### 13. COURSES OF STUDY AND SCHEME OF ASSESSMENT

**M.Sc. THEORETICAL COMPUTER SCIENCE**

**COURSES OF STUDY AND SCHEME OF ASSESSMENT**

**M.Sc. THEORETICAL COMPUTER SCIENCE**

(Minimum No. of credits to be earned: 210*)

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**Total 31 Hrs**

|                | 17 | 2 | 12 | 24 | 550 | 250 | 800 |

II SEMESTER

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**Total 30 Hrs**

|                | 16 | 2 | 12 | 23 | 550 | 250 | 800 |

* Indicates is the minimum number of credits to be earned by a student.
** - Total 40 hrs in semesters I & II put together. Grade: Completed / Not Completed.

CA – Continuous Assessment; FE – Final Examination; CAT – Category; BS – Basic Sciences; HS – Humanities & Social Sciences; ES – Engineering Sciences; PC – Professional Core; PE – Professional Elective; OE – Open Elective; EEC – Employability Enhancement Course, MC – Mandatory Course.
### M.Sc. THEORETICAL COMPUTER SCIENCE 2015 REGULATIONS

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| IV SEMESTER|                                                  |            |         |             |    |    |        |
|------------|--------------------------------------------------|------------|         |             |    |    |        |
| 15XT41     | LINEAR ALGEBRA AND NUMERICAL ANALYSIS            | 3          | 2       | 0          | 4  | 50 | 50    | 100  | BS |
| 15XT42     | SOFTWARE ENGINEERING                             | 3          | 0       | 0          | 3  | 50 | 50    | 100  | PC |
| 15XT43     | OPTIMIZATION TECHNIQUES                          | 3          | 0       | 0          | 3  | 50 | 50    | 100  | PC |
| 15XT44     | OPERATING SYSTEMS                                | 3          | 0       | 0          | 3  | 50 | 50    | 100  | BS |
| 15XT45     | COMPUTER NETWORKS AND TCP/IP                     | 3          | 0       | 0          | 3  | 50 | 50    | 100  | PC |
| 15XT46     | OPTIMIZATION TECHNIQUES WITH R LAB               | 0          | 0       | 4          | 2  | 100| -     | 100  | PC |
| 15XT47     | OPERATING SYSTEMS LAB (LINUX)                    | 0          | 0       | 4          | 2  | 100| -     | 100  | PC |
| 15XT48     | COMPUTER NETWORKS AND TCP/IP LAB                 | 0          | 0       | 4          | 2  | 100| -     | 100  | PC |
|             | **Total 29Hrs**                                  | **15**     | **2**   | **12**     | **22** | 550| 250   | 800  |    |

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CA – Continuous Assessment; FE – Final Examination; CAT – Category; BS – Basic Sciences; HS – Humanities & Social Sciences; ES – Engineering Sciences; PC – Professional Core; PE – Professional Elective; OE – Open Elective; EEC – Employability Enhancement Course; MC – Mandatory Course.
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**BASIC SCIENCES (BS)**

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## Professional Electives (PE)

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## Employability Enhancement Courses (EEC)

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SEMESTER - I

15XT11 MATHEMATICAL METHODS  3 2 0 4

LIMITS AND CONTINUITY: Graphs of standard functions of single variable, Limit, continuity, piecewise continuity, periodic, differentiable, Riemann sum, integrable functions, fundamental theorem of calculus.  (7+4)

SEQUENCES & SERIES: Sequences – increasing, decreasing, bounded, function limit properties - Series – convergence and divergence – alternating series test, absolute convergence – ratio test, power series, Taylor series (single variable).  (5+3)


MULTIPLE INTEGRALS: Evaluation of multiple integrals – Cartesian and polar, Change of order of integration - Applications of multiple integrals to find area and volume of solid.  (9+5)

FOURIER SERIES: Even and odd functions, Dirichlet's conditions, statement of Fourier theorem, Fourier coefficients, change of scale, Half-range sine and cosine series, RMS value, Parseval’s theorem, Applications to signals and systems.  (7+6)

ORDINARY DIFFERENTIAL EQUATIONS: Linear Differential Equations of first order - Exact differential equations, Integrating factors, Bernoulli equations -Linear Differential Equations of higher order with constant coefficients -Euler's equation with variable coefficients - Simultaneous equations - Method of variation of parameters. Modeling simple systems.  (12+8)

Total L:45+T:30=75

TEXT BOOKS:

REFERENCES:

15XT12 ENGLISH FOR PROFESSIONAL SKILLS  3 0 0 3

READING COMPREHENSION: Developing Reading Skills like Skimming and Scanning for information, Critical Reading, Inferential, Cognition, and analytical Skills- appropriate reading texts to be used from general, scientific, and literary genres.  (10)

PRINCIPLES OF CLEAR WRITING: The fundamental aspects of formal writing like objectivity, conciseness, clarity, simplicity, coherence, parallelism, unity, cohesion and accuracy to be focused. Writing in different ways to create an emphasis – samples from news items, creative articles and reports to be used.  (4)

TECHNICAL WRITING: Technical Style, Mechanics, Critical Evaluation of different types of technical texts and different genres of technical writing – Format and different types of formal reports – Technical Papers.  (4)

CORRESPONDENCE: Memos, Principles of Official, Social, and E-mail Correspondence to be focused.  (4)

FOCUS ON SOFT SKILLS: Intra and Interpersonal Communication, Telephone Etiquette, Body language and Interview Techniques.  (5)

PRACTICALS: Listening exercises using Language Laboratory, Making short speeches, Group Discussions and Role-Plays.  (18)

Total L:45

TEXTBOOK:
1. Teaching Material prepared by the Faculty, Department of English.

REFERENCES:

15XT13 MATERIALS SCIENCE


SEMICONDUCTORS AND DEVICES: Elemental and compound semiconductors. Intrinsic and extrinsic semiconductors - Properties. Hall effect - Hall coefficient in extrinsic semiconductors, experimental determination of Hall coefficient. Application of Semiconductors – Solar Cells, LED and LCD. Introduction to semiconductor memory devices: Random Access Memory (RAM), Read only Memory (ROM), DRAM CCD. (12)


ADVANCED MATERIALS AND APPLICATIONS: NANO MATERIALS - Synthesis - PVD and ball milling techniques, properties, applications. Shape Memory alloys (SMA) – Characteristics, properties of NiTi alloy, application in MEMS. Superconductivity - types of superconductors - High Tc superconductors, Application of superconductors - SQUID, Levitation and cryotron. (12)

TEXT BOOKS:

REFERENCES:

15XT14 ANALOG AND DIGITAL ELECTRONICS

SEMICONDUCTOR DEVICES AND CIRCUITS: (Qualitative treatment only) Fundamental aspects of semiconductors - PN junction diode - Zener diode - Rectifiers - Zener voltage regulators - Filters - Bipolar Junction Transistors - Transistor Amplifiers - Field Effect Transistor. (7)

NUMBER SYSTEM AND CODES: Binary - Octal - Hexadecimal - BCD - excess three - Gray codes - Error correcting and detecting codes. (7)

DIGITAL CIRCUITS AND GATES: AND, OR, NOT, NAND and NOR gates - exclusive OR gates. Positive and negative logic systems - Digital integrated circuits - Characteristics - TTL and MOS logic circuits - Comparison. (6)

BOOLEAN ALGEBRA AND KARNAUGH MAPS: Boolean relations - Laws and theorems - Simplifications - Karnaugh maps and simplifications - Don't care conditions - NAND-NAND realizations. (7)

COMBINATIONAL LOGIC: Design and Implementation of Half and Full adders - Subtractors - Parallel adders - Carry look ahead addition - Encoders and decoders - Multiplexers and De-multiplexers. (8)

SEQUENTIAL LOGIC: R-S, J-K, D and T type Flip-Flops - Binary counters: Ripple and synchronous types - UP/DOWN counters - Decade counters - Shift registers - Ring counters. (7)

OPERATIONAL AMPLIFIERS: Definition of terms - Inverting and non-inverting amplifiers, inverting summing amplifier, integrators and differentiators. (9)

A/D AND D/A CONVERTORS: DACs - weighted and binary ladder types – ADCs - counter, dual slope, successive approximation types. (9)
TEXT BOOKS:

REFERENCES:

15XT15 C PROGRAMMING

3003

PROBLEM SOLVING: Introduction to Problem Solving- Program development- Analyzing and Defining the Problem- Modular Design – Algorithm-Flow Chart - Programming language-Types of programming language- Program Development Environment. (3)

C LANGUAGE: Introduction to C Language - C character set - Identifiers and Keywords - Data Types - Constants - Variables - Arrays - Declarations - Expressions - Statements - Symbolic constants - Operators and Expressions - Library Functions - Data Input and Output Functions. (6)

CONTROL STATEMENTS: While Statement - Do While Statement –For Loop–NestedLoop - If Else - Switch - Break - Continue - Comma Operator – GotoStatement. (4)

