital certificates.

References:


1. Computational model

2. The concept of Computer Architecture

3. Introduction to Parallel Processing

4. Introduction to ILP Processors

5. Pipelined Processors

6. VLIW Architecture

7. Super Scalar Processors

8. Processing of Control transfer instruction

9. Code Scheduling for ILP-processors

10. Introduction to Data Parallel Architecture, SIMD Architecture, MIMD Architecture


12. Multi threaded Architecture

13. Distributed Memory MIMD Architecture


Reference:


2. Computer Architecture by Stone
CS-507 Advance Database Management Systems

L T P 3 1

Introduction of DBMS, Types of DBMS and their advantages and disadvantages
Introduction of RDBMS, Types of relational query language, Normalization, Query optimization
Database protection in RDBMS – Integrity, Concurrency control, Recovery
Distributed Databases: concepts, structure, trade-offs
Method of data distribution – fragmentation, replication, design & advance concepts of
DDBMS
Introduction to object oriented databases
Deductive databases
Data warehousing Concepts: Architecture, Dataflows, Tools & Technologies, Data
Marts
Data Mining & Online Analytical Processing
Spatial & Multimedia databases
Mobile Computing & Mobile Databases

Textbooks:
3) Thomas Conolly, Carolyn Begg, "Database Systems", Pearson Education.
4) Alexis Leon, Mathews Leon, "Database Management Systems".
5) C.J.Date, "An Introduction to DBMS", Narosa Publishing House.
Introduction: Brief history of Programming Language, Characteristics of programming language.

Programming Language Processors: The structure and operation of a computer, Hardware and firmware computers, Translator and simulator computers, Syntax, semantics and virtual computers, hierarchies of computers, binding and binding time.

Elementary Data Types: Data object, variable and constants, data types, specification of elementary data types, declarations, type checking and type conversion, assignment and initialization, numeric data types, enumerations, Boolean, characters.

Structured Data Types: Structured data object and data types, specification of data structure types, implementation of data structure types, declarations and type checking for data structures, vector and arrays, record, character strings, variable sized data structures, pointers and programmer-constructed data objects, sets, file and input/output.

Subprogram And Programmer-Defined Data Types: Evolution of the data type concept, Abstraction, encapsulation, and information hiding, subprogram, type definitions, abstract data types.

Sequence Control: Implicit and explicit sequence control, sequence control within expression, sequence control between statements, subprogram sequence control, recursive subprogram, exceptions and exception handlers, Co-routines, scheduled subprograms, tasks and concurrent execution, data structures and sequence control.

Data Control: names and referencing environments, static and dynamic scope, block structure, local data and local referencing environments, shared data, task and shared data.

Storage Management: Major Runtime elements requiring storage, programmer and system controlled storage management, storage management phases, static storage management, stack based storage management, heap storage management.

Syntax And Translation: General syntactic criteria, syntactic elements of language, stages in translation, formal definition of syntax.

Operating And Programming Environment: Batch processing environment, interactive environments, embedded system environments, programming environments.


References:
Programming Languages, design and implementation second edition by Terrence W. Pratt Prentice Hall of India pvt.ltd. New Delhi.
The Students are required to implement the applications based on

1. Fuzzy databases
2. Expert databases
3. Object-oriented Databases
4. Distributed databases
5. Library management system
6. Crop management system
7. On-line sharing of computer systems
8. Highway systems
9. Hospital management system
10. Hotel management system
11. University management system
12. Inventory control
13. Railway management system
14. Any other similar database system


Wavelets: Wavelet functions, Wavelet transformations in one and two dimensions, fast wavelet transform.

Image Compression: Image compression models, Error free compression, Lossy compression.

Image segmentation: Line detection, edge detection, Edge linking and boundary detection, region based segmentation.

Representation and Description: Representation, Boundary and Regional Descriptors, Relational Descriptors.

Object Recognition: Pattern and pattern classes, recognition based on Decision Theoretic Methods, Structural Methods.

