STRUCTURE
&
SYLLABUS

Master in Science (Information Technology)

P.G. Department of Information and Communication Technology
Fakir Mohan University
Vyasa Vihar, Balasore – 756019

M.SC (IT) COURSE STRUCTURE

SEMESTER I

PAPER NO.	PAPER NAME	MARKS		CREDIT
		By University	Internal Assessment	
T101	Computer Organization and Architecture	40	10	04
T102	Problem Solving and Programming through C	40	10	04
T103	Discrete Mathematical Structure	40	10	04
T104	Operating System	40	10	04
L105	Operating System / Computer Architecture Lab.	50		04
L106	C-Programming Lab.	50		04
TOTAL		300		24

SEMESTER I I

PAPER NO.	PAPER NAME	MARKS		CREDIT
		By University	Internal Assessment	
T201	Data Structure Using C++	40	10	04
T202	Database Management System	40	10	04
T203	Theory of Probability	40	10	04
T204	Software Engineering	40	10	04
L205	Data Structure Using C++ Lab.	50		04
L206	DBMS (Oracle) Lab.	50		04
TOTAL		300		24

SEMESTER I I I

PAPER NO.	PAPER NAME	MARKS		CREDIT
		By University	Internal Assessment	
T301	Object Oriented Programming Using JAVA	40	10	04
T302	Design and Analysis of Algorithms	40	10	04
T303	Computer Graphics and Multimedia	40	10	04
T304	Fundamentals of Information and Communication Technology(CBCS)	40	10	04
L305	Object Oriented Programming Using JAVA Lab.	50		04
L306	Computer Graphics and Multimedia Lab.	50		04
TOTAL		300		24

SEMESTER IV

PAPER NO.	PAPER NAME	MARKS		CREDIT
		By University	Internal Assessment	
T401	Compiler Design	40	10	04
T402	Artificial Intelligence	40	10	04
T403	Computer Network	40	10	04
T404	Elective -I	40	10	04
L405	Minor Project Work	50		04
L406	Artificial Intelligence Lab.	50		04
TOTAL		300		24

ELECTIVE-I

1. Object Oriented Analysis & Design Using UML
2. Bioinformatics.
3. Financial Engineering.
4. Mobile Computing.
5. Embedded System.
6. Computer Security.
7. Parallel and distributed system.
8. Simulation Modeling.

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1st Semester
M.SC (IT)
Syllabus

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T101 Computer Organization and Architecture

T102 Problem Solving and Programming Through C

T103 Discrete Mathematical Structure

T104 Operating Systems

L105 Operating System / Computer Architecture Laboratory

L106 C Programming Laboratory

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T101: Computer Organization & Architecture

Unit-I: Digital components: Functional units of a computer, logic gates, Minimization of Boolean Expressions, Flip-Flips, Decoders, Encoders, Multiplexers, Counters, and Registers. Data Representation: Number systems, Representations of signed and unsigned numbers, alphanumeric codes, Addition of binary numbers, subtraction, 2's complement, and Floating point number representation.

Unit-II: Register Transfer Language & Micro-operations: Concepts of the Bus, Timings in Register transfer, Languages used for data transfer in registers, Data movement from/to memory, Arithmetic circuits, Half adder, full adder, N-bit adder, Logical micro operation, arithmetic logic unit. Instruction sets for basic computer: Addressing modes, Instruction cycles, Control signal generation.

Unit-III: Central Processing Unit: General register organization, Memory stacks, Instruction types, Interrupts, Instruction pipelining, Arithmetic pipelining.
Input Output Organization: Input devices, output devices, synchronous and asynchronous communication, Modes of data transfer from I/O to memory, Vector and Priority Interrupts, Direct Memory Access, Input Output Interface.

Unit-IV: Memory Organization: Comparison of different types of memories, Main memories, Memory management. Cache memory organization: Locality of reference, Hit ratio, Mapping process. Virtual memory organization: Mapping addresses space into memory space, page replacement.

Text Books:

1. M. Moris Mano, Computer System Architecture, Prentice Hall of India, 6th Edition.

2. John P. Hayes, Computer architecture and organization, Tata McGraw Hill, 4th Edition.

Reference Books:

1. P. N. Basu, Computer Organization and Architecture, Vikas Publication, 2nd Edition.

2. H. Patterson, Computer Architecture: A Quantitative approach, Elsevier, 5th Edition.

3. W. Stalling, Computer Organization and architecture, Pearson Education Asia, 5th Edition.

4. Donald Leach & Albert Malvino, Digital Principles & Applications, McGraw Hill, 7th Edition.

T102: Problem Solving and Programming Through C

Unit I: Fundamentals of Disk Operating System, Linux commands and editor, Introduction to programming and programming languages**:** Evolution of programming languages; algorithm, flow charts, structured programming, the compilation process: object code, source code, executable code; operating system: types, evolution, translators.

Unit II: C Language Fundamentals: Character set, Identifiers, Keywords, Data Types, Constant and Variables, Statements, Expressions, Operators, Precedence of operators, Input-output Assignments, Control structures, Decision making and Branching, Decision making & looping.

Unit III: Arrays, Strings & Functions: One dimensional & Multidimensional arrays and their applications, Declarations, Manipulation. & String- handling functions. Modular programs, User defined predefined functions, formal vs Actual arguments, Functions category, function prototypes, parameter passing, Recursion, Storage Classes: Auto, Extern, Global, and Static.

Unit IV: Pointers: Pointer variable and its importance, Pointer Arithmetic, passing parameters by reference, Structures, Union and File handling: Declaration of structures, pointer to structure, pointer to function, unions, Dynamic memory allocations, unions, file management.

Text Books:

1. Brian W. Kernighan & Dennis M. Ritchie, The C Programming Language, Prentice Hall of India, 2nd Edition, 1988.
2. Byron S. Gottfried, Programming in C, Tata McGraw-Hill, 2nd Edition, 1998.

References Books:

1. S. Dehuri, P. S. Mishra, B. Dinda, and N. Padhy, Programming in C, India-Tech, New Delhi, 2012.
2. V. Rajaraman , Computer Programming in C, Prentice Hall of India, 2002.
3. Yashavant Kanetkar, Exploring C, 2nd Edition, BPB Publications.

T103: Discrete Mathematical Structure

Unit I: Logic, Prepositional Equivalences, Predicates and Quantifiers, Methods of Proofs, Mathematical Induction, and Recursive Definitions, Relations and their properties, n-ary Relations and their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Orderings.

