DETAILED SYLLABUS

CS2001 LOGIC DESIGN

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Number systems and codes, Boolean algebra: postulates and theorems, constants, variables and functions, switching algebra, Boolean functions and logical operations, Karnaugh map: prime cubes, minimum sum of products and product of sums
Module 2 (10 (T) + 7(P) Hours)
Quine-McClusky algorithm, prime implicant chart, cyclic prime implicant chart, Petrick's method, Combinational Logic: introduction, analysis and design of combinational logic circuits, parallel adders and look-ahead adders, comparators, decoders and encoders, code conversion, multiplexers and demultiplexers, parity generators and checkers
Module 3 (10 (T) + 7(P) Hours)
Programmable Logic Devices, ROMs, PALs, PLAs, PLA folding, design for testability. Introduction to sequential circuits, memory elements, latches
Module 4 (12 (T) + 7(P) Hours)
Flip-flops, analysis of sequential circuits, state tables, state diagrams, design of sequential circuits, excitation tables, Mealy and Moore models, registers, shift registers, counters

References:

1. T. L. Floyd, R. P. Jain, Digital Fundamentals, 8/e, Pearson Education, 2006
2. C. H. Roth, Jr., L. L. Kinney, Fundamentals of Logic Design, 6/e, Cengage Learning, 2009
3. M M Mano, M D Ciletti, Digital Design, 4/e, Pearson Education, 2008
4. N. N. Biswas, Logic Design Theory, Prentice Hall of India, New Delhi, 1993

CS2301 INTRODUCTION TO PROGRAMMING

Pre-requisite: Nil

L	T	P	C
4	0	0	4

Total Hours: 56 Hrs

Module I: (14 Hours)
Data types, operators and expressions: Identifiers and keywords, data types, literals, variables, constants, operators- arithmetic, assignment, comparison, logical, bit-wise. Special operators
Input output streams- I/O streams, keyboard and screen I/O, manipulators, I/O stream flags.
Control statements: conditional expressions, loop statements, nested control structures, breaking control statements.
Module 2: (14 Hours)
Functions and program structures: Defining functions, return statement, function prototype, user defined functions, actual and formal arguments,, local Vs global variables, default arguments, order of function declaration, mutually invocated functions, nested functions, scope rules, side effects, storage class specifiers, recursive functions, preprocessors, header files, standard functions.
Arrays: Array notation, declaration, initialization, processing with arrays, arrays and functions, multidimensional arrays, and character arrays.

Pointers and strings: Pointer arithmetic, pointers and functions, pointers to functions, passing a function to another function, pointers and arrays, arrays of pointers, pointers and strings, pointers to pointers.
Structures, union and bit fields: declaration of structure, processing with structure, initialisation, function and structure, arrays of structures, nested structures, pointers and structures, Union, bit fields, typedef, enumeration.

Module III (14 Hours):

Classes and objects: Structures and classes, declaration, member function, defining the objects of a class, accessing members, arrays of classes, union and classes, nested classes.
Special member functions: Constructors, destructors, inline functions, static class members, friend functions, dynamic memory allocation, this pointer, mutable.
Single and multiple inheritance: Single inheritance, types of base classes, types of derivation, multiple inheritance, container classes, member access control.
Overloading functions and operators: Functions overloading, operator overloading, Binary and unary operators overloading.

Module IV (14 Hours):

Polymorphism and virtual functions: Polymorphism, early binding, polymorphism with pointers, virtual functions, late binding, pure virtual functions, abstract classes, constructors and destructors under inheritance, virtual destructors, virtual bases classes.
Templates, namespaces and exception handling: function template, class template, overloading function templates, exception handling, namespaces.
Data file operations: Opening and closing files, stream state member functions, reading/ writing character files, binary file operations; classes, structures, arrays and nested classes and file operations. Random access file operations.
Introduction of standard template library (STL): Vector classes, double ended queues, list classes, stack classes, queue classes, etc.

References:

1. D Ravichandran, Programming with C++, 3/e, Tata McGraw Hill Education Private Ltd, 2001.
2. Eric Nagler, Learning C++ - A hands-on approach, 3/e, Cengage Laerning India, 2004.

MA6010 DISCRETE MATHEMATICS

Pre-requisite: Nil

L	T	P	C
3	0	0	3

Total Hours: 42 Hrs

Module 1 (12 Hours)

Propositional Calculus: Propositions, Truth tables , tautologies and contradictions, logical equivalence, logical arguments, normal forms, consistency completeness and independence, formal proofs , natural deduction. Predicate Calculus: predicates, quantifiers, arguments, theory of inference, resolution algorithm.

Module 2 (10 Hours)

Relations and functions, pigeon hole principle, cardinals, countable and uncountable sets, diagonalization, equivalence relations and partitions, partial order, lattices, Boolean Algebra.

Module 3 (10 Hours)

Semi groups, monoids, groups and subgroups, homomorphism, cosets, normal sub groups, products and quotients, Lagrange's theorem, permutation groups, Cayley's theorem.

Module 4(10 Hours)

Rings, Integral domains, fields, ideals and quotient rings, Euclidian domain, polynomial rings, division algorithm, field factorization, unique factorization, field extensions.

References

1. P. Grimaldi, Discrete and Combinatorial Mathematics, Addisson Wesley, 1994.
2. J.P Trembley, R. Manohar, Discrete Mathematical Structures with applications to Computer Science, Tata Mc Graw Hill, New Delhi, 2003.
3. B.Kolman, R C Busby, Discrete Mathematical Structures for Computer Science, PHI, 1994.
4. C.L Liu, Elements of Discrete Mathematics, 2/e, Mc Graw Hill, 1985.
5. J.L. Mott, A.Kandel, T.P Baker, Discrete Mathematics for Computer Scientists and Mathematicians, 2/e, PHI, 1986.
6. J.K Truss, Discrete Mathematics for Computer Scientists, Addison Wesley, 1999.
7. I.N Hernstein, Topics in Algebra, Wiley Eastern, 1975.

MS1001 PROFESSIONAL COMMUNICATION

Pre-requisite: Nil

L	T	P	C
3	**0**	**0**	**3**

Total Hours : 42 Hours

Module 1 (11 Hours)

Verbal Communication: Received pronunciation; how to activate passive vocabulary; technical/non-technical and business presentations; questioning and answer skills; soft skills for professionals; role of body postures, movements, gestures, facial expressions, dress in effective communication; information/Desk/Office/Telephone conversation; how to face an interview/press conference; Group discussions, debates, elocution.

Module 2 (9 Hours)

Reading Comprehension: skimming and scanning; factual and inferential comprehension; prediction; guessing meaning of words from context; word reference; use and interpretation of visuals and graphics in technical writing.

Module 3 (11 Hours)

Written Communication; note making and note taking; summarizing; invitation; advertisement, agenda, notice and memos; job application; resume and curriculum vitae; utility, technical, project and enquiry reports; paragraph writing: General-specific, Problem-solution, Process-Description, Data-Comment.

Module 4 (11 Hours)

Short essays: description and argument; comparison and contrast; illustration; using graphics in writing; tables and charts, diagrams and flow charts, maps and plans, graphs; how to write research paper; skills of editing and revising; skills of referencing; what is a bibliography and how to prepare it.

References

1. Adrian Doff and Christopher Jones, Language in USE-Upper intermediate, self-study workbook and classroom book, Cambridge University Press, 2000.
2. Sarah Freeman, Written Communication, Orient Longman, 1978.
3. Mark Ibbotson, Cambridge English for Engineering, Cambridge University Press, November 2008.

4. T Balasubramanian, English Phonetics for Indian Students: A Workbook, Mac Millan Publishers, India, 2000.
5. Chris Mounsey, Essays and Dissertation, Oxford University Press, February 2005.
6. Sidney Greenbaum, The Oxford English Grammar, Oxford University Press, March 2005
7. Krishna Mohan and Meera Banerjee, Developing Communication Skills, Mac Millan India Ltd., 2000
8. Krishna Mohan and Meenakshi Raman, Effective English Communication, Tata Mc-Graw Hill, 2000.

CS2391 INTRODUCTORY PROGRAMMING LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)

Programming environment - scripting and shell programming, debugging tools.

Scheme programming language, Interpreter specification.

Practical (42 Hours)

Programming Assignments

1. Programming exercises, Searching, sorting with iterative constructs.
2. Functions and parameter passing, recursion.
3. Pointers and linked list implementation
4. Program to illustrate the use of structures, and union,
5. Program to write classes and creation of objects illustrating the purpose constructors and destructors.
6. Programs to illustrate inheritance, overloading of functions and operators and polymorphism.
7. Programs to illustrate the use of templates, namespaces and exception handling

References:

1. D Ravichandran, Programming with C++, 3/e, Tata McGraw Hill, 2001.
2. Eric Nagler, Learning C++- an hands-on approach, 3/e, Cengage Learning India, 2004.

CS2004 COMPUTER ORGANIZATION

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Computer abstraction and technology: basic principles, hardware components, Measuring performance: evaluating, comparing and summarizing performance.
Instructions: operations and operands of the computer hardware, representing instructions, making decision, supporting procedures, character manipulation, styles of addressing, starting a program.

Module 2 (10 (T) + 7(P) Hours)
Computer arithmetic: signed and unsigned numbers, addition and subtraction, logical operations, constructing an ALU, multiplication and division, floating point representation and arithmetic, Parallelism and computer arithmetic.

Module 3 (10 (T) + 7(P) Hours)
The processor: building a data path, simple and multicycle implementations, microprogramming, exceptions, Pipelining, pipeline data path and Control , hazards in pipelined processors

Module 4 (12 (T) + 7(P) Hours)
Memory hierarchy: caches, cache performance, virtual memory, common framework for memory hierarchies
Input/output: I/O performance measures, types and characteristics of I/O devices, buses, interfaces in I/O devices, design of an I/O system, parallelism and I/O.

References:

1. D. A. Pattersen and J. L. Hennesy, Computer Organisation and Design: The Hardware/ Software Interface, 4/e, Morgan Kaufman, 2009.
2. V. P. Heuring and H. F. Jordan, Computer System Design and Architecture, Prentice Hall, 2003.

CS2005 DATA STRUCTURES AND ALGORITHMS

Pre-requisite: Nil

L	T	P	C
4	0	0	4

Total Hours: 56 Hrs

Module 1 (14 Hours)
Time and space complexity analysis of algorithms - Asymptotic analysis - Big Oh - Omega - theta notations - Searching and Sorting - Binary search - Quick sort - Heap sort - priority queue using heap - complexity analysis of search and sorting algorithms - average case analysis of quick sort.