References:

Digital Image Processing by Rafael C. Gonzalez, Richard E. Woods
CS-504 DISTRIBUTED SYSTEMS


2. Interprocess communication: API for internet protocol, Marshalling. Client server communication, group communication case study: unix

3. Distributed objects and remote invocation: communication between Distributed objects, RPC, events and notification case study: Java RMI

4. Operating System Support: Operating System layer. Protection, processes and threads, operating system architecture

5. Distributed File System: File service architecture, network file system, Sun network file system, Andrew file system Case Study: unix

6. Name services: Name services and domain name system, directory and discovery services Case Study: Global Name service

7. Transaction and concurrency control: transactions, nested transactions, Locks, optimistic concurrency control, time stamp ordering, Comparison of methods for concurrency control

8. Distributed transaction: Flat and nested distributed transactions. Atomic Commit protocol, Distributed dead locks

9. Distributed Multimedia systems; characteristics of multimedia, multimedia data, Quality of service management, resource management, stream adaptation. Case study; Tiger video file server.

10. Distributed shared memory: design and implementation issues, sequential consistency and Ivy and Release Consistency Munin Case Study of distributed systems: CORBA

Books:
2. A.S. Tanenbaum, Modern operating Systems, Prentice Hall
3. www.cdk3.net/ref
4. www.ietf.org/rfc
CS-506 Compiler Design

Course Contents:

Compiler structure: analysis-synthesis model of compilation, various phases of a compiler, tool based approach to compiler construction.

Lexical analysis: interface with input, parser and symbol table, token, lexeme and patterns. Difficulties in lexical analysis. Error reporting. Implementation. Regular definition, Transition diagrams, LEX.

Syntax analysis: CFGs, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence grammars, LR parsers (SLR, LALR, LR), YACC.

Syntax directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions.

Type checking: type system, type expressions, structural and name equivalence of types, type conversion, overloaded functions and operators, polymorphic functions.

Run time system: storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation.


Code generation and instruction selection: issues, basic blocks and flow graphs, register allocation, code generation, dag representation of programs, code generation from dags, peep hole optimization, code generator generators, specifications of machine.

Books and References:

C. Fischer and R. LeBlanc. *Crafting a Compiler in C*, Benjamin Cummings.
Fraser and Hanson. *A Retargetable C Compiler: Design and Implementation*, Addison-Wesley.
CS-508 NATURAL LANGUAGE PROCESSING

Goals of NLP: Survey of applications, Levels of linguistic processing: morphology, syntax, semantics, Language processors: recognisers, transducers, parsers, generators, Language as a rule-based system, Language understanding as an inferential activity.

Resources for NLP: lexicons and knowledge bases.

Elements of formal language theory: alphabet, string, language, grammar, productions, symbol vocabulary, generator, recogniser, procedure.

Types of grammar: the Chomsky Hierarchy.


Parsing: definition of a parser, derivations, basic parsing strategies for context free grammars, determinism and non-determinism, decidability, data structures and algorithms for parsing, unification based grammar formalisms.

Ambiguity and its resolution: Syntactic ambiguities and heuristics, lexical ambiguities and selectional restrictions, indeterminacy of reference.

Generation and Dialogue: Syntactic generation algorithms and reversibility, text planning, modelling dialogue agents.

Text Book:


References:


# CS-510 Artificial Intelligence

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## Introduction, Intelligent agents

**Problem Solving:** Solving problems by searching, Informed search and exploration, constraint satisfaction problems, adversarial search.

**Knowledge and Reasoning:** Logical agents, first order logic, Inference in first order logic, knowledge representation.

**Planning:** Planning and acting in real world.

**Uncertain Knowledge and Reasoning:** Uncertainty, Probabilistic Reasoning, Probabilistic Reasoning over time, Making Simple decisions.

**Learning:** Learning from observations, knowledge in learning, Reinforcement learning.

**Communication, Perceiving and acting:** Communication, Perception, Probabilistic language processing

## References:

CS-512 Object Oriented Analysis and Design using UML

1. Object Oriented Design and Modelling:
   Object Oriented Fundamentals, Objects and object classes, object oriented design process,
   importance of modelling, principles of modelling, object oriented modelling.