Unit II: Basics of Counting, Pigeonhole Principle, Recurrence Relations, Solving Recurrence Relation, Generating Functions, Inclusion - Exclusion and its application.

Unit III: Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring, Trees and their applications, Spanning Trees.

UNIT IV: Languages and Grammars: Finite-state Machines with or without output, Equivalence of DFA & NFA, Properties of Language accepted by the Finite Automata, Regular Expressions. Language Recognitions, Pushdown Automata, Turing Machines.

Text Books:

1. K. H. Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill, 4th Edition, 2003.
2. Mott, A. Kandel, T. P. Baker - Discrete Mathematics for Computer Scientists & Mathematicians, Prentice Hall of India, 1999.

Reference Books:

1. C. L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill.

2. Alan Tucker, applied Combinatorics, Wiley.

3. K. Bogart, S. Drysdale, C. Stein. Discrete Math for Computer Science Students. Available online.

T104: Operating Systems

Unit I: Overview: Evolution and types of operating systems. Process Management: Process concepts, operations on processes, process control block. Scheduling: Types of schedulers, process scheduling criteria, CPU scheduling algorithms, evaluation of scheduling algorithms.

Unit II: Inter process Communication & Synchronization: Mutual Exclusion, Semaphores, classic problems of synchronization, deadlocks: reusable and consumable resources, characterization of deadlock, prevention, avoidance, detection and recovery from deadlocks.

Unit III: Memory Management: Basic hardware, address binding, swapping, contiguous memory allocation, paging, segmentation, virtual memory management: demand paging, page replacement algorithms, Allocation of frames, Thrashing.

Unit IV: Storage Management: File concepts, access methods, directory structure, file system implementation, directory implementation, disk space management, disk structure and disk scheduling algorithms. I/O systems: I/O Hardware, polling, interrupt driven I/O, direct memory access.

Text Book:

1. Avi Silberschatz, Peter Baer Galvin, and Greg Gagne, Operating System Concepts, 8th Ed., Addition Wesley.

Reference Books:

2. Milan Milenkovic, Operating Systems: Concept and Design, 3rd Ed., McGraw Hill Inc.
3. Andrew S. Tanenbaum, "Modern Operating Systems", 3rd Ed, Prentice Hall Professional Technical Ref.

L105: Operating System / Computer Architecture Laboratory

Operating System:

- Introduction to OS: DOS, Windows, and Linux/Unix- vi editor basics, common commands, Shell Programming

Computer Architecture:

- Recognition of various components of Personal Computer (PC), dismantling and assembling a PC.

- Some experiments using Hardware trainer kits for SMPS, CPU, Hard disk, Motherboard, printer, real time clock, etc.

- Simulation of simple fundamental units like half adder, full adder, multiplexer, de-multiplexer, Arithmetic logic Unit, Simple processor (CPU) etc using VHDL code.

L106: C Programming Laboratory

- Program in C to find the sum and average of the given numbers using for loop, while loop, and do-while loop.
- Program in C to sum the series $X^1+X^2+X^3+X^4+X^5+\ldots\ldots\ldots+X^n$.
- Program in C to construct pyramid of digits.
- Program in C to find average of n numbers using an array.
- Program in C to print the sum of first 'n' even natural numbers.
- Program in C to read a two-dimensional array and find the sum of the elements in the row-wise and column-wise separately and display the sums of the rows and columns.
- Program in C to print the numbers and its cube from 1 to 10 using following control statements a) if-then-else b) for loop c) while loop d) do-while loop.
- Program in C to read a two dimensional square matrix A and display its transpose.
- Program in C that prints the factorial of given numbers using i) for loop ii) while loop iii) do…while loop.
- Program to read data from the keyboard, write it to a file called INPUT, again read the same data from the INPUT file, and display it on the screen.
- Program in C that print a given numbers whether it is prime or not using i) for loop ii) while loop iii) do…while loop.
- Program in 'C' to read the students name and its average marks. If a student gets less than 40 then declare that he fails or else the passes. Prepare a computers list of give the list of names in alphabetical order separately for passed and failed students.
- Program in C to display a name 27 times using the nested for loop.
- Program to initialize the member of a structure and to display the contents of the structure on the screen.
- Program in C to find the sum of given the two numbers using the global variable declaration.
- A file named DATA contains a series of integer number. Code a program to read these numbers and then write all "odd" numbers to a file to be called ODD and all "even" numbers to a file to be called EVEN.
- Program in C to display the number and its square from 0 to 10 using register variables.
- Program to read a character from the keyboard and to display it on to the screen using the getchar ( ), getch ( ), putchar ( ) and putch ( ).
- Program in C to fund the factorial of the given numbers using the recursive function.
- Program in C to find Fibonacci sequence by recursion.
- Program in C to find the sum of two nonnegative numbers recursively.
- Program in C to find minimum and maximum of numbers using recursion.
- Program in C to search for an element using binary search with recursion.
- Program to declare a union as a pointer data type and display the contents of the union using pointer operator.

- Program in C to find the sum of a given non-negative integers using a recursive function.
    - Sum = 1 + 2 + 3 + 4 + …… n.
- Program assigns some values to the members of a structure and to display a structure and to display the structure on the video screen using the structure tag.
- Program in C to find the sum of given the two numbers using the global variable declaration.
- Program to display the memory address of a variable using pointer before incrimination and after incrimination.
- Program in C to find the largest and smallest element in a vector.
- Program in C to find second largest and smallest element in a vector.
- Program in C to delete duplicates in a vector.
- Program in C to add two matrices.
- Program in C to sort the elements of a vector in ascending order.
- Program in C to insert an element into the vector.
- Program in C to delete an element from the vector.
- Program in C to find the smallest element in an array using pointers.
- Program to read a character from the keyboard and to display it on to the screen using the getchar ( ), getch ( ), putchar ( ) and putch ( ).

2nd Semester
M.SC (IT)
Syllabus

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T201 Data Structure Using C++

T202 Database Management System

T203 Theory of Probability

T204 Software Engineering

L205 Data Structure Using C++ Laboratory

L206 DBMS (Oracle) Laboratory

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T201: Data Structure Using C++

Unit I: C++ class overview, class definition, object, class members, access control, class scope, constructors and destructors, parameter passing methods, inline functions, static class members, this pointer, friend functions, dynamic memory allocation and de-allocation (new and delete).

Unit II: Function overloading, operator overloading, generic programming- function and class templates, inheritance, base and derived classes, inheritance types, base class access control, runtime polymorphism using virtual functions, abstract classes.

Unit III: Arrays, stacks and queues, linked lists, operations, insertion, deletion and searching, hash functions, hash table methods.

