Syllabus

for

4-Years B. Tech. in Computer Science & Engineering

(Effective from 2017 Admitted Batch onwards)

Department of Computer Science and Engineering
National Institute of Technology Sikkim
South Sikkim - 737 139

CS 11101	Computer Programming	3-0-0	3

Module 1: Fundamentals of Computer
History of Computer, Classification of Computers, Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices, Binary Arithmetic & logic gates, High level language, compiler and assembler (basic concepts), Basic concepts of operating systems like MS DOS, MS WINDOW, UNIX, Algorithm & flow chart.

Module 2: C Fundamentals
The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements; Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation; Input and Output: Standard input and output, formatted output -- printf, formatted input scanf.

Module 3: Flow of Control, Functions
Statement and blocks, if - else, switch, loops - while, for do while, break and continue, go to and labels; Basic of functions, function types, functions returning values, functions not returning values, auto, external, static and register variables, scope rules, recursion, function prototypes, C preprocessor, command line arguments.

Module 4: Array, Pointer, Structures, Union, Files
One dimensional arrays, pointers and functions, multidimensional arrays; Basic of structures, structures and functions, arrays of structures, bit fields, formatted and unformatted files.

Text Book:
1. V. Rajaraman, Fundamental of Computers, PHI
2. E. Balaguruswamy, Programming in C, TMH
3. Y. Kanetkar, Let us C, BPB

Reference Books:
B. W. Kernighan and D. M. Ritchie, C Programming Language, 2nd Edition.

CS 11201	Computer Programming Laboratory	0-0-3	2

Module 1
DOS System commands and Editors (Preliminaries) UNIX system commands and *vi* (Preliminaries)

Module 2
Simple Programs: simple and compound interest. To check whether a given number is a palindrome or not, evaluate summation series, factorial of a number, generate Pascal's triangle, find roots of a quadratic equation

Module 3
Programs to demonstrate control structure: text processing, use of break and continue, etc.
Programs involving functions and recursion

Module 4
Programs involving the use of arrays with subscripts and pointers and **dynamic memory allocation**, Programs using structures and files.

Text Book:
C Programming Language (2nd Edition By B. W. Kernighan & D. M. Ritchie)

Reference Books:
E. Balaguruswamy, Programming in C, TMH

CS 12101	Logic For Computer Science	2-0-0	2

Module 1
Propositional Logic: Proposition, well formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Theory of Inference ,Natural Deduction.

Module 2
Predicate logic: Terms, Formulas - Well Formed Formula (WFF) of Predicate Logic, Constructing Formulas; Free and bound variables, Reasoning with Predicate Logic, deduction rules, Quantifier, Semantics, Undecidability of predicate logic, Expressiveness, second-order logic.

Module 3
Verification: Linear-time temporal (LTL) logic, Syntax and Semantics, Model checking: systems, tools, properties, Branching-time temporal logic - Syntax and Semantics of CTL, Model-checking algorithms

Module 4
Program verification: Partial and total correctness, Proof calculus, Modal logic – syntax and semantics, Binary decision diagrams.

Text Book:

1. Logic for Computer Science Steve Reeves and Michael Clarke. Addison-Wesley, 1990. ISBN: 0-201-41643-3.
2. Logic for Computer Science. Jean H. Gallier. Harper and Row, New York, 1986.
3. First-Order Logic and Automated Theorem Proving. Melvin Fitting. Springer Verlag, Berlin, 1990.
4. A Mathematical Introduction to Logic. Herbert B. Enderton. Academic Press, New York, 1972.

Reference Books:

Logic for Computer Science Steve Reeves and Michael Clarke. Addison-Wesley, 1990. ISBN: 0-201-41643-3.

CS 13101	Data Structure and Algorithm	3-1-0	4

Module 1: Introduction, Array
Basic concepts; Mathematical Background; Complexity Analysis; Arrays: one dimensional, multi-dimensional, Sparse Matrix, Elementary Operations;

Module 3: Stack, Queue, Linked List
Stack: Representation, elementary operations and applications such as infix to postfix, postfix evaluation, parenthesis matching; Queue: Simple queue, circular queue, dequeue, elementary operations and applications; Linked list: Linear, circular and doubly linked lists, elementary operations and applications such as polynomial manipulation;

Module 3: Tree, Graph
Tree: Binary tree representation, tree traversal, complete binary tree, heap, binary search tree, height balanced trees like AVL tree and 2-3 tree, tries, red-black tree, B-tree, other operations and applications of trees; Graph: representation, Adjacency list, graph traversal, path matrix, connected components, DAG, topological sort, Spanning tree;

Module 4: Sorting, Searching, Hashing, File Structure
Sorting: Selection sort, bubble sort, quick sort, merge sort, heap sort, radix sort; Searching: linear and binary search; Hashing: hash tables, hash functions, open addressing; File structures: Introduction, data file types, file organization, file access methods.

Recommended Books:

1. A. V. Aho, J. D. Ullman and J. E. Hopcroft, Data Structures and Algorithms, Addison Wesley

2. E. Horowitz, S. Sahni and S. Anderson-Freed, Fundamental of Data Structure in C, W.H. Freen Company.
3. S. Lipschutz, Data Structures, Shaum's Outlines Series, TMH

CS 13102	JAVA Programming	3-0-0	3

Module 1

Class Fundamentals , Object & Object reference , Object Life time & Garbage Collection, Creating and Operating Objects , Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes ,Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism , Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method. Use of "this " reference, Use of Modifiers with Classes & Methods, Design of Accessors and Mutator Methods Cloning Objects, shallow and deep cloning, Generic Class Types.

Module 2

Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods , Role of Constructors in inheritance , Overriding Super Class Methods ,Use of super, Polymorphism in inheritance, Type Compatibility and Conversion Implementing interfaces.

Module 3

Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Packag, CLASSPATH Setting for Packages, Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages.

Module 4

The Idea behind Exception ,Exceptions & Errors ,Types of Exception, Control Flow In Exceptions, JVM reaction to Exceptions, Use of try, catch, finally, throw, throws in Exception Handling, In-built and User Defined Exceptions, Checked and Un-Checked Exceptions, GUI Programming

Text Book:

1. E. Balaguruswamy, Programming with JAVA, Tata-McGraw-Hill
2. H. Schildt, JAVA: The complete reference, McGraw-Hill

Reference Books:

Ken Arnold, James Gosling, David Holmes, Java Programming Language.

CS 13103	Computer Graphics	3-0-0	3

Module 1: Introduction

Introduction; Graphics Hardware: I/O Devices, printers, non-VDU devices; Basic raster graphics algorithms for drawing primitives; Scan conversion; Region filling; Anti-aliasing: different types of solutions;

Module 2: Clipping, Viewing and Representation of curves and surfaces

Clipping techniques : lines, polygons, text; Generating characters; Geometrical transformations; viewing in 2D & 3D; Input devices; interaction techniques and tasks; Dialogue design; Object hierarchy; Representing curves and surfaces: Hermite, Bezier, and other related interpolation techniques, splines; Solid modeling;

Module 3: Projections and Color

Projections: parallel, perspective, affine; Color: achromatic and colored light, color models and their inter conversion, CIE diagram; visible surface detection; illumination models & shading, mathematics for computer graphics;

Module 4: GUI
GUI: concepts of window programming, X-windows programming on unix / linux platforms, open GL programming in windows/linux environments.