FUNCTIONS: Defining Function - Accessing a Function - Passing Arguments to Functions - Specifying Arguments-Data Types - Function Prototypes - Storage Classes - Auto - Static - Extern and Register Variables. (6)

ARRAYS: Defining Array –Processingarray - Passing array to a function - Multi dimensional array - Array and strings. (5)

POINTERS: Declarations - Pointers to a function - Pointers and one dimensional arrays - Operating a pointer - Pointer and multi-dimensional arrays - arrays of pointers - passing functions to other functions. (7)

STRUCTURES AND UNIONS: Definition of Structure and Union - Processing a structure - User defined data types - Structures and pointers - Passing structure to functions - Self-referential structures. (6)

FILES: File concepts – Operations on Files – Types of Files, Various Read and Write Functions on Files. (4)

ENUMERATED DATA TYPE: Typedef–PreprocessorDirectives - Command Line Arguments. (4)

TEXT BOOKS:

REFERENCES:

15XT16 MATERIALS SCIENCE AND DIGITAL ELECTRONICS LAB

0042

MATERIALS SCIENCE LABORATORY:
1. Resistivity of an Alloy – Carey Foster’s Bridge.
2. Band Gap of Thermistor – Post Office Box.
4. Temperature co-efficient of Resistance – Post Office Box.
5. Efficiency of Solar Cell.

DIGITAL ELECTRONICS LABORATORY:
1. Study of basic logic gates and realization of logic gates using universal gates.
2. Multiplexer and Demultiplexer.
3. Half and full adder / subtractor.
4. Encoder and decoder.
5. Binary counter.
6. BCD to seven segment decoder.
7. Study of D/A converter.
8. Crystal Oscillator using logic gates.

**Total**: 60

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### 15XT17 C PROGRAMMING LAB

0 0 4 2

1. Simple programs to understand the concepts of data types.
2. Familiarizing conditional, control and repetition statements.
3. Usage of single and double dimensional arrays including storage operations.
4. Implementation of functions, recursive functions.
5. Defining and handling structures, array of structures and union.
6. Implementation of pointers, operation on pointers dynamic storage allocation.
7. Creating and processing data files.

**Note:**
Separate Problem Sheets will be provided in due course.

**Total**: 60

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### 15XT18 ENGINEERING GRAPHICS AND GEOMETRIC MODELLING

0 0 4 2

**INTRODUCTION:** BIS specifications - lines, lettering, and dimensioning. Projection – types.

**FIRST ANGLE PROJECTION:** Introduction- Projection of points, lines, planes, and solids – parallel, perpendicular and inclined to planes.

**ISOMETRIC PROJECTION:** Introduction- prismatic and cylindrical components.

**INTERACTIVE GRAPHICS:** Parametric modeling – 1D, 2D and 3D geometry – transformations - display – points, lines using software.

**CURVES:** Types- parametric curves generation-displaying - evaluating points on curves.

**SURFACES:** Types- parametric surface generation-displaying - evaluating points on surfaces.

**SOLIDS:** Generation of part models using Computer Aided Geometric Modeling software.

#### LAB

**Engineering Graphics using CAD**

1. Introduction to CAD Software.
2. Exercise on first angle projection of
   - a. Points
   - b. Lines
3. Exercise on projection of
   - a. Planes
   - b. Solids
4. Exercise on conversion of isometric to orthographic projection.
5. Exercise on orthographic to isometric projection.
6. Exercise on Sectioning of regular solids.
7. Exercise on Perspective projection of simple solids.

**Geometric Modeling using a graphical programming language**

1. Modeling and displaying a point and line using orthographic projection and performing simple geometric transformation.
2. Modeling and displaying of parametrically represented analytical curves
   - a. Circle
   - b. Ellipse
3. Modeling and displaying of parametrically represented synthetic curves
   - a. Bezier Curve
   - b. B-spline
4. Modeling and displaying of parametrically represented NURBS curve.
5. Modeling and displaying of parametrically represented synthetic surface
   - a. Planar surface
   - b. Ruled surface
7. Modeling and displaying of B-Spline surface.

