

**Syllabus**  
**BE (Computer Engineering)**  
**2008 Course**

## **Preamble**

Dear Students and Teachers, we, the Board of Studies Computer Engineering, are very happy to present BE Computer Engineering Syllabus (2008 course). We are sure you will find this syllabus interesting and challenging. The objective of the syllabus is to inculcate reading, innovative thinking, technical-writing and presentation habits in the students. Development of skills and imparting knowledge is also important part of syllabus. To achieve these objectives teachers are encouraged to take home tutorials, class tutorials, students presentations and invited talks in addition to the lectures conducted by teachers. Review and interactive discussions on home tutorials, classroom tutorials and students presentation along with review of recent advances in the subject is a must. There is mountainous growth in the areas of computer applications, subjects, technology and algorithms. The computer equipments are becoming very faster, granular with concurrent architectures and operating systems environments. Along with the Industry, the open-source movement has also contributed to the great extent. The education must withstand with this growth and demand of innovation and be the front-runner to lead the path of progress and innovation. We give you best wishes to take this syllabus and travel the path of success.

Board of Studies  
Computer Engineering

**BE (COMPUTER ENGINEERING)- 2008 COURSE STRUCTURE**

**Term-I**

| Subject Code | Subject                           | Teaching Scheme |           | Examination Scheme |            |           |            | Total Marks |
|--------------|-----------------------------------|-----------------|-----------|--------------------|------------|-----------|------------|-------------|
|              |                                   | Lect.           | Pract.    | Th                 | TW         | Pr        | Or         |             |
| 410441       | Design & Analysis of Algorithms   | 04              |           | 100                |            | —         |            | 100         |
| 410442       | Principles of Compiler Design     | 04              | —         | 100                | —          | —         | —          | 100         |
| 410443       | Object Oriented Modeling & Design | 04              | 02        | 100                | 25         | —         | 50         | 175         |
| 410444       | Elective-I                        | 03              | 02        | 100                | 25         | —         | 50         | 175         |
| 410445       | Elective-II                       | 03              |           | 100                | ----       | —         | ---        | 100         |
| 410446       | Computer Laboratory-I             | —               | 04        | —                  | ----       | 50        | —          | 050         |
| 410447       | Project Work                      | ---             | 02        | ---                | 50         | ---       | ---        | 050         |
|              | <b>Total</b>                      | <b>18</b>       | <b>10</b> | <b>500</b>         | <b>100</b> | <b>50</b> | <b>100</b> | <b>750</b>  |
|              | <b>Total of Part I (A)</b>        | <b>28 Hrs</b>   |           | <b>750</b>         |            |           |            |             |

**Term II**

| Subject Code  | Subject                              | Teaching Scheme |            | Examination Scheme |            |            |            | Total Marks |
|---------------|--------------------------------------|-----------------|------------|--------------------|------------|------------|------------|-------------|
|               |                                      | Lect.           | Pract      | Th                 | TW         | Pr         | Or         |             |
| <b>410448</b> | <b>Distributed Operating Systems</b> | <b>04</b>       | <b>---</b> | <b>100</b>         | <b>---</b> | <b>---</b> | <b>---</b> | <b>100</b>  |
| 410449        | Advanced Computer Architecture       | 04              |            | 100                |            |            |            | 100         |
| 410450        | Elective-III                         | 04              | 02         | 100                | 50         | —          | 50         | 200         |
| 410451        | Elective-IV                          | 04              | ---        | 100                | ---        | —          | ---        | 100         |
| 410452        | Computer Laboratory II               | —               | 04         | — —                | 50         | 50         | —          | 100         |
| 410447        | Project Work                         | —               | 06         | —                  | 100        | —          | 50         | 150         |
|               | <b>Total</b>                         | <b>16</b>       | <b>12</b>  | <b>400</b>         | <b>200</b> | <b>50</b>  | <b>100</b> | <b>750</b>  |
|               | <b>Total of Part II (B)</b>          | <b>28 Hrs</b>   |            | <b>750</b>         |            |            |            |             |
|               | <b>Grand Total (A+B)</b>             |                 |            | <b>1500</b>        |            |            |            |             |

**Th: Theory    TW: Term Work**

**Pr: Practical    Or: Oral**

### **Elective I**

- 1) Image Processing**
- 2) Design & Analysis of Computer Networks**
- 3) Artificial Intelligence**
- 4) Software Architecture**

### **Elective III**

- 1) Pattern Recognition**
- 2) High Performance networks**
- 3) Neural Networks**
- 4) Advanced Databases**

### **Elective II**

- 1) Multimedia Systems**
- 2) Mobile Computing**
- 3) Embedded Systems**
- 4) Software Testing & Quality Assurance**

### **Elective IV**

- 1) VLSI & Digital System Design**
  - 2) Operations Research**
  - 3) Cloud Computing**
  - 4) Information Security**
- or Open Elective**

**Open Elective:** Any other Electives that are being taught in Term II under the Faculty of Engineering or individual college and Industry, together, can define new elective using framework of Elective IV defined in syllabus structure and GET IT APPROVED FROM BOARD OF STUDIES COMPUTER ENGINEERING AND OTHER NECESSARY STATUTORY SYSTEMS IN THE UNIVERSITY OF PUNE BEFORE 30<sup>th</sup> DECEMBER.

The BE Project Term work assessment for Term I will be done by selecting panel of examiners amongst senior teachers of Computer Engineering. Existing prevailing practices are followed for all remaining examinations and assessment work.

**410441: Design and Analysis of Algorithms**

**Teaching Scheme:**  
Teaching 4Hrs/Week

**Examination Scheme**  
**Theory: 100 Marks**

| Unit            | Content  | Teaching Scheme |
|-----------------|--|-----------------|
| <b>Unit I</b>   | Asymptotic notations, necessary mathematical foundation, introduction to Algorithm, Algorithm specifications, Performance analysis, Review of proof techniques: Contradiction and Mathematical induction, Solving Recurrence Equations. Introduction to NP-Hard And NP-Complete Problems, Divide And Conquer And Greedy Strategy, Performance analysis of Algorithmic Strategies<br><b>Divide and Conquer:</b> General Strategy, Exponentiation, Quick Sort and Merge Sort.<br><b>Greedy Method:</b> General Strategy, Knapsack problem, Job sequencing with Deadlines, Optimal merge patterns, Minimal Spanning Trees and Dijkstra's algorithm. | 10              |
| <b>Unit II</b>  | Dynamic Programming, Study of different ways to implement Knapsack Problem. Implementation of OBST, Traveling Salesperson Problem. General Strategy, Multistage graphs, OBST, 0/1 Knapsack, Traveling Salesperson Problem, Flow Shop Scheduling.   | 6               |
| <b>Unit III</b> | <b>Backtracking:</b> General Strategy, 8 Queen's problem, Graph Coloring, Hamiltonian Cycles, 0/1 Knapsack.<br><b>Branch and Bound:</b> General Strategy, 0/1 Knapsack, Traveling Salesperson Problem.<br>Design of N Queen's problem, Hamiltonian Cycles  | 6               |
| <b>Unit IV</b>  | <b>Basic Concepts:</b> Non deterministic algorithms, The classes NP Hard and NP Complete, Cook's Theorem, NP Hard graph problems: Clique Decision problem, Node cover Decision problem, Chromatic number decision problem, Directed Hamiltonian Cycle Problem, TSP Decision problem, AND/OR Graph decision problem, <b>NP-Hard Scheduling problems:</b> Scheduling Identical processors, Flow shop scheduling, Job shop scheduling. NP-Hard Scheduling. Study of NP-Hard and NP-COMPLETE problems. Solving NP-COMPLETE problem.  | 6               |
| <b>Unit V</b>   | Parallel Algorithms, Study of different graph problems. Implementation of different sorting problems on multiprocessor system. Computational Model, Basic Techniques and Algorithms, Complete Binary Tree, Pointer Doubling, Prefix Computation, Selection, Merging, Sorting, Graph Problems.  | 6               |
| <b>Unit VI</b>  | Case Studies of Algorithmic Designs & Applications, Implementation of Huffman Problem. Deadlock detection and avoidance implementation. Image edge detection algorithms, Resource allocation algorithm with deadlock avoidance, Heuristic search algorithm, Coding theory algorithm  | 6               |

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|--|
| (Huffman coding), Sorting & Convex hulls algorithm. Review and interactive discussions on home tutorials, classroom tutorials and students presentation. Review of recent advances in the subject. |
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**Text Books:**

1. Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2<sup>ND</sup> Edition. University Press, ISBN: 978 81 7371 6126, 81 7371 6126
2. Bressard, "Fundamental of Algorithm.", PHI

**Reference Books:**

1. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithm" PHI
2. A. V. Aho and J.D. Ullman, "Design and Analysis of Algorithms", Pearson Education ISBN 978 81 317 0205 5
3. Horowitz , Sahani: "Computer Algorithms / C++ , ", 2<sup>ND</sup> Edition. University Press, ISBN: 978 81 7371 6119, 81 7371 611 0

## 41442 Principles of Compiler Design

**Teaching Scheme**  
Lectures: 4 Hrs/Week

**Examination Scheme**  
Theory: 100 marks

| Unit            | Contents   | Teaching Scheme |
|-----------------|--|-----------------|
| <b>Unit I</b>   | <p>Introduction to lexical Analysis and Syntax analysis. Review of lexical analysis: alphabet, token, lexical error, Block schematic of lexical analyser, Introduction to phases of Compiler, Lexical Analysis. Automatic construction of lexical analyser-(LEX), LEX specification and features.</p> <p>Introduction: Role of parsers, Top down-RD parser, Predictive parsers, LL (k) parsers, Bottom up Parsers - Operator precedence parsers, shift-Reduce: SLR, LR (k), LALR etc. using ambiguous grammars. Error detection and recovery, Automatic construction of parsers (YACC), YACC specifications,</p> | 13              |
| <b>Unit II</b>  | <p>Introduction to Semantic Analysis and syntax directed translation, Need of semantic analysis, type checking and type conversion</p> <p>Syntax directed definitions, construction of syntax trees, bottom-up evaluation of S-attributed Definitions, L-attributed definitions, Top-down translation,</p>   | 06              |
| <b>Unit III</b> | <p>Declarations, assignment statements, iterative statements, case statements, arrays, structures, conditional statements, Boolean expressions, back patching, procedure calls, Intermediate Code Generation, Intermediate languages, Intermediate languages programming structures, Intermediate code generation using YACC. Review and interactive discussions on home tutorials, classroom tutorials and students presentation. Review of recent advances in the subject.</p>   | 06              |
| <b>Unit IV</b>  | <p>Run-time Storage organization, Storage organization and allocation strategies, Source language issues, Storage organization and allocation strategies for block structured and non block structured languages, Activation record, variable-length data, procedure parameters, nested procedures, access to non-local names, procedure Call and return, static and dynamic scope. Symbol Table organization and management</p> <p>Run-time Storage organization</p>  | 05              |
| <b>Unit V</b>   | <p>Introduction: Issues in code generation, Basic blocks and flow graphs, next-use information, Target machine description, Register allocation and assignment, Dag representation of basic blocks, Peephole optimization, Generating code from a DAG, Dynamic programming, Code generator concept.</p>  | 06              |
| <b>Unit VI</b>  | <p>Introduction and Classification of code optimization, Principle sources Of Optimization, optimization of basic blocks,</p> <p>Introduction, Loops in flow graphs, Optimizing transformations:</p>   | 06              |

|  |   |  |
|--|---|--|
|  | <p>Introduction, Loops in flow graphs, Optimizing transformations: compile time evaluation, Common sub-expression elimination, variable propagation, code movement, strength reduction, dead code elimination and loop optimization, Local optimization, DAG based local optimization. Global Optimization: Control and data flow analysis, Computing Global Data flow information: meet over paths, Data flow equations, Data flow analysis, Iterative data flow analysis: Available expressions, live range identification.</p> |  |
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**Text books:**

1. A V Aho, R. Sethi, J D Ullman, "Compilers: Principles, Techniques, and Tools", Pearson Education, ISBN 81 - 7758 - 590 - 8

**References Books:**

1. K. Cooper, L, Torczon, "Engineering a Compiler", Morgan Kaufmann Publishers, ISBN 81-8147-369-8.
2. K. Loudon, "Compiler Construction: Principles and Practice", Cengage Learning, ISBN 978-81-315-0132-0
3. J. R. Levine, T. Mason, D. Brown, "Lex & Yacc", O'Reilly, 2000, ISBN 81-7366 - 061-X.
4. S. Chattopadhyay, "Compiler Design", Prentice-Hall of India, 2005, ISBN 81-203-2725-X.