Unit IV: Trees**:** Representation of trees, graphs, representation of graphs, graph search methods, DFS, BFS, sorting and searching techniques.

Text Books:

1. S. Sahni, "Data structures, Algorithms, and Applications in C++ ", University Press (India) Pvt. Ltd. , 2nd edition
2. Michael T. Goodrich et al., "Data Structures and Algorithms in C++ ", Wiley student edition, John Wiley and Sons.

Reference Books:

1. Mark Allen Weiss, "Data structures and algorithm analysis in C++", Pearson Education Ltd., 2nd Edition
2. Adam Drozdek Thomson, Data structures and algorithm in C++, 3rd Edition,
3. Langsam Yedidyah, Augenstein J Moshe, Tenenbaum M Aaron , "Data structures using C and C++", PHI, 2nd Edition
4. Walter Savitch, "Problem solving with C++", Pearson education, 4th Edition

T202: Database Management System

Unit I: Database System Architecture–Introduction to Database Systems, Data Abstraction, Data Independence, Three Schema Architecture, Database administrator, Users, Database languages, Overall system structure
Data Models-Hierarchical, Network, Relational Model and Object Oriented Data models, Entity-Relationship (E-R) Model, E-R Diagram,keys, Reduction of E-R Diagram to tables.

Unit II: Relational Query Languages:Relational algebra, extended operations, tuple and domain relational calculus basic operations, SQL – basic structure, set operations, aggregate functions, nested sub queries, Integrity Constraints

Relational Database Design: Functional dependencies, Armstrong's axioms, decomposition, Normalization using Functional, Multi-valued, Join dependencies, Normal forms

Unit III: Query processing and Optimization: Evaluation of Relational Algebra Expressions, QueryEquivalence,Join strategies, Query optimization, Creation of complex values and objects
Transaction Processing:Transaction concept, Transaction state, Concurrent executions,Serializability.

Unit IV: Concurrency Control and Recovery:Concurrency control, Locking and Time-stamp based schedules, Multi-version and Optimistic Concurrency control schemes, Recovery System, Deadlock handling
Database System Architectures: Centralized Systems, Client server systems, Parallel databases, Distributeddatabases, Data Mining and Warehousing concepts

Text Books:

1. Henry F. Korth and Abraham Silberschatz, S. Sudarshan, "Database System Concepts", 6th edition, McGraw-Hill, 2012.
2. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 6th edition, Pearson Education

Reference Books:

1. Bipin C. Desai, "An Introduction to Database Systems", West Publications, 8th edition, 2006.
2. C. J. Date, "An introduction to Database Systems", Addison Wesley Publications, 6th edition 1995.
3. Gary W. Hansen and James V. Hansen, "Database Management and Design", Prentice Hall, 1996.
4. Jeffrey A. Hoffer, Mary B. Prescott, Fred R. Mcfadden, Modern Database Management, Prentice Hall, 6th edition, 2002, 7th edition.
5. Ronald J. Norman, Object Oriented Systems Analysis and Design, Prentice Hall 1996.

T203: Theory of Probability

Unit I: Basic Notions of Probability, Finite Sample Space, Basic concepts of Permutation and Combination, Conditional Probability and Independence, Bayes Theorem and its Applications, Random Variables.

Unit II: Probability Distributions: Discrete and Continuous-Binomial, Poission, Normal, Exponential and Uniform.

Unit III: Mathematical Expectation, Moments and moment Generating Functions, Basic Concepts of Law of Large Numbers and Central Limit Theorem, Correlation and Regression.

Unit IV: Assignment: Random Number Generation Program, Correlation and Regression analysis of Data (Possibly through Computers).

Text Books:

1. K.S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Applications, PHI, 2nd Edition.
2. Joe L. Mott, Abraham Kandel, Theodore P. Baker, "Discrete Mathematics and Applications", PHI, 2nd edition.
3. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, Educational Publishers, New Delhi, 1999.

T204: Software Engineering

Unit I: Software Engineering: Definition. Phases in Software Engineering. Software Characteristics , Classification of Software. Software Process, Software Life Cycle Models Selection Criteria of Software Process Models.

Software Requirement. Types of Requirements, Feasibility Study, Types of Feasibility. Requirements Analysis Structured Analysis Requirements Specification, purpose of SRS, characteristics of SRS, structure of SRS.

Unit II: Basics of Software Design, Data Design, Architectural Design, Component-level Design, Cohesion & Coupling, User Interface Design , Coding Guidelines, Coding Methodology, Code Verification Techniques, Coding Tools.

Software Testing Strategies, V Model of Software Testing, Levels of Software Testing, Testing Techniques, Software Testing Tools, Debugging.

Unit III: Basics of Software Maintenance, Types of Software Maintenance, Software Maintenance Life Cycle, Software Maintenance Models, Techniques for Maintenance, Tools for Software Maintenance

Project Planning Process Scheduling Project Staffing People Capability Maturity Model Risk Management

Unit IV: Basics of Cost Estimation, Software Cost Estimation Process, Decomposition Techniques, Software Estimation Models. Basics of Software Configuration Management.

Quality concepts, Software Quality Assurance Activities, Evaluation of Quality, Capability maturity model, Software Reliability.

Text Book:

1. Roger S. Pressman, Software Engineering, A practitioner's Approach, 6th edition, McGrawHill International Edition.

Reference Books:

1. K.K. Agarwal & Yogesh Singh, Software Engineering, New Age International Publishers
2. Waman S Jawadekar, Software Engineering Principles and Practice, McGraw-Hill Companies.
3. Ian Sommerville, Software Engineering, 9th edition, Addition Wesley, 2011.

L205: Data Structures Using C++ Laboratory

1. Write C++ programs to implement the following using an array.
    a) Stack ADT
    b) Queue ADT
2. Write C++ programs to implement the following using a singly linked list.
    a) Stack ADT
    b) Queue ADT
3. Write C++ program to implement the de-queue (double ended queue) ADT using a doubly linked list.
4. Write a C++ program to perform the following operations:
    a) Insert an element into a binary search tree.
    b) Delete an element from a binary search tree.
    c) Search for a key element in a binary search tree.
5. Write a C++ program to implement circular queue ADT using an array.
6. Write C++ programs that use non-recursive functions to traverse the given binary tree in
    a) Preorder
    b) Inorder and
    c) Postorder.
7. Write a C++ programs for the implementation of bfs and dfs for a given graph.
8. Write C++ programs for implementing the following sorting methods:
    a) Quick sort
    b) Merge sort
    c) Heap sort
9. Write a C++ program to perform the following operations
    a) Insertion into a B-tree
    b) Deletion from a B-tree
10. Write a C++ program to perform the following operations
    a) Insertion into an AVL-tree
    b) Deletion from an AVL-tree
11. Write a C++ program to implement Kruskal's algorithm to generate a minimum spanning tree.
12. Write a C++ program to implement Prim's algorithm to generate a minimum spanning tree.
13. Write a C++ program to implement all the functions of a dictionary (ADT) using hashing.