Recommended Books:
1. D. Hearn and M. P. Baker, Computer Graphics, McGraw Hill
2. Z. Xiang and R. A. Plastock, Shaum's Outline of Computer Graphics, McGraw Hill

CS 13104	Discrete Mathematics	3-0-0	3

Module 1
Number Systems: Decimal Number Systems, Binary Number Systems, Hexadecimal Number Systems, Octal Number Systems, Binary Arithmetic.
Propositions and Logical Operations: Notation, Connections, Normal forms, Truth Tables, Equivalence and Implications, Theory of inference for statement calculus, Predicate calculus, Rules of Logic, Mathematical Induction and Quantifiers

Module 2
Sets, Relations and Diagraphs: Review of set concepts, Relations and digraphs, Properties of relations, Equivalence relations, Computer representation of relations and digraphs, Manipulation of relations, Partially Ordered sets (Posets)

Module 3
Recurrence Relations: Towers of Hanoi, Iterations, Homogeneous linear equations with constant coefficients, particular solution, difference table, finite order differences, Line in a plane in general position

Module 4
Groups and Applications: Monoids, semi groups, Product and quotients of algebraic structures, Isomorphism, homomorphism, auto-morphism, Normal subgroups, Codes and group codes
Classification of Languages: Overview of Formal Languages, Representation of regular languages and grammars, finite state machines.

Text Book:
Elements of Discrete Mathematics by C. L. Liu

CS 13201	Data Structure and Algorithm Laboratory	0-0-2	1

Theory
Review of dynamic memory allocation - use of pointers - review of recursion. File organization.

Practical
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.

Books and 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

CS 13202	JAVA Programming Laboratory	0-0-2	1

Programming using Classes and Objects, Programs using Operator Overloading

Programming using Inheritance, Polymorphism and its types, Programs using Arrays and Pointers

Programming using Dynamic memory allocation, Programs using Templates and Exceptions

Programming using Sequential and Random access files

Text Book:

Ken Arnold, James Gosling, David Holmes, Java Programming Language**.**

CS 13203	Computer Graphic Laboratory	0-0-2	1

Theory

OpenGL programming - constructs and standards.

Practical

1. Implementation of Algorithms for drawing 2D Primitives – Line (DDA, Bresenham) – all slopes Circle (Midpoint)
2. 2D Geometric transformations –
   Translation
   Rotation Scaling
   Reflection Shear
   Window-Viewport
3. Composite 2D Transformations
4. Line Clipping
5. 3D Transformations – Translation, Rotation, Scaling.
6. 3D Projections – Parallel, Perspective.
7. Creating 3D Scenes.
8. Image Editing and Manipulation – Basic Operations on image using any image editing software, Creating gif animated images, Image optimization.
9. 2D Animation – To create Interactive animation using any authoring tool.

Books and References:

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

CS 14101	Computer Organization and Architecture	3-0-0	3

Module 1: Introduction and CPU

Basic structure of computers; Instruction format; Instruction sequencing; Addressing modes; Central Processing Unit: Concepts, CPU Organization, Execution of Programs, Control Structure, Hardwired Control Unit, Micro-programmed Control Unit, RISC and CISC architecture, ALU Design;

Module 2: Computer Arithmetic

Addition and Subtraction of signed numbers; Design of Fast Adders; Multiplication of positive and signed numbers; Fast Multiplication; Integer Division; Floating-Point Numbers and Operations;

Module 3: I/O and Memory Organization
I/O Organization: Programmed, Memory-Mapped, Interrupts, Direct Memory Access; Memory Organization: Memory Hierarchy, Semiconductor RAM, ROM, Cache Memories, Cache Mapping, Performance, Virtual Memories, Associative Memory, Secondary storage;

Module 4: Architecture
Computer Architecture: Overview, Performance evaluation of CPU, Pipelining, Pipelining hazards, Static and Dynamic scheduling, Instruction level parallelism, Loop unrolling, Taxonomy of parallel computers, SIMD and MIMD Machines, Multiprocessor architectures, Cache coherence, Message Passing systems, Case study of latest architectures such as fourtezza;

Text Books:
1. J. P. Hayes, Computer Architecture and Organization, McGraw-Hill
2. M. Mano, Computer System Architecture, PHI

Reference Books:
1. Stallings W, "Computer Organization and Architecture – Designing for Performance", PHI.
2. Hayes J.P, "Computer Architecture and Organization", Tata McGraw Hill.
3. Hamacher C, Vranesic Z and Zaky S, "Computer Organizaton", Tata McGraw Hill

CS 14102	Computer Networks	3-0-0	3

Module 1: Overview of Data Communication and Networking
Network Architecture; OSI Reference Model; TCP/IP Protocol Suite;

Module 2: Physical Layer and Data Link Layer
Physical Layer: Physical Characteristics of Interface and Media, Representation of Bits, Synchronization of Bits, Data Rate, Line Configuration, Physical Topology, Transmission Mode, Switching; Data Link Layer: Framing, Physical Addressing, Flow Control, Error Control, Access Control: Pure/slotted ALOHA, CSMA/CD, CSMA/CA, TDMA, FDMA, CDMA;

Module 3: Network Layer and Transport Layer
Network Layer: Routing Algorithms, Congestion Control, Internet Protocol version 4 (IPv4), Address Resolution Protocol (ARP), Internet Control Message Protocol (ICMP), Networking & Internetworking Devices, Introduction to IPv6; Transport Layer: TCP, UDP;

Module 4:Network Applications
Electronic Mail (SMTP, POP); Client-Server Model; Socket Interface; Introduction to HTTP, FTP, DNS, DHCP.

Text Books:
1. A. S. Tanenbaum, Computer Networks, PHI
2. B. A. Forouzan, Data Communication and Networking, TMH
3. W. Stallings, Data and Computer Communication, PHI

CS 14103	Graph Theory and Combinatories	3-0-0	3

Module 1 and 2: Combinatorics
Introduction and scopes, permutations, combinations, derangements, Binomial and Multinomial coefficients, Principles of inclusion and exclusions; Generating functions, Theory of counting, Fibonacci numbers, Recurrence relations, Catalan numbers, Permutation groups, Burnside's theorem, Polya's theorem of counting, Cycle index, Stirling numbers, Euler numbers.

Module 3 and 4: Graph Theory
Introduction, Graphs and sub-graphs, representations, Paths, Cycles, diameter, girth, trees, connectivity, Eulerian tours, Hamilton cycles, matching, systems of distinct representatives, edge coloring, independent sets, cliques, vertex coloring, Ramsey theory, planar graphs, regular polyhedral, directed graphs, properties of some special graphs

Recommended Books:

1. J. Harris, J. L. Hirst and M. Mossinghoff, Combinatorics and Graph Theoy, Springer.
2. Wilson, Introduction to graph theory, Pearson Edication.
3. Balakrishnan, Graph Theory, Schaum's Outline Series, TMH.

CS 14201	Computer Organization and Architecture Laboratory	0-0-2	1

Design of registers, shift registers, ALU, Serial adder, Carry Look-ahead adder design, Multiplier, Basic Assembly language Programming, Memory design, study and simulation of 5-stage pipelining, score borading, Tomasulo's algorithm, Loop unrolling, Multiple issue super scalar.