Module 2 (14 Hours)
Linked lists - Stack and Queue - Binary tree - in-order, pre-order and post-order traversals - complexity analysis - representation and evaluation of arithmetic expressions using binary tree - Binary Search trees - insertion, deletion and search - average case complexity analysis.

Module 3 (14 Hours)
File structure - Merge sort - B Tree - complexity analysis - Data structures for disjoint sets - union by rank and path compression - complexity analysis - Hash tables.

Module 4 (14 Hours)
Graph representation- DFS, BFS, minimum spanning tree problem - Kruskal's algorithm - implementation using disjoint set data structure - complexity analysis – Prim's algorithm - Shortest path problem - Dijkstra's algorithms - implementation of Prim's and Dijkstra's algorithms using priority queue data structure - complexity analysis. Floyd-Warshall algorithm.

References:

1. T. H. Cormen, C. E. Lieserson, R. L. Rivest, C. Stein, Introduction to Algorithms, 3/e, MIT Press, 2003
2. S. Dasgupta, C. H. Papadimitriou, U. Vazirani, Algorithms, McGraw Hill, 2006.
3. A. V. Aho, J. D. Ullman and J. E. Hopcroft, Data Structures and Algorithms, Addison Wesley, 1983.

CS2094 DATA STRUCTURES LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)
Review of dynamic memory allocation - use of pointers - review of recursion. File organization.

Practical (42 Hours)
1. Searching: Binary search implementation
2. Sorting: Heap sort, Quick sort and Merge sort implementation
3. Stack and Queue implementation using linked list
4. Arithmetic expression to postfix
5. Postfix to expression tree, tree traversal and evaluation
6. Binary search tree - insert, delete and search
7. Linear time DFS and BFS implementation with adjacency list representation
8. Kruskal's algorithm implementation in O((n+e)log n) complexity.
9. Prim's algorithm implementation in O((n+e) log n) complexity.
10 Dijskstra's algorithm implementation in O((n+e) log n) complexity.

References:

1. T. H. Cormen, C. E. Lieserson and R. L. Rivest, Introduction to Algorithms, PHI, 1998.
2. S. Sahni, Data structures, Algorithms, and Applications in C++, McGraw Hill, 1998.

CS3002 DATABASE MANAGEMENT SYSTEMS

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Database System concepts and architecture, Data modeling using Entity Relationship (ER) model and Enhanced ER model, Specialization, Generalization, Data Storage and indexing, Single level and multi level indexing, Dynamic Multi level indexing using B Trees and B+ Trees.

Module 2 (10 (T) + 7(P) Hours)
The Relational Model, Relational database design using ER to relational mapping, Relational algebra and relational calculus, Tuple Relational Calculus, Domain Relational Calculus, SQL.

Module 3 (10 (T) + 7(P) Hours)
Database design theory and methodology, Functional dependencies and normalization of relations, Normal Forms, Properties of relational decomposition, Algorithms for relational database schema design.

Module 4 (12 (T) + 7(P) Hours)
Transaction processing concepts, Schedules and serializability, Concurrency control, Two Phase Locking Techniques, Optimistic Concurrency Control, Database recovery concepts and techniques, Introduction to database security.

References:

1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 5/e, Pearson Education, 2008.
2. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3/e, McGraw Hill, 2003.
3. Peter Rob and Carlos Coronel, Database Systesm- Design, Implementation and Management, 7/e, Cengage Learning, 2007.

CS3003 OPERATING SYSTEMS

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Review of operating system strategies - resources - processes - threads - objects - operating system organization - design factors - functions and implementation considerations - devices - characteristics - controllers - drivers - device management - approaches - buffering - device drivers - typical scenarios such as serial communications - storage devices etc

Module 2 (10 (T) + 7(P) Hours)
Process management - system view - process address space - process and resource abstraction - process hierarchy - scheduling mechanisms - various strategies - synchronization - interacting & coordinating processes - semaphores - deadlock - prevention - avoidance - detection and recovery

Module 3 (10 (T) + 7(P) Hours)
Memory management - issues - memory allocation - dynamic relocation - various management strategies - virtual memory - paging - issues and algorithms - segmentation - typical implementations of paging & segmentation systems

Module 4 (12 (T) + 7(P) Hours)
File management - files - implementations - storage abstractions - memory mapped files - directories and their implementation - protection and security - policy and mechanism - authentication - authorization - case study of Unix kernel and Microsoft Windows NT (concepts only)

Virtual machines – virtual machine monitors – issues in processor, memory and I/O virtualization, hardware support for virtualization.

References:
1. Silberschatz, Galvin and Gagne, Operating System Principles, 7/e, John Wiley, 2006.
2. William Stallings, Operating Systems, 5/e, Pearson Education, 2003.
3. Crowley C., Operating Systems - A Design Oriented Approach, Tata McGraw Hill, New Delhi, 2007.
4. Tanenbaum A. S., Modern Operating Systems, 3/e Prentice Hall, Pearson Education, 2000.
5. Gary J. Nutt, Operating Systems - A Modern Perspective, 3/e, Addison Wesley, 2001.

CS3004 SOFTWARE ENGINEERING

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (8 (T) + 7(P) Hours)
Introduction to Software Engineering – Reasons for software project failure – Similarities and differences between

software and other engineering products.
Software Development Life Cycle (SDLC) – Overview of Phases.
Detailed Study of Requirements Phase: Importance of Clear Specification – Formal specification methods including algebraic specification in detail.

Module 2 (15 (T) + 7(P) Hours)
Problem partitioning (subdivision) - Power of Abstraction
Concept of functional decomposition – process modeling - DFDs
Concept of data modeling – ER diagrams
Class and component level designs – Object Oriented Design - UML and Design Patterns (only introduction)

Module 3 (8 (T) + 7(P) Hours)
Coding and Testing :
Structured programming – internal documentation and need for standards – Methods of version control - Maintainability.
Introduction to secure programming.
Types of testing – Specification of test cases – Code review process

Module 4 (11 (T) + 7(P) Hours)
Software Project Management: Introduction to metrics. Software Process Models. Costing, Scheduling and Tracking techniques. Software configuration management - versioning. Reusable components. Mathematical methods of risk assessment and management. Methods of software licensing and introduction to free software.

References:

1. Roger S Pressman, Software Engineering: A Practitioner's Approach , 6/e, McGraw Hill, 2008.
2. T C Lethbridge and R Laganiere, Object Oriented Software Engineering, Tata McGraw Hill, 2004.
3. Pankaj Jalote, Software Engineering: A Precise Approach, Wiley India, 2010.
4. A Shalloway and J Trott, Design Patterns Explained: A new perspective on object oriented design, Pearson, 2004.

CS3006 COMPUTER NETWORKS

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Computer Networks and Internet, the network edge, the network core, network access, delay and loss, protocol layers and services, Application layer protocols, Web 2.0, Socket Programming,

Module 2 (10 (T) + 7(P) Hours)
Transport layer services, UDP, TCP, New transport layer Protocols, congestion control, new versions of TCP, Network layer services, routing, IP, routing in Internet, router, IPV6, multicast routing.

Module 3 (10 (T) + 7(P) Hours)
Link layer services, error detection and correction, multiple access protocols, ARP, Ethernet, hubs, bridges, switches, wireless links, mobility, PPP, ATM, MPLS, VLAN.

Module 4 (12 (T) + 7(P) Hours)
Multimedia networking, streaming stored audio and video, real-time protocols, security, Cryptography, authentication, integrity, key distribution, network management.

References:

1. J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring Internet, 3/e, Pearson Education, 2005.
2. Peterson L.L. & Davie B.S., Computer Networks, A systems approach, 3/e, Harcourt Asia, 2003.
3. Andrew S. Tanenbaum, Computer Networks, 3/e, PHI, 1996.
4. Adrian Farrel, The Internet and its Protocols a Comparative Approach, Elsevier, 2005.

CS3301 OBJECT ORIENTED PROGRAMMING

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Module I (10 (T) + 7(P) Hours)

Overview of programming language paradigms – Structured, Procedural, Functional and Logic.

Typed and untyped languages. Abstract Data Types. Introduction to object orientation. Concept of Encapsulation. Examples from any object oriented language.

Module II (13 (T) + 7(P) Hours)

Data and Procedural Abstraction – Class as a combination of both the abstractions. Variables and Methods. Class Hierarchies – Concept of Inheritance. Scope and Visibility. Base, Derived and Abstract Classes. Examples from any object oriented language.

Module III (12 (T) + 7(P) Hours)

Memory Management in object oriented paradigm – Constructors, Destructors. Initialization and garbage collection. Concept of overloading. Concept of polymorphism. Concept of dynamic binding. Examples from any object oriented language.

Module IV (7 (T) + 7(P) Hours)

Object Orientation as a design approach. Introduction to UML – Study of various design diagrams including standard representation methods of Entity Relationships and Algorithms in UML. Introduction to Object Constraint Language. Implementation approaches – Refactoring.

References:

1. Budd T, An Introduction to Object Oriented Programming, 3/e, Pearson, 2003.
2. David West, Object Thinking, Microsoft Press, 2004.
3. C Thomas Wu , An Introduction to object oriented programming with JAVA", 4/e, The McGraw-Hill, 2001.
4. Eckel B, Thinking in C++, Prentice Hall, 2004.
5. Eckel B, Thinking in Java, Prentice Hall, 2004.
6. Fowler M and Scott K, UML Distilled, Addison Wesley, 2000.

ME4104 PRINCIPLES OF MANAGEMENT

Prerequisite: Nil

Total Hours: 42

L	T	P	C
3	0	0	3

Module 1 (9 Hours)
Introduction to management theory, Characteristics of management, Management as an art/profession, Systems approach to management, Task and responsibilities of a professional manager, Levels of managers and skill required. Management process – planning – mission – objectives – goals – strategy – policies – programmes – procedures.

Module 2 (9 Hours)
Organizing – principles of organizing – organization structures, Directing – delegation – span of control – leadership – motivation – communication, Controlling.

Module 3 (12 Hours)
Decision making process – decision making under certainty – risk – uncertainty – models of decision making, Project management – critical path method – programme evaluation and review technique – crashing.

Module 4 (12 Hours)
Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management.

References

1. Koontz, H., and Weihrich, H., Essentials of Management: An International Perspective, 8/e, McGraw Hill, 2009.
2. Hicks, Management: Concepts and Applications, Cengage Learning, 2007.
3. Mahadevan, B., Operations Management, Theory and Practice, 2/e, Pearson Education Asia, 2009.
4. Kotler, P., Keller, K.L., Koshy, A., and Jha, M., Marketing Management, 13/e, Pearson Education Asia, 2009.
5. Khan, M.Y., and Jain, P.K., Financial Management: Text, Problems and Cases, McGraw Hill, 2007.