L206: DBMS (Oracle) laboratory

Creating, Altering, Dropping tables with Constraints, Insert Table.

- Experiment 1: Create Tables
- Experiment 2: Alter table with changes in columns
- Experiment 3: Alter table with constraints
- Experiment 4: Dropping Tables
- Experiment 5: Inserting Data into Tables.

Inserting, Simple Select, Char, Number, Date functions

- Experiment 6: Simple Select
- Experiment 7: Select with conditions.
- Experiment 8: Using character functions.
- Experiment 9: Using number functions.
- Experiment 10: Using date functions.

Detailed SELECT with sub-queries, EQUI-JOINS, correlated sub-queries.

- Experiment 11: Single row sub-queries.
- Experiment 12: Multiple row sub-queries.
- Experiment 13: Equal joins.
- Experiment 14: correlated sub-queries.

GROUPING, SET, UPDATE, DELETE, VIEWS

- Experiment 15: Aggregate functions.
- Experiment 16: Grouping clauses
- Experiment 17: Select groups with having
- Experiment 18: Union/Intersection statements
- Experiment 19: Creating and dropping views.

Back Logs, if any and/or Additional Exercises

3rd Semester

M.SC (IT)

Syllabus

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T301 Object Oriented Programming Using Java

T302 Design and Analysis of Algorithms

T303 Computer Graphics and Multimedia

T304 Fundamental of Information and Communication Technology (CBCS)

L305 Object Oriented Programming Using Java Laboratory

L306 Computer Graphics and Multimedia Laboratory

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Fakir Mohan Studies (Non-Credit Course)

T301: Object Oriented Programming Using Java

Unit I: Introduction to Java and Java programming Environment: Object Oriented Programming, Fundamental Programming Structure: Data Types, variable, Typecasting Arrays, Operators and their precedence. Control Flow, Java's Selection statements, (if, switch, iteration, statement, while, do while, for, nested loop). Concept of Objects and Classes, Using Exiting Classes building your own classes, constructor overloading, static , final, this keyword.

Unit II: Inheritance, Packages & Interfaces: Using Super to Call Super class constructor, Method overriding, dynamic method Dispatch, Using Abstract Classes, Using final with inheritance. The Object Class, Packages, Access Protection, Importing package, Interface, Implementing Interfaces, variables in Interfaces, Interfaces can be extended.

Unit III: Exception Handling, Multi Threading, & String Handling: Fundamentals, Types Checked , Unchecked exceptions, Using try & catch, Multiple catch, throw , throws, finally, Java's Built in exceptions, user defined exception. Multi Threading, Java Thread Model, Thread Priorities, Synchronization, Creating a thread, Creating Multiple threads, Using join ( ), wait () & notify ( ).String handling, String constructors, String length, Character Extraction, String Comparison, Modifying a string, Java I/O.

Unit IV: Applets, AWT: Basics, Architecture, Skeleton, The HTML APPLET Tag, Passing Parameters to Applets, Applet context and show documents ( ). AWT: AWT Classes window fundamentals, component, container, panel, Window, Frame , Canvas, Creating a frame window in an Applet , working with Graphics , Control Fundamentals , Layout managers, Handling Events by Extending AWT components.

Textbooks:

1. Y. Daniel Liang, Introduction to Java Programming Comprehensive Version, Prentice Hall, 7th Edition, 2009.
2. Herbert Schildt, Java: The Complete Reference, TMH, 5th Edition.

Reference Books:

1. E. Balguruswamy, Programming with JAVA, TMH, 4th Edition.
3. Cay S. Horstmann, Big Java: Early Objects, 5th Edition, International Student Version.
4. Wigglesworth Joe, Java Programming: Advanced Topics, Cengage Learning.
5. H.M. Deitel & Paul J. Deitel, Java How to Program, PHI, 8th Edition

T 302: Design and Analysis of Algorithms

Unit I: Introduction: Introduction to Design and Analysis of Algorithm, Growth of Functions, Recurrences. Sorting and Selection: Insertion sort, Heapsort, Quicksort, Sorting in Linear Time, Selection.

Unit II: Algorithm Design & Analysis Techniques (I): Divide and Conquer & Randomization (Examples: Quick Sort, Miller-Robin Primality Test). Data Structure: Binomial Heaps, Fibonnaci Heaps.

Unit III: Algorithm Design & Analysis Techniques (II): Dynamic Programming (Examples-Traveling Salesperson Problem), Greedy Method (Example: Activity-Selection Problem, Job Sequencing with Deadlines), Backtracking (Examples: 8-Queens Problem & Subset sum Problem).

Unit IV: Graph Algorithms: Data Structure for Disjoint Sets, Minimal Spanning Tree (Algorithms Kruskal & Prim), Single Source Shortest Paths (Dijkstra's Algorithm), All Pairs of Shortest Paths (Floyd- Warshall Algorithm), Topological Sort, String Matching Algorithms, NP-Completeness and Introduction to Approximation Algorithms.

Text Books:

1. T. H. Cormen, C. E. Leiserson & R. L. Rivest, Introduction to Algorithms, PHI, 3rd Edition.
2. E. Horwitz, S. Sahani, S. Rajasekharn, Fundamentals of Computer Algorithms, Galgotia Publication, 2000.

Reference Books:

1. Alfred V. Aho, John E. Hopcroft, and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Addison Wesley Longmans, 1998.
2. G. Brassard, P. Bratley, Fundamentals of Algorithmic, PHI, 1998.

T303: Computer Graphics and Multimedia

Unit I: Applications of computer graphics, Elements of pictures created in computer graphics, Graphics display devices, Basic raster graphics algorithms for drawing 2D primitives: Characteristics of good line drawing algorithms, line drawing algorithms: Simple DDA, Symmetric DDA, Bresenham's Line Drawing Algorithm. Circle drawing algorithms.