Text Book:

Peter Abel IBM PC Assembly Language and Programming

CS 14202	Computer Networks Laboratory	0-0-2	1

Practical: Protocol simulation; Socket programming; Program development for ftp, SNMP, SMTP, etc; Exercises in network programming;

Experiment 1: Implementation of basic Client Server program using TCP Socket (Eg. Day time server and client).
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 system).
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.

Text Books:

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 – Inter process 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/
5. Elliotte Rusty Harold, Java Network Programming, 3rd Edition, O'Reilly, 2004.

CS 15101	Theory of Computation	3-1-0	4

Module 1
Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from other, Myhill- Nerode

Theorem

Module 2

Regular Expression (RE): Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

Module 3

Context Free Grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs

Module 4

Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG.

Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions,

Text Book:

Hopcroft and Ullman, "Introduction to Automata Theory, Languages and Computation"Pearson Education, 3rd edition, 2014

CS 15102	Database Management System	3-0-0	3

Module 1: Introduction and ER Model

Overview of a DBMS - Purpose of Database Systems; View of Data; Data Models; DDL; DML; Transaction Management; Storage Management; Database Administrator; Database Users; Overall System Structure; Entity-Relationship Model: Basic Concepts, Design Issues, Mapping Constraints, Keys, ER-Diagram, Weak Entity Sets, Extended ER-Diagram, Reduction of ER-Schema to Tables;

Module 2: Relational Model ad SQL

Relational Model Concepts: Structure of Relational Databases, Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus, Extended Relational-Algebra Operations, Modification of the Database, Views; Structured Query Language;

Module 3: Integrity Constraints and Relational Database

Integrity Constraints: Domain Constraints, Referential Integrity, Assertions, Triggers, Functional Dependencies; Relational Database Design: Decomposition, Normalization, application of the concepts in distributed environment.

Module 4: Transaction and Concurrency Control, File Organization & Query Processing

Transactions and Concurrency Control: Transaction Concepts, Transaction State, Concurrent Executions, Serializability, Recoverability, Lock-Based Protocols, Timestamp-Based Protocols, Deadlock Handling; File Organization & Query Processing: File Organization, Organization of Records in Files, Data Dictionary Storage, Steps in Query Processing;

Recommended Books:

1. Henry F. Korth and Silberschatz Abraham, Database System Concepts, Mc.Graw Hill.
2. Ramakrishnan, Database Management System, McGraw-Hill

CS 15103	Operating System	3-0-0	3

Module 1
Introduction, Categories of OS, Computer System Architecture, Interrupts, Storage Structure, Hardware Protection; OS Structures: OS Components, System Calls, System Structures, Virtual Machines, System Design Goal, SYSGEN;

Module 2
Process: Process Concept, Process Sate, PCB, Process Scheduling, Schedulers, Process Creation, Process Termination, Co-operating Process, Producer Consumer Problem, Inter-process Communication, Client Server Communication, Threads, Process Synchronization, Critical Section Problem, CPU Scheduling: CPU Scheduler, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, Priority Scheduling, Round Robin Scheduling, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling; Deadlock: Introduction, Deadlock Prevention, Deadlock Avoidance, Resource Allocation Graph Algorithms, Deadlock Detection, Prevention and Recovery;

Module 3
Memory Management: Memory Hierarchy, Memory Types, Main Memory Architecture, Cache Memory, Address Binding, Dynamic Loading, Linking, Overlays, Logical vs Physical Addresses, Swapping, Contiguous Memory allocation, Fragmentation, Segmentation, Virtual Memory, Paging, Demand Paging, Page Replacement Algorithms, Thrashing; Secondary Storage Structure: Disk Structure, Disk Scheduling, Disk Management

Module 4
Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

Text Books:
1. A. Silbersehatz and J. L. Peterson, Operating System Concepts, Wiley.
2. Dhamdhere, Operating System, TMH
3. W. Stalling, Operating Systems, Maxwell McMillan International Editions

Reference Books:
A.Silbersehatz and J. L. Peterson, Operating System Concepts, Wiley.

CS 15104	Design and Analysis of Algorithm	3-1-0	4

Module 1: Introduction
Notions of algorithms; Algorithm paradigms; Complexity analysis; Asymptotic notations; Practical Complexities;

Module 2: Divide-and-Conquer and Greedy Approach
Divide-and Conquer paradigm: Recurrence relations, finding maximum and minimum, k^{th} smallest selection, Strassen's matrix multiplication; Greedy Algorithms: Knapsack problem, tree vertex splitting, job sequencing, activity selection problem, minimum cost spanning tree; optimal storage on tapes, optimal merge patterns, single-source shortest paths;

Module 3: Dynamic Programming and Backtracking
Dynamic Programming: Multistage graph problem, single-source and all pairs shortest paths, Traveling sales person problem, Longest common subsequence problem; Back Tracking: 8-queens problem, sum-of-subsets, graph coloring, Hamiltonian cycles;

Module 4: Branch-and-Bound and NP-Hard/Complete

Branch-and-Bound: Least cost search, 15-puzzel problem; NP-Hard and NP complete problems, Introduction to approximation algorithms.

Recommended Books:

1. E. Horowitz, S. Sahni and S. Rajasekeran, Computer Algoritms, Silicon Press
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, Introduction to Algorithms, MIT Press

CS 15201	Database Management System Laboratory	0-0-2	1

Structured Query Language

Creating Database: Creating a Database, Creating a Table, Specifying Relational Data Types, Specifying Constraints, Creating Indexes

Table and Record Handling: INSERT statement; Using SELECT and INSERT together; DELETE, UPDATE, TRUNCATE statements; DROP, ALTER statements

Retrieving Data from a Database: The SELECT statement, Using the WHERE clause, Using Logical Operators in the WHERE clause, Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Creating and executing trigger, curser and Stored Procedure on the database.

CS 15202	Operating System Laboratory	0-0-2	1

Module 1

Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands).

Module 2

Different system call: programs-starting new process, replacing a process image, duplicating a process image,

Module 3

Signal handling, sending signals, signal interface, signal sets. **POSIX Threads:** programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)

Module 4

Pipes(use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO)

Text Book:

A. Silbersehatz and J. L. Peterson, Operating System Concepts, Wiley.

CS 16101	Compiler Design	3-0-0	3

Module 1

Introduction**:** Compilers – Analysis of the source program – Phases of a compiler – Cousins of the Compiler – Grouping of Phases – Compiler construction tools – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens.

Module 2

Syntax Analysis**:** Role of the parser –Writing Grammars –Context-Free Grammars – Top Down parsing – Recursive Descent Parsing – Predictive Parsing – Bottom-up parsing – Shift Reduce Parsing – Operator Precedent Parsing – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser.

Module 3

Intermediate code generation: Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples);
Introduction– Principal Sources of Optimization – Optimization of basic Blocks – DAG representation of

Basic Blocks - Introduction to Global Data Flow Analysis

Module 4
Runtime Environments – Source Language issues – Storage Organization – Storage Allocation strategies – Access to non-local names – Parameter Passing, Error detection and recovery. Code Optimization: Introduction, basic & flow graph. Peephole optimization

Text Books:
1. Aho, Sethi and Ullman, Compiler Principles, Techniques and Tools, Pearson Education.
2. Holub, Compiler Design in C, PHI.