CS4021 NUMBER THEORY AND CRYPTOGRAPHY

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (8 (T) + 7(P) Hours)
Divisibility theory in integers. Extended Euclid's algorithm. Modular Arithmetic – exponentiation and inversion. Fermat's Little Theorem, Euler's Theorem. Solution to congruences, Chinese Remainder Theorem

Module 2 (12 (T) + 7(P) Hours)
Review of abstract algebra – Study of Ring Zn, multiplicative group Zn* and finite field Zp – Gauss Theorem (cyclicity of Zp*) - Quadratic Reciprocity.
Primality Testing – Fermat test, Carmichael numbers, Solovay Strassen Test, Miller Rabin Test - analysis.

Module 3 (13 (T) + 7(P) Hours)
Notions of security. Introduction to one secret key cryptosystem (DES) and one cryptographic hash scheme (SHA). Public Key Cryptosystems – Diffie Hellman Key Agreement Protocol, Knapsack crypto systems, RSA. Elgamal's encryption and signature scheme.

Module 4 (9 (T) + 7(P) Hours)
Authentication Protocols: One way and Mutual Authentication, Challenge Response protocols, Lamport's scheme, Needham Schroeder protocol. Interactive proof systems, Zero Knowledge Proof systems – soundness and completeness – Fiat-Shamir identification scheme.

References:

1. H. Delfs and H. Knebl, Introduction to Cryptography: Principles and Applications, Springer, 2002.
2. Serge Vaudney, A Classical Introduction to Cryptography: Applications for Communications Security,

Springer, 2009.
3. Bernard Menezes, Network Security and Cryptography. Cengage Learning, 2010.
4. B A Forouzan and D Mukhopadyay, Cryptography and Network Security 2/e, Tata McGraw Hill, 2010.

CS4022 PRINCIPLES OF PROGRAMMING LANGUAGES

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Programming Languages: Concepts and Constructs. Untyped Arithmetic Expressions – Introduction, Semantics, Evaluation.

Module 2 (10 (T) + 7(P) Hours)
Untyped Lambda Calculus – Basics, Semantics. Programming in Lambda Calculus.

Module 3 (10 (T) + 7(P) Hours)
Typed Arithmetic Expressions – Types and Typing relations, Type Safety.
Simply Typed Lambda Calculus – Function types, Typing relations, Properties of typing.

Module 4 (12 (T) + 7(P) Hours)
Extensions to Simply Typed Lambda Calculus – Unit type, Let bindings, Pairs, Records, Sums, Variants, References, Exceptions.

References:

1. Benjamin C. Pierce, Types and Programming Languages, MIT Press, 2002
2. David A. Schmidt, Programming Language Semantics. In Allen B. Tucker, Ed. Handbook of Computer Science and Engineering, CRC Press, 1996.
3. Luca Cardelli, Type Systems. In Allen B. Tucker, Ed. Handbook of Computer Science and Engineering, CRC Press, 1996.
4. Michael L. Scott, Programming Language Pragmatics, Elsevier, 2/e, 2004.

CS4023 COMPUTATIONAL INTELLIGENCE

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10(T) + 7(P) Hours)
Artificial Intelligence: History and Applications, Production Systems, Structures and Strategies for state space search- Data driven and goal driven search, Depth First and Breadth First Search, DFS with Iterative Deepening, Heuristic Search- Best First Search, A* Algorithm, AO* Algorithm, Local Search Algorithms and Optimization Problems, Constraint satisfaction, Using heuristics in games- Minimax Search, Alpha Beta Procedure. Implementation of Search Algorithms in LISP

Module 2 (10(T) + 7(P) Hours)
Knowledge representation - Propositional calculus, Predicate Calculus, Forward and Backward chaining, Theorem

proving by Resolution, Answer Extraction, AI Representational Schemes- Semantic Nets, Conceptual Dependency, Scripts, Frames, Introduction to Agent based problem solving. Implementation of Unification, Resolution and Answer Extraction using Resolution.

Module 3 (10(T) + 7(P) Hours)
Machine Learning- Symbol based and Connectionist, Social and Emergent models of learning, Planning-Planning and acting in the real World, The Genetic Algorithm- Genetic Programming, Overview of Expert System Technology- Rule based Expert Systems, Introduction to Natural Language Processing. Implementation of Machine Learning algorithms.

Module 4 (12(T) + 7(P) Hours)
Languages and Programming Techniques for AI- Introduction to PROLOG and LISP, Search strategies and Logic Programming in LISP, Production System examples in PROLOG.

References:

1. George F Luger, Artificial Intelligence- Structures and Strategies for Complex Problem Solving, 4/e, Pearson Education, 2002.
2. E. Rich and K.Knight, Artificial Intelligence, 2/e, Tata McGraw Hill, 1996.
3. S Russel and P Norvig, Artificial Intelligence- A Modern Approach, 2/e, Pearson Education, 2002
4. Nils J Nilsson, Artificial Intelligence a new Synthesis, Elsevier, 1998.
5. Winston. P. H, LISP, Addison Wesley, 1982.
6. Ivan Bratko, Prolog Programming for Artificial Intelligence, 3/e, Addison Wesley, 2000.
7. Dr.Russell Eberhart and Dr.Yuhui shi, Computational Intelligence - Concepts to Implementation, Elsevier, 2007.
8. Fakhreddine O Karray, Clarence De Silva, Soft Computing and Intelligent Systems Design- Theory tools and Applications, Pearson Education, 2009.

CS4024 INFORMATION THEORY

Pre-requisite: Nil

L	T	P	C
4	0	0	4

Total Hours: 56 Hrs

Module 1 (14 Hours)
Foundations: Review of probability theory, entropy and information, random sources, i.i.d and Markov sources, discrete finite state stationary Markov sources, Entropy rate of stationary sources, Computation of stationary distributions.

Module 2 (14 Hours)
Source Coding: Prefix and uniquely decodable codes - Kraft's and Macmillan's inequalities - Shannon's source coding theorem - Shannon Fano code, Huffman code - optimality - Lempel Ziv code - optimality for stationary ergodic sources.

Module 3 (14 Hours)
Channel Coding: BSC and BEC channel models - Channel capacity - Shannon's channel coding theorem - existence of capacity achieving codes for BEC, Fano-Elias Inequality.

Module 4 (14 Hours)
Cryptography: Information theoretic security - Perfect secrecy - Shannon's theorem - perfectly secret codes - Introduction to computational security and pseudo random sources.

References:

1. T. M. Cover and J. A. Thomas, Elements of Information Theory, Addison Wesley, 1999.
2. D. J. Mackay, Information Theory, Inference and Learning Algorithms. Cambridge University Press, 2002.

3. H. Delfs and H. Knebl, Introduction to Cryptography, 2/e, Springer, 2010.

CS4025 GRAPH THEORY AND COMBINATORICS

Pre-requisite: Nil

L	T	P	C
4	0	0	4

Total Hours: 56 Hrs

Module 1 (14 Hours)
Generating functions and applications: Power series expansion and generating functions, Catalan and Stirling numbers, solving recurrence equations using generating functions, Lambert series, Bell series and Dirichlet series, Applications.

Module 2 (14 Hours)
Existential Combinatorics: Ramsey theory, Ramsey theorem, Ramsey numbers, lower bound for R(k,k), Lovasz local lemma - bound on R(k,k) using Lovasz lemma, applications of local lemma.

Module 3 (14 Hours)
Matching theory: Bipartite matching, Konig's theorem, Hall's Matching Theorem, Network flow, Max flow min cut theorem, integrality, Ford Fulkerson method
Connectivity: Properties of 2 connected and 3 connected graphs, Menger's theorem, Applications

Module 4 (14 Hours)
Planar graphs and Colouring: Planar graphs, 5 color theorem, Brook's theorem, edge coloring, Vizing's theorem, list colouring, Thomassen's theorem.

References:
1. R. P. Grimaldi, Discrete and Combinatorial Mathematics, Addison Wesley, 1998.
2. R. P. Stanley. Enumerative Combinatorics, Cambridge University Press, 2001.
3. P. J. Cameron, Combinatorics: Topics, Techniques and Algorithms, Cambridge University Press, 1995.

CS4026 COMBINATORIAL ALGORITHMS

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Network Flows: Review of graph theory – spanning trees, shortest paths. Connectivity, Network Flows - Max flow min cut theorem, algorithms of Ford-Fulkerson, Edmond Karp, preflow-push algorithms.

Module 2 (10 (T) + 7(P) Hours)
Primal Dual Theory: Linear programming – Primal dual theory, LP-duality based algorithm design.
Applications to Network flow and other combinatorial problems, Applications to graph theory - Konig's theorem, Halls theorem, Menger's theorem.

Module 3 (10 (T) + 7(P) Hours)
Matching Theory: Tutte's theorem, Primal dual algorithms – Hungarian algorithm, Edmond's maximum matching algorithm. Application to marriage problems, Hopcroft Karp algorithm.

Module 4 (12 (T) + 7(P) Hours)
Approximation: Primal Dual approximation algorithms for set cover, Maximum satisfiability, Steiner tree, multicut, Steiner forest, sparsest cut and k-medians.

References:

1. D. West, Graph Theory, Prentice Hall, 2002.
2. D. Jungnickel, Graphs Networks and Algorithms, Springer, 2005.
3. U. Vazirani, Approximation Algorithms, Springer, 2003.
4. T. H. Cormen, C. E. Leiserson, R. L. Rivest, S. C. Stein, Introduction to Algorithms, 4/e, McGraw Hill, 2010.

CS4027 TOPICS IN ALGORITHMS

Pre-requisite: Nil

L	T	P	C
4	0	0	4

Total Hours: 56 Hrs

Module 1 (14 Hours)
Discrete Probability: Probability, Expectations, Tail Bounds, Chernoff Bound, Markov Chains. Random Walks Exponential Generating Functions, homogeneous and non-homogeneous of first and second degrees. Review of algorithm analysis.