## 410443 Object Oriented Modeling and Design

### Teaching Scheme

Lectures: 4 Hours /Week

Practical: 2 Hours/Week

### Examination Scheme:

Theory: 100 Marks

Term Work: 25 Marks

Oral: 50 Marks

| Units           | Contents  | Hrs/<br>Unit |
|-----------------|---|--------------|
| <b>UNIT I</b>   | What is modeling? Object Oriented Thinking, History of UML<br>Building Blocks of UML, OCL: what & why, expression syntax<br>Introduction to OMG standards MDA, XMI, UML 2.0. RUP<br>emphasizing Inception, Elaboration, Construction, Transition<br>Phases. 4+1 Architecture, UML Meta model, Extensibility<br>mechanisms like stereotypes, tagged values, constraints and profiles.<br>MDA, XMI, UML 2.0                         | 7            |
| <b>UNIT II</b>  | Requirements modeling: Gathering & classifying requirements,<br>Requirements metamodel, Requirements workflow<br>Detail Use case specifications, Use cases & RUP, Advanced<br>use-case modeling, Activity diagrams. Review and interactive<br>discussions on home tutorials, classroom tutorials and students<br>presentation. Review of recent advances in the subject.<br>Use-case modeling (actors, use cases, relationships), | 7            |
| <b>UNIT III</b> | Package diagrams, Basic Class diagrams, Need, purpose &<br>application of UML diagrams, CRC method, Advanced Class<br>diagrams, Object diagrams, Composite structure diagrams,<br>Illustrations of Package diagrams, Basic Class diagrams, Object<br>diagrams, Composite structure diagrams   | 7            |
| <b>UNIT IV</b>  | Need, purpose & application of sequence diagrams, Communication<br>diagrams, Interaction Overview diagrams, Timing Diagram, State<br>Machine diagrams,  | 6            |
| <b>UNIT V</b>   | Component Diagram, Interfaces and ports, Deployment<br>diagrams, Need, purpose & application of above diagrams two, three<br>tier architecture,   | 6            |
| <b>UNIT VI</b>  | Concept of Forward Engineering and Reverse Engineering of<br>UML Diagrams, Design patterns, Forward Engineering and Reverse<br>Engineering of all diagrams of UML 2.0. UML diagrams for<br>following design patterns: Singleton, Abstract factory, Façade,<br>proxy, Iterator, Observer. Design pattern examples  | 7            |

**Text Books:**

1. Jim Arlow, Ila Neustadt "UML 2 and the Unified Process : Practical Object-Oriented Analysis and Design" (2nd Edition) (Pearson)
2. Grady Booch, James Rumbaugh, Ivar Jacobson "Unified Modeling Language User Guide", The (2nd Edition) (Addison-Wesley Object Technology Series) (Hardcover)
3. Mike O'Docherty, "Object Oriented Analysis & Design", Wiley India
4. Object-Oriented Analysis and Design Using UML, An introduction to unified Process and design patterns, by Mantha Mahesh, PHI Publications, ISBN 978-81-203-3322-2.

**Reference Books:**

1. Erich Gamma Richard Helm, "Design patterns" Elements of reusable Object – Oriented Software, Pearson Education.
2. Tom Pender, "UML 2 Bible", Wiley publication,
3. Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", Third Edition (Paperback), Addison Westey
4. Dan Pilone, Neil Pitman "UML 2.0 in a Nutshell", (In a Nutshell (O'Reilly)) Paperback)

# Object Oriented Modeling and Design Lab

## Objectives of the Laboratory:

- To learn how to understand the requirements of a system, its scope.
- To learn good design, good modeling practices, document them and be able to discuss the pros and cons of your designs and models.
- To learn issues in modeling large, complex systems with example hypothetical systems
- To learn concepts, best practices in software, firmware development today and explore UML 2.0 Basic And Advanced concepts and notation for the same:
- To use UML 2.0 diagrams for modeling different aspects of a system throughout the SDLC lifecycle.
- To model an entire system using UML 2.0
- To learn effective use of any CASE TOOL for UML 2.0.

## Outcomes:

- 1) Students will be able to document SRS.
- 2) Students will be able to develop structural models.
- 3) Students will be able to develop behavioral models.
- 4) Students will be able to create Architectural models.
- 5) Students will be able to select the set of appropriate diagrams to develop a system model.
- 6) Students will be skilled in a CASE Tool

To meet above objectives teachers will help students choose a hypothetical system preferably either a commercial, web based or embedded system for modeling. The students will try and identify scope of such a system as realistically as possible. Students will learn to draw, discuss different UML 2.0 diagrams, their concepts, notation, advanced notation, forward and reverse engineering aspects. As far as possible draw as many diagrams for one single system, unless they are not applicable for the chosen system in which case other systems may be chosen for specific diagrams.

Any 8 diagrams can be drawn using tool, the other diagrams can be drawn on paper. Optionally one may draw Interaction overview diagrams, timing diagrams, and composite structure diagrams, object diagrams for your system as study assignments, paper based assignment or in cases relevant even in CASE TOOL

**The faculties are advised to use Project Based Learning [PBL] to conduct this lab.**

**410444: Elective I: Image Processing**

**Teaching Scheme:**  
**Teaching: 3Hrs/Week**  
**Practical: 2 Hrs/week**

**Examination Scheme**  
**Theory: 100 Marks**  
**Term Work: 25 Marks**  
**Oral: 50 Marks**

| <b>Unit</b>     | <b>Content</b>  | <b>Teaching Scheme</b> |
|-----------------|---|------------------------|
| <b>Unit I</b>   | What is digital image processing? Origin, usage and application of image processing. Fundamental steps and component of image processing system. Introduction to Human Visual System. Digital representation of images (monochrome & color). Elements of matrix theory, Digital Imaging Hardware & Software.  | 6                      |
| <b>Unit II</b>  | Basic image preprocessing (contrast enhancement, simple noise reduction, color balancing), Spatial transformation Gray Level liner and non-linear transformation, Histogram Processing, Hadamard and Walsh transformation. Image enhancement in spatial and frequency domain: basic fundamental, smoothing and sharpening domain filters. Sampling & Quantization.                                  | 6                      |
| <b>Unit III</b> | Image Processing filters, Image Segmentation & Analysis, Implementation Feature extraction: Edges, Lines & corners detection, Texture & shape measures.<br>Segmentation & thresholding, region extraction, edge (Canny) & region based approach, use of motion in segmentation. Feature extraction-Edges, Lines & corners detection, Texture & shape measures.                                      | 6                      |
| <b>Unit IV</b>  | Image Restoration & Reconstruction.<br>Introduction, Model of Image degradation, Noise Models, Classification of image restoration techniques, Blind-deconvolution techniques, Lucy Richardson Filtering, Wiener Filtering.   | 6                      |
| <b>Unit V</b>   | Image Compression & Object Recognition.<br>Introduction to Image Compression and its need, Coding Redundancy, Classification of Compression Techniques (Lossy and Losless - JPEG, RLE, Huffman, Shannon fano), Scalar & Vector Quantization. Introduction to Object Recognition, Object Representation (Signatures, Boundary Skeleton), Simple Boundary Descriptors, Regional descriptors(Texture). | 6                      |
| <b>Unit VI</b>  | Wavelets & Application of Image Processing.<br>Background: Image pyramids, Sub-band coding, Haar and Daubechies Wavelets. Image Compression using Wavelets (JPEG 2000). Principal Component Analysis & Local Component Analysis for dimension reduction.  | 6                      |

|  |   |  |
|--|---|--|
|  | Applications-<br>Medical Image Processing, Face detection, Iris Recognition |  |
|--|---|--|

**Text books:**

1. Digital Image Processing and Computer Vision, Sonka, lavac, Boyle, Cenage Learning.
2. Digital Image Processing, R.C. Gonzalez, R.R. Woods(TMh)
3. Digital Image Processing And Analysis, PHI, B. Chanda, D.Datta Mujumdar.

**References Books:**

1. Anil Jain, "Fundamentals Of Digital Image Processing", Anil Jain PHI, ISBN-81-203-0929-4
2. Digital Image Processing using MATLAB, R.C. Gonzalez, R.R. Woods(Person), 2nd Edition.
3. Digital Image Processing, S.Jayaraman, T. Veerakumar ( Mc Graw Hill).
4. Introduction to Digital Image Processing with MATLAB, Alasdair McAndrew, Cenage Learning

**Assignment for Image Processing (Using Object oriented techniques/OpenCV)**

- 1) Write a program to create a simple image file , save the same in .tiff format, and display it .
- 2) Write a program for image transformation, (recommended using Hadamard or Walsh transformation method or latest advanced transformation method).
- 3) Write a program using derivative filtering technique for edge detection and further thinning the edge.
- 4) Write a program for image enhancement , use suitable algorithm for
  - a. Histogram equalization & specification,
  - b. Local enhancement,
  - c. Smoothing and
  - d. Sharpening
- 5) Write a program to illustrate
  - a. Constrained image restoration, and
  - b. Unconstrained image restoration
- 6) Implement any of the following application/ or any Image processing application using MATLAB/ OpenCV
  - a. Medical Image Processing
  - b. Face detection
  - c. Iris Recognition

(Note: Students will submit the term work in the form of journal .The journal will contain minimum six assignments. Oral examination will be based on term work submitted.)