CS 16102	Software Engineering	3-0-0	3

Module 1
Introduction to Software Engineering – Reasons for software project failure – Similarities and differences betweensoftware and other engineering products.
Software Development Life Cycle (SDLC) – Overview of Phases in different models such as waterfall, win-win etc.; Detailed Study of Requirements Phase: Requirement analysis, Importance of Clear Specification – Formal specification methods includingalgebraic specification in detail, clean room software engineering.

Module 2
Problem partitioning (subdivision) - Power of Abstraction, Concept of functional decomposition – process modeling – Concept of data modeling – ER diagrams, Class and component level designs – Object Oriented Design - UML and Design Patterns and choreography.

Module 3
Conversion of domain model to coding:Structured programming – internal documentation and need for standards – Methods of version control –maintainability, Introduction to secure programming.
Testing of prototypes:Types of testing – Specification of test cases – Code review process

Module 4
Software Project Management: Introduction to metrics. Software Process Models. Costing, Scheduling and Trackingtechniques. Software configuration management - versioning. Reusable components. Mathematical methods of riskassessment and management. Methods of software licensing and introduction to open and free software.

Text Book:
1. Roger S Pressman, Software Engineering: A Practitioner's Approach, McGraw Hill.
2. T C Lethbridge and R Laganiere, Object Oriented Software Engineering , Tata McGraw Hill.
3. PankajJalote, Software Engineering: A Precise Approach , Wiley India.
4. A Shalloway and J Trott, Design Patterns Explained: A new perspective on object oriented design

CS 16103	Artificial Intelligence	3-1-0	4

Module 1: Introduction, Intelligent Agents and Problem Solving
Overview of Artificial intelligence: Problems of AI, AI technique, Tic-Tac-Toe problem; Intelligent Agents: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents; Problem Solving: Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Module 2: Search Techniques
Solving problems by searching; problem solving agents; searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies; Heuristic search strategies: Greedy best-first search, A* search, memory bounded

heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems; Adversarial search: Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

Module 3: Knowledge & Reasoning
Knowledge representation issues; representation & mapping; approaches to knowledge representation; issues in knowledge representation; Using predicate logic: Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction; Representing knowledge using rules: Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge; Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.

Module 4: Planning and Learning
Planning: Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques; Natural Language Processing: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing; Learning: Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning; Expert Systems: Representing and using domain knowledge, expert system shells, knowledge acquisition.

Recommended Books:

1. Ritch & Knight, Artificial Intelligence, TMH
2. Russel, Artificial Intelligence, Pearson
3. Patterson, Introduction to Artificial Intelligence & Expert Systems, PHI

CS 16104	Image Processing	3-0-0	3

Module 1: Introduction
Background; Digital Image Representation; Fundamental steps in Image Processing; Elements of Digital Image Processing; Digital Image Formation: A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform; Mathematical Preliminaries: Neighbor of pixels, Connectivity, Relations, Equivalence & Transitive Closure, Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.

Module 2: Image Enhancement
Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.

Module 3: Image Restoration
Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.

Module 4: Image Segmentation
Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing via The Hough Transform; Thresholding -Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.

Recommended Books:

1. Gonzalves, Digital Image Processing, Pearson
2. Jahne, Digital Image Processing, Springer
3. Chanda & Majumder, Digital Image Processing & Analysis, PHI
4. Jain, Fundamentals of Digital Image Processing, PHI

CS 16201	Software Engineering Laboratory	0-0-2	1

Assignments to be given from the following:

1. Preparation of requirement document for standard application problems in standard format.(e.g Library Management System, Railway Reservation system, Hospital management System, University Admission system etc.)
2. Project Schedule preparation using MS project.
3. Use Case diagram, Class diagram, Sequence diagram, domain model and prepare Software Design Document using tools like Rational Rose/Visual Studio.(For standard application problems)
4. Estimation of project size and its justification using Function Point(FP) for calculation.
5. Design Test Script/Test Plan(both Black box and White Box approach) penetration testing plan.
6. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity, Cost etc.).

CS 16202	Compiler Design Laboratory	0-0-2	1

Construction of NFA from Regular Expression, Construction of DFA from NFA, construction of minimized DFA from a given regular expression, check whether a grammar is left recursion and remove the left recursion , remove left factoring,

Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs, new lines and it also ignore the comment spaces,

Implementation of shift Reduce parsing Algorithm, check whether a grammar is Operator precedent, construction of operator precedence parser table, Recursive Descent Parser, compute FIRST of non-terminals, compute FOLLOW of non-terminals, Constructing TOP DOWN parser table, Construct a LL(1) parser for an expression , Design and implementation of predictive parsing, Design and Implementation of Shift reduce parsing algorithm, construction of LR parsing table , Implement LALR parsing

CS 16203	Image Processing Laboratory	0-0-2	1

Theory

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

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

Books and 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.

CS 17101	Cryptography and Network Security	3-0-0	3

Module 1

Algebra: Group, cyclic group, cyclic subgroup, field, probability.
Number Theory: Fermat's theorem,Cauchy's theorem, Chinese remainder theorem, primality testing algorithm, Euclid's algorithm forintegers, quadratic residues, Legendre symbol, Jacobi symbol etc.

Module 2

Cryptography and cryptanalysis, Classical Cryptography, substitution cipher, different type of attack:CMA,CPA, CCA etc. Shannon perfect secrecy, OTP,
Pseudo random bit generators, stream ciphers andRC4.

Module 3

Block ciphers: Modes of operation, DES and its variants, AES, linear and differential cryptanalysis; One-way function , Trapdoor one-way function, Public key cryptography, RSA cryptosystem, Diffie-Hellman key exchange algorithm, Elgamal Cryptosystem; Cryptographic hash functions, Secure hash algorithm, Message authentication, digital signature, RSAdigital signature, Elgamal digital signature.

Module 5

IKE and IPSec; SSL/TLS; E-mail Security and PGP

Text Book:

Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, Second edition, Tata McGraw Hill, 2011

Reference Books:

1. W. Stallings, Cryptography and Network Security Principles and practice, 5/e, Pearson EducationAsia, 2012.
2. Stinson. D. Cryptography: Theory and Practice, third edition, Chapman & Hall/CRC, 2010.
3. Thomas Koshy, Elementary Number Theory with applications, Elsevier India, 2005

CS 17201	Cryptography and Network Security Laboratory	0-0-2	1

1. Simple shit cipher and transposition cipher in a client server mode using socket programming.
2. Implementation of protocol cipher having specific number of rounds in fiestal and non-fiestal mode
3. Creation of key pair in PGP sending mail using PGP and S-MIME
4. Invenstigation of cryptanalysis in veginere cipher
5. Cryptanalysis of affine cipher for a known plan text attack
6. Investigation of ssecurity whole in linux and windows-OS
7. Test of linear and differential cryptanalysis on DES
8. Implementation of two fish/blow fish cipher
9. Solving simple security problems using the tools such as Wireshark, NMAP etc.

Text Book:

Saiful Azad and Al-Sakib Khan Pathan, “Practical Cryptography: Algorithms and Implementations

Using C++".