Module 2 (14 Hours)
Randomized Algorithms, Moments and Deviations. Tail Inequalities. Randomized selection.
Las Vegas Algorithms. Monte Carlo Algorithms. Parallel and Distributed Algorithms. De-Randomization
Complexity: Probabilistic Complexity Classes

Module 3 (14 Hours)
Proof Theory. Examples of probabilistic algorithms. Probabilistic Method and Proofs, Proving that an algorithm is correct 'Almost sure'. Complexity analysis of probabilistic algorithms, Probabilistic Counting. Super recursive algorithms and inductive Turing machines

Module 4 (14 Hours)
Kolmogorv Complexity – Basic concepts. Models of Computation. Applications to analysis of algorithms. Lower bounds. Relation to Entropy. Kolmogorov complexity and universal probability. Godel's Incompleteness Theorem. Chatin's Proof for Godel's Theorem.

References:

1. R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge University Press, 1995.
2. C. H. Papadimitriou, Computational Complexity, Addison Wesley, 1994.
3. Dexter C. Kozen, The Design and Analysis of Algorithms, Springer Verlag, 1992.
4. Ronald Graham, Donald Knuth, Oren Patashnik, Concrete Mathematics, Addison-Wesley, 1989.

CS4028 QUANTUM COMPUTATION

Pre-requisite: Nil

L	T	P	C
4	0	0	4

Total Hours: 56 Hrs

Module 1 (14 Hours)
Review of Linear Algebra. The postulates of quantum mechanics. Review of Theory of Finite Dimensional Hilbert

Spaces and Tensor Products

Module 2 (14 Hours)
Complexity classes. Models for Quantum Computation. Qubits. Single and multiple qubit gates. Quantum circuits. Bell states. Single qubit operations. Controlled operations and measurement. Universal quantum gates. Quantum Complexity classes and relationship with classical complexity classes

Module 3 (14 Hours)
Quantum Algorithms – Quantum search algorithm - geometric visualization and performance. Quantum search as a quantum simulation. Speeding up the solution of NP Complete problems. Quantum search as an unstructured database. Grover's and Shor's Algorithms.

Module 4 (14 Hours)
Introduction to Quantum Coding Theory. Quantum error correction. The Shor code. Discretization of errors, Independent error models, Degenerate Codes. The quantum Hamming bound. Constructing quantum codes – Classical linear codes, Shannon entropy and Von Neuman Entropy.

References:
1. Nielsen, Michael A., and Isaac L. Chuang, Quantum Computation and Quantum Information. Cambridge, UK, Cambridge University Press, 2002.
2. Gruska, J. Quantum Computing, McGraw Hill, 1999.
3. Halmos, P. R. Finite Dimensional Vector Spaces, Van Nostrand, 1958.
4. Peres, Asher. Quantum Theory: Concepts and Methods**.** Springer, 1993.

CS4029 TOPICS IN THEORY OF COMPUTATION

Pre-requisite: CS3001 Theory of Computation

L	T	P	C
4	0	0	4

Total Hours: 56 Hrs

Module 1 (14 Hours)
Recursion, The primitive recursive functions, Turing machines, Arithmetization, Coding functions , The normal form theorem, The basic equivalence and Church's thesis, Canonical coding of finite sets, Computable and computably enumerable sets, Diagonalization, Computably enumerable sets , Undecidable sets , Uniformity, Many-one reducibility, The recursion theorem, Proof for Godel's Incompleteness Theorem based on Recursion theorem.

Module 2 (14 Hours)
The arithmetical hierarchy, Computing levels in the arithmetical hierarchy , Relativized computation and Turing degrees, Turing reducibility , Limit computable sets, Incomparable degrees

Module 3 (14 Hours)
The priority method, Diagonalization, Turing incomparable sets , Undecidability , Constructivism, randomness and Kolmogorov complexity, Compressibility and randomness, Undecidability

Module 4 (14 Hours)
Scheme, programming and computability theory based on a term-rewriting, "substitution" model of computation by Scheme programs with side-effects; computation as algebraic manipulation: Scheme evaluation as algebraic manipulation and term rewriting theory.

References:
1. R. I. Soare, Recursively enumerable sets and degrees, Springer-Verlag, 1987.
2. G. E. Sacks, Higher recursion theory, Springer Verlag, 1990.
3. M. Li and P. Vitányi, An introduction to Kolmogorov complexity and its applications, Springer-Verlag, 1993.

4. Dexter C. Kozen, Automata and Computability, Springer-Verlag, 1997.
5. S. C. Kleene, Introduction to Metamathematics, Van Nostrand, 1950.
6. MIT OpenCourseWare on Computability Theory of and with Scheme at http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-844-computability-theory-of-and-with-scheme-spring-2003/ Accessed on 26/11/2010

CS4030 COMPUTATIONAL COMPLEXITY

Pre-requisite: Nil

L	T	P	C
4	0	0	4

Total Hours: 56 Hrs

Module 1 (14 Hours)
Review of Complexity Classes, NP and NP Completeness, Space Complexity, Hierarchies, Circuit satisfiability, Savitch and Immerman theorems, Karp Lipton Theorem.

Module 2 (14 Hours)
Randomized Complexity classes, Adleman's theorem, Sipser Gacs theorem, Randomized Reductions, Counting Complexity, Permanent's and Valiant's Theorem

Module 3 (14 Hours)
Parallel complexity, P-completeness, Sup-liner space classes, Renegold's theorem, Polynomial hierarchy and Toda's theorem

Module 4 (14 Hours)
Arthur Merlin games, Graph Isomorphism problem, Goldwasser-Sipser theorem, Interactive Proofs, Shamir's theorem.

References:

1. S. Arora, B. Barak, Computational Complexity: A Modern Approach, Cambridge University Press, 2009.
2. Papadimtriou C. H.., Computational Complexity, Addison Wesley, 1993.
3. Motwani R, Randomized Algorithms, Cambridge University Press, 1995.
4. Vazirani V., Approximation Algorithms, Springer, 2004.

CS4031 COMPUTATIONAL ALGEBRA

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Number Theory: Review of groups and rings and vector spaces, Euclid's algorithm, Structure of the ring Z_n Algorithms for computation in the ring Z_n - modular inversion, exponentiation, Chinese remaindering.

Module 2 (10 (T) + 7(P) Hours)
Finite fields: Structure theory of finite fields - Factorization of polynomials over finite fields - Berlekamp's algorithm, Cantor Zassenhaus algorithm, Fourier Transform algorithm for finite fields.

Module 3 (10 (T) + 7(P) Hours)
Primality Testing: Solovay Strassen test, Miller Rabin test, Agrawal, Kayal Saxena algorithm.

Module 4 (12 (T) + 7(P) Hours)
Applications: Euclid's algorithm for rational polynomial approximation and decoding BCH and RS codes. Applications to public key cryptography.

References:

1. V. Shoup, A computational Introduction to Number Theory and Algebra, Cambridge University Press, 2005.
2. H. Delfs and H. Knebl, Introduction to Cryptography, Springer, 1998.
3. J. von zur Gathen, Modern Computer Algebra, Cambridge University Press, 2003.
4. W. C. Huffman and V. Pless, Fundamentals of Error Correcting Codes, Cambridge University press, 2003.

CS4032 COMPUTER ARCHITECTURE

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (8(T) + 7(P) Hours)
Fundamentals – Technology trend -performance measurement –Comparing and summarizing performance-quantitative principles of computer design –Amdahl's law- instruction set architectures – memory addressing- –type and size operand - encoding an instruction set - role of compilers - case study – MIPS 64 architecture – Review of pipelining - MIPS architecture

Module 2 (10(T) + 7(P) Hours)
Instruction level parallelism and its limits - dynamic scheduling –-dynamic hardware prediction - multiple issue processor – multiple issue with dynamic scheduling-hardware based speculation- limitation of ILP-Case study P6 micro-architecture Introduction to multicore processors,

Module 3 (16(T) + 12(P) Hours)
Multiprocessor and thread level parallelism- classification of parallel architecture-models of communication and memory architecture-Symmetric shared memory architecture-cache coherence protocols-distributed shared memory architecture-directory based cache coherence protocol- Memory consistency-relaxed consistency models multi threading- exploiting thread level parallelism multicore architecture, Memory hierarchy design - reducing cache misses and miss penalty, reducing hit time - main memory organization - virtual memory and its protection -. Memory issues in multicore processor based systems

Module 4 (8(T) + 2(P) Hours)
Storage Systems, Faults and reliability, Networks, Queuing, Design of storage systems – case studies

References

1. Hennesy J. L. & Pattersen D. A., Andrea C. Arpaci-Dusseau, Computer Architecture: A Quantitative approach, 4/e, Morgan Kaufman, 2007.
2. Pattersen D. A. & Hennesy J. L., Computer Organisation and Design: The Hardware/ Software Interface, 3/e, Harcourt Asia, 2006.

CS4033 DISTRIBUTED COMPUTING

Pre-requisite: CS2005 Data Structures and Algorithms

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10(T) + 7(P) Hours)
Characteristics of Distributed Systems, Distributed systems Versus Parallel systems, Models of distributed systems, Happened Before and Potential Causality Model, Models based on States, Logical clocks, Vector clocks, Verifying clock algorithms, Direct dependency clocks.

Module 2 (10(T) + 7(P) Hours)
Mutual exclusion using Time stamps, Distributed Mutual Exclusion (DME) using timestamps, token and Quorums, Centralized and distributed algorithms, proofs of correctness and complexity analysis. Drinking philosophers problem, Dining philosophers problem under heavy and light load conditions. Implementation and performance evaluation of DME algorithms.

Module 3 (10(T) + 7(P) Hours)
Leader election algorithms, Global state detection, Global predicates, Termination Detection, Control of distributed computation, disjunctive predicates. Performance evaluation of leader election algorithms on simulated environments.

Module 4 (12(T) + 7(P) Hours)
Self stabilization, knowledge and common knowledge, Distributed consensus, Consensus under Asynchrony and Synchrony, Checkpointing for Recovery, R- Graphs

References:

1. Vijay K. Garg., Elements of Distributed Computing, Wiley & Sons, 2002.
2. Sukumar Ghosh, Distributed Systems An Algorithmic Approach, Chapman & Hall, CRC Computer and Information Science Series, 2006.
3. Tanenbaum S, Distributed Operating Systems, Pearson Education, 2005.
4. Coulouris G, Dollimore J. & Kindberg T., Distributed Systems Concepts and Design, 2/e, Addison Wesley 2004.
5. Chow R. and Johnson T., Distributed Operating Systems and Algorithms, Addison Wesley, 2002.

CS4034 MIDDLEWARE TECHNOLOGIES

Pre-requisite: CS4033 Distributed Computing

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Publish/Subscribe matching algorithm, event based systems, notification filtering mechanisms, Composite event processing, content based routing, content based models and matching, matching algorithms, distributed hash tables (DHT)

Module 2 (10 (T) + 7(P) Hours)
Distributed notification routing, content based routing algorithms, engineering event based systems, Accessing publish/subscribe functionality using APIs. Scoping, event based systems with scopes, notification mappings, transmission policies, implementation strategies for scoping.