Unit II: 2D geometric transformations and 2D viewing: Basic transformations, Matrix representations and homogeneous coordinates, Composite transformations, Clipping and windowing: Need for clipping and windowing, Line clipping Algorithms: midpoint subdivision, Cohen-Sutherland, Cyrus-Beck, Liang-Barsky, polygon clipping Algorithms: Sutherland-Hodgeman, Weiler-Atherton , window-to-viewport coordinate transformation.

Unit III: 3D concepts & 3D object representations: Polygon surfaces, Curved lines and surfaces, Spline representations, Bezier & B-spline curves. 3D geometric transformations and 3D viewing: Translation, Rotation, Scaling, Parallel & Perspective projections.

Unit IV: Introduction to Multimedia, Hardware elements, applications, data interface standards of Multimedia, Non Temporal Media: Text, Hypertext, Images. Multimedia Input/output technologies, Digital Audio, Digital video, Wave Files, Music, MIDI , Multimedia Authoring, Compression and decompression structure: Lossless& Lossy compression, Binary Image compression.

Text Books:

1. Donald Hearn & M. Pauline Baker, Computer Graphics C Version, Second Edition, Pearson Education.

2. James D. Foley, A. van Dam, Steven K. Feiner & John F. Hughes, Computer Graphics Principles & Practice, Second Edition in C, Pearson Education.

3. Fred T. Hofstetter, Multimedia Literacy, Tata McGraw Hill, 1995.

Reference Books:

1. Roy A. Plastock & Zhigang Xiang, Schaum's Outline of Computer Graphics, Second Edition, Tata McGraw-Hill.

2. Ranjan Parekh, Principles of Multimedia, McGraw-Hill

L 305: Objects Oriented Programming Using JAVA Laboratory

1. Introduction, Compiling & executing a java program.
2. Program with data types & variables.
3. Program with decision control structures: if, nested if etc.
4. Program with loop control structures: do, while, for etc.
5. Program with classes and objects.
6. Implementing data abstraction & data hiding.
7. Implementing inheritance.
8. Implementing and polymorphism.
9. Implementing packages.
10. Implementing generics.
11. Program with modern features of java.
12. Implementing interfaces and inner classes
13. Implementing wrapper classes
14. Implementing generics.
15. Implementing cloning.
16. Implementing Reflections
17. Working with files.
18. Implementing a Lexical Analyzer
19. Implementing a parser
20. Implementing a code generator

L306: Computer Graphics and Multimedia Laboratory

1. Introduction to OpenGL Programming.
2. Implementing line drawing algorithms.
3. Implementing circle drawing algorithms.
4. Implementing ellipse drawing algorithms.
5. Implementing Line Clipping Algorithms.
6. Implementing Polygon Clipping Algorithms.
7. Implementing 2-d Transformations.
8. Implementing 3-d Transformations.
9. Implementing scan fill, boundary fill algorithms.
10. Implementing seed fill, flood fill algorithm.
11. Writing program on B-Splines, Bezier Curves
12. Writing program on Mandelbrot set & Julia set.
13. Writing program on Sierpinski gasket, Koch curve.
14. Writing program on Fractal trees & forest.
15. Writing program on wire frame model & terrain generation.
16. Implementing Ray tracing algorithm.
17. Writing program on Animation & Morphing techniques.

T304: Fundamentals of Information and Communication Technology

Unit I : Data, Information, and Computer Organization: – Introduction, Types of Data, A Simple Model of a Computer, Data Processing Using a Computer.

Data Storage: Introduction, Memory organization, Physical Devices used as Memory Cells, Random access Memory, Read only Memory, Secondary Memory, Compact Disk Read only Memory (CDROM), Flash Memory.

Central Processing Unit: Introduction, The Structure of a Central Processing Unit, Interconnection of CPU with Memory and I/O Units.

Unit II : Data Organization and Software: Data Organization: Introduction, Organizing a Database, Structure of a Database, Database Management System, Example of Database Design, Non-text Databases, Archiving Databases. Processing Numerical and Text Data: Introduction, Use of Spreadsheets, Numerical Computation Examples, Microsoft Word, Notepad, Learning Power point Presentation. Software: Introduction, Operating System, Flowcharts, Algorithms, Programming Languages, Classification of Programming Languages.

Unit III: Internet Technology: Computer Networks: Introduction, Local Area Network (LAN), Applications of LAN, Wide Area Network (WAN), Internet, Naming Computers Connected to Internet, The Future of Internet Technology.

Some Internet Applications: Introduction, E-mail, Information Browsing Service, The World Wide Web, Information Retrieval from the World Wide Web, Other Facilities Provided by Browsers, Audio on the Internet, Pictures, Animation and Video via Internet

Unit IV:

Societal Impacts and Ethics of Information Technology: Introduction, Privacy, Security, and Integrity of Information, Disaster Recovery, Intellectual Property Rights, Careers in Information Technology and other relevant applications in business, science, Judicial System, Health Care System, and engineering.

Text Books:

1. V. Rajaraman, Introduction to Information Technology, Prentice Hall of India, New Delhi.
2. P. K. Sinha and P. Sinha, Computer Fundamentals, BPB Publication.

Reference Books:

1. V. Rajaraman, Fundamentals of computers, Prentice Hall of India, New Delhi.
2. M. M. Mano, Computer System Architecture, Prentice Hall of India, New Delhi, 1995
3. Efraime Turban, R. Kelly Rainer, and Richard E. Potter, Introduction to Information Technology, Wiley.
4. Raj Kamal, Internet and Web Technology, Tata McGraw Hill Education.
5. J. P. Glaser and Cloudia Salzberg, The Strategic Application of Information Technology in Health Care Organization, Jossey- Bass.
6. R. Elmasri and S. B. Navathe, Fundamentals of Database System, Addison Wisley.

4th Semester
M.SC (IT)
Syllabus

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T401: Compiler Design

T402: Artificial Intelligence

T403: Computer Networks

T404: Elective-I

L405: Minor Project Work

L406: Artificial Intelligence Laboratory

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T401: Compiler Design

UNIT I: Introduction to Compiling and Lexical Analysis: Compilers, Analysis of the source program, the phases of a compiler, Cousins of the compiler, the grouping of phases, Compiler-construction tools.

Lexical Analysis -The role of the lexical analyzer, Input buffering, Specification of tokens, Recognition of tokens, A language for specifying lexical analyzers, Design of a lexical analyzer generator.

UNIT II: Syntax Analysis: The role of the parser, Context-free grammar, writing a grammar, Top- down parsing, Bottom-up parsing, Operator-precedence parsing, LR parsers, Parser generators.

Syntax-Directed Translation: Syntax-directed definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, Top-down translations, Bottom-up evaluation of inherited attributes.