**410444: Elective I: Design and Analysis of Computer Networks****Teaching Scheme:****Teaching: 3Hrs/Week****Practical: 2 Hrs/week****Examination Scheme****Theory: 100 Marks****Term Work: 25 Marks****Oral: 50 Marks**

| <b>Unit</b>     | <b>Content</b>   | <b>Teaching Scheme</b> |
|-----------------|--|------------------------|
| <b>Unit I</b>   | Introduction, Review of background concepts of computer networks and data communication<br>Review of discrete random variables, point processes<br>Delay Models- Little's theorem, M/M/1 Queue System, M/G/1 system, generalized state dependent arrival and service system, Markov chains, Network of queues, open queuing system, closed queuing system, Independence assumption.  | 6                      |
| <b>Unit II</b>  | Introduction, Resource constraints and their metrics, common design techniques, performance analysis and tuning, summarization of various techniques (e.g multiplexing, pipelining, virtualization, randomization, soft state etc), Network design, Analysis and design of switching fabrics, Access networks and Backbone design. Modeling and simulation techniques, System Design, Study and analysis of System Design, Implementation of System Design, Simulation techniques of System Design | 6                      |
| <b>Unit III</b> | Introduction, Requirements, Fundamental choices, scheduling best effort connections and guaranteed service connections, comparison of various approaches, Open loop and closed loop flow control, comparison of closed loop schemes (stop and wait, static window, TCP Tahoe, TCP Vegas, ATM Forum, Credit based etc.), Study of flow control and scheduling, Implementation aspects of open loop and closed loop flow control.  | 6                      |
| <b>Unit IV</b>  | Introduction and Framework for Traffic management, Traffic Models, Traffic classes, Renegotiation, Signaling, Admission control, peak load pricing, capacity planning, QOS (ATM Forum and IETF approaches), ATM Forum and IETF approaches  | 6                      |
| <b>Unit V</b>   | Router/Switch architectures and algorithms<br>Introduction and overview of router architecture and hardware Prefix match IP lookup, IP trace back, Packet scheduling algorithms and RED/AQM, Router algorithms for network measurements, Implementation aspects of Router/Switch architectures and algorithms  | 6                      |
| <b>Unit VI</b>  | Functions and responsibilities, Network planning and implementation, Sub-netting, Bandwidth management, security issues, Tools for BW and security management, Security Issues and tools for BW  | 6                      |

**Text Books:**

1. An Engineering approach to computer Networking by S.Keshav, Pearson education
2. Network Algorithms by George Varghese, Morgan Kaufmann (For Unit 5)

**Reference Books:**

1. Data networks by D.Bertsekas and R Gallagar, Printice Hall
2. Design and Analysis of Communication Networks By V Ahuja , McGraw Hill
3. Kershenbaum A., "Telecommunication Network Design Algorithms", Tata McGraw Hill

**Design 6 suitable assignments based on following topics for the purpose of Design and Analysis of Computer Networks Laboratory**

1. Study of Network Simulators, Open Virtual Network Tools
2. Use of Little's theorem or Marcov Chains for design and analysis of network queues.
3. Using simulation tools and test data perform design and analysis of access network and backbone design
4. Analysis of Flow control and scheduling algorithms using test data
5. Network Analysis based decision system for Admission control, peak load pricing, capacity planning
6. Design and analysis of router Algorithm for network measurements using network simulation tools
7. Network planning and implementation: Bandwidth issue, Security Issues

### 410444: Elective I: Artificial Intelligence

**Teaching Scheme:**  
**Teaching: 3Hrs/Week**  
**Practical: 2 Hrs/week**

**Examination Scheme**  
**Theory: 100 Marks**  
**Term Work: 25 Marks**  
**Oral: 50 Marks**

| Unit            | Content   | Teaching Scheme |
|-----------------|---|-----------------|
| <b>Unit I</b>   | <p>Introduction and Intelligent systems, What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Applications of A.I.</p> <p><b>Intelligent Agents</b><br/>           Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents, How the components of agent programs work.</p>   | 6               |
| <b>Unit II</b>  | <p>Solving Problems by Searching, Study and analysis of Various searching algorithms. Implementation of Depth-first search<br/>           Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bi-directional search Informed (Heuristic) Search Strategies: Greedy best-first search A* search: Minimizing the total estimated solution cost, Conditions for optimality: Admissibility and consistency, Optimality of A*, Memory-bounded heuristic search, Heuristic Functions, Generating admissible heuristics from sub problems: Pattern databases, Learning heuristics from experience</p> <p><b>Beyond Classical Search</b><br/>           Local Search Algorithms and Optimization Problems: Hill-climbing search Simulated annealing, Local beam search, Genetic algorithms, Local Search in Continuous Spaces, Searching with Non-deterministic<br/> <b>Actions:</b> AND-OR search trees, Searching with Partial Observations</p> | 6               |
| <b>Unit III</b> | <p>Adversarial Search and Constraint Satisfaction Problems, Study of mini-max algorithm</p> <p><b>Adversarial Search:</b> Games, Optimal Decisions in Games, The mini-max algorithm, Optimal decisions in multiplayer games, Alpha--Beta Pruning, Move ordering , Imperfect Real-Time Decisions, Evaluation functions, Cutting off search, Forward pruning, Search versus lookup, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games</p> <p>Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Variations on the CSP formalism, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, Alpha-beta pruning and CSP, Implementation aspects of mini-max algorithm and CSP.</p>   | 6               |

|                |   |   |
|----------------|---|---|
| <b>Unit IV</b> | <p>Logical agents and Classical Planning, Study and comparison of knowledge representation structures. Implementation aspects of Backtracking algorithm and forward and backward chaining</p> <p><b>Logical Agents:</b> Knowledge representation structures: Frames, semantic net, Scripts, Logic: Propositional Logic, Propositional Theorem Proving, Inference and proofs, Proof by resolution, Conjunctive normal form, Horn clauses and definite clauses, Forward and backward chaining, A complete backtracking algorithm, Syntax and Semantics of First-Order Logic, Symbols and interpretations, Knowledge Engineering in First-Order Logic, Unification, Resolution, Introduction to logic programming (PROLOG)</p> <p><b>Classical Planning:</b> Definition of Classical Planning, The complexity of classical planning, Algorithms for Planning as State-Space Search, Forward (progression) state-space search, Backward (regression) relevant-states search, Heuristics for planning, Planning Graphs, Other Classical Planning Approaches, Hierarchical Planning</p> | 6 |
| <b>Unit V</b>  | <p><b>Quantifying Uncertainty:</b><br/>Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, Representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees</p> <p><b>Learning from Examples:</b><br/>Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, Inducing decision trees from examples.</p>   | 7 |
| <b>Unit VI</b> | <p>Natural language processing and Expert systems,</p> <p><b>Natural Language Processing:</b><br/>Language Models, Steps in NLP, Syntactic Analysis (Parsing), Semantic interpretation, Discourse and pragmatic Processing, Text Classification. Discourse and pragmatic Processing, Implementation aspects of Syntactic Analysis (Parsing)</p> <p><b>Expert Systems:</b><br/>What is Expert system, Components of Expert System, Case studies on Expert System</p>   | 6 |

**Text Book:**

1. Artificial Intelligence: A Modern Approach by Peter and Norvig ISBN-0-13-103805-2,

**Reference Books:**

1. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair ISBN-978-0-07-008770-5, TMH,

2. Prolog Programming for A.I. by Bratko, TMH
3. Artificial Intelligence by Saroj Kausik ISBN:- 978-81-315-1099-5, Cengage Learning
4. Artificial Intelligence and Intelligent Systems by Padhy, Oxford University Press,

**Artificial Intelligence Laboratory Assignments:**

1. Implementation of A\* algorithm for solving Puzzle problems.
2. Implementation of MinMax Search Procedure with alpha beta pruning for finding the solutions of games.
3. Implementation of Unification algorithm by considering Resolution concept.
4. Implementation of Constraint Satisfaction Problem for solving Crypt-arithmetic Problems.
5. Implementation of Solving Uncertainty Problems like Weather forecasting
6. Implementation of Parsing methods to categorize the text  
Or
7. Implementation of Mini Expert System

## 420444 Elective I: Software Architecture

### Teaching Scheme

Lectures: 3 Hrs/Week

Practical: 2 Hrs/week

### Examination Scheme

Theory: 100 marks

Oral: 50 Marks

Term Work: 25 Marks

| Unit            | Contents  | Nos.<br>Hrs |
|-----------------|---|-------------|
| <b>Unit I</b>   | Introduction to Software Architecture, Architecture Business Cycle, What is software architecture, software architecture requirements, Architecture structures and views, Documenting software architectures, Opportunities and Advances in software architectures.   | 6           |
| <b>Unit II</b>  | Introduction to Quality Attributes, Need of quality attributes, Understanding quality attributes, architecture and quality attributes, achieving quality attributes. Case study of quality attributes in software architecture templates. Deriving Quality Attributes for software architectures  | 6           |
| <b>Unit III</b> | Design Patterns: history, principles and expectations. Study of a number of representative patterns like Singleton, Factory, Adaptor, Facade, Proxy, Iterator, Observer, Mediator, composite, chain of. Ways of using patterns<br>Case studies of patterns in software architecture   | 6           |
| <b>Unit IV</b>  | Introduction to Middleware, Types of Middleware, Application servers, Introduction to Java EE, Introduction to Java EE technologies like JMS, JDBC, RPC, RMI, SOCKET. EJB 3.0 Architecture, Entity, Session, Message beans, XML, XSLT. Specifications and characteristics of Middleware technologies. Recent advances in Middleware technologies                      | 6           |
| <b>Unit V</b>   | Introduction to three tier and <i>n</i> -Tier Web Architectures, XML, Client side technologies HTML, DHTML, Java Applets, Active X controls, DOM, AJAX. Need of Client side technology in multi-tier architectures<br>Examples of three tier and <i>n</i> -tier architectures, client side technologies<br>Case study of mobile or portable client side technologies. | 6           |
| <b>Unit VI</b>  | Need of server side technology in multi-tier architectures, Java Web Services, Server side technologies: JSP, JSF, SOA,MVC. Java Servlets, struts   | 6           |

**Text Book:**

1. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Second Edition, Pearson ,ISBN 978-81-775-8996-2
2. Erich Gamma,"Design Patterns"
3. "Java Sever Programming" Black Book dreamTech Press ISBN: \978-81-7722-835-9
4. xyz, PHI Publications

**Reference Book:**

1. James L. Weaver, Kevin Mukhar, "Beginning J2EE 1 .4: From Novice to Professional
2. Richard N.Taylor , Nenad M. "Software Architecture Foundation Theory and practice ",Wiley ISBN: 978-81-265-2802-8.
3. Java6 Programming, Black Book dreamTech Press ISBN:978-81-7722-736-9

## **Software Architecture Laboratory**

**Objectives:**

- Understand various non-functional requirements that lead to need for good Architecture and good Design.
- Explore various design Patterns and learn to implement them
- Understand how to design and partly implement Client Server systems using components and web services
- Explore implementations of some of the underlying technologies of distributed client server applications

Faculty can set assignments based on Microsoft / Java world /OR Open source based languages, platforms, Middleware, APIs.

**Design Patterns**

1. Study any two patterns and SUBMIT a design pattern specification these in a standard format along with their UML diagrams. The specification must include Problem/ Issue, Audience/ Context, Forces, Solution, Discussion/ Consequences/ Implementation, Related Patterns, Example Instances, References.
2. Implement an ITERATOR/OBSERVER or any two patterns pattern in language of your choice and submit it along with a write-up with its specification.
3. Study and submit a report for any of the MVC based Frameworks (J2EE/EJB)

### **Implement a web application for a system covering**

4. A representative paper design of the above system using navigation, components, interfaces, its deployment issue with UML
5. Develop dynamic and interactive web client using JSP, Scripting/Applets/ActiveX controls
6. Develop server side programming with database handling/ servlets /EJB/webservice on server side with security aspects covered.