Module 3 (10 (T) + 7(P) Hours)
Composite event detection, detection architectures, security, fault tolerance, congestion control, mobility, existing notification standards- JMS, DDS, HLA.

Module 4 (12 (T) + 7(P) Hours)
Topic based systems, Overlays, P2P systems, overlay routing, Case studies- REBECA, HERMES, Gryphon. Commercial systems- IBM Websphere MQ, TIBCO Rendezvous.

References:

1. Gero Muhl, Ludger Fiege, Peter R. Pietzuch, Distributed Event Based Systems. Springer, 2006.
2. Chris Britton and Peter Bye, IT Architectures and Middleware. Pearson Education, 2/e, 2005.
3. Yanlei Diao, and Michael J. Franklin, Query Processing for High-Volume XML Message Brokering. VLDB 2003.
4. Chee-Yong Chan, Minos Garofalakis and Rajeev Rastogi, RE-Tree: An Efficient Index Structure for Regular Expressions, VLDB, 2002.
5. Peter R. Pietzuch, Brian Shand, Jean Bacon. A Framework for Event Composition in Distributed Systems, Proc. of the 4th Int. Conf. on Middleware, 2003.

CS4035 COMPUTER SECURITY

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Operating system security - Access Control – MAC, DAC, RBAC. Formal models of security - BLP, Biba, Chinese Wall and Clark Wilson. Overview of SE Linux. Software vulnerabilities - Buffer and stack overflow, Phishing. Malware - Viruses, Worms and Trojans.

Module 2 (14 (T) + 7(P) Hours)
Network Security - Security at different layers – IPSec / SSL / PGP. Security problems in network domain - DoS, DDoS, ARP spoofing and session hijacking. DNS attacks and DNSSEC. Cross-site scripting XSS worm, SQL injection attacks. Intrusion Detection Systems (IDS). DDoS detection and prevention in a network.

Module 3 (9 (T) + 7(P) Hours)
Security in current domains – WEP - Wireless LAN security - Vulnerabilities - frame spoofing. Cellphone security - GSM and UMTS security. Mobile malware - bluetooth security.

Module 4 (9 (T) + 7(P) Hours)
Security in current applications – Security case studies of Online banking and Credit Card Payment Systems. Challenges in security for web services and clouds.

References:

1. Bernard Menezes, Network security and Cryptography, Cengage Learning India, 2010.
2. B A Forouzan and D Mukhopadyay, Cryptography and Network Security, 2/e, Tata McGraw Hill, 2010.
3. Dieter Gollmann, Computer Security, John Wiley, 2006.

CS4036 ADVANCED DATABASE MANAGEMENT SYSTEMS

Pre-requisite: CS3002 Database Management Systems

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Distributed database concepts - overview of client - server architecture and its relationship to distributed databases, Concurrency control Heterogeneity issues, Persistent Programming Languages, Object Identity and its implementation, Clustering, Indexing, Client Server Object Bases, Cache Coherence.

Module 2 (10 (T) + 7(P) Hours)
Parallel Databases: Parallel Architectures, performance measures, shared nothing/shared disk/shared memory based architectures, Data partitioning, Intra-operator parallelism, Pipelining, Scheduling, Load balancing, Query processing- Index based, Query optimization: cost estimation, Query optimization: algorithms, Online query processing and optimization, XML, DTD, XPath, XML
indexing, Adaptive query processing

Module 3 (10 (T) + 7(P) Hours)
Advanced Transaction Models: Savepoints, Sagas, Nested Transactions, Multi Level Transactions. Recovery: Multi-level recovery, Shared disk systems, Distributed systems 2PC, 3PC, replication and hot spares, Data storage, security and privacy- Multidimensional K- Anonymity, Data stream management.

Module 4 (12 (T) + 7(P) Hours)
Models of Spatial Data: Conceptual Data Models for spatial databases (e.g. pictogram enhanced ERDs), Logical data models for spatial databases: raster model (map algebra), vector model, Spatial query languages, Need for spatial operators and relations, SQL3 and ADT. Spatial operators, OGIS queries

References:

1. Avi Silberschatz, Hank Korth, and S. Sudarshan. Database System Concepts, 5/e, McGraw Hill, 2005.
2. S. Shekhar and S. Chawla. Spatial Databases: A Tour, Prentice Hall, 2003.
3. Ralf Hartmut Guting, Markus Schneider, Moving Objects Databases Morgan Kaufman, 2005.
4. R. Elmasri and S. Navathe, Fundamentals of Database Systems, Benjamin- Cummings, 5/e, 2007.

CS4037 CLOUD COMPUTING

Pre-requisite: CS4033 Distributed Computing

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
New Computing Paradigms & Services: Cloud computing , Edge computing , Grid computing , Utility computing , Cloud Computing Architectural Framework, Cloud Deployment Models, Virtualization in Cloud Computing, Parallelization in Cloud Computing, Security for Cloud Computing, Cloud Economics , Metering of services.

Module 2 (10 (T) + 7(P) Hours)
Cloud Service Models: Software as a Service (SaaS), Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Service Oriented Architecture (SoA), Elastic Computing, On Demand Computing, Cloud Architecture, Introduction to virtualization.

Module 3 (10 (T) + 7(P) Hours)
Types of Virtualization, Grid technology , Browser as a platform, Web 2.0, Autonomic Systems, Cloud Computing Operating System, Deployment of applications on the cloud, Case studies- Xen, VMware, Eucalyptus, Amazon EC2.

Module 4 (12 (T) + 7(P) Hours)
Introduction to Map Reduce, Information retrieval through Map Reduce, Hadoop File System, GFS, Page Ranking using Map Reduce, Security threats and solutions in clouds, mobile cloud computing, Case studies- Ajax, Hadoop.

References:

1. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, 2009.
2. Jason Venner, Pro Hadoop, Apress, 2009.
3. Timothy Chou , Introduction to cloud computing & Business, Active Book Press, 2010.
4. Current literature- Journal & conference papers

CS4038 DATA MINING

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Introduction to data mining-challenges and tasks Data preprocessing, data analysis, measures of similarity and dissimilarity, Data visualization –concepts and techniques

Module 2 (10 (T) + 7(P) Hours)
Classification- decision tree-performance evaluation of the classifier, comparison of different classifiers, Rule based classifier, Nearest-neighbor classifiers-Bayesian classifiers-support vector machines, Class imbalance problem

Module 3 (10 (T) + 7(P) Hours)
Association analysis –frequent item generation rule generation, evaluation of association patterns

Module 4 (12 (T) + 7(P) Hours)
Cluster analysis,-types of clusters, K means algorithm, cluster evaluation, application of data mining to web mining and Bioinformatics

References:

1. Pang-Ning Tan,Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education 2006.
2. Han and Kamber, Data Mining: Concepts and Techniques, 2/e, Morgan Kaufmann, 2005.

CS4039 MULTI AGENT SYSTEMS

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Introduction to agent and multi-agent systems, different types of agents, abstract architecture, distributed problem solving, application areas, Software tools for modeling Multi-Agent Systems

Module 2 (10 (T) + 7(P) Hours)
Agent communication, communication languages KQML and FIPA ACL Communication policies and protocols, Protocol Modeling

Module 3 (10 (T) + 7(P) Hours)
Negotiation in multi-agent- agent environment, game theoretical model , heuristic approach, argumentation based approach

Module 4 (12 (T) + 7(P) Hours)
Distributed decision making –evaluation criteria -Social welfare, Pareto Efficiency, Individual Rationality, Stability, Application of multiagent systems in complex distributed problem solving, Modeling distributed multi-agent systems.

References:

1. M. Wooldrige, An Introduction to multi-agent systems, Wiley, 2009.
2. R. Norvig, Artificial Intelligence: A modern approach, Prentice Hall, 2010.

CS4040 BIOINFORMATICS

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Molecular biology primer, gene structure and information content, Bioinformatics tools and databases, genomic information content, Sequence Alignment, Algorithms for global and local alignments, Scoring matrices, Dynamic Programming algorithms.

Module 2 (10 (T) + 7(P) Hours)
Introduction to Bio-programming languages, Restriction Mapping and Motif finding, Gene Prediction, Molecular Phylogenetics, Phylogenetic trees, Algorithms for Phylogenetic Tree construction.

Module 3 (10 (T) + 7(P) Hours)
Combinatorial pattern matching, Repeat finding, Keyword Trees, Suffix Trees, Heuristic similarity search algorithms, Approximate pattern matching.

Module 4 (12 (T) + 7(P) Hours)
Microarrays, Gene expression, Algorithms for Analyzing Gene Expression data, Protein and RNA structure prediction, Algorithms for structure prediction. Emerging trends in bioinformatics algorithms and databases.

References:

1. Neil C Jones and Pavel A Pevzner, An Introduction to Bioinformatics Algorithms, MIT Press, 2004.
2. David W Mount, Bioinformatics- Sequence and Genome Analysis, 2/e, Cold Spring Harbor Laboratory Press, New York, 2004.
3. D. E. Krane and M. L. Raymer, Fundamental Concepts of Bioinformatics, Pearson Education, 2003.
4. T. K. Attwood and D. J. Parry-Smith, Introduction to Bioinformatics, Pearson Education, 2003.
5. Current Literature.

CS4041 NATURAL LANGUAGE PROCESSING

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10(T)+7(P) Hours)
Introduction to Natural Language Processing, Different Levels of language analysis, Representation and

understanding, Linguistic background. Grammars and parsing, Top down and Bottom up parsers.

Module 2 (10(T)+7(P) Hours)
Transition Network Grammars, Feature systems and augmented grammars, Morphological analysis and the lexicon, Parsing with features, Augmented Transition Networks.

Module 3 (10(T)+7(P) Hours)
Grammars for natural language, Movement phenomenon in language, Handling questions in context free grammars, Hold mechanisms in ATNs, Gap threading, Human preferences in parsing, Shift reduce parsers, Deterministic parsers, Statistical methods for Ambiguity resolution

Module 4 (12(T)+7(P) Hours)
Semantic Interpretation, word senses and ambiguity, Basic logical form language, Encoding ambiguity in logical from, Thematic roles, Linking syntax and semantics, Information Retrieval, Recent trends in NLP.