UNIT III: Run-Time Environments: Source language issues, Storage organization, Storage-allocation strategies, Access to nonlocal names, Parameter passing, Symbol tables, Language facilities for dynamic storage allocation, Dynamic storage allocation techniques, Storage allocation in Fortran.

Intermediate Code Generation: Intermediate languages, Declarations, Assignment statements, Boolean expressions, Case statements.

UNIT IV: Code Generation: Issues in the design of a code generator, The target machine, Run-time storage management, Basic blocks and flow graphs, Next- use information, A simple code generator, Register allocation and assignment, The Dag representation of basic blocks.

Code Optimization: Introduction, The principle source of optimization, Optimization of basic blocks, Loops in flow graphs.

Text Books:

1. John E. Hopcraft & Jeffery D. Ullman, "Introduction to Automata Theory, Languages and Computation", Narosa Publishing House, New Delhi.

2. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers - Principles, Techniques and Tools", Addison Wesley.

T 402: Artificial Intelligence

Unit I: Concepts in AI, problem solving in AI, Defining an AI Problem as state space search, production systems, AI problem characteristics.

Heuristic Search Techniques: generate-and-test, hill climbing, best first search, problem reduction, simulated annealing.

Unit II: Knowledge Representation in AI, approaches & issues in knowledge representation, Knowledge Representation using predicate logic, forward and backward reasoning, semantic nets, frames, scripts & conceptual Dependency.

Unit III: Expert systems: Architecture, the knowledge base, inference engine, Knowledge acquisition Expert system development process MYCIN as an example.

Natural language processing: Syntactic processing, Semantic analysis, Disclosure & pragmatic processing.

Unit IV: Introduction to pattern recognition and classification process, learning Classification patterns, Visual image understanding, image transformation, Preliminary concepts of parallel and distributed AI, Artificial Neural networks, LMS learning rule, general Delta Rule, Back Propagation.

Text Books:

1. E. Rich and Knight, "Artificial Intelligence", 2nd Edition, TMH.
2. S. J. Russel and P. Norvig, "Artificial Intelligence: A Modern Approaches", Prentice Hall, 2010.

Reference Books:

3. D.W.Patterson, "Introduction to AI and Expert Systems", PHI.
   2.D. W. Rolston, "Principles of AI and Expert Systems Development", Mc Graw Hill.
3. P. H. Winston, "Artificial Intelligence", Addison Wesley.

T403: Computer Networks

Unit I : Overview of computer Networks, Data communication, Network hardware and software, Network protocols and standards, Point-to-point and multipoint line configuration, Network topologies: Bus, Ring, Tree, Star, Mesh, Hybrid, Types of Networks: Local area, Wide area and Metropolitan area Networks. OSI and TCP/IP reference models.

Unit III: Digital Transmission: Line coding, Block coding, Parallel and serial transmission, Transmission media: Guided media (twisted pair, coaxial, Fiber-optic cable), Unguided media. Multiplexing: Frequency division, Error Detection and Correction: Types of errors, Error Detection, Block coding, Redundancy checks and checksum, Error correction methods: Single-bit error correction, Hamming code, Burst error correction.

Unit III: Data links Control: Flow & Error control: Stop-and Wait ARQ, Sliding window ARQ. Data link protocols: Asynchronous and synchronous protocols, Character and bit oriented protocols, Local Area Networks: Traditional Ethernet, Fast Ethernet, IEEE802 standards, Token Bus, Token Ring, Fiber Distributed Data Interface (FDDI). Switching: Circuit switching. Packet switching, message switching.

Unit IV: Integrated Services Digital Network (ISDN): Services, History, subscriber access to ISDN, the ISDN layers, Broadband ISDN. X.25 layers, protocols related to X.25.Frame Relay: Introduction, Frame Relay Operation, Congestion control, Leaky Bucket algorithm. Networking and Internetworking devices: Repeaters, Bridges, Routers, Gateways, Routing Algorithms. TCP/IP Protocols Suit: Overview, Network layer, Addressing, Subneting, Transport layer: UDP & TCP, Application layer: Client-server model, BOOTP, DHCP, Domain Name Space(DNS), Telnet, File Transfer Protocol (FTP), Simple Mail Transfer protocol (SMTP), Simple network management protocol (SNMP), HTTP.

Text Book:

1. Behrouz A. Forouzan, "Data Communication and Networking", 2nd Edition, 2003, Tata McGraw Hill

Reference Books:

1. Andrew S. Tanenbaum, "Computer Networks", Third Edition, Prentice-Hall India, 1996.
2. Alberto Leon-Garcia &,Indra Widjaja, "Communication Networks-Fundamental Concepts and Key Architectures", McGraw-Hill, 2000.
3. W. Stallings, "Data & Computer Communication", 5th Edition, Prentice Hall India, 1998
4. S Keshav, "An Engineering Approach to Computer Networking", Addition Wesley, 1998

L405: Minor Project Work

- The project work of 4 Credits to be done by the student based upon the courses taught in the current and previous semesters.
- Each student should submit a project report and the marks will be awarded on the report as well as the presentation by the student.

L406: Artificial Intelligence Lab oratory

Development of programs for simulation of computer games like: Tic-Tac Toe, N-queens Problems, Chess, etc.

Simulation of Nervous system

Simulation of evolutionary theory

Knowledge representation using AI Tools

Design of medical expert systems

T404: Elective –I

T404: Object Oriented Analysis & Design Using UML

Unit I: Importance of Modeling, Principles of modeling, Overview of UML, Building blocks of UML. Analysis and design, Object oriented analysis and design, Classes, Relationships, class diagrams.

Unit II: Advanced classes, Advance Relationships, Interfaces, types and roles, Packages, Instances, Object diagrams.

Unit III: Interactions, Use cases, Use case diagrams, Interaction diagrams, activity diagrams, Process and threads, Time and space, State chart diagram.

Unit IV: Components, Component diagrams, Deployment and Deployment diagram, Collaboration and Collaboration diagram.

Text Books:

1. Grady Booch, James Rambaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", Pearson Education. 2nd Edition, 2004.
2. Michael R. Blaha and James R Rambaugh, "Object-Oriented Modeling and Design with UML", Second Edition, 2005, Pearson Education, Inc. New Delhi.
3. Mark Priestley, "Practical Object-Oriented Design with UML", Second Edition, 2006, McGraw-Hill Education, India. New Delhi.