2. Introduction to UML:
   Conceptual model of UML, building blocks of UML, Mechanisms in UML, architecture, software
   development life cycle.

3. Basic Structural Modelling
   Classes, relationships, common mechanisms, class and object diagrams.

4. Advanced structural Modelling
   Advanced classes, advanced relationships, Interfaces types and roles, packages, instances and object
   diagrams.

5. Collaboration Diagrams and Sequence Diagrams
   Terms, concepts and depicting a message in collaboration diagrams. Terms and concepts in sequence
   diagrams. Difference between collaboration and sequence. diagram. Depicting synchronous messages
   with/without priority call back mechanism.

6. Basic behavioral modelling
   Interactions, use cases, Use Case Diagrams, Interaction Diagrams and activity diagrams.

7. Advanced behavioral modelling:
   Events and signals, state machines, process and threads, time and space, state chart diagrams.

8. Architectural Modelling:
   Terms, Concepts, examples, Modelling techniques for component diagrams and deployment
   diagrams.

books:


Text/References:

CS-516 EMBEDDED SYSTEMS

- Introduction And Examples Of Embedded Systems, Concept Of Embedded System Design: Design challenge, Processor technology, IC technology, Design technology, Trade-offs


- Memory: Introduction, Memory write ability, Storage performance, Tradeoffs, Common memory types Memory hierarchy and cache

- AVR 8515 microcontroller: Architecture and Programming in assembly and C.

- Interfacing Analog and digital blocks: Analog-to-Digital Converters (ADCs), Digital-to-Analog, Converters (DACs), Communication basics and basic protocol concepts, Microprocessor interfacing: I/O addressing, Port and Bus based, I/O, Memory mapped I/O, Standard I/O interrupts, Direct memory access, Advanced communication principles parallel, serial and wireless, Serial protocols I²C, Parallel protocols PCI bus, Wireless protocol IrDA, blue tooth.

- Different peripheral devices: Buffers and latches, Crystal, Reset circuit, Chip select logic circuit, timers and counters and watch dog timers, Universal asynchronous receiver, transmitter (UART), Pulse width modulators, LCD controllers, Keypad controllers.

- Design tradeoffs due to thermal considerations and Effects of EMI/ES etc.

- Software aspect of embedded systems: Challenges and issues in embedded software development, Co-design

Embedded software development environments: Real time operating systems, Kernel architecture: Hardware, Task/process control subsystem, Device drivers, File subsystem, system calls, Embedded operating systems, Task scheduling in embedded systems: task scheduler, first in first out, shortest job first, round robin, priority based scheduling, Context switch: Task synchronization: mutex, semaphore, Timers, Types of embedded operating systems, Programming languages: assembly languages, high level languages

- Development for embedded systems: Embedded system development process, Determine the requirements, Design the system architecture, Choose the operating system, Choose the processor, Choose the development platform, Choose the programming language, Coding issues, Code optimization, Efficient input/output, Testing and debugging, Verify the software on the host system, Verify the software on the embedded system

Text /Reference
Frankvahid/Tony Givargis, “Embedded System Design- A unified Hardware/software Introduction”.
Dreamteach Software team,” Programming for Embedded Systems”
AVR 8515 manual
J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing"
CS-518 NEURAL NETWORKS AND FUZZY LOGIC