References:
1. James Allen, Natural Language Understanding, 2/e, Pearson Education, 2003.
2. T Siddiqui and U S Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
3. D Juraffsky and J H Martin, Speech and Language Processing, Pearson Education, 2000.

CS4042 WEB PROGRAMMING

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Internet and its architecture, Client Server Networking - Creating an Internet Client, Application Protocols and http, Presentation aspects html, CSS and Java script, Creating a web server, Serving Dynamic Content- CGI – overview of technologies like PHP – applets – JSP. Implementation examples.

Module 2 (10 (T) + 7(P) Hours)
Web server architecture, Programming threads in C, Shared memory synchronization, Performance measurement and workload models. Comparison using existing benchmarks.

Module 3 (10 (T) + 7(P) Hours)
Web development frameworks – Detailed study of one open source web framework - Ruby Scripting, Ruby on rails – Design, Implementation and Maintenance aspects.

Module 4 (12 (T) + 7(P) Hours)
Service Oriented Architecture – SOAP. Web 2.0 technologies. – AJAX. Development using Web2.0 technologies. Introduction to semantic web.

References:
1. Dave Thomas, with Chad Fowler and Andy Hunt. Programming Ruby: The Pragmatic Programmer's Guide, 3/e, Pragmatic Programmers, May 2008.
2. Balachander Krishnamurthy and Jennifer Rexford. Web Protocols and Practice: HTTP/1.1, Networking Protocols, Caching, and Traffic Measurement, Addison Wesley Professional, 2001.

CS4043 IMAGE PROCESSING

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Fundamentals of Image processing: Digital image representation, Elements of Digital image processing systems, Image model, Sampling and Quantization, Basic relations between pixels.

Image transforms: One dimensional Fourier transform, Two dimensional Fourier transform, Properties of two dimensional Fourier transform. Walsh transform, Hadamard transform, Discrete cosine transform, Haar transform, Slant transform.

Module 2 (10 (T) + 7(P) Hours)
Image enhancement techniques: Spatial domain methods, Frequency domain methods, Intensity transform, Histogram processing, Image subtraction, Image averaging, Smoothing filters, Sharpening filters, Spatial masks from frequency domain.

Module 3 (10 (T) + 7(P) Hours)
Image Segmentation: Thresholding: Different types of thresholding methods, Point detection, Edge detection: Different types of edge operators, Line detection, Edge linking and boundary detection, Region growing, Region splitting, Region Merging.

Module 4 (12 (T) + 7(P) Hours)
Image Data Compression: Fundamentals, Compression models, Error free compression, Lossy Compression, Image compression standards.
Applications of Image Processing: Medical imaging, Robot vision, Character recognition, Remote Sensing.

References:

1. R.C.Gonzalez and R.E.Woods, Digital Image Processing, Addison-Wesley, 2007.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis, and Machine Vision, 2/e, PWS Publishing, 1999.

CS4044 PATTERN RECOGNITION

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Introduction: Machine Perception , Pattern Recognition Systems, The Design Cycle, Learning and Adaptation.
Baye's Decision Theory: Bayes Decision Theory, Minimum Error rate Classification, Classifiers, Discriminant functions and Decision Surfaces, Normal Density, Discriminant functions for the Normal Density, Bayes Decision Theory for Discrete features

Module 2 (10 (T) + 7(P) Hours)
*Maximum Likelihood and Bayesian Parameter Estimation :*Maximum Likelihood Estimation, Bayesian Estimation, Bayesian Parameter Estimation, Gaussian Case and General Theory.
Non Parametric Techniques: Density Estimation, Parzen Windows , K- Nearest Neighbor Estimation,NN rule, Metrics and NN Classification, Fuzzy Classification

Module 3 (10 (T) + 7(P) Hours)
Linear Descriminant Functions : Linear Discriminant Functions and Decision Surfaces, Generalized Discriminant Functions, The two-category linearly separable case , Minimizing the perceptron criterion function, relaxation procedures, non- separable behavior, Minimum Squared- Error procedures.

Module 4 (12 (T) + 7(P) Hours)
Multi Layer Neural Networks : Feed-forward Operation, Classification, Back – propagation Algorithm, Error Surfaces, Back-propagation as Feature mapping.

References:

1. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, John-Wiley, 2004.
2. J. T. Tou and R. C. Gonzalez, Pattern Recognition Principles, Tou and Gonzalez, Wiley, 1974.

CS4045 MEDICAL IMAGE PROCESSING

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Introduction to digital image processing: images, image quality, basic operations.
Radiography: Introduction, X-rays, interaction with matter, detectors, dual energy imaging, quality clinical use, biologic effect and safety, Fourier Slice Theorem Basics.

Module 2 (10 (T) + 7(P) Hours)
X-ray Computed tomography: Introduction, X-ray detectors in CT, imaging, cardiac CT, image quality, clinical use, biologic effects and safety.
Magnetic resonance imaging: Introduction, physics of transmitted signal, interaction with tissue, signal detection and detector, imaging. Biologic effects and safety

Module 3 (10 (T) + 7(P) Hours)
Nuclear imaging, Introduction, radionuclides, interaction of Gama-photons and particles with matter, data acquisition, imaging, image quality, equipment, clinical use, biologic effects and safety
Ultrasound imaging: Physics of acoustic waves, generation and detection of ultrasound, grayscale imaging, Doppler imaging, image quality, equipment, clinical use, biologic effects and safety.

Module 4 (12 (T) + 7(P) Hours)
Medical image analysis: Manual and automated analysis, computation strategies for automated medical image analysis, pixel classification.

References:

1. Paul Suetens, Fundamentals of medical imaging, Cambridge University Press, 2009.
2. Bushberg, J. A. et al., The Essential Physics of Medical Imaging , 2/e, L. Williams and Wilkins, 2002.

CS4046 COMPUTER VISION

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Introduction and overview, pinhole cameras, radiometry terminology. Sources, shadows and shading: Local shading models- point, line and area sources; photometric stereo. Color: Physics of color; human color perception, Representing color; A model for image color; surface color from image color.

Module 2 (10 (T) + 7(P) Hours)
Linear filters: Linear filters and convolution; shift invariant linear systems- discrete convolution, continuous convolution, edge effects in discrete convolution; Spatial frequency and fourier transforms; Sampling and aliasing; filters as templates; Normalized correlations and finding patterns. Edge detection: Noise; estimating derivatives; detecting edges. Texture: Representing texture; Analysis using oriented pyramid; Applications; Shape from texture. The geometry and views: Two views.

Module 3 (10 (T) + 7(P) Hours)
Stereopsis: Reconstruction; human stereo; Binocular fusion; using color camera.

Module 4 (12 (T) + 7(P) Hours)
Segmentation by clustering: Human vision, applications, segmentation by graph theoretic clustering. Segmentation by fitting a model, Hough transform; fitting lines, fitting curves;

References:

1. David A Forsynth and Jean Ponce, Computer Vision- A modern approach, Pearson education series, 2003.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, Digital image processing and computer vision, Cengage learning, 2008.
3. Schalkoff R. J., Digital Image Processing and Computer Vision, John Wiley, 2004.

CS4047 COMPUTER GRAPHICS

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70Hrs

Module 1 (10 (T) + 7(P) Hours)
Graphics Pipeline - overview of vertex processing, primitive generation, transformations and projections, clipping, rasterisation, fragment processing - Graphics Hardware - overview of GPU architecture, how GPUs SIMD architecture suits computer graphics.

Module 2 (10 (T) + 7(P) Hours)
Coordinate Systems - representations, homogenous coordinates, object, camera, world, and screen coordinate system, changing coordinate systems. Transformations - affine transformations, translation, rotation, scaling in homogenous coordinates, matrix representations, cumulation of transformations. Viewing and Projections - orthographic and perspective projection, camera positioning, Hidden Surface Removal - its importance in rendering, z buffer algorithm, clipping, culling, Data Structures for efficient implementation of the transformations and projections.

Module 3 (10 (T) + 7(P) Hours)
Lighting and Shading - light sources, normal computation, reflection models, flat and smooth shading , Introduction to Textures and Mapping - Rendering Techniques - slicing, volume rendering, iso-surface extraction, ray casting, multi resolution representations for large data rendering. Data Structures for efficient implementation.

Module 4 (12 (T) + 7(P) Hours)
Geometric Modelling - Data structures - tree representations, hierarchical models, scene graphs - particle systems

and representations - introduction to modeling and solving dynamics based on physics, Introduction to Curves Surfaces (Bezier, splines) and Meshes - structured and unstructured.

References:

1. E. S. Angel, Interactive Computer Graphics, A top-down approach with OpenGL, 5/e, Pearson Education, 2009.
2. D. Hearn and M. P. Baker, Computer Graphisc with OpenGL, Prentice Hall, 2003, 3/e, Prentice Hall, 2003.

CS4048 TOPICS IN COMPILERS

Prerequisite: CS3005 Compiler Design

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1: Attribute grammars (10(T) + 7(P) hours)
Analysis, use, tests, circularity. Issues in type systems.

Module 2: Analysis and Optimizations (10(T)+7(P) hours)
Advanced topics in Data Flow, Control Flow and Dependency analysis, Loop optimizations – invariant code motion, elimination of partial redundancy, Experimental platforms – SUIF.

Module 3: ILP Compilation (11(T) + 7(P) hours)
Issues in compilation for ILP based processors. Effect of VLIW, Speculative, Predicated instructions, multithreaded processors.

Module 4: Dynamic Compilation (11(T)+7(P) hours)
Introduction, methods, case studies, implementation, software tools.

References:

1. ACM SIGPLAN.
2. ACM TOPLAS.
3. Steven Muchnick, Advanced Compiler Design Implementation, Morgan Kauffmann Publishers, 1997
4. Aho A.V, Lam M.S, Sethi R and Ullman J. D, Compilers – Principles, Techniques and Tools, Pearson, 2007.

CS4049 ADVANCED COMPUTER NETWORKS

Pre-requisite: CS3006 Computer Networks

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours): Introduction- Internet design philosophy, layering and end to end design principle. MAC protocols for high-speed LANS, MANs, wireless LANs and mobile networks, VLAN. Fast access technologies.

Module 2 (10 (T) + 7(P) Hours): IPv6: Why IPv6, basic protocol, extensions and options, support for QoS, security, neighbour discovery, auto-configuration, routing. Changes to other protocols. Application Programming Interface for IPv6, 6bone. IP Multicasting, wide area multicasting, reliable multicast. Routing layer issues, ISPs and peering, BGP, IGP, Traffic Engineering, Routing mechanisms: Queue management, packet scheduling. MPLS, VPNs

Module 3 (10 (T) + 7(P) Hours): TCP extensions for high-speed networks, transaction-oriented applications. New options in TCP, TCP performance issues over wireless networks, SCTP, DCCP.