Reference Books:

1. Grady Booch, "Object-Oriented Analysis and Design with Applications", Third Edition, 2007, Pearson Education, Inc. New Delhi.
2. Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analvsis and Design and Iterative Development", Third Edition, 2005, Pearson Education, Inc. New Delhi.
3. Mike O'Docherty, "Object Oriented Analysis and Design: Understanding System Development with UML 2,0", 2005, Wiley India Pvt. Ltd., New Delhi.

T404: Bioinformatics

Unit I : Introduction, Algorithms and Complexity: Biological Algorithms versus Computer Algorithms, Notations, Algorithm Design Techniques, Tractable versus Intractable Problems. Molecular Biology Primer: Genes, Molecules, Structure of DNA, Proteins, Analysis. Exhaustive Search: Restriction Mapping, Impractical Restriction Mapping Algorithms, A Practical Restriction Mapping Algorithm, Regulatory Motifs in DNA Sequences, Profiles, The Motif Finding Problem, Search Trees, Finding Motifs, Finding a Median String.

Unit II: Greedy Algorithms: Genome Rearrangements, Sorting by Reversals, Approximation Algorithms, Breakpoints: A Different Face of Greed, A Greedy Approach to Motif Finding. Dynamic Programming Algorithms: The Power of DNA Sequence Comparison, the Change Problem Revisited, the Manhattan Tourist Problem, Edit Distance and Alignments, Longest Common Subsequences.

Unit III: Sequence Alignment: Global sequence alignment, the Needleman and Wunsch algorithm, Scoring Alignments, Local Sequence Alignment, the smith-waterman algorithm. Alignment with Gap Penalties, Multiple Alignment, Gene Prediction, Statistical Approaches to Gene Prediction, Similarity-Based Approaches to Gene Prediction, Spliced Alignment. Divide and Conquer Approach to Sorting, Space Efficient Sequence Alignment, Block Alignment.

Unit IV: Graph Algorithms: Graphs and Genetics, DNA Sequencing, Shortest Superstring ,Problem, DNA Arrays as an Alternative Sequencing Technique, Sequencing by Hybridization, Fragment Assembly in DNA Sequencing, Protein Sequencing and Identification, The Peptide Sequencing Problem, Spectrum Graphs, Protein Identification via Database Search, Spectral Convolution, Spectral Alignment. Combinatorial Pattern Matching: Repeat Finding, Hash Tables, Exact Pattern Matching, Keyword Trees, Suffix Trees, Heuristic Similarity Search Algorithms, Approximate Pattern Matching, BLAST: Comparing a Sequence against a Database.

Text Books:

1. Neil C. Jones and Pavel A. Pevzner, An Introduction to Bioinformatics Algorithms, MIT Press, 2004.
2. Ion Mandoiu and Alexander Zelikovsky, Bioinformatics Algorithms, Techniques & Applications, Wiley Inter-Science, 2008
3. Wing-Kin Sung, Algorithms in Bioinformatics: A Practical Introduction, CRC Press (Taylor & Francis Group), 2009.

Reference Books:

1. T.K. Attwood and Phukan Smith, Introduction to Bioinformatics, Pearson Education.
2. B. Bergeron, Bio-informatics Computing, Pearson Education.
3. J.M Claverie and C.N. Notredame, Bioinformatics- A beginners Guide, Wiley Pub.

T404: Financial Engineering

Unit I: Introduction to Stochastic Calculus: Martingales, Brownian motions, Diffusions and stochastic differential equations, It's lemma, Girsanov's theorem.
The Fundamental Theorem of Asset Pricing: Arbitrage, numeraires and martingale measures, The martingale property of asset prices, The martingale property of forward and futures prices, The risk-neutral martingale measure, and the forward martingale measure.
Unit II: Martingale Pricing and Monte Carlo Simulation: The martingale approach to derivative pricing. Examples: Black-Scholes and Black formulas. Monte Carlo simulation. Euler discretization. Choleski decomposition. Estimating the greeks through Monte Carlo simulation.
Unit III: Introduction to Equity Derivatives: Key features of empirical volatility surfaces for equity derivatives. Implications for price distributions. Time-series evidence from the VIX. Volatility derivatives. Variance swaps: pricing and synthetic replication. The construction of the VIX. Quantos. Hedging with stochastic volatility and jumps.
Unit IV: Introduction to Fixed Income Derivatives: Basic instruments (swaps, caps and oors, swaptions). The market pricing formulas and quoting conventions. Empirical volatility surfaces for xed income derivatives. Pricing caps, oors and swaptions as bond options.
Modeling Volatility: Local volatility models: the constant elasticity of variance (CEV) model and the implied volatility function (IVF) model. Stochastic volatility models: the Heston model. Calibration and Monte Carlo implementation of stochastic volatility models.

Text Books:

1. John C. Hull, Options, Futures, and Other Derivatives, 6th edition, Prentice Hall, 2005.
2. Paul Glasserman, Monte Carlo Methods in Financial Engineering, 1st edition, Springer,2004.
3. Riccardo Rebonato, Volatility and Correlation, 2nd edition, Wiley, 2004.

Reference Books:

1. Damiano Brigo and Fabio Mercurio, Interest Rate Models - Theory and Practice, 2nd edition, Springer, 2006.
2. Riccardo Rebonato,Modern Pricing of Interest-Rate Derivatives: The LIBOR Market Model and Beyond, 1st edition, Princeton University Press, 2002.
3. Philipp J. Schonbucher, Credit Derivatives Pricing Models, 1st edition, Wley, 2003.

T404 Mobile Computing

Unit I: Applications, history of mobile communication, introduction to GSM system, GSM background, GSM operational and technical requirements. cell layout and frequency planning, mobile station, base station systems, switching sub systems, home locations, register, Visiting Location Register (VLR), equipment identity register, echo canceller. GSM network structure, Recent Advances and application Standards in Mobile OS.

Unit II: Time and Frequency Domains representations, structure of TDMA slot with frame; Time organization of signaling channels, frequency hopping. TDMA standards and Applications, Time Organization of signaling Channels.

Unit III: Mobility Management, Signaling protocols, steps in formation of a call, location updates, MS-PSTN call, PSTN-MS call, MS-MS call, call handover. Functioning and types of PSTN networks. Security issues in mobile computing, Authentication, encryption, Characteristics of SIM, equipment identification. Security Application development for Mobile OS.

Unit IV: Multiplexing issues in time and frequency domains, FDMA, TDMA, CDMA, Physical layer, data link layer, MAP Protocols, MTP3, SCCP, TCAP protocol, message formation, MAP protocol-MAP protocol for MM, MAP protocol for basic service support. Application layers RR-layer, MM-layer, CC-Layer, API's for mobile application development.