1. Neural networks: introduction, neural networks, supervised or unsupervised learning, feed forward network, Hopfield network
2. Neural network models: neural network models, layers in neural network and their connections, Instar, outstar, weights on connections, threshold function, application- Adaline and madaline
3. Backpropagation: feed forward back propagation network- mapping, layout, training, BPN applications
4. Learning and training: objectives of learning, Hebb’s rule, delta rule, supervised learning, unsupervised networks, learning vector quantizer, associative memory models, one-shot learning, resonance, stability, training and convergence
6. BAM- bidirectional associative memory, inputs and outputs, weights and training, FAM-fuzzy associative memory, association, FAM neural networks, encoding
7. Adaptive Resource theory- network for ART, processing in ART
8. Kohonen Self Organizing Map- Competitive learning, lateral inhibition, training law for Kohonen network, implementation, applications to pattern recognition
9. Application of fuzzy Logic:
10. Fuzzy databases and quantification, fuzzy control, designing fuzzy logic controller

Books:
3. Freeman A. James, Skapura M. David- neural networks algorithms, applications and programming Techniques, Pearson Education

Optimal Point: Local optimal point, global optimal point and inflection point.

Single Variable Optimization Techniques:
- Optimality criterion.
- Bracketing method (Bounding phase method)
- Region elimination methods (Internal halving method, Golden section search method)
- Point estimation method (successive quadratic estimation methods)
- Gradient-based methods (Newton-Raphson method, Bisection method, secant. Cubic search method.)
- Root finding using optimization techniques.

Multivariable Optimization Techniques:
- Optimality criterion
- Unidirectional search method
- Direct Search method (Hooke-Jeeves Pattern Search method, Powell’s conjugate direction method)
- Gradient-based methods (Steepest descent method, Newton’s method, Marquardt’s methods)

Constrained Optimization Algorithms:
- Kuhn-Tucker conditions.
- Transformation method (Penalty function method)
- Direct search for constrained minimization (variable elimination method, complex search method)

Linear Programming:
- Linear programming problems, Simplex method of linear programming techniques.

Text Book:
1. Optimization for engg. design by Kalyanmoy Deb. (PH)

Reference Books:
4. Optimization :Theory & Practice by beveridge & Schecter, (McGraw
CS-517 Parallel Computing

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3 1 -

Course Contents:

Introduction: Paradigms of parallel computing: Synchronous - vector/array, SIMD, Systolic; Asynchronous - MIMD, reduction paradigm.

Hardware taxonomy: Flynn's classifications, Handler's classifications.

Software taxonomy: Kung's taxonomy, SPMD.

Abstract parallel computational models: Combinational circuits, Sorting network, PRAM models, Interconnection RAMs. Parallelism approaches - data parallelism, control parallelism


Parallel Programming: Shared memory programming, distributed memory programming, object oriented programming, data parallel programming, functional and dataflow programming.

Scheduling and Parallelization: Scheduling parallel programs. Loop scheduling. Parallelization of sequential programs. Parallel programming support environments.

Books and References:


Research articles.
CS-519 Fundamental Concepts of Bioinformatics

MOLECULAR BIOLOGY AND BIOLOGICAL CHEMISTRY: The genetic material, Gene structure and information content, Protein structure and function, The nature of chemical bonds, Molecular biology tools, Genomic information content.

DATA SEARCHES AND PAIRWISE ALIGNMENTS: Dot plots, Simple alignments, Scoring, Gaps, Scoring matrices, The Needleman and Wunsch algorithm, Local and global alignments, Database searches, Multiple sequence alignments.

SUBSTITUTION PATTERNS: Patterns of substitutions within genes, Estimating substitution numbers, Variations in substitution rates between genes, Molecular clocks, Evolution in organelles.

DISTANCE-BASED METHODS OF PHYLOGENETICS: History of molecular phylogenetics, Advantages to molecular phylogenies, Phylogenetic trees, Distance matrix methods, Maximum likelihood approaches, Multiple sequence alignments.

CHARACTER-BASED APPROACHES TO PHYLOGENETICS: Parsimony, Inferred ancestral sequences, Strategies for faster searches, Consensus trees, Tree confidence, Comparison of phylogenetic methods, Molecular phylogenies.


PROTEIN FOLDING: Polypeptide composition, Secondary structure, Tertiary and quaternary structure, Protein folding, Structure prediction.

PROTEOMICS: Protein classification, Experimental techniques, Inhibitors and drug design, Ligand screening, X-ray crystal structures, Empirical methods and prediction techniques, Posttranslational modification prediction.