Module 4 (12 (T) + 7(P) Hours): DNS issues, other naming mechanisms, overlay networks, p2p networks, web server systems, web 2.0, Internet traffic modelling, Internet measurements. Security – Firewalls, Unified threat Management System, Network Access Control.

References:

1. Adrian Farrel, The Internet and its protocols a comparative approach, Elsevier, 2005
2. M. Gonsalves and K. Niles._IPv6 Networks, McGraw Hill, 1998.
3. W. R. Stevens, TCP/IP Illustrated, Volume 1: The protocols, Addison Wesley, 1994.
4. G. R. Wright, TCP/IP Illustrated, Volume 2: The Implementation, Addison Wesley, 1995.
5. W. R. Stevens, TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols, Addison Wesley, 1996.
6. Articles in various journals and conference proceedings.
7. RFCs and Internet Drafts, available from Internet Engineering Task Force.

CS4050 DESIGN AND ANALYSIS OF ALGORITHMS

Pre-requisite: CS2005 Data Structures & Algorithms

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Analysis: RAM model - big Oh - big Omega – Asymptotic Analysis, recurrence relations, probabilistic analysis - linearity of expectations - worst and average case analysis of sorting algorithms, binary search - hashing algorithms - lower bound proofs for the above problems - amortized analysis - aggregate - accounting and potential methods - analysis of Knuth-Morris-Pratt algorithm - amortized weight balanced trees

Module 2 (10 (T) + 7(P) Hours)
Problem Solving, Classical Algorithm paradigms,: divide and conquer - Strassen's algorithm, O(n) median finding algorithm - dynamic programming - matrix chain multiplication - optimal polygon triangulation - optimal binary search trees - Floyd-Warshall algorithm - CYK algorithm - greedy - Huffman coding - Knapsack, Kruskal's and Prim's algorithms for MST - backtracking - branch and bound - traveling salesman problem - matroids and theoretical foundations of greedy algorithms

Module 3 (10 (T) + 7(P) Hours)
Complexity: complexity classes - P, NP, Co-NP, NP-Hard and NP-complete problems - cook's theorem- NP-completeness reductions for clique - vertex cover - subset sum - hamiltonian cycle - TSP - integer programming - approximation algorithms - vertex cover - TSP - set covering and subset sum

Module 4 (12 (T) + 7(P) Hours)
Probabilistic algorithms: pseudo random number generation methods - Monte Carlo algorithms - probabilistic counting - verifying matrix multiplication - primality testing - Miller Rabin test - integer factorization - Pollard's rho heuristic - amplification of stochastic advantage - applications to cryptography - interactive proof systems - les vegas algorithms - randomized selection and sorting - randomized solution for eight queen problem - universal hashing - Dixon's integer factorization algorithm

References:

1. Cormen T.H., Leiserson C.E, Rivest R.L. and Stein C, Introduction to Algorithms, Prentice Hall India, 3/e, 2010
2. Motwani R and Raghavan P., Randomized Algorithms, Cambridge University Press, 2001.

3. Anany Levitin, Introduction to the Design & Analysis of Algorithms, Pearson Education. 2003
4. Basse S., Computer Algorithms: Introduction to Design And Analysis, Addison Wesley, 2000.
5. Manber U., Introduction to Algorithms: A Creative Approach, Addison Wesley, 2006.
6. Aho A. V., Hopcroft J. E. & Ullman J. D., The Design And Analysis of Computer Algorithms, Addison Wesley, 2003.

CS4051 CODING THEORY

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Linear Codes: Review of linear algebra - Linear codes and syndrome decoding. Generator and parity check matrices. Hamming geometry and code performance. Hamming codes. Error correction and concept of hamming distance.

Module 2 (10 (T) + 7(P) Hours)
Cyclic codes: BCH codes, Reed-Solomon codes – Polynomial time decoding. Shift register encoders for cyclic codes. Cyclic hamming codes. Decoding BCH – key equation and algorithms. Berlekamp's Iterative decoding Algorithm.

Module 3 (10 (T) + 7(P) Hours)
Convolutional codes : Viterbi decoding. Concept of forward error correction. State diagram, trellises.
Concept of space time codes. Space Time Trellis codes. Path enumerators and proof of error bounds.
Applications to wireless communication.

Module 4 (12 (T) + 7(P) Hours)
Codes on Graphs: Concept of girth and minimum distance in graph theoretic codes. Expander Graphs and Codes – linear time decoding. Basic expander based construction of list decodable codes. Sipser Spielman algorithm. Bounding results.

References:

1. R. Johannesson and K. Sh. Zigangirov, Fundamentals of Convolutional Coding, Wiley-IEEE Press, 1999.
2. W. C. Huffman and V. Pless, Fundamentals of error correcting codes, Cambridge University Press, 2003.
3. van Lint J. H. An Introduction to Coding Theory, 2/e, Springer-Verlag, 1992.
4. R.J. McEliece, The Theory of Information and Coding, Addison Wesley, 1997.

CS4052 LOGIC FOR COMPUTER SCIENCE

Pre-requisite: Nil

L	T	P	C
3	0	2	4

Total Hours: 70 Hrs

Module 1 (10 (T) + 7(P) Hours)
Propositional logic, syntax of propositional logic, semantics of propositional logic, truth tables and tautologies, tableaus, soundness theorem, finished sets, completeness theorem.

Module 2 (10 (T) + 7(P) Hours)

Predicate logic, syntax of predicate logic, free and bound variables, semantics of predicate logic, graphs, tableaus, soundness theorem, finished sets, completeness theorem, equivalence relations, order relations, set theory.

Module 3 (10 (T) + 7(P) Hours)
Linear time Temporal Logic(LTL), syntax of LTL, semantics of LTL, Buchi Automata, Buchi recognizable languages and their properties, Automata theoretic methods, Vardi-Wolper Construction, Satisfiability problem of LTL, Model checking problem of LTL.

Module 4 (12 (T) + 7(P) Hours)
Software Verification: Introduction to Tools used for software verification - SPIN and SMV, Method of verification by the tools.

References:

1. Jerome Keisler and H. Joel Robbin, Mathematical Logic and Computability, McGraw-Hill, 1996.
2. Papadimitriou. C. H., Computational Complexity, Addison Wesley, 1994.
3. Gallier, J. H., Logic for Computer Science: Foundations of Automatic Theorem Proving, Harper and Row, 1986.

CS3091 COMPILER LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours) Practical (42 Hours)

Module 1 (2 (T) + 6(P) Hours)
Generation of lexical analyzer using tools such as LEX

Module 2 (6 (T) + 14(P) Hours)
Generation of parser using tools such as YACC. Creation of Abstract Syntax Tree

Module 3 (3 (T) + 10(P) Hours)
Creation of Symbol tables. Semantic Analysis.

Module 4 (3 (T) + 12(P) Hours)
Generation of target code.

References:

1. W. Appel, Modern Compiler Implementation in C, Cambridge University Press, 1998.
2. V. Aho, M. S. Lam, R. Sethi, J. D. Ullman, Compilers- Principles, Techniques & Tools, 2/e, Pearson Education, 2007.

CS3092 OPERATING SYSTEMS LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56Hrs

Theory (14 Hours)
Unix system programming fundamentals and system calls.

Practical (42 Hours)
Linux shell programming, Inter process communication-Pipes, semaphores, Shared memory and Message passing Loading executable programs into memory and execute System Call implementation-read(), write(), open () and close()
Multiprogramming-Memory management- Implementation of Fork(), Wait(), Exec() and Exit() System calls
Support for software TLB- TLB implementation – implementation of LRU replacement algorithm
File system implementation-demand paging - page fault exception – page replacement policy
Implementation of Synchronization primitives -Semaphore, Locks and Conditional Variables
Build Networking facilities - Mailbox

References:

1. Gary J. Nutt, Operating Systems, Pearson Education, 3/e, 2004.
2. Daniel P Bovet, Marco Cesati , Understanding the Linux Kernel, O'Reilly Media, 3/e, 2005.

CS3093 NETWORKS LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours): Introduction, Overview of Unix Programming Environment, Unix Programing Tools, Introduction to Computer Networking and TCP/IP, Introduction to Socket Programming, TCP Sockets and Concurrent Servers, Threads, I/O Multiplexing and Socket Options, UDP Sockets and Name and Address Conversions, Daemon Processses and Inetd Superserver, Advanced I/O and Timeouts, Non-blocking Sockets, Unix Domain Sockets, Broadcasting, Multicasting, Advanced UDP Sockets, Ioctl Operations.
Introduction to open source firewall packages. Introduction to network emulators and simulators.

Practical (42 Hours)
Experiment 1: Implementation of basic Client Server program using TCP Socket (Eg. Day time server and clent).
Experiment 2: Implementation of basic Client Server program using UDP Socket.
Experiment 3: Implementing a program with TCP Server and UDP Client.
Experiment 4: Implementation of TCP Client Server program with concurrent connection from clients.
Experiment 5: Implementing fully concurrent application with a TCP server acting as a directory server and client programs allowing concurrent connection and message transfer (Eg. Chat sytem).
Experiment 6: Fully decentralized application like a Peer to Peer system. This program is to implement without a designated Sever as in the case of experiment 5.
Experiment 7: Experiments with open source firewall/proxy packages like iptables,ufw, squid etc.
Experiment 8: Experiments with Emulator like Netkit, Emulab etc.
Experiment 9: Experiments with Simulator like NS2, NCTU NS etc.

References:

1. W. Rıchard Stevens, Unix Network Programming – Networking APIs: Sockets and XTI Volume 1, 2nd Edition, Pearson Education, 2004.
2. W. Rıchard Stevens, Unix Network Programming – Interprocess Communications Volume 2, 2nd Edition, Pearson Education, 2004.
3. Warren W. Gay, Linux Socket Programming by Example, 1st Edition, Que Press, 2000.
4. Brian Hall, Beej's Guide to Network Programming, http://beej.us/guide/bgnet/ Accessed May, 2011.
5. Elliotte Rusty Harold, Java Network Programming, 3rd Edition, O'Reilly, 2004.
6. Douglas C. Schmidt, and Stephen D. Huston, C++ Network Programming, Volume 2, Addison-Wesley,

2003.

CS3094 PROGRAMMING LANGUAGES LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)
Functional programming foundations review.
Practical (42 Hours)

Module 1 (5 (T) + 12(P) Hours)
Introduction to functional programming. Interpreter for the language of untyped arithmetic expressions.