## 410445: Elective II: Multimedia Systems

Teaching Scheme:

Teaching: 3Hrs/Week

Examination Scheme

Theory: 100 Marks

| Unit     | Content  | Teaching Scheme |
|----------|--|-----------------|
| Unit I   | <p><b>MM Introduction:</b><br/>Overview of multimedia, Multimedia building blocks, Digital representation, Interaction techniques and devices.</p> <p><b>Multimedia architecture:</b><br/>Introduction to multimedia architectures, User interfaces, Windows multimedia support, Windows API for Multimedia, Multimedia Database Systems, Media streaming, Multimedia authoring tools, Multimedia OS.<br/>Programming aspects of using Windows/Open-source API for developing applications, Design &amp; programming aspects of application for audio/video streaming.</p>   | 6               |
| Unit II  | <p>Introduction to Image Processing and Compression applications,</p> <p><b>Image Processing:</b><br/>Basic Image fundamentals, Image data types, image file formats (GIF, BMP, TIFF, JPEG), Image acquisition, Image enhancement: Enhancement by point processing, Spatial filtering, Color image processing.</p> <p><b>Image compression:</b> Types of compression: Lossy &amp; lossless, symmetrical &amp; asymmetrical, intraframe &amp; interframe Hybrid, Loss less: RLE, Shannon- Fano algorithm, Arithmetic coding. Lossy: Vector quantization, fractal compression technique, transform coding, psycho-analysis, interframe correlation. Hybrid: JPEG-DCT<br/>Programs considerations for image enhancement using point processing and image compression.</p> | 6               |
| Unit III | <p><b>Multimedia Audio:</b><br/>Data structures used in audio files, Characteristics of sound waves, psycho, digital audio, MIDI and MIDI File format, CD and DVD formats.</p> <p><b>Audio file formats:</b> WAV, VOC, AVI, MPEG Audio<br/><b>Audio compression:</b> Compression in audio PCM,DM, DPCM<br/>Study of different audio file formats and compression techniques<br/>Programming considerations for audio compression.</p>  | 6               |
| Unit IV  | <p>Study of different text formats and video formats.</p> <p><b>Text :</b>Visual representation of text, Digital representation of text, Text compression: Huffman coding, LZ &amp; LZW,<br/><b>Text file formats:</b> TXT, DOC, RTF, PDF.<br/><b>Video:</b> Digitization of video, Video capturing , Video transmission standards; EDTV, CCER, CIF, SIF, HDTV, Video formats: H-26I, H-263. MPEG Video compression. Video streaming. Study and</p>  | 5               |

|                |  |   |
|----------------|--|---|
|                | analysis of video formats, compression and streaming   |   |
| <b>Unit V</b>  | <p>Animation and Multimedia Languages, Learn to use OpenGL</p> <p><b>Animation:</b> Basics of animation, types of animation, principles of animation, techniques of animation, Creating animation.</p> <p><b>OpenGL:</b> Open GL over windows/Linux, Extension, programming languages, SDK, shadowing techniques, rendering, Programming aspects in creating simple animation using OpenGL</p>       | 5 |
| <b>Unit VI</b> | <p>Multimedia Communication and applications, Study of Multimedia networking, Quality of data transmission, Multimedia over IP, Media on Demand</p> <p><b>Applications</b></p> <p>Media Entertainment, Media consumption, web-based applications, e-learning and education, Students Presentations:</p> <p>Different Multimedia applications, Analysis and development of Multimedia application</p> | 5 |

### Text Book

1. Ralf Steinmetz and Klara Nahrstedt "Multimedia Computing, Communication and Applications", Pearson Education.
2. K.R. Rao, "Multimedia Communication Systems: Techniques, Standards, and Networks", TMH.
3. Ranjan Parekh, "Principles of Multimedia", TMH.

### References:

1. Gonzalez, Woods, "Digital Image Processing" Addison Wesley
2. Ze-Nian Li, Marks S. Drew, "Fundamentals of Multimedia", Pearson Education.
3. Edward Angel, "OpenGL: A Primer", Addison-Wesley.
4. "DeMustified Video"
5. Parag Havaladar, Gerard Medioni, "Multimedia Systems", Cengage Learning.

## 410445 Elective II: Mobile Computing

Teaching Scheme: 3Hrs/Week

Marking Scheme :  
Theory: 100 Marks

| Unit     | Content  | Hrs/Unit |
|----------|--|----------|
| Unit I   | Applications, history of mobile communication, introduction to GSM system, GSM background, GSM operational and technical requirements. cell layout and frequency planning, mobile station, base station systems, switching sub systems, home locations, register, Visiting Location Register (VLR), equipment identity register, echo canceller. GSM network structure, Recent Advances and application Standards in Mobile OS | 6        |
| Unit II  | Time and Frequency Domains representations, structure of TDMA slot with frame; Time organization of signaling channels, frequency hopping. TDMA standards and Applications, Time Organization of signaling Channels  | 6        |
| Unit III | Mobility Management, Signaling protocols, steps in formation of a call, location updates, MS-PSTN call, PSTN-MS call, MS-MS call, call handover. Functioning and types of PSTN networks  | 6        |
| Unit IV  | Security issues in mobile computing, Authentication, encryption, Characteristics of SIM, equipment identification, Review and interactive discussions on home tutorials, classroom tutorials and students presentation. Review of recent advances in the subject. Security Application development for Mobile OS   | 6        |
| Unit V   | Multiplexing issues in time and frequency domains, FDMA, TDMA, CDMA,   | 6        |
| Unit VI  | Physical layer, data link layer, MAP Protocols, MTP3, SCCP, TCAP protocol, message formation, MAP protocol-MAP protocol for MM, MAP protocol for basic service support. Application layers RR-layer, MM-layer, CC-Layer, API's for mobile application development  | 6        |

### Text Books

1. Asha Mehrotra, GSM System Engg. ,Artech House
2. William C.Y. Lee, Mobile Communication Design Fundamentals , Wily Series In Telecommunication

### Reference Books

1. Jerry D. Gibson, The Mobile Communication Handbook , IEEE Press
2. Jochen Schiller, Mobile Communication, Pearson Education Asia

3. Garg V., Joseph E. Wilkes, "Wireless and personal Communications Systems", Prentice Hall
4. Android: Wireless Application Development Developer's Library, by Lauren Darcey and Shane Conder, 2nd Edition, Addison Wesley, Free Online Edition

**410445: Elective II: Embedded Systems****Teaching Scheme:  
Teaching 3Hrs/Week****Examination Scheme  
Theory: 100 Marks**

| <b>Unit</b>     | <b>Content</b>  | <b>Teaching Scheme</b> |
|-----------------|---|------------------------|
| <b>Unit I</b>   | Introduction to Embedded Systems, Review of Microprocessors and Micro-controllers, Multiprocessor systems using General Purpose Processor. CISC and RISC Processor architectures. DSP processor. Design Process in Embedded System, Components of Embedded System & its Classification, Characteristic of embedded system. Introduction to embedded processor, Digital Signal Processor, Application Specific System Processor, Design Process in Embedded System, Design metrics, Steps in design process. Challenges in Embedded System design, Design Examples. Advances in Embedded Systems | 06                     |
| <b>Unit II</b>  | System hardware, Interrupt structure and Applications, ARM7 Processor - Architecture, Programmer's model, Modes of operation, Interrupt Structure and Applications. Comparison with ARM9. Details of Components of Embedded Systems- Management of Power Supply, Clocking Unit, Real Time Clock and Timers, Reset Circuitry and Watchdog Timer. Structural Units of Processor, Processor and Memory Selection, Memory Map Of Embedded System, Interfacing Processors , Memories and I/O. Processor and Memory Selection, Memory Map Of Embedded System  | 06                     |
| <b>Unit III</b> | I/O interfacing and Communication Buses, Serial Data Communication using USB/CAN/RS-232C and Comparison. I/O devices, ADC / DAC, Optical Devices such as LED / LCD Display devices, Opto-Isolator, Relay & stepper motor, Timers/Counters. Parallel v/s serial communication. Parallel ports their uses in device interfacing. Different serial communication Protocols- RS232C, RS 485, I <sup>2</sup> C, CAN, & USB – Protocol Architecture, topology, different Packets, Communication Cycle, Arbitration, Applications. Their comparison and area of application.                           | 06                     |
| <b>Unit IV</b>  | Programming concepts, Embedded System Programming, C /C++/Java programming concepts, Software development cycle, Assembly language V/s High Level Language and its suitability for applications development, C program elements – Micros and functions, data types, data structures, modifiers, statements, loops and pointers, queues and stacks, List & Order List and their use in the implementation of Embedded System software. Brief overview of Embedded System Programming In C++ & Java. Process of Converting assembly language program and C language program to ROM image.         | 06                     |

|                |   |    |
|----------------|---|----|
|                | Difference between Compilers & Cross Compilers. Embedded System testing, simulation and debugging tools – simulators, laboratory tools-Oscilloscope, Logic Analyzer and In-Circuit Emulator.  |    |
| <b>Unit V</b>  | Device Handling and Concepts of Real Time Operating Systems, Programmed I/O v/s Interrupt based I/O, Interrupts, their sources, types and Interrupt service mechanisms, Context, Context Switching, Interrupt Latency, Response time, Deadline. Device drivers as ISRs - Brief about different types of device drivers, Virtual Device Drivers, Real Time & embedded System OS, their differences, Handheld Operating Systems. Interrupt Routines in RTOS environment, RTOS Tasks and their Scheduling models, Strategy for synchronization between the processes,  | 06 |
| <b>Unit VI</b> | Exemplary Operating Systems and Representative Embedded Systems, Design of tasks and synchronization and IPCs<br>Examples of Real Time OS, embedded System OS and Handheld OS – Windows XP Embedded, Embedded Linux, VxWorks, MicroC/OS II, Palm OS, Symbian OS - Their features and applications, Representative Embedded Systems – Digital Thermometer, Handheld computer, Navigation system, IP phone, Software Defined Radio, Design Examples and case study of – Mobile Phone, Digital camera, Automatic Cruise control System, their Block diagram, class diagrams, Design of tasks and synchronization and IPCs. (Features, IPC used, Scheduling, Applications), Design of tasks and IPCs. | 06 |

### **Text Books**

1. Rajkamal, “Embedded System Architecture Programming Design” Tata Graw Hill Publication Second Edition, 2008.
2. Dr. K. V. K. K. Prasad “Embedded / real time System : Concepts, Design, & Programming – Black Book” Dreamtech Press Publication.
3. Andrew N. Sloss, Domiic Symes, Chris Wright, “ARM System Developer’s Guide-Designing and Optimizing Software”, Elsevier Publication, 2004.