CS 17301	Cloud Computing	3-1-0	4

Module 1: Introduction

Definition of Cloud Computing: Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models, Service models, Cloud Reference model, Characteristics of Cloud Computing, Benefits and advantages of Cloud Computing; Cloud Architecture: A brief introduction on Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients; Services and Applications by Type: IaaS, PaaS, SaaS, IDaaS and CaaS.

Module 2: Use of Platforms in Cloud Computing

Concepts of Abstraction and Virtualization: Virtualization technologies, Load Balancing and Virtualization, Hypervisors, Machine Imaging, Porting of applications in the Cloud; Concepts of Platform as a Service; Use of PaaS Application frameworks; Use of Google, Amazon and Microsoft Web Services;

Module 3: Cloud Infrastructure

Cloud Management: Features of network management systems, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle); Cloud Security: Cloud security concerns, Security boundary, Security service boundary, Overview of security mapping, Security of data, Identity management.

Module 4: Concepts of Services and Applications

Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs; Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs; Cloud-based Storage: Cloud storage definition – Manned and Unmanned; Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail.

Recommended Books:

1. B. Sosinsky, Cloud Computing Bible, Wiley India
2. R. Buyya, C. Vecchiola and S. T. Selvi, Mastering Cloud Computing, McGraw Hill
3. A. T. Velte, Cloud computing: A practical approach, TMH
4. Miller, Cloud Computing, Pearson
5. Moyer, Building applications in cloud: Concept, Patterns and Projects, Pearson

CS 17302	Advance Computer Networks	3-1-0	4

Module 1

Review of Networking Concepts. MAC layer issues: MAC protocols for high-speed LANS, MANs, wireless LANs and mobile networks, VLAN. Fast access technologies, Ethernet 802.3, ARP, IP addressing and Subnetting, NAT and PAT, Variable Length Subnet Masking, CIDR

Module 2

End to End protocols (10) TCP connection establishment and termination, Sliding window concepts, other issues: wraparound, silly window syndrome, Nagle's algorithm, adaptive retransmission, TCP extensions. Congestion and flow control, Queuing theory, TCP flavors: Tahoe, Reno, New-Reno, TCP-SACK, TCP-RED and TCP-Vegas.Transport protocol for real time (RTP), Quality of service: Integrated Services, Differentiated services, TCP extensions for high-speed networks, transaction-oriented applications.

Module 3

Routing and Multicast.Structure of internet: Autonomous systems, Intra-domain routing: OSPF and RIP, Inter-domain routing: BGP. Multicasting: Group Management (IGMP), Internet scale multicasting: Reverse path broadcast, MOSPF, DVMPRP, PIM. 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 4

Peer to peer and overlay networks. Concept of overlays, Unstructured Overlays: overlay networks, Internet traffic modelling, P2P Network, Gnutella, Concepts of Distributed Hash Table, Structured Overlays: Chord, CAN, Pastry.

Text Books:

1. Computer Networks: A Systems Approach, by Peterson and Davie, 5th Ed. Morgan Kauffman, 2011
2. Computer Networking: Top Down Approach, by Kurose and Ross, 6th Ed. Pearson, 2011

Reading List:

1. V. Paxson. "End-to-end Internet packet dynamics," in IEEE/ACM Transactions on Networking, Vol. 7, No 3, June, 1999.
2. W. Stevens, "TCP Slow Start, Congestion Avoidance, Fast Retransmit, and Fast Recovery Algorithms," RFC2001.3. K. Fall and S. Floyd, "Simulation-based comparison of Tahoe, Reno, and SACK TCP," Computer Communication Review, vol. 26, pp. 5--21, July 1996.
3. L. Brakmo and L. Peterson, "TCP Vegas: End-to-End Congestion Avoidance on a Global Internet," IEEE Journal on Selected Areas in Communications, 13(8), October 1995, 1465--1480.
4. Stoica, I., Morris, R., Karger, D., Kaashoek, F., Balakrishnan, H.: Chord: A scalable peer-to-peer lookup service for Internet applications.
5. Rowstron, A., Druschel, P.: Pastry: Scalable, decentralized object location and routing for large-scale peer to peer system
6. W. R. Stevens, TCP/IP Illustrated, Volume 1: The protocols, Addison Wesley, 1994.
7. G. R. Wright, TCP/IP Illustrated, Volume 2: The Implementation, Addison Wesley, 1995.
8. W. R. Stevens, TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols, Addison Wesley, 1996.
9. Articles in various journals and conference proceedings.
10. RFCs and Internet Drafts, available from Internet Engineering Task Force.

CS 17303	Information and Coding Theory	3-1-0	4

Module 1

Overview of Entropy: Entropy of discrete random variables- Joint, conditional and relative entropy- Chain rule for entropy, Mutual information and conditional mutual information, Relative entropy and mutual Information;

Overview of Lossless source coding: Discrete Memory-less sources, Uniquely decodable codes- Instantaneous codes- Kraft's inequality – Average codeword length, Optimal codes- Huffman coding, Arithmetic Coding, Lemplel-Ziv Coding, Shannon's Source Coding Theorem.

Lossy source coding: preliminaries, Markov sources, Rate distortion theory, data compression schemes.

Module 2

Review of Channel Capacity and Coding Theorem: Channel Capacity- Discrete memory-less channels (DMC) and channel transition probabilities, Capacity computation for simple channels- Shannon's Channel Coding Theorem for DMC, Converse of Channel Coding Theorem

Review of Continuous Sources and Channels: Differential Entropy: Mutual information- Waveform channels- Gaussian channels- Shannon-Harley Theorem, Shannon limit, efficiency of digital modulation schemes-power limited and bandwidth limited systems.

Discrete channels with memory, finite memory semi-continuous channel.

Module 3

Network source coding, Joint network source coding, Linear network codes, feedback in network codes, multiple access networks (lossless and near lossless source coding), broadcast channels, feedback.

Module 4
A review of convolutional codes, introduction to quantum information theory.

Book:
Thomas M. Cover and Joy A. Thomas, "Elements of Information Theory", John Wiley & Sons, 2006

References:

1. Shu Lin and Daniel. J. Costello Jr., "Error Control Coding: Fundamentals and applications", 2nd Ed., Prentice Hall Inc, 2004.
2. Robert Gallager, "Information Theory and Reliable Communication", John Wiley & Sons, 1968.
3. R. E. Blahut, "Theory and Practice of Error Control Codes", Addison-Wesley, 1983.

CS 17304	Natural Language Processing	4-0-0	4

Module 1: Introduction, Tokenization and Morphology
Regular Expressions and Automata: Introduction to NLP, Regular Expression, Finite State Automata; Tokenization: Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance; Morphology.

Module 2: Language Modeling, Hidden Markov Models and POS Tagging
Language Modeling: Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models; Hidden Markov Models and POS Tagging: Markov Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based and Machine Learning based approaches, Evaluation

Module 3: Text Classification and Context Free Grammar
Text Classification: Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques; Context Free Grammar: Context Free Grammar and Constituency, Some common CFG phenomena for English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing.

Module 4: Computational Lexical Semantics and Information Retrieval
Computational Lexical Semantics: Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – Word Net, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity; Information Retrieval: Boolean Retrieval, Term-document incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval.