Module 2 (3 (T) + 12(P) Hours)
Interpreter for the language of Untyped Lambda Calculus

Module 3 (3 (T) + 9(P) Hours)
Interpreter for the language of Typed arithmetic expressions.

Module 4 (3 (T) + 9(P) Hours)
Interpreter for Simply Typed Lambda Calculus and its extensions.

References:

1. Benjamin C. Pierce, Types and Programming Languages, MIT Press, 2002.

CS3095 DATABASE MANAGEMENT SYSTEMS LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)
Study of Postgres SQL, PL/SQL programming and JDBC. Concepts of views, scripts, triggers and transactions, SQL DBA, PHP, Eclipse. Servlets

Practical (42 Hours)
Laboratory exercises which include defining schemas for applications, creation of a databases, writing SQL and PL/SQL queries, to retrieve information from the databases, use of host languages, interface with embedded SQL, use of forms & report writing packages available with the chosen RDBMS product preferably Postgres SQL Programming exercises on using scripting languages like PHP, Giving web interfaces for back end database applications.

Exercises on Programming in Java for connecting Postgres SQL databases using JDBC.
Exercises on creating web page interfaces for database applications using servlets.

References:

1. Avi Silberschatz, Hank Korth, and S. Sudarshan, Database System Concepts, 5/e, McGraw Hill, 2005.
2. R. Elmasri and S. Navathe, Fundamentals of Database Systems, Addison Wesley, 5/e , 2007.

CS3096 COMPUTATIONAL INTELLIGENCE LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)
State Space Search, Two-agent Games, Logic, Machine Learning

Practical (42 Hours)
State Space Search – Water Jug Problem, Missionaries and cannibals, Tower of HANOI, Eight puzzle, Implementation of these problems using both uninformed and informed search. – BFS, DFS, Best First Search, A*

Two-agent Games – Tic-Tac-Toe using Min-Max search and Alpha-Beta pruning, *Constraint Satisfaction Problems* – N-Queens using Heuristic repair and constraint propagation

Logic-Unification, Resolution,Answer Extraction Using Resolution

Machine Learning – Decision Tree, Candidate Elimination, Clustering (K-means), Neural net learning (Perceptron), Genetic algorithms (2SAT), Expert Systems, Natural Language Processing

References:

1. George F Luger, Artificial Intelligence- Structures and Strategies for Complex Problem Solving, 4/e, Pearson Education, 2002.
2. E. Rich, K.Knight, Artificial Intelligence, 2/e, Tata McGraw Hill, 2000.
3. S Russel, P Norvig, Artificial Intelligence- A Modern Approach, 2/e, Pearson Education, 2002.
3. Winston. P. H, LISP, Addison Wesley, 1996.
4. Ivan Bratko, Prolog Programming for Artificial Intelligence, 3/e, Addison Wesley, 2000.

CS3097 WEB PROGRAMMING LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)
Review of basic technologies and concepts in Web Programming
Practical (42 Hours)

- Basic web client: Client programming, processing and parsing data when reading from a network socket - basics of the HTTP protocol.
- Basic web server: Client-server programming - Implement a protocol. 1.0 specification of HTTP - conditional get and cookies.

- Concurrent web server: Modifying web server for pool of threads - semaphores to synchronize access to shared memory.
- Performance evaluation: Workload generation, and performance evaluation. performance improvement gained by using threads - optimization.
- Peer-to-peer web browser: Peer-to-peer programming – building a distributed system. Peer to peer file sharing – synchronization similar to BitTorrent tracker. Quantifying scalability.
- Complete web application: Developing a database-driven complete web application following SDLC. Database backend (say MySQL) – application in PHP / Rails.

References:

1. Sam Ruby, Dave Thomas and David Heinemeier Hansson. Agile Web Development with Rails, 3/e, Pragmatic Programmers, 2009.
2. Hugh E. Williams and David Lane. Web Database Applications with PHP and MySQL, 2/e, O'Reilly & Associates, May 2004.

CS4091 BIOCOMPUTING LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56Hrs

Module 1 (3 (T) + 10 (P) Hours)
Familiarization with Bioinformatics Resources: Understanding of biological databases [GenBank, EMBL, DDBJ, PDB, PIR, SwissProt], Retrieving and analyzing various types of data from these databases, Study of sequence alignment tools (both standalone and online versions) [DotPlot, Clustal, BLAST, FASTA], Study of PHYLIP.

Module 2 (3 (T) + 10 (P) Hours)
Introduction to Bio-programming languages: BioPerl, BioPython, BioJava.

Module 3 (3 (T) + 10 (P) Hours)
Study of Genomics and Proteomics Tools: Working with Genscan, Study of molecular visualization tools [Rasmol, Deep View], Study of Protein structure prediction tools [SCOP, MODELLER, I-TASSER]

Module 4 (5 (T) + 12 (P) Hours)
Implementation of algorithms in Bioinformatics: Sequence analysis and alignment, Motif finding, Protein structure prediction, Construction of Phylogenetic trees.

References:

1 Neil C Jones and Pavel A Pevzner, An Introduction To Bioinformatics Algorithms, MIT Press, 2004.

2 Richard Ernest Bellman, Dynamic Programming, Princeton University Press, 2003.

3 Dan Gusfield, Algorithms On Strings, Trees, And Sequences, Cambridge University Press, 1997.

4 Gary Benson and Roderic Page, Algorithms In Bioinformatics, Springer, Vol 2812, 2003.

CS4092 DATA MINING LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours) + Practical (42 Hours)
Introduction to Scilab Matrix operations, Plotting functions, contours (2(T)+6(P)Hours)
Classification Bayesian classifier, Perceptron , Support Vector Machine(3(T)+12(P) Hours)
Clustering K-means and EM Clustering (3(T)+6(P) Hours) Association rule mining (2(T)+6(P) Hours)
Feature selection (2(T)+6(P) Hours) Introduction to Weka (2(T)+6(P) Hours)

References:

1. Pang-Ning Tan,Michael Steinbach and Vipin Kumar Introduction to Data Mining, Pearson Education 2006.
2. Han and Kamber, Data Mining: Concepts and Techniques, 2/e, Morgan Kaufmann.

CS4093 IMAGE PROCESSING LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)
An introduction to digital images- sampling, quantization. Basic image processing, arithmetic processing. Image enhancement and point operation. Image enhancement and spatial operation. Color images and models models. Frequency domain operations.

Practical (42 Hours)
Lab1: An introduction to digital images- sampling, quantization, Image re-sampling, Image properties: bit-depth
Lab2: Basic image processing, arithmetic processing

Lab3: Image enhancement and point operation- Linear point operation, clipping, thresholding, negation, non-linear mapping, intensity slicing, image histogram, histogram equalization.

Lab4: Image enhancement and spatial operation- Convolution, correlation, linear filtering, edge detection.
Lab5: Color images- color models, color enhancement, color thresholding.
Lab6: Frequency domain operations- fourier transform, freq domain filtering

References:

1. Rafael C., Gonzalez & Woods R.E., Digital Image Processing, Addison Wesley, 2007.
2. Jain A.K, Fundamentals of Digital Image Processing, Prentice Hall, Englewood Cliffs, 2002.
3. Schalkoff R. J., Digital Image Processing and Computer Vision, John Wiley, 2004.

CS4094 COMPUTER VISION LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)

Edge operations: Various edge operators.
Segmentation and clustering techniques and applications.
Colouring and color image processing. Object detection and classification.

Computation of 3D scene from 2D.

Practical (42 Hours)
MatLab implementation for the following:

1. Edge operations:
2. Segmentation: by clustering, segmentation by fitting models-Vision applications.
3. Colouring techniq ues, Pseudo-colouring,
4. Colour image analysis.
5. Object detection and classifications
6. Computation of 3D scene from 2D.

References:

1. David A Forsynth and Jean Ponce (2003), Computer Vision- A modern approach, Pearson education series, 2003.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle (2008), Digital image processing and computer vision, Cengage learning, 2008.
3. Schalkoff R. J., Digital Image Processing and Computer Vision, John Wiley, 2004.

CS4095 COMPUTER GRAPHICS LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)
OpenGL programming - constructs and standards.

Practical (42 Hours)
Drawing Geometric Primitives - case studies.
Create simple models.
Interactive Transformations and Projections
Parsing simple mesh file formats
Rendering meshes.
Case Study: Model a scene, Place lights on the scene, render shadows and texture models.

References:

1. D. Shreiner, M. Woo, J. Neider and T. Davis, OpenGL Programming Guide, Addison Wesley, 2005.

CS4096 SOFTWARE ENGINEERING LABORATORY

Pre-requisite: CS3004 Software Engineering

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)
Introductory Lectures on the use of appropriate tools is to be given.
Peer review discussions of deliverables will also be done in theory sessions.

Practical (42 Hours)
Objective is to develop a significant software product using sound software engineering principles by small student groups. Choice of appropriate methodology and standard tools are also expected. The lab will have deliverables at each milestone of development.

1. Problem Statement / Product Specification
2. Project Plan – Project Management Tool to be identified and Estimation and Costing to be done.
3. Requirements Document – Specification Tool choice to be justified - In class Review
4. Design Document – Choice of Methodology to be justified - In class Review
5. Code and Test Report – Peer review documents of standards adherence to be provided
6. Demo – Integrated Product or Solution to the problem
7. Review of the process and analysis of variation from initial plan and estimation.

References:

1. Roger S Pressman, Software Engineering: A Practitioner's Approach, 6/e, Mc Graw Hill, 2008.

CS4097 OBJECT ORIENTED PROGRAMMING LABORATORY

Pre-requisite: Nil

L	T	P	C
1	0	3	3

Total Hours: 56 Hrs

Theory (14 Hours)

Procedural vs. Objected oriented approaches – Concept of Abstraction - Design and analysis using OO methodologies. Introduction to UML.

Practical (42 Hours)

The implementation has to be done using languages like C++/Java/C#.

Programs to study

Functions – Control structures – String handling – File handling
Error and Exception handling
Class – Objects –Instantiation
Principles of Inheritance, Encapsulation, Polymorphism – Overloading, Virtual functions
OO Design with stress on interface specification. Automated code generation and component reuse - UML

References:

1. B Stroustrup, The C++ Programming Language, 3/e, Addison Wesley, 1997.
2. Steve Oualline, Practical C++ Programming, 2/e, O'Reilly & Associates, 2002.
3. J Nino and F A Hosch, An introduction to programming and object oriented design using Java, Wiley India, 2010.