Bioinformatics Computing (International Edition)
Books: Dan Krane, Michael Raymer, Bryan Bergeron
CS-521 VLSI DESIGN

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- CMOS Circuit And Logic Design: CMOS Logic Gate Design, Basic Physical Design of Simple Gate, CMOS Logic Structures, Clocking Strategies, I/O Structures, Low Power Design.


- CMOS Sub System Design: Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements, Control-FSM, Control Logic Implementation.

Texts / References
Elective –IV
CS-520 Quantitative Technique

L T P
3 1 -

Role of quantitative methods in decision making. Probability and decision making, decision making under uncertainty, the value of additional information, Bay’s theorem. Probability models and decision making. Sample survey methods. Methods of measuring and forecasting business changes, index numbers, time series analysis. Markov Analysis.

Background of Operations Research, classification of problems in operations research, phases of operations research study.

Linear programming, formulation of mathematical models, solution of linear programming problems involving design of product mix, resource allocation, transportation and assignment by graphical, simplex and dual simplex methods, Duality theorem and applications, use of computer to solve linear programming problems.


Queuing theory notation and assumptions, Poisson’s queuing models, non-Poisson queuing models, queues in series, queuing decision models, Application to scheduling and maintenance problems.

Reference Books:

| Quantitative Methods and Operations Research for Business and Economics | Ahuja, K.K | Kalyani Publisher | 1990 |
| | Gopikuttan, G. | Himalya Publishers | 1994 |
**CS-522 Robotics**

**L T P**

3 1 -

**Introduction**: Classification of robots, basic robot components, manipulator end effectors, controller, power unit, sensing devices, specification of robot systems, accuracy precision and repeatability.

**Robot Motion Analysis**:
Manipulator Kinematics, Inverse Manipulator Kinematics, Manipulator Dynamics-newton-Eulor and Lagrange formulation, Trajector generation.

**Robotic sensing devices**:
Position, velocity and acceleration sensors, proximity and range sensors, touch and slip sensors, tactile sensors, force and torque sensors.

**Robotic vision system**: imaging components, picture coding, object recognition, training and vision systems, review of existing vision systems.

**Robotics programming**:
Methods of robot programming, types of programming, robotics programming languages, artificial intelligence.

**Robot applications**: material transfer and machine loading/unloading, processing applications, welding and painting assembly and inspection, future robotic applications and related technologies developments.

**Economics analysis of robotics**: Robotics project analysis, life cycle costs, data required for economic analysis, methods of economics analysis.

**Books recommended**:
1. **Fundamentals of Robotics Analysis and control**: Robert J. Schiling
2. **Industrial robotics**: Groover, weiss nagel and odrey, Mc Graw Hill
CS-524 Object-Oriented Programming with Visual Basic.NET

L T P
3 1 -

An overview of the object-oriented paradigm, The .NET environment, Structures and abstract data types, Using classes, Class member scoping and access modifiers, Inheritance and derived classes, Using abstract base classes, Using interfaces, Implementing the IEnumerable and IComparable interfaces, Designing and implementing exception classes, Design patterns and refactoring in VB.NET, Object internals: reflection and attributes, Object persistence: serialization, Building a Windows application, Building a Web services application, Building a Windows services application, Building an ASP.NET application, Building an ADO.NET application.

Books: Michael McMillan

CS-526 Business Information System

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3 1 -

Basic concepts - understanding information and information systems, Hardware, Software, Networks, telecommunications and the Internet, E-business applications, Acquiring and developing BIS, Initiating systems development, BIS project management, Systems analysis, Systems design, System build, implementation and maintenance, BIS strategy, Managing e-business, Managing information security, End-user computing - providing end-user services, Ethical, legal and moral constraints on information systems.

Books:

Business Information Systems
Technology, development and management for the e-business
2nd Edition
Paul Bocij, Dave Chaffey, Andrew Greasley, Simon Hickie