### **Reference Book:**

1. Rajkamal, “Embedded System Architecture Programming Design” Tata Graw Hill Publication first Edition.
2. Dr. K. V. K. K. Prasad, Gupta Dass, Verma “Programming for Embedded system “ Wiley – Dreamtech India Pvt. Ltd.
3. CAN Specification Version 2.0 Protocol Standard.
4. USB Specification Version 2.0 Protocol Standard.
5. I2C Specification Protocol Standard.
6. ARM7/TDMI(ReV4)- Technical Ref Manual
7. Tammy Noergaard, “ Embedded Systems Architecture” by Elsevier

## 410445 Elective II: Software Testing and Quality Assurance

**Teaching Scheme**  
Lectures: 3 Hrs/Week

**Examination Scheme**  
Theory: 100 marks

| Unit            | Contents   | Hrs/<br>Unit |
|-----------------|--|--------------|
| <b>Unit I</b>   | Introduction, Basics of Software Testing, Testing Principles, Goals, Testing Life Cycle, Phases of Testing, Defects, Defect Life Cycle, Defect Report, Test Plan(IEEE format), Importance of testing in software production cycle.   | <b>04</b>    |
| <b>Unit II</b>  | Introduction, Need of black box testing, Black box testing Concept, Requirement Analysis, Test case design criteria, Testing Methods, requirement based testing, Positive & negative testing, Boundary value analysis, Equivalence Partitioning class, state based or graph based, cause effect graph based, error guessing, documentation testing & domain testing, design of test cases. Case studies of Black-Box testing.                  | <b>06</b>    |
| <b>Unit III</b> | Introduction, Need of white box testing, Testing types, Test adequacy criteria, static testing by humans, Structure - logic coverage criteria, Basis path testing, Graph metrics, Loop Testing, Data flow testing, Mutation Testing, Design of test cases. Testing of Object oriented systems, Challenges in White box testing, Case-study of White-Box testing  | <b>06</b>    |
| <b>Unit IV</b>  | Test organization, Structure of testing, Measurement tools, Testing metrics: Type of metric – Project, Progress, Productivity, Metric plan, Goal Question metric model, Measurement in small & large system.<br>Other Software Testing: GUI testing, Validation testing, Regression testing, Scenario testing, Specification based testing, Adhoc testing, Sanity testing, Smoke testing, Random Testing. Advances in Software Testing Methods | <b>06</b>    |
| <b>Unit V</b>   | Software quality, Quality attribute, Quality Assurance, Quality control & assurance, Methods of quality management, Cost of quality, Quality management, Quality factor, Quality management & project management, Software quality metrics-TQM, Six Sigma, ISO, SQA Model.   | <b>04</b>    |
| <b>Unit VI</b>  | Manual testing, Automated Testing Tools & Case studies, Study of Testing tools (QTP, Rational Robot, Winrunner, Loadrunner), Case studies based on Web based, GUI testing, Manual testing Vs Automated testing, Automated Testing Tools Case studies   | <b>04</b>    |

**Text books:**

1. Software Testing, Second Edition By: **Ron Patton**, Pearson Education  
ISBN-13: 978-0-672-32798-8
2. Software Testing Principles and Tools By M.G. Limaye TMG Hill  
Publication, ISBN 13:978-0-07-013990-9
3. Software Testing Principles and Practices By Naresh Chauhan, Oxford  
University Press, ISBN 0-19-806184-6
4. Software testing Principle and Practices By Ramesh Desikan, Pearson  
Education, ISBN 81-7758-121-X
5. Software Testing Concepts and Tools By Nageshwar Rao , Dreamtech ,ISBN  
81-7722-712-2

**References Books:**

1. Metric and Model in Software Quality Engineering , By Stephen H Kan, Pearson  
Education ISBN 81-297-0175-8
2. Effective methods for software testing by William Perry , Willey Publication,  
ISBN 81-265-0893-0
3. Foundation of software testing by Dorothy Graham, Erik Van Veenendaal.  
CENGAGE learning ,ISBN 978-81-315-0218-1
4. Software Testing Tools by Dr.K.V.K. Prasad, Dreamtech Press ISBN: 10:81-  
7722-532-4

## 410446 Computer Laboratory-I

**Teaching Scheme**  
**Practical: 4 hrs/week**

**Examination Scheme**  
**Practical: 50 Marks**

### **Principles of Compiler Design Assignments**

#### **LEX**

1. Assignment to understand basic syntax of LEX specifications, built-in functions and Variables.
2. Implement a lexical analyzer for a subset of C using LEX Implementation should support Error handling,

#### **YACC**

1. Assignment to understand basic syntax of YACC specifications, built-in functions and Variables
2. Write an ambiguous CFG to recognize an infix expression and implement a parser that recognizes the infix expression using YACC. Provide the details of all conflicting entries in the parser table generated by LEX and YACC and how they have been resolved

#### **Intermediate Code Generation**

3. Write an attributed translation grammar to recognize declarations of simple variables, "for", assignment, if, if-else statements as per syntax of C or Pascal and generate equivalent three address code for the given input made up of constructs mentioned above using LEX and YACC. Write a code to store the identifiers from the input in a symbol table and also to record other relevant information about the identifiers. Display all records stored in the symbol table.

#### **Code Optimization**

4. Assignment to optimize the generated equivalent three-address code in 3<sup>rd</sup> assignment.

#### **Code Generation**

5. Generate the target code for the optimized code in 4<sup>th</sup> assignment.

## 410447 Project Work

### Objectives:

*To expose students with project-product development cycle using industrial experience, use of state-of-art technologies. To encourage and expose students for participation in National/ International paper presentation activities. Exposure to Learning and knowledge access techniques using Conferences, Journal papers and participation in research activities.*

### Term I

#### Teaching Scheme:

Practical: 2 Hours/Week

#### Examination Scheme:

Term Work: 50 Marks

### Term I project term work

1. Internal guide allocation for the BE Project: Assistant Professor in computer engineering can guide the BE Project. In case of non-availability of qualified guide, HOD can allocate the senior teacher as a guide, without compromising the quality of the work. The Project laboratory of 4 project groups (3 to 4 students in one group) constituting one laboratory batch (2 hrs per week), be allocated to the guide.

The project group will submit the synopsis including title of the project, Technical Key Words (Ref. ACM Keywords) and relevant mathematics associated with the Project, names of atleast two conferences, where papers can be published, Review of Conference/Journal papers (atleast 10 papers + White papers or web references, (if any)) supporting the project idea, Plan of project execution using planner or alike project management tool. (Recommended dates: 3 weeks after Commencement of the Term). Preferably, the projects are Industry Sponsored or part of high level research/ Sponsored Research Project that are not conducted for any award of the educational degree.

2. The project conduct and procedures are amended as detailed below:-  
Problem statement feasibility assessment using, satisfiability analysis and NP-Hard, NP-Complete or P type using modern

- algebra and relevant mathematical models.(recommended date of submission:- 8 weeks before term end)
3. Use of above to identify objects, morphism, overloading, functions and functional relations and any other dependencies. (recommended submission date:- 6 weeks before term end)
  4. Functional dependency graphs and relevant UML diagrams or other necessities.(recommended submission date:- 3 weeks before term end)
  5. Testing of problem statement using generated test data (using mathematical models, Function testing principals) selection and appropriate use of testing tools, testing of UML diagram's reliability. (recommended submission date:- two weeks before term end)
  6. The index of submission must cover above mentioned 5 heads in addition to the instructions by the guide.
  7. Students must submit atleast one technical paper on the project design in the conferences/workshops in IITs, Central Universities or UoP Conferences or equivalent International Conferences.
  8. A Report consisting of problem definition, literature survey, platform choice, *SRS (System Requirement Specification)* Document in specific format and high-level design document along with Annex A: Laboratory assignments on Project Analysis of Algorithmic Design, Annex B: Laboratory assignments on Project Quality and Reliability Testing of Project Design at the end of term-I and Annex C: Project Planner and progress report. The term work at the end of Term-I shall be assessed and evaluated for 50 marks by the panel of examiners in the subject (Internal (preferably guide) and external examiner from Computer Department of Engineering Colleges).

### **Term-I Project Laboratory Assignments**

1. Project problem statement feasibility assessment using NP-Hard, NP-Complete or satisfiability issues using modern algebra and/or relevant mathematical models.

2. Use of above to identify objects, morphisms, overloading in functions (*if any*), and functional relations and any other dependencies (*as per requirements*).
3. Use of above to draw functional dependency graphs and relevant UML diagrams or other necessities using appropriate tools.
4. Testing of project problem statement using generated test data (using mathematical models, GUI, Function testing principals, *if any*) selection and appropriate use of testing tools, testing of UML diagram's reliability.

## 410448: Distributed Operating Systems

**Teaching Scheme:**  
Teaching 4Hrs/Week

**Examination Scheme**  
**Theory: 100 Marks**

| Unit            | Content   | Teaching Scheme |
|-----------------|---|-----------------|
| <b>Unit I</b>   | <p><b>Fundamentals</b> – Fundamentals of OS, What is Distributed System? Evolution of Distributed Computing System, Distributed Computing System Models , Distributed Computing gaining popularity Issues in Designing Distributed System, Introduction to Distributed Computing Environment, Protocols for Distributed System, Network, Interprocess Communication, Issues in Interprocess Communication</p> <p><b>Message Passing</b> - Introduction , Desirable features of good message passing system, Issues in IPC by Message passing, RPC, RMI Synchronization, Buffering, Multidatagram messages, Encoding and decoding of message data, Process addressing, Failure Handling, Group communication, Case Study: RMI, CORBA. Advances in Distributed Systems</p>  | 7               |
| <b>Unit II</b>  | <p><b>Architecture of Distributed System</b> – Introduction, Motivations, Concepts of Distributed System, Process Synchronization, System architecture types, Distributed operating system, NOS, Middleware Communication Networks, Communication primitives, Architectural models of Distributed System</p> <p><b>Synchronization</b><br/>Introduction, Inherent Limitations of a Distributed System, Lamport’s logical clock, Vector clock, Global states, Concept of Process, Process Migration, Threads Clock synchronization, Event ordering, Mutual Exclusion, Deadlock, Election Algorithms<br/>Issues in Designing Distributed System and role of middleware in Distributed System</p>  | 6               |
| <b>Unit III</b> | <p><b>Distributed Mutual Exclusion</b> – Introduction, Classification of mutual exclusion algorithms, Preliminaries, A simple solution to distributed mutual exclusion, non token based algorithms, Ricart Agrawala algorithm, Token based algorithms, Suzuki Kasami’s broadcast algorithms</p> <p><b>Distributed Deadlock detection</b> – Introduction, Preliminaries , Deadlock handling strategies , Issues in deadlock detection and resolution, Control organizations for distributed deadlock detection, Centralized deadlock detection algorithms, Distributed deadlock detection algorithms, Avoidance and Prevention algorithms, Hierarchical deadlock detection algorithms</p> <p><b>Agreement Protocols</b> – Introduction, System Model, Classification of agreement problems, Solutions to the Byzantine Agreement problem, Applications of Agreement algorithm, Distributed Synchronization and</p> | 8               |

|                |  |   |
|----------------|--|---|
|                | Agreement Protocol, Concepts of Mutual exclusion, Deadlock Solution to Distributed Mutual exclusion  |   |
| <b>Unit IV</b> | <p>Distributed Resource Management, Concepts of File System, Scheduling Algorithms</p> <p><b>Distributed File System</b><br/>Introduction , Architecture, Mechanisms for building distributed file system, Design issues, Case studies, Log structured file systems, Google FS</p> <p><b>Distributed Shared Memory</b> – Introduction, Architecture and Motivation, algorithms for implementing DSM, Memory Coherence, Coherence protocols, Design issues, Case studies-Linda</p> <p><b>Distributed Scheduling</b> – Introduction, Motivation, Issues in load distribution, Components of load distributing algorithms, Stability, Load distributing algorithms, Performance Comparison, Selecting a suitable load sharing algorithms, Requirements for load distributing, Load sharing policies, Task migration</p> <p>Distributed File System: Comparisons</p>   | 8 |
| <b>Unit V</b>  | <p>Recovery and Security mechanism, Concepts of Database system Security, Basic concepts of Recovery and Types of Failures</p> <p><b>Recovery</b> – Introduction, Basic concepts, Classification of failures, Backward and forward error recovery, Backward error recovery, Recovery in concurrent systems, Consistent set of checkpoints, Synchronous and Asynchronous check pointing and recovery</p> <p><b>Fault tolerance</b> – Introduction, Issues, Atomic actions and committing, Commit Protocols, Non blocking Commit protocols, Voting protocols, Majority based Dynamic Voting protocol, Dynamic vote, Reassignment protocols, Failure Resilient Processes, Reliable communication, Case studies-BAR Fault Tolerance, Targon/32 UNIX</p> <p><b>Access and Flow control</b> – Introduction, Preliminaries, Access matrix Model, Implementations of Access Matrix, Safety in Access matrix model, advanced models of protection, Case studies-Unix OS</p> <p>Distributed Fault tolerance and Security, Advances in Recovery and security mechanisms</p> | 8 |
| <b>Unit VI</b> | <p>Emerging Trends in Distributed System, Concepts of Cluster, Concepts of Grid Computing</p> <p><b>Grid Computing</b><br/>Introduction to GRID Computing, How Grid Computing Works, Grid Middleware, Grid Architecture, Types of Grids Grid Computing Applications, Simulators</p> <p><b>SOA:</b> Basic SOA Definition, Overview of SOA, SOA and Web Services, Service Oriented Grid, SOA Design and Development, Advantages and Future of SOA</p> <p>Grid computing, Cloud and SOA</p>   | 5 |