Recommended Books:

1. Manning and Schutze, Foundation of Statistical Natural Language Processing, MIT Press
2. Jurafsky and Martin, Speech and Language Processing, Pearson Education

CS 17305	E-Commerce Technologies	4-0-0	4

Module 1: Introduction
Definition; Scope of E-Commerce; Hardware requirements; E-Commerce and Trade Cycle; Electronic Markets; Electronic Data Interchange; Internet Commerce

Module 2: Business to Business and Legal Issues
Electronic Markets; Electronic Data Interchange (EDI; EDI and Business; Inter-Organizational E-commerce; Risks: Paper Document vs. Electronic document, Authentication of Electronic document, Laws; Legal issues for Internet Commerce: Trademarks and Domain names, Cybersquatting, Copyright,

Digital Rights Managements, Jurisdiction issues, Service provider liability, Enforceable online contract.

Module 3: Security Issues
Security Solutions: Symmetric and Asymmetric Cryptosystems, RSA, DES, and Digital Signature, Protocols for secure messaging; Secure Electronic Transaction (SET) Protocol; Electronic cash over internet; Electronic payment System; Consumer trade transaction; Secure page on the Web.

Module 4: E-business
Internet bookshops and e-readers; Software supplies and support; Electronic Newspapers; Internet Banking; Virtual Auctions; Online Share Dealing; Gambling on the net; E-Diversity.

Recommended Books:
1. D. Whitley, E-Commerce-Strategy, Technologies & Applications, TMH
2. K. K. Bajaj, E-Commerce- The cutting edge of business, TMH

CS 17306	Data Mining	3-1-0	4

Module 1
Introduction to data mining-challenges and tasks, Data warehousing & Data preprocessing, Data analysis, measures of similarity and dissimilarity, Data visualization –concepts and techniques

Module 2
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
Association analysis –frequent item generation, rule generation, evaluation of association patterns, Web mining-support and confidence calculation

Module 4
Cluster analysis,-types of clusters, K means algorithm, cluster evaluation, application of data mining to Bioinformatics

Reference Books:
1. Pang-NingTan,Michael Steinbach and Vipin Kumar , Introduction to Data Mining, Pearson Education.
2. Han and Kamber, Data Mining: Concepts and Techniques (2e), Morgan Kaufmann.

CS 17307	Computer Vision	4-0-0	4

Module 1
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
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
Stereopsis: Reconstruction; human stereo; Binocular fusion; using color camera.

Module 4
Segmentation by clustering: Human vision, applications, segmentation by graph theoretic clustering. Segmentation by fitting a model, Hough transform; fitting lines, fitting curves;

Books and 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

CS 17308	Quantum Computation	3-1-0	4

Module 1:
Quantum Mechanical Model of the atom; Dual Behaviour of Matter; Particle nature of Electromagnetic Radiation; Dual nature of Electromagnetic Radiation. Planck's Quantum Theory: Heisenberg's Uncertainty Principle, Significance, Reasons of failure of Bohr's Model, Quantization of energy and Bohr's Model, Explanation of photoelectric effect, Derivation of de-Broglie Relationship, Verification of dual nature of electrons, Double-slit experiment.

Module 2
Quantum Mechanical model of atom. Hamiltonian operator: Hydrogen atom and the Schrodinger equation, Spin of Electron, Orbitals and Quantum Numbers, Orbit orbitals and its importance, Shapes of atomic orbitals, Energies of Orbitals;
Filling of orbitals in atom: Auflau Principle, Pauli's Exclusion Principle, Pauli Matrices, Hund's rule of Maximum Multiplicity; Electronic Configuration of atoms; Stability of Completely filled and Half-filled Subshells: Evidence of Quantum electronic states, Absorption spectrum. Hydrogen spectrum.

Module 3:
Basic postulates; Superposition principle; Stern-Gerlach Experiment; Measurement in quantum mechanical system; Density operators.

Module 4:
The idea of qubit gates; Quantum algorithms; Quantum Fourier transform and applications; Shor algorithm; Computational Complexity; Quantum Search; Physical realization of Quantum Computers; Bell States; Quantum Teleportation, EPR Paradox; Entanglement.

Books and References:

1. J. J. Sakurai, Modern Quantum Mechanics, Addision-Wesley (1994).
2. D. Boummeester, AEkart and A. Zeilinger, The Physics of Quantum Information,Springer (2000).
3. C. Macchiavello, G. M. Palma and A. Zeilinger, Quantum Computation and Quantum Information Theory, World Scientific (2000)

CS 17309	Web Programming	3-1-0	4

Module 1
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
Web server architecture, Programming threads in C, Shared memory synchronization, Performance measurement and workload models. Comparison using existing benchmarks.

Module 3
Web development frameworks – Detailed study of one open source web framework – Scripting Languages–Design, Implementation and Maintenance aspects.

Module 4
Service Oriented Architecture – SOAP. Web 2.0 technologies. – AJAX. Development using Web2.0 technologies. Introduction to semantic web. Web Servers (IIS, PWS and Apache).

Reference Books:
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 (1/e), Addison Wesley Professional, 2001

CS 17310	Pattern Recognition	4-0-0	4

Module 1
Introduction: Machine Perception, Pattern Recognition Systems, The Design Cycle, Learning and Adaptation. Bay'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
Maximum Likelihood and Bayesian Parameter Estimation: Maximum Likelihood Estimation, Bayesian Estimation, Bayesian Parameter Estimation, Gaussian Case and General Theory.Hidden Markov models; Non Parametric Techniques: Density Estimation, Parzen Windows, K- Nearest Neighbor Estimation, Nearest Neighbour rule, Metrics and Nearest Neighbour Classification, Fuzzy Classification, k-Means Clustering, Self-Organizing Maps.

Module 3
Linear Discriminant 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 behaviour, Minimum Squared- Error procedures. Support vector machines,Algorithm-independent machine learning-Bias and Variance, Bootstrapping-Adaboost Algorithm, Boosting, Bagging

Module 4
Multi-Layer Neural Networks: Feed-forward Operation, Classification, Back – propagation Algorithm,

Error Surfaces, Back-propagation as Feature mapping, Radial Basis Function Networks, Decision trees: Axis-parallel, Oblique, Impurity measures; Graphical Model,

Text Book:

R. O. Duda, P. E. Hart and D. G. Stork, Pattern classification, John Wiley & Sons, 2002.

References:

1. C. M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995.
2. V. N. Vapnik, The Nature of Statistical Learning Theory, Springer, 2000.
3. N. Cristianini and J. Shawe-Taylor, An Introduction to Support Vector Machines, Cambridge University Press, 2000.

CS 18101	Parallel and Distributed Computing	3-1-0	4

Module 1

Introduction; Need; Parallelism in uniprocessors systems; Characteristics of Distributed Systems, Distributed systems Versus Parallel systems, Models of distributed systems, Happened Before and Potential Causality Model, Models based on States.