Text Books:

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

Reference Books:

1. Jerry D. Gibson, The Mobile Communication Handbook, IEEE Press
2. Jochen Schiller, Mobile Communication, Pearson Education Asia
3. V. Garg and E.Joseph, Wilkes—Wireless and personal Communications Systems, Prentice Hall
4. Lauren Darcey and Shane Conder, Android: Wireless Application Development Developer's Library, 2nd Edition, Addison Wesley.

T404 EMBEDED SYSTEMS

Unit I: Introduction: An embedded system, Processor in the system, other hardware units, software embedded into a systems, exemplary embedded system-on-chip (SOC) and VLSI circuit
Unit II: Devices and Device Drivers ; I/O devices, Timer and counting devices, serial communication using the IC, CAN and advance I/O buses between the networked multiple devices, Host system or Computer parallel communication between the networked I/O multiple devices using the ISA, PCI, PCI-X and advance buses, Device drivers, Parallel port devices drivers in a system, Serial port device drives in a system, Interrupt servicing (Handling) mechanism.
Unit III: Software and Programming Concept: Processor selection for an embedded system, memory selection for an embedded system, Embedded programming in C ++, Embedded programming in JAVA, Unified modeling language (UML), multiple processes and application, problem of sharing data by multiple tasks and routines, Inter process communication. Real time Operating System: Operating system services, I/O subsystem, Network operating system, Real Time and embedded system, Need of well tested and debugged Real time operating system (RTOS), Introduction to C/ OS- II.
Unit IV: Case studies of programming with RTOS : Case study of an embedded system for a smart card Hardware and Software Co-design : Embedded system project management, Embedded system design and co-design issues in system development process, design cycle in the development phase for an embedded system, Use of software tools for development of an embedded system, Issues in embedded system design.

Text Books

1. Raj Kamal, Embedded Systems: Architecture, Programming, and Design, TMH, 2003
2. Felice Balarin et al., Hardware Software Co-design of Embedded System, Kulwer Academic Publishers,
3. Sriram V. Iyer and Pankaj Gupat, Embedded Real time system Programming, TMH

T404 Computer Security

UNIT I: Attacks on Computer and Computer Security: Concepts, Architecture, Security attacks, Security services, Principles of Security, A Model for Internetwork security. Cryptography: Concepts and Techniques, Introduction, Plain & Cipher text, Substitution Techniques, Transposition Techniques, Encryption, Decryption, Symmetric and asymmetric key Cryptography, Steganography, key range and Key size, possible types of attack.

UNIT II: Block Ciphers and the Data Encryption Standards: Principles, The Data Encryption Standard (DES), Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principle, International data encryption algorithm (IDEA). Advanced Encryption Standard: Origins, Structure, Round Functions, Key Expansion, AES Implementation.

UNIT III: Asymmetric Key Algorithms: Brief history, overview, The RSA Algorithm. Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards, Knapsack algorithm. Digital certificates, Private Key Management, public key cryptography standards

UNIT IV: IP Security: Overview, Architecture, Authentication, Encapsulating Security Payload. Web Security: requirements, secure sockets layer and Transport layer security, Secure Electronic Transaction, Electronic Mail Security. System security: Intrusion Detection, Password Management, Malicious Software: Types of Malicious Software, Viruses, Worms, Denial of Service Attacks, Firewalls: The Need for Firewalls, Firewall Characteristics, Types of Firewalls.

Text Books:

1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education.
2. Atul Kahate, Cryptography and Network Security, 2nd Edition, TMH
3. Eric Maiwald, Fundamentals of Network Security, Dreamtech press.
4. Charlie Kaufman, Radia Perlman and Mike Speciner, Network Security - Private Communication in a Public World, Pearson/PHI.
5. Robert Bragg, Mark Rhodes, Network Security: The complete reference, TMH

T404: Parallel and Distributed System

Unit I: Introduction to parallel computing: Parallel programming platforms: Trends in microprocessor Architectures, Limitations of memory system performance, Dichotomy of parallel computing platforms, physical organization of parallel platforms, communication costs in parallel machines, Routing mechanisms for interconnection network, Impact of process processors mapping and mapping techniques.

Unit II: Principles of parallel algorithm design: Preliminaries, Decomposition techniques, Characteristics of tasks and interactions, Mapping techniques for load balancing, Methods for containing. Interactions overheads, Parallel algorithm models. Basic communication operations: One-to-All Broadcast and All-to-One Reduction, All-to-All broadcast and reduction All-Reduce and prefix sum operations, scatter and gather, All-to-All personalized communication, circular shift, Improving the speed of some communication operation.

Unit III: Analytical modeling of parallel programs: Performance metrics for parallel systems, Effect of granularity of performance, scalability of parallel system, Minimum execution time and minimum cost-optimal execution time, asymptotic analysis of parallel programs, other scalability metrics. Programming using the message passing paradigm:

Unit IV: Principle of message: Passing programming, Send and receive operations, The message passing interface, Topologies and embedding, Overlapping communication with computation, collective communication and computation operations, Groups and communicators. Dense matrix algorithm: Matrix-vector multiplication, Matrix-matrix algorithm, Solving a system of linear equations.

Text Book:

1) Ananth Gram, Anshul Gupta, George Karypis, and Vipin Kumar, Introduction to Parallel Computing, Second Edition, Person Education.
2) Michael J. Quinn, Parallel computing Theory and Practice, Second Edition, TMH.

T404: Simulation Modeling

Unit I: Selected illustrative examples of simulation applications. Models: Structural, Process, Continuous, Discrete, Deterministic, Random, input/output, static, dynamic, multilevel.

Unit III: Simulation: Analog/Digital/Hybrid, verification, validation. Data Modelling and Analysis Population parameters, hypotheses testing, confidence-intervals, goodness of fit, estimating transient/steady-state characteristics, variance reduction. Simulation Process :

Unit III: Problem formulating, model building, data acquisition, model translation, verification, validation, strategic and tactical planning, experimentation, analysis of results,

Unit IV: Implementation and documentation. Simulation Languages: Examples from SIMSCRIPT, GPSS, GASP, SIMULA, etc.

Text Books:

1. G.Gordon, System Simulation, 2nd ed., Prentice Hall, 1978.
2. Narsing Deo, System Simulation with Digital Computers, Prentice Hall, 1976.
3. J.R. Leigh, Modelling and Simulation, Peter Peregrims Ltd., 1983.
4. A.M.Law, W.D.Kelton, Simulation Modelling and Analysis, Mcgraw Hill, 1982.