**Text books:**

1. "Distributed O.S Concepts and Design", P.K.Sinha, PHI
2. "Advanced concepts in Operating Systems", Mukesh Singhal & N.G.Shivaratri, TMH
3. "Distributed Computing", Sunita Mahajan, Seema Shah, OXFORD University Press

**Reference Books:**

1. "Distributed System Principles and Paradigms", Andrew S. Tanenbaum, 2<sup>nd</sup> edition , PHI
2. "Distributed Systems", Colouris , 3<sup>rd</sup> Edition

**410449: Advanced Computer Architecture**

**Teaching Scheme:**  
Theory: 4Hrs/Week

**Examination Scheme**  
Theory: 100 Marks

| Unit            | Content   | Teaching Scheme |
|-----------------|---|-----------------|
| <b>Unit I</b>   | <p>Overview of Parallel Processing and Pipelining Processing, study and comparison of uni-processors and parallel processors. Conventional and EPIC architecture. Evolution of parallel processors, future trends and there architecture.</p> <p><b>Overview of Parallel Processing and Pipelining Processing</b><br/>Necessity of high performance, Constraints of conventional architecture, Parallelism in uni-processor system, Evolution of parallel processors, future trends, Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture, Case study of Intel Itanium Processor.</p> <p><b>Principles of scalable performance:</b> Performance Metrics and Measures, Speedup Performance Laws.<br/>Programming aspects for Intel Itanium Processor</p> | 6               |
| <b>Unit II</b>  | <p>Principles and implementation of Pipelining, Classification of pipelining processors, Pipeline Architecture, Study and comparison of processors with and without pipelining. General pipelining reservation table, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Job sequencing and Collision, Advanced pipelining techniques, loop unrolling techniques, out of order execution, software scheduling, trace scheduling, Predicated execution, Speculative loading, Register Stack Engine, Software pipelining, VLIW (Very Long Instruction Word) processor, Case study: Super scalar Architecture- Pentium, Ultra SPARC. Super scalar architecture of Pentium, Ultra SPARC, Advances in pipeline architectures. Implementation issues of a program on any pipelined processor their analysis.</p>         | 8               |
| <b>Unit III</b> | <p>Study and comparison of Vector and array processors, Vector and Array Processor, Basic vector architecture, Issues in Vector Processing, Vector performance modeling, vectorizers and optimizers, Case study: Cray Arch.</p> <p><b>SIMD Computer Organization</b> Masking and Data network mechanism, Inter PE Communication, Interconnection networks of SIMD, Static Vs Dynamic network, cube hyper cube and Mesh Interconnection network.</p> <p><b>Parallel Algorithms For Array Processors:</b> Matrix Multiplication. Sorting,<br/>SIMD computer organization. Implementation issues of Matrix multiplication and sorting on array processor and their analysis.</p>   | 8               |

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| <b>Unit IV</b> | <p>Microprocessor Architectures, study and comparison of Loosely and Tightly coupled multiprocessors.</p> <p>Loosely and Tightly coupled multiprocessors, Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP), Cow's and NOW's Cluster and Network of Work Stations), Chip Multiprocessing (CMP), Case Study of IBM Power4 Processor Inter Processor Communication and Synchronization,</p> <p>Implementation issues of a program on multiprocessor system.</p> | 8 |
| <b>Unit V</b>  | <p>Study of Architecture of Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions.</p> <p><b>Parallel Programming Techniques:</b> Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming. Implementation issues of a multithreaded program.</p>   | 7 |
| <b>Unit VI</b> | <p>Parallel software issues, study of parallel programming concepts.</p> <p>a) Parallel algorithms for multiprocessors, classification of parallel algorithms, performance of parallel algorithms</p> <p>b) Operating systems for multiprocessors systems, Message passing libraries for parallel programming interface, PVM (in distributed memory system), Message Passing Interfaces (MPI), Threads (in shared memory system)</p> <p>c) Parallel Programming Languages : Fortran 90, Occam, C-Linda, CCC etc.</p> <p>d) Issues towards cluster computing. Introduction to Neuro Computing and Grid Computing.</p>   | 8 |

**Text Books**

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw-Hill international Edition
2. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill

**References:**

1. V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.
2. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition.
3. Kai Hwang, Scalable Parallel Computing.
4. Harrold Stone, High performance computer Architecture.
5. Richard Y. Kain, Advanced Computer Architecture
6. <http://www.intel.com/products/processor> (for Intel Itanium Processor)

### 410450: Elective III: Pattern Recognition

**Teaching Scheme:**  
**Teaching 4Hrs/Week**  
**Practical: 2 Hrs/Week**

**Examination Scheme**  
**Theory: 100 Marks**  
**Term Work: 50 Marks**  
**Oral: 50 Marks**

| Unit            | Content  | Teaching Scheme |
|-----------------|--|-----------------|
| <b>Unit I</b>   | Basics of pattern recognition<br>Features, Feature Vectors and Classifiers, Supervised versus Unsupervised Pattern Recognition, Comparison of Supervised and unsupervised Pattern Recognition, Feature Vectors and Classifiers   | 7               |
| <b>Unit II</b>  | Bayesian decision theory: Classifiers, Linear Discriminant Functions and Decision Hyperplanes, Perceptron, Least Squares Methods, Mean Square Estimation Revisited, Review and interactive discussions on home tutorials, classroom tutorials and students presentation. Review of recent advances in the subject. Challenges in Bayesian decision theory  | 7               |
| <b>Unit III</b> | Parameter estimation methods, Maximum-Likelihood estimation, Gaussian mixture models, Expectation-maximization method, Bayesian estimation.  | 7               |
| <b>Unit IV</b>  | Context-dependent classification, Sequential Pattern classification, Context-dependent classification Discrete hidden Markov models, Continuous density hidden Markov models, Dimension reduction methods, Fisher discriminant analysis, Principal component analysis,   | 7               |
| <b>Unit V</b>   | Non-parametric techniques for density estimation, Parzen-window method, K-Nearest Neighbour method, Linear discriminant function based classifiers, Perceptron, Support vector machines.   | 7               |
| <b>Unit VI</b>  | Non-metric methods for pattern classification, Non-numeric data or nominal data, Decision trees, Unsupervised learning and clustering, Criterion functions for clustering, Algorithms for clustering: K-means, Hierarchical and other methods, Cluster validation, Review and interactive discussions on home tutorials, classroom tutorials and students presentation. Review of recent advances in the subject. Implementation issues in algorithms for clustering | 7               |

**Text Books:**

1. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
2. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

**Reference Books:**

1. Statistical Pattern Recognition, by K. Fukunaga, 2nd edition, Morgan Kaufmann, 1990.

2. Statistical Pattern Recognition, by A. Webb, Arnold, 1999.

**Pattern Recognition Practical Assignment Topic (design six suitable assignments based on the following topic)**

1. Write program to build a Bayesian classifier
2. Write a program to recognize line patterns in a given set of points.
3. Implement Image Block matching by 2D Log Search and Brute-force approach
4. Write a program to implement Edit Distance Problem
5. Exploring difference between color spaces and color-based image segmentation.  
**Experiments with edge detection:**
6. Exploring different feature spaces - using Fourier shape descriptors, experimenting with wavelet transform, template matching.
7. Using and interpretation of ROC curves, experiments with PCA and ICA.

### 410450: Elective III: High Performance Networks

**Teaching Scheme:**  
**Teaching 4Hrs/Week**  
**Practical: 2 Hrs/week**

**Examination Scheme**  
**Theory: 100 Marks**  
**Term Work: 50 Marks**  
**Oral: 50 Marks**

| Unit            | Content   | Teaching Scheme |
|-----------------|---|-----------------|
| <b>Unit I</b>   | Introduction and Applications of Gigabit Ethernet<br>Business Drivers and need of it, Architecture and Overview of Gigabit Ethernet, Gigabit Ethernet Media Access Control (Half Duplex operation Vs Full Duplex Operation), Gigabit Ethernet Physical layer (1000Base X and 1000Base T), Applications of Gigabit Ethernet, Ethernet summery Migration from 10Mbps to Gigabit Ethernet, Network Design using Gigabit Ethernet a case study, Architecture and Overview of Gigabit Ethernet. Gigabit Ethernet Physical layer (1000Base X and 1000Base T)  | 7               |
| <b>Unit II</b>  | Integrated Services Digital Network, ISDN Interfaces and functions, Conceptual overview of Signaling System Numbers, Frame relay<br>LAPF protocol, Concept of DLCI and its significance, Frame Relay Congestion control, ISDN Interfaces and functions (transmission structure, U-N Configuration, Protocol architecture etc) Congestion Notification (FECN, BECN and CLLM)<br>Conceptual view of ISDN and ISDN standards, ISDN Interfaces and functions (transmission structure, U-N Configuration, Protocol architecture etc), ISDN Data Link layer (LAPD protocol, terminal adoption, I.465/v.120 ),ISDN Network layer (Overview, basic call control using Q.931), ISDN services, Conceptual overview of Signaling System Number 7<br><b>Frame Relay:</b><br>Frame relay Vs X.25, Frame relay Protocols and services (protocol architecture, Frame Mode call control), LAPF protocol (Both Core and Control), Concept of DLCI and its significance, Frame Relay Congestion control, Need, Congestion Control frame Work, Network use of CIR, and DE bit, Congestion Notification (FECN,BECN and CLLM). | 6               |
| <b>Unit III</b> | Driving forces and need, B-ISDN standards and services, B-ISDN Functional Architecture, B-ISDN Transmission structure, B-ISDN protocol architecture, SONET/SDH and comparison with other available standards<br><b>ATM:</b> Overview, ATM protocol architecture, Virtual Channels and Virtual Path Switching, Detail Functionality of ATM Layer( Cell structure , HEC, Cell Delineation etc),ATM Adoption layer (need, different types and comparison),ATM traffic and Congestion control ,Requirements, ATM service categories ,ATM traffic descriptors, ATM QOS parameters, Classical IP over ATM,ATM in LAN environment (LANE).  | 8               |
| <b>Unit IV</b>  | VDSL and DSL background and technological capabilities and its standards, Architecture, Conceptual overview of VDSL, Background and technological capabilities, Standards and associations, Architecture, Conceptual overview of VDSL, Deployment Case study, Market status   | 8               |

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|                | and future.  |   |
| <b>Unit V</b>  | Introduction to MPLS and QOS, Network Components of MPLS, working RSVP protocol, MPLS network Components, MPLS basic working, Applications, IETF approach, RSVP protocol, Integrated & differential Services Framework.  | 8 |
| <b>Unit VI</b> | WiFi & WiMax Basics, IEEE Standards, Physical layer specifications, Introduction of WiFi and WiMax, WiMax Standards<br>MAC protocol and operation, WiMax physical and MAC layer overviews<br>Introduction to IEEE 802.11 standards, Physical layer specifications, MAC protocol and operation, Comparison of various standards. Implementing WiFi Network (Including configuration), Introduction to various WiMax Standards, WiMax physical and MAC layer overviews, OFDM and OFDMA, QOS and WiMax. | 5 |

**Text Books:**

1. William Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM" 4th edition (Pearson Education)
2. Rich Seifert, "Gigabit Ethernet"(Addison Wesley Inc.)