Module 2

Models of distributed computation; Design issues; Operating systems for distributed computing: Distributed algorithms and applications, Clock synchronization algorithms;- Logical clocks, Vector clocks, Verifying clock algorithms, Direct dependency clocks. Fault Tolerance; Fault tolerant, termination detection algorithms and leader election algorithms

Module 3

Review of pipelining, pipelined vector processing methods, Embedding other networks, Parallel algorithm design; Performance and scalability; Parallel programming- Algorithms for array processors: sum, prefix computation, matrix multiplication; parallel sorting:

Module 4

Interconnection topologies, load balancing, memory consistency model, Message passing interface (MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory),

Text Book:

1. Introduction to Parallel Computing, by Kumar, Grama, Gupta and Karypis, Benjamin Cummings Publishing Co., 2nd Ed., 2003.
2. Using MPI: Portable Parallel Programming with the Message-Passing Interface, by William Gropp, Ewing Lusk, and Anthony Skjellum, 2nd Ed., 1999.

Reference Books:

1. M. J. Quinn, Parallel Computing: Theory and Practice, McGraw Hill.
2. H. Attiya and J. Welch, Distributed Computing: Fundamentals, Simulation and Advanced Topics, McGraw Hill

CS 18301	Machine Learning	3-1-0	4

Module 1

Overview and preliminaries, generation of data set, manipulation on data set, storage and representation of data, Dynamic system modelling – Rotational, Translational systems; Interchange of system modelling – Differential, State Space, Transfer Function; Time response of dynamic systems – LTI, Nonlinear Systems

Module 2

Introduction to Neural Networks, SLP, MLP, RBFN, Recurrent Network, SOM, Fuzzy Systems

Module 3
Sensors and Actuators, Mobile Robots, Position, and Orientation, Equations of Motion, Transformations, Path Planning, and Trajectories, Introduction to Robotic Arm/ Manipulator, Forward Kinematics, Inverse Kinematics, Redundancy and redundancy resolution

Module 4
Case study of applications of Neural Network on Mobile Robot, Case study of applications of Neural Network on Robot Manipulator, Case study of applications of Fuzzy Logic on Mobile Robot, Case study of applications of Fuzzy Logic on Robot Manipulator.

Books and References:

1. Robot Analysis and Control, H. Asada, J. J. Slotine, Wiley
2. Robot Modeling and Control, Spong, Hutchinson, and Vidyasagar, Wiley
3. A Mathematical Introduction to Robotic Manipulation, Murray,Li,andSastry, CRC
4. IntroductiontoRobotics:MechanicsandControl, Craig, Addison-Wesley
5. Robotics Technology and Flexible Automation, S. R. Deb, S. Deb, McGraw Hill

CS 18302	High Performance and Grid Computing	4-0-0	4

Module 1
Introduction to Computer Systems: Processors, Memory, I/O Devices; Cost, timing, and scale (size) models. Program Execution: Process, Virtual Memory, System Calls, Dynamic Memory Allocation.

Module 2
Machine-Level View of a Program, typical RISC instruction set and execution, Pipelining. Performance issues and Techniques, Cost and Frequency Models for I/O, paging, and caching. Temporal and spatial locality. Typical Compiler Optimizations.

Module 3
Parallel Computing: Introduction to parallel Architectures and Interconnection Networks, communication latencies. Program parallelization: task partitioning and mapping, data distribution, Message passing, synchronization and deadlocks. Distributed memory programming using MPI/PVM. Shared memory parallel programming. Multithreading.

Module 4
Introduction - Definition and Scope of grid computingGrid Computing Organizations and their roles – Grid Computing analog –
Grid Computing road map.

Books and References:

1. Dowd, K., High performance Computing, O'Reilly Series, 1993.
2. Culler, D., and Singh, J.P., Parallel Computer Architecture: A Hardware/Software Approach. Morgan Kaufmann Pub., 1999.
3. Gropp, W., Lusk, E., and Skjellum, A., Using MPI: Portable Parallel Programming with the Message-passing Interface, MIT Press, 1997.
4. Joshy Joseph & Craig Fellenstein, "Grid Computing", PHI, PTR-2003.
5. Ahmar Abbas, "Grid Computing: A Practical Guide to technology and Applications", Charles River media – 2003.

CS 18303	Information Retrieval Techniques and Evaluation	3-1-0	4

Module 1: Introduction: Boolean retrieval, term-vocabulary, postings-lists, Dictionaries; Index

Construction: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Dynamic indexing;

Module 2: Retrieval Models: term weighting, vector space model, probabilistic model, language models, computing scores in a complete search system; Evaluation: system evaluation, standard test collection, concept of relevance, metrics like precision, recall, average precision, mean average precision, F-measure;

Module 3: Relevance feedback and query expansion: Rocchio algorithm; Text classification: Naïve Bayes; Text clustering: Flat Clustering, Hierarchical Clustering.

Module 4: XML Retrieval: Basic concepts, Challenges, Evaluation; Web search: Introduction, web characteristics, web graph; Web crawl: overview, crawler architecture; Link Analysis: PageRank, Hubs and Authorities; Social search.

Text Books:

1. Manning, Raghavan and Schutze, Introduction to Information Retrieval, Cambridge University Press.
2. Baeza-Yates and Riberio-Neto, Modern Information Retrieval, Addison-Wesley.
3. Soumen Chakrabarti, Mining the Web, Morgan-Kaufman.

CS 18304	Bioinformatics	3-1-0	4

Module 1: Molecular Biology Premier: Genetic material, Genes, Structure of DNA, Analyzing DNA, Proteins; Mapping and Sequencing DNA: Restriction mapping, DNA sequencing, Shortest super string problem, Sequencing by hybridization, SBH as a Hamiltonian path problem;

Module 2: Sequence Comparison: Edit distance and alignment, Local alignment, Alignment with gap penalties, global alignment, Multiple alignment, Space-Efficient alignment; Finding Signals in DNA: Regularity Motifs in DNA sequences, Profiles, Motif finding problem, Median string problem, Brute force approach, Branch and bound algorithm, A greedy approach, A randomized algorithm;

Module 3: Clustering and Evolutionary Trees: Gene Expression analysis, Hierarchical clustering, k-Means clustering, Evolutionary trees, Additive-matrices, Small Parsimony, Large parsimony, Phylogenetic alignment, Phylogenetic networks, Galled-trees;

Module 4: Protein Structure and Folding: Protein stability and folding, Evolution of protein structures, classifications of protein structures, protein structure prediction and modeling, Prediction of protein function, drug discovery and development.

Recommended Books:

1. C. Setubal and J. Meidanis, Introduction to Computational Molecular Biology, PWS Publishing Company, Boston.
2. P. A. Pevzner, Computational Molecular Biology – An Algorithmic Approach, MIT Press.
3. R. Durbin, S. R. Eddy, A. Krogh and G. Mitchison, Biological Sequence Analysis – Probabilistic Models of Proteins and Nucleic Acids, Cambridge University Press.