**Reference Books :**

1. Sumit kaseera and Pankaj Sethi , "ATM Networks Concepts and protocols" Tata McGraw Hill Publication.
2. Fundamental of WiMAX by Jeffery Andrews, Arunabha Ghosh and Rias Muhammad Pearson Education (For Unit VI)

**Design 6 suitable assignment form the following topics for HPN Laboratory**

1. Survey of Open Source Simulation tools for HPN, Virtual Network Laboratory for HPN
2. Network Scalability (Servers) using Gigabit Ethernet
3. Implementation of ISDN (U-N interface, Router configuration, Costing etc.)
4. Frame relay Congestion Control
5. Performance study of RSVP protocol using virtual HPN test-bed.
6. New node detection and authentication implementation in WiFi environment or simulated WiFi environment
7. Latency time measurements in different HPN Server-Client graphs configurations in simulated scalable environment (For example, HPN organization using bipartite graph)

### 410450 Elective III: Neural Network

Teaching Scheme: 4 Hrs. / Week

Practical: 2 Hrs/Week

Exam Scheme:

Paper: 100 Marks

Term Work: 50 Marks

Oral: 50 Marks

| Unit     | Contents   | Hrs/<br>Unit |
|----------|--|--------------|
| Unit I   | Introduction to Neural Networks, Biological Neural Networks, Characteristics of Neural Networks, Models of Neuron, Basic data structures: mapping of vector spaces, clusters, principal components. Basic Learning Rules, Recent advances in Neural Networks         | 6            |
| Unit II  | The Perceptron and its learning law. Classification of linearly separable patterns. Adaptive networks, Supervised Learning Neural Networks, Single layer and multi layer perceptrons, Radial basis function networks, Modular neural networks, Adaline and madaline, | 8            |
| Unit III | Stochastic Processes and Neural Networks and Stimulated Annealing, Analysis of pattern storage Networks, Analysis of linear auto adaptive feed forward networks, Boltzman machine.   | 8            |
| Unit IV  | Analysis of linear auto adaptive feed forward networks, Feedback Neural Networks, Analysis of linear auto adaptive feed forward networks, Stochastic Networks & Stimulated Annealing, Boltzman machine Multilayer Perceptrons, Analysis of pattern storage Networks. | 6            |
| Unit V   | Unsupervised Learning, Adaptive Resonance Theory, Unsupervised Learning Networks Competitive learning, learning vector quantization, Principal component analysis of Hebbian Learning, Adaptive Resonance Theory, Kohonen self-organizing maps.                      | 8            |
| Unit VI  | Applications of Neural Networks, Pattern classification, Pattern classification, Associative memories, Optimization, Applications in Image Processing, Applications in decision making, Applications in Image Processing, Applications in decision making            | 6            |

#### Text Books

1. B. Yegnanarayana, "Artificial Neural Networks", PHI
2. Jacek M. Zurada, Introduction to artificial neural systems, Jaico Publ. House, 1994.

3. James A Freeman, David M Skapura, "Neural Networks-Algorithms, Applications and Programming Techniques," Person Education

### **Reference Books**

1. Haykin, "Neural Network a comprehensive Foundation", PHI
2. Anderson, "An introduction to Artificial Neural Networks", Prentice Hall

### **Neural Networks Laboratory Assignment**

Teachers are instructed to frame suitable assignments on the following topics

1. Implementation of Perceptron Learning algorithm and Adaline algorithm for two class / three class problems.
2. Implementation of back propagation algorithm/ simulator for character recognition.
3. Implementation of BAM simulator.
4. Implementation of Hopfield network.
5. Implementation of ART simulator
6. Implementation of SOFM network.

### 410450: Elective III: Advanced Databases

**Teaching Scheme:**  
**Teaching 4Hrs/Week**  
**Practical: 2 Hrs/Week**

**Examination Scheme**  
**Theory: 100 Marks**  
**Term Work: 50 Marks**  
**Oral: 50 Marks**

| Unit            | Content  | Teaching Scheme |
|-----------------|--|-----------------|
| <b>Unit I</b>   | Introduction, Parallel database architecture, speedup, scale-up I/O parallelism, Inter-query and Intra-query parallelism, Inter-operational and Intra-operational parallelism, parallel query evaluation, Design of parallel systems, Implementation issues of Parallel query evaluation, Design of parallel systems, Comparison of Inter-query and Intra-query parallelism.   | 08              |
| <b>Unit II</b>  | <i>Distributed Databases</i> , Study of DDBMS architectures, Comparison of Homogeneous and Heterogeneous Databases, Analysis of Concurrency control in distributed databases, Implementation of Distributed query processing.<br>Distributed data storage, Distributed transactions, Commit protocols, Availability, Distributed query processing, Directory systems-ldap, Distributed data storage and transactions.  | 08              |
| <b>Unit III</b> | Overview of client server architecture, Databases and web architecture, N-tier architecture, XML, Introduction, Structure of XML Data, XML Document Schema, DTD, Querying and Transformation: XQuery, FLOWR, XPath, XML validation, Web server, API to XML, Storage of XML Data, XML Applications: web services, Web based system, Implementation of XML validations, Use of web servers. XML and DTD implementation, Use of Web service like Amazon web service or Microsoft Azure.       | 06              |
| <b>Unit IV</b>  | Introduction to Decision Support, Data Warehousing, Creating and maintaining a warehouse. Introduction to Data warehouse and OLAP, Multidimensional data model, Data Warehouse architecture, OLAP and data cubes, Operations on cubes, Data preprocessing need for preprocessing, Multidimensional data model, OLAP and data cubes, Data warehousing Concepts, Study of Data preprocessing need for preprocessing, Simulating and maintaining a Warehouse, Analysis of Data preprocessing. | 06              |
| <b>Unit V</b>   | Introduction to data mining , Data mining functionalities, clustering - k means algorithm, classification - decision tree, Bayesian classifiers, Outlier analysis, association rules - apriori algorithm, Introduction to text mining, Implementing Clustering - k means algorithm, Analysis of Decision tree.   | 06              |

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| <b>Unit VI</b> | Information retrieval - overview, Relevance ranking using terms and hyperlinks, synonyms, homonyms, ontologies, Indexing of documents, measuring retrieval effectiveness, web search engines, Information retrieval and structured data. Information Retrieval, Study and Comparison of Synonyms, Homonyms, Ontologies. Implementation issues of Relevance ranking Algorithm. | 06 |
|----------------|---|----|

**Text Books :**

1. Abraham Silberschatz, Henry Korth, S. Sudarshan, "Database system concepts", 5<sup>th</sup> Edition, McGraw Hill International Edition
2. Jiawei han, Micheline Kamber, "Data Mining: Concepts and systems", Morgan Kaufmann Publishers

**Reference Books**

1. Rob Coronel, Database systems: "Design implementation and management", 4th Edition, Thomson Learning Press
2. Raghu Ramkrishnan, Johannes Gehrke, "Database Management Systems", Second Edition, McGraw Hill International Edition
3. Thomas Connolly, Carolyn Beg "Database Systems :Practical approach to design implementation and management " third edition, Pearson education

**List of Laboratory Assignment Topics**

1. Implementation of partitioning techniques and handling of skew
2. Directory systems using LDAP (Latest version)
3. Building cubes and OLAP analysis and construction of data mart
4. Association rule (Apriori algorithm) or Clustering algorithm (K-means)
5. IR assignment: TF, IDF, Stop words
6. Case Study : Anyone DBMS from open source: mysql, postgres SQL  
Anyone DBMS from: ORACLE, SQL server, DB2, CauchDB

## 410451 Elective IV: VLSI and Digital Systems

Teaching Scheme: 4Hrs/Week

Evaluation Scheme: Theory 100 Marks

| Unit            | Content  | Teaching Scheme |
|-----------------|--|-----------------|
| <b>Unit I</b>   | VLSI concepts and technology, Semiconductors, Semiconductor Devices, Integrated circuits and the Planar Process, Semiconductor Technology Families, Computer Simulation of VLSI  | 6               |
| <b>Unit II</b>  | <b>Modern CMOS Technology</b><br>Introduction, Choosing a Substrate, Active Region Formation, Process Option for Device Isolation – Shallow Trench Isolation, N and P Well Formation, Process Options for Active Region and Well Formation, Gate Formation, Tip or Extension(LDD) Formation, Source/Drain Formation, Contact and Local Interconnect Formation, Multilevel Metal Formation, CMOS Process Flow   | 8               |
| <b>Unit III</b> | Historical Development and Basic Concepts Crystal Structure, Basic Properties of Silicon Wafers Crystal Growth Wafer Fabrication Wafer Preparation and specification, Light sources, wafer exposure systems, Photoresists, Defects in crystals, Raw materials and Purification, Czochralski and Float-Zone Crystal Growth Methods, Wafer Preparation and specification, Lithography: Light sources, Mask engineering: Basic concepts of Thermal oxidation and the si/sio2 Interface, Basic concepts of dopant diffusion , implants in real silicon, basic concepts of chemical vapor deposition , physical vapor deposition, basic concepts of wet etching and plasma etching, back-end technology, contacts, interconnects and vias, dielectrics, Contamination reduction: Clean factories, wafer Cleaning, gettering, Wafer Development and Dopants. | 6               |
| <b>Unit IV</b>  | What is VHDL? Introduction: Modeling Digital Systems: describing systems, events, propagation delays, and concurrency, waveforms and timing, signal values, shared signals, simulation vs. synthesis: the simulation model, the synthesis model, field programmable gate arrays(FPGAs), basic language concepts: signals, entity-architecture, concurrent statements, constructing VHDL models using CSAs , understanding delays, The role of hardware description languages, VHDL Programming   | 6               |
| <b>Unit V</b>   | Introduction to Digital Design, Analog versus Digital, Software aspects of digital design, application-specific IC's, Digital devices, electronic aspects of digital design, integrated circuits, programmable logic devices, number systems and codes, digital circuits, digital-design levels, Software aspects of digital design  | 8               |
| <b>Unit VI</b>  | Combinational logic design principles, sequential logic design principles, Memories, CPLDS, and FPGAs  | 6               |

**Text Books:**

1. Silicon VLSI Technology: Fundamental, Practice and Modeling by James D Plummer et. al., Pearson education ISBN 978-81-317-2604-4
2. VHDL: from simulation to synthesis by Sudhakar Yalamanchili Pearson education ISBN 81-7808-558-5
3. Digital Design: principles and practices fourth edition by John F. Wakerly Pearson prentice hall ISBN 978-81-317-1366-2