CS 18305	Public Key Infrastructure and Trust Management	3-1-0	4

Module 1: Asymmetric key cryptography: RSA cryptosystem, RABIN Cryptosystem ElGamal Cryptosystem, message Integrity & Authentication; Random Oracle model, message authentication, Cryptographic hash functions; MD hash families, Whirlpool, SHA-512

Module 2: Digital Signature; Process and services, attacks on digital signatures, Digital Signature Schemes; Digital certificates and PKIs; Different PKIs: PGP (Pretty Good Privacy): Web of trust, applications; X.509: X.500, Certification Authority (CA), Registration Authority (RA), Root-CA, X.509

Protocols, Simple PKI (SPKI), Simple Distributed Security Infrastructure (SDSI);

Module 3: Entity Authentication; Passwords and Challenge Response, zero-knowledge and bio-metrics, Key management; security key distribution, Kerberos, Symmetric Key aregreement, Public Key Distribution and Hi-jacking, Issues of revocation, Anonymity and Privacy Smartcard integration with PKIs, Trust management systems,

Module 4: Email Security, PGP and S-MIME, Application in e-commerce, e-business, e-payment, e-health and mobile applications

Text Books:

1. C. Adams and S. Lloyd, Understanding PKI: Concepts, Standards, and Deployment Considerations, Addison-Wesley Professional.
2. T. Austin, PKI - Public Key Infrastructure, John Wiley & Sons.
3. Suranjan Choudhury, Public Key Infrastructure Implementation and Design, John Wiley & Sons.

CS 18306	Soft Computing	4-0-0	4

Module 1: Introduction
Soft Computing concepts; Biological and artificial neuron: analogy; introduction to fuzzy sets and fuzzy logic systems; introduction to Genetic Algorithm, Adaptive Resonance Theory, Applications.

Module 2:Fuzzy sets and Fuzzy logic systems
Classical Sets and Fuzzy Sets and Fuzzy relations; Membership functions; Fuzzy to Crisp conversions; Classical Logic and Fuzzy Logic; Fuzzy Rule based Systems; Applications of Fuzzy Logic: Fuzzy Logic based software in embedded system, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting

Module 3:Neural Network
Introduction to Neural Networks; Learning Mechanisms; Neural Network models; Competitive learning networks; Neuo-Fuzzy modeling; Applications of Neural Networks: Pattern Recognition and classification.

Module 4: Genetic Algorithms and Other Soft Computing Techniques
Simple GA; crossover and mutation; Multi-objective Genetic Algorithm (MOGA); Applications of Genetic Algorithm; Ant colony optimization (ACO); Particle Swarm Optimization (PSO)

Recommended Books:

1. S. Rajasekaran and G. Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI
2. S N Sivanandam and S. Sumathi, Principles of Soft Computing, John Wiley & Sons
3. Jang, Sun and Mizutani, Neuro-Fuzzy and Soft computing, PHI

CS 18307	Computational Complexity	3-1-0	4

Module 1: Molecular Biology Premier: Genetic material, Genes, Structure of DNA, Analyzing DNA, Proteins; Mapping and Sequencing DNA: Restriction mapping, DNA sequencing, Shortest super string problem, Sequencing by hybridization, SBH as a Hamiltonian path problem;

Module 2: Sequence Comparison: Edit distance and alignment, Local alignment, Alignment with gap penalties, global alignment, Multiple alignment, Space-Efficient alignment; Finding Signals in DNA: Regularity Motifs in DNA sequences, Profiles, Motif finding problem, Median string problem, Brute force approach, Branch and bound algorithm, A greedy approach, A randomized algorithm;

Module 3: Clustering and Evolutionary Trees: Gene Expression analysis, Hierarchical clustering, k-Means clustering, Evolutionary trees, Additive-matrices, Small Parsimony, Large parsimony, Phylogenetic alignment, Phylogenetic networks, Galled-trees;

Module 4: Protein Structure and Folding: Protein stability and folding, Evolution of protein structures, classifications of protein structures, protein structure prediction and modeling, Prediction of protein function, drug discovery and development.

Recommended Books:

1. C. Setubal and J. Meidanis, Introduction to Computational Molecular Biology, PWS Publishing Company, Boston.
2. P. A. Pevzner, Computational Molecular Biology – An Algorithmic Approach, MIT Press.
3. R. Durbin, S. R. Eddy, A. Krogh and G. Mitchison, Biological Sequence Analysis – Probabilistic Models of Proteins and Nucleic Acids, Cambridge University Press.

CS 18308	Wireless and Mobile Network Security	4-0-0	4

Module 1

Introduction to Wireless and Mobile Networks, Wireless Transmission: Signals, Antennas, Signal Propagation, Multiplexing, Modulation, SpreadSpectrum, Wireless Medium Access Control: Common Problems, SDMA, FDMA, TDMA, CDMA

Module 2

Wireless Telecommunications Systems: GSM, DECT, TETRA, UMTS, IMT-2000, LTE, Satellite Systems: Introduction, Deficiencies of existing GEO/MEO/LEO Satellite Systems, Satellite, Architectures, Satellite Routing, Satellite Channel Access, Satellite Handover, High Altitude Platforms, Applications.

Module 3

Wireless LAN: IEEE 802.11, Bluetooth, RFIDand Security issues. Mobile TCP, Mobile Network Layer: Problems of IP in Wireless, Principles behind Mobile IP, Problems, Security, issues, DHCP, Game Theory for Wireless Networks.

Module 4

Mobile Network Layer II: Ad Hoc Networks, Routing in Ad-hoc Networks, Wireless Sensor Networks, Mobile Transport Layer, Support for Mobility: File Systems, databases, WWW and Mobility, WAP, Security of mobile node, Security infrastructure for wireless and mobile networks.
Threat analysis of wireless and mobile networks

Text Book:

J. Schiller, Mobile Communications, new edition, Addison Wesley.

Reference Books:

Wireless Communications and Networks, William Stallings, 2nd edition, Prentice Hall.

CS 18309	Advance Data Structure and Algorithm	3-1-0	4

Module 1

Link lists: Single, doubly and Circular linked list, Stack and Queue.

Module 2

Binary search tree (BST): Insertion and deletion of nodes in BSTs, Querying a BST (finding max, min or a given node).AVL Tree (all Rotations), Multi-way Search Trees: B Tree, B+ Trees, Red-Black Trees, Binomial Heaps, Graph Representation, Graph Traversals, DFS, BFS, Shortest path algorithms- Shortest path un weighted graph, Shortest path weighted graph, Dijkstra's algorithms, Minimal spanning tree,

Prim's algorithm, Kruskal's algorithm Traveling salesman problems, Floyd warshall algorithms.

Module 3

Divide and Conquer Algorithms, Master Theorem, Dynamic Programming, Hashing, String Algorithms – String Matching Algorithms – Brute Force Method-Robin Karp String Matching Algorithms – String Matching with Finite automata- KMP algorithms – Boyce Moore Algorithms, Approximation Algorithms: Travelling Sales Person Problem, Vertex Cover Problem, Set Cover Problem.

Module 4

Line segments and determine whether any pair of segments intersects. Plane Sweep Techniques with its applications, Convex Hull problem (Extreme point algorithm, incremental algorithm, divide & conquer approach). Randomized algorithms: Use of probabilistic inequalities in analysis, applications using examples. Graph algorithms: Matching and Flows. Parallel algorithms: Basic techniques for sorting, seraching, merging.. Complexity classes - NP-Hard and NP-complete Problems - Cook's theorem NP completeness reductions.

Books and References:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, Introduction to Algorithms, Prentice hall.
2. Jon Kelinberg and Eva Tardos, Algorithm Design, Pearson
3. Data Structures Using C Second Edition Reema Thareja
4. Franco P. Preparata and Michael Ian Shamos, Computational Geometry An Introduction, Springer-Verlag

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