## 410451 Elective IV: Operations Research

Teaching Scheme: 4Hrs/Week

Evaluation Scheme: Theory 100 Marks

| Unit            | Content   | Teaching Scheme |
|-----------------|---|-----------------|
| <b>Unit I</b>   | Operation Research Models, Solving the OR model, Queuing and Simulation Models, Linear Programming (LP) Applications, Modeling with Linear Programming: Two-Variable LP model, Simplex method and sensitivity analysis, Advanced Linear Programming, Graphical LP Solutions, Duality, Goal Programming.   | 6               |
| <b>Unit II</b>  | Review of basic probability, Random variables and Probability distributions, Random Processes, Transition Probability and Transition Matrix, Variations in expected value criteria, Four Common distributions, Solutions of mixed strategy games.<br>Decision making under certainty, Decision making under risk, Decision making under uncertainty, Marcov Process and Marcov chain, Game theory: Introduction and definitions, Characteristics of Game theory, Maxima-minima, Saddle point, Optimal Strategies and value of game, solution of game with saddle point, Continuous review models, Multi- period models. | 8               |
| <b>Unit III</b> | Queuing system, queuing problem, Transient and steady States, List of symbols, Utilization factor, Elements of Queuing models, Generalized poisson queuing model, Specialized Poisson Queues, M/G/1 formula, Role of exponential distribution in queuing systems, Birth and Death Models, Queuing decision models, Review of recent advances in the subject.  | 6               |
| <b>Unit IV</b>  | Job sequencing: Introduction, Terminology and Notions, Principal Assumptions, Solution of sequencing problem,<br>Project Management: Applications and basic steps in PERT/CPM techniques, Network diagrams with time estimates and analysis, resource allocation, Processing $n$ jobs with 2 machines, processing 2 jobs with $m$ machines, Processing $n$ jobs with $m$ machines, Problem of dimensionality, Inventory Models  | 6               |
| <b>Unit V</b>   | Non-Linear Programming (NLP) Introduction, Practical solutions of NLP, General form of NLP, Canonical form of NLP, Introduction to Separable functions, Piece-wise linear approximation of NLP, Geometric programming problem, Constrained and unconstrained problems of Maxima and Minima, Lagrangian method, To derive necessary condition of optimality, "Normality" and "Orthogonality" conditions, Problems with inequality constrains. Computational procedures of Fractional Algorithms  | 8               |
| <b>Unit VI</b>  | Concept of dynamic programming, Deterministic dynamic programming, Forward and Backward recursion, Minimum path problem, models of single additive constraint, Multiplicatively Separable return, Applications of dynamic programming in  | 6               |

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|  | production, linear programming and reliability, Decision trees and Bellman's principle of optimality, Recursive nature of computations in dynamic programming, Equipment replacement problem, Investment models, Expectation of a random variable. Problem of dimensionality, Inventory Models, |  |
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Text Books:

1. Operations Research: An Introduction by Hamdy A Taha, Eighth Edition, Pearson Publications, ISBN 978-81-317-1104-0
2. Operations Research by Dr. S.D. Sharma, Eleventh Edition, Kedar Nath Ram Nath Publication

## 410451 Elective IV: Cloud Computing

Teaching Scheme: 4Hrs/Week

Examination Scheme  
Theory: 100 Marks

| Unit            | Content  | Hrs/<br>Unit |
|-----------------|--|--------------|
| <b>Unit I</b>   | <p>Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering &amp; Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS</p> <p>Cloud computing platforms: Infrastructure as service: Amazon EC2, Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing</p>   | 8            |
| <b>Unit II</b>  | <p>Introduction to Cloud Technologies, Study of Hypervisors</p> <p>Compare SOAP and REST</p> <p><b>Webservices, AJAX and mashups</b>-Web services: SOAP and REST, SOAP versus REST, AJAX: asynchronous 'rich' interfaces, Mashups: user interface services</p> <p><b>Virtualization Technology</b>: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization</p> <p><b>Multitenant software</b>: Multi-entity support, Multi-schema approach, Multi-tenance using cloud data stores, Data access control for enterprise applications,</p>  | 8            |
| <b>Unit III</b> | <p>Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo.</p> <p>Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Mapreduce, Features and comparisons among GFS,HDFS etc, Map-Reduce model</p>  | 6            |
| <b>Unit IV</b>  | <p>Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud</p> <p><b>Cloud computing security architecture</b>: Architectural Considerations- General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Identity Management and Access control-Identity management, Access control, Autonomic Security</p> <p><b>Cloud computing security challenges</b>: Virtualization security management-virtual threats, VM Security Recommendations, VM-Specific Security techniques, Secure Execution Environments and Communications in cloud.</p> | 6            |
| <b>Unit V</b>   | <p>Issues in cloud computing, Implementing real time application over cloud platform</p> <p>Issues in Intercloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment.</p> <p>Cloud Middleware. Mobile Cloud Computing. Inter Cloud issues. A grid of clouds, Sky computing, load balancing, resource optimization, resource dynamic reconfiguration, Monitoring in Cloud</p>  | 6            |

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| <b>Unit VI</b> | Cloud computing platforms, Installing cloud platforms and performance evaluation<br>Features and functions of cloud platforms:<br>Xen Cloud Platform, Eucalyptus, OpenNebula, Nimbus, TPlatform, Apache Virtual Computing Lab (VCL), Enomaly Elastic Computing Platform, | 6 |
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**Text Book:**

1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper (Wiley India Edition)
2. Enterprise Cloud Computing by Gautam Shroff, Cambridge
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India

**Reference Book:**

1. Google Apps by Scott Granneman, Pearson
2. Cloud Security & Privacy by Tim Malhar, S.Kumaraswamy, S.Latif (SPD, O'REILLY)
3. Cloud Computing : A Practical Approach, Antohy T Velte, [et.al](#) McGraw Hill,
4. Cloud Computing Bible by Barrie Sosinsky, Wiley India
5. Stefano Ferretti et.al., "QoS-aware Clouds", 2010 IEEE 3rd International Conference on Cloud Computing

### 410451: Elective IV: Information Security

**Teaching Scheme:**  
Teaching 4Hrs/Week

**Examination Scheme**  
**Theory: 100 Marks**

| Unit            | Content  | Teaching Scheme |
|-----------------|--|-----------------|
| <b>Unit I</b>   | Need of information security- Legal, Ethical and Professional Issues<br>Attributes of security- authentication, access control, confidentiality, authorization, integrity, non-reproduction<br>OSI security architecture- attacks, services and mechanisms<br>Information security management-security policy, standards, guidelines and procedures, security lifecycle. Introduction to cryptography- Classical cryptography. Case-study: Information security management used in organizations, Problems on classical ciphers, Security architecture, Different standards related to IS. | 8               |
| <b>Unit II</b>  | Introduction to Secret key and cryptography, Encrypt given messages using DES, AES, IDEA, Problems on cryptography algorithms, Principles, finite fields, stream cipher, block cipher modes of operation, DES, Triple DES, AES, IDEA, RC5, key distribution.   | 6               |
| <b>Unit III</b> | Introduction to Public key and Cryptography, Encrypt given messages using ECC, Problems on key generation, cryptography algorithms Principles, Introduction to number theory, RSA- algorithm, security of RSA, <b>Key management</b> -Diffie-Hellman key exchange, man-in-the-middle attack, Elliptical curve cryptography,  | 6               |
| <b>Unit IV</b>  | Study of applications and comparison of authentication functions, MAC, hash functions etc. Implementation and analysis of authentication functions, MAC, hash functions etc. Requirements of message authentication, authentication functions, MAC, hash functions, MD5, SHA-512, HMAC, digital signatures, DSA, PKI, Authentication applications-, X.509, Kerberos.   | 8               |
| <b>Unit V</b>   | Introduction to Network, Transport and Periphery Security, Study of IPSEC, TLS, and SSL, Firewalls-design principles, trusted systems, Intrusion Detection System, Intrusion Prevention System.<br>Implementation and analysis of IPSEC, TLS, and SSL, Firewalls-design principles, trusted systems, Intrusion Detection System, Intrusion Prevention System<br>IPSEC, TLS, and SSL, Firewalls-design principles, trusted systems, Intrusion Detection System, Intrusion Prevention System. Introduction to cryptography- Classical cryptography.  | 6               |
| <b>Unit VI</b>  | Study of Security services, web and email security considerations, Electronic commerce security. Implementation and analysis of Security services, web security considerations, Electronic commerce security. Security services, web security considerations, PEM, PGP, S/MIME,  | 6               |

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|  | Electronic commerce security- SET, Smart cards, strengths of Security services. |  |
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**Text Books:**

1. William Stallings "Cryptography and network security, principles and practices", Pearson

**Reference Books:**

1. Bernard Menezes, "Network Security and Cryptography", Cengage Learning.
2. Nina Godbole, "Information System Security", Wiley India Pvt.Ltd., ISBN978-81-265-1692-6.
3. Charlie Kaufman, Radia Perlman and mike speciner "Network security, private communication in a public world"
4. Christopher M. King, Curtis Patton and RSA press "Security architecture, design deployment and operations".
5. Robert Bragge, Mark Rhodes, Heith straggberg "Network Security, The Complete Reference", Tata McGraw Hill Publication

## 410452 Computer Lab II

Teaching Scheme  
Practical: 4 Hrs/Week

Examination Scheme  
Term Work: 50 Marks  
Practical: 50 Marks

1. **Inter-process communication using socket programming/ RPC mechanism including implementing multi-threaded echo server.**
  
2. **Threads clock synchronization. Assignment on election algorithms.**  
Simulation of election algorithms (Ring and Bus Topology).
  - a. **a.Bully**
  - b. **b.Ring**
  
3. **Distributed/Hierarchical deadlock detection algorithms.** Clock synchronization: NTP / Lamports clock.
  
4. **Load distributing algorithms, Performance comparison.** Study of Distributed File System: NFS – CODA
  
5. Backward error recovery in concurrent systems. Re-assignment protocols.
  
6. Application development on Cluster/Grid computing.

## **410447 Project Work (Term II)**

### **Objectives:**

*To expose students with project-product development cycle using industrial experience, use of state-of-art technologies. To encourage and expose students for participation in National/ International paper presentation activities. Exposure to Learning and knowledge access techniques using Conferences, Journal papers and participation in research activities.*

### **Term II Project Term Work**

#### **Teaching Scheme**

**Practical: 6 Hours/Week**

#### **Examination Scheme:**

**Term Work: 100 Marks**

**Oral: 50 Marks**

- 1) Project workstation selection, installations and setup along with report to the guide. (recommended submission date:- 3 weeks after commencement of second term)
- 2) Programming of the project, GUI (*if any*) as per 1<sup>st</sup> Term term-work submission.(recommended submission date:- Progress report every week during laboratory)
- 3) Test tool selection for various testing recommended by preferably external guide and generate various testing result charts, graphs etc. including reliability testing. (7 weeks before Term II Conclusion)
- 4) Review of design and necessary corrective actions taking into consideration feedback report of Term I assessment, and other competitions/conferences participated like IIT, Central Universities, University Conferences or equivalent centers of excellence etc.
- 5) Students must submit and preferably publish atleast one technical paper in the conferences held by IITs, Central Universities or UoP Conference or International Conferences in Europe or US.
- 6) Final term work submissions in the prescribed format given by the guides consisting of a project report consisting of a preliminary report prepared in term-I, detailed design (all necessary UML diagrams) document, User Interface design, Laboratory assignments on test cases and test results generated by selected project testing tool, conclusions, appendix (if necessary), glossary, tools used and references at the end of Term-II.

The Term II examination is conducted by panel of examiners (preferably guide and expert from Industry having atleast 5 years subject experience (or senior teacher in the subject in case of non-availability of industry expert). The project assessment shall be done using Live Project Demonstration [in existing functional condition], using necessary simulators (*if required*) and presentation by the students. The remarks of Term I assessment and related corrective actions must be assessed during examining the term-work.

### **Term-II Project Laboratory Assignments**

1. Project workstation selection, installations along with setup and installation report preparations.
2. Programming of the project functions, interfaces and GUI (*if any*) as per 1<sup>st</sup> Term term-work submission using corrective actions recommended in Term-I assessment of Term-work.
3. Test tool selection and testing of various test cases for the project performed and generate various testing result charts, graphs etc. including reliability testing.
4. Review of design and necessary corrective actions taking into consideration the feedback report of Term I assessment, and other competitions/conferences participated like IIT, Central Universities, University Conferences or equivalent centers of excellence etc.