**Total**: 60

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**TEXT BOOKS:**


**REFERENCES:**

SEMESTER – 2
15XT21 DISCRETE STRUCTURES


RELATIONS AND FUNCTIONS: Definition and properties of binary relations – Representing Relations – Closures of Relations – Composition of Relations – Equivalence Relations – Partitions and Covering of Sets – Partial Orderings – n-ary Relations and their Applications. Functions-Injective, Surjective, Bijective functions, Composition, Identity and Inverse. (10)

COMBINATORICS: Basics of counting – The Pigeonhole principle - Permutations and Combinations with and without repetition, Permutations with indistinguishable elements, distribution of objects - Generating permutations and combinations in lexicographic order. (8)

RECURRENCE RELATIONS:Some Recurrence Relation Models- Solutions of linear homogeneous recurrence relations with constant coefficients- solution of linear non-homogeneous recurrence relations by the method of characteristic roots. (5)


Total L:45

TEXT BOOKS:

REFERENCES:

15XT22 COMPLEX VARIABLES AND TRANSFORMS


TRANSFORM METHODS: Concept of Transformation - Examples for Transformations. (5)

LAPLACE TRANSFORM: Definition - Transforms of Standard Functions - Transform of unit step function - Dirac delta function. – Transforms of derivatives and integrals -Transforms of Periodic functions - Inverse Laplace transform- Convolution Theorem. Method of solving ordinary linear differential equations with constant coefficient and solving integral equations by Laplace transform technique - Some applications to engineering problems. (14)


Total L:60

TEXT BOOKS:
15XT23 PROBABILITY AND STATISTICS


RANDOM VARIABLES: Discrete and continuous random variables - probability mass function and density function - distribution function - Expectation and variance. Discrete distributions: Binomial, Poisson and Geometric - Continuous distributions: Uniform, Normal, Exponential and Weibull - Joint probability distributions - marginal and conditional distributions - statistical independence , Conditional expectation Moments and moment generating functions- Sums of independent random variables. (12+8)

LIMIT THEOREMS: Markov and Chebyshev inequalities, Law of Large numbers, Central Limit Theorem. (4+4)

STATISTICAL INFERENCE: Sampling distribution - Estimation: Point estimation, interval estimation - Criteria of a good estimator – Interval estimation of mean, proportion, and variance (single sample and two samples) - Maximum likelihood estimator. Hypothesis Testing: General concepts - Errors in Hypothesis testing - One-and two-tailed tests - Tests concerning mean, proportion, and variance - Tests for Goodness of fit and independence of attributes. (11+7)

CORRELATION AND REGRESSION: introduction - Estimation using the regression line - Correlation analysis -Limitations, errors, and caveats of using regression and correlation analyses - Multiple regression and correlation analysis - Inferences about population parameters – Modeling techniques. (6+5)

ANALYSIS OF VARIANCE: Introduction to design of experiments, Analysis of variance - Completely Randomized Design and Randomized Block Design. (5+2)

Total L:45 +T:30 =75

REFERENCES:

15XT24 DATA STRUCTURES AND ALGORITHMS

INTRODUCTION: Software Development process – Abstraction - Data structures - Abstract Data Types - Primitive data structures - Analysis of algorithms - Best, worst and average case time complexities - notations. (4)

ARRAYS: Operations - Implementation of one, two, three and multi dimensioned arrays – Sparse and dense matrices - Applications. (3)

STACKS: Primitive operations - Sequential implementation - Applications: Subroutine handling - Recursion – Expression Processing. (4)

QUEUES: Primitive operations - sequential implementation - Priority Queues - Dequeues - Applications: Image component labeling; Machine shop simulation. (4)


TREES: Terminologies – Binary tree: Properties - Sequential and linked representation - Common binary tree operations - Traversals - Expression trees - Infix, Postfix and Prefix expressions - Threaded trees - Tournament trees - Heaps, Max heap, Min heap. (10)
SORTING AND SEARCHING: Insertion sort, selection sort, bubble sort, heap sort, iterative quick sort and merge sort, count sort and radix sort - searching, Linear Search, Binary search– Algorithms and their time complexities.

TEXT BOOKS:

REFERENCES:

15XT25 OBJECT ORIENTED PROGRAMMING


FUNCTIONS IN C++: Function Prototyping - Call by Reference - Return by reference - Inline functions - Default, Const Arguments - Overloading - Friend and Virtual Functions - Classes and Objects - Member functions - Nesting of Member functions - Private member functions - Memory allocation for Objects - Static data members - Static MemberFunctions - Arrays of Objects - Objects as Function Arguments - Friend Functions - Returning Objects - Const Member functions - Pointers to Members.

CONSTRUCTORS: Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors – Destructors overloading.

OPERATOR OVERLOADING: Overloading Unary and Binary Operators - Overloading Binary Operators using Friend functions – Operator Type conversion.


TEMPLATES & EXCEPTION HANDLING: Introduction to Templates, Generic Functions and Generic Classes – Exception Handling – Examples.

STREAMS: String I/O - Character I/O - Object I/O - I/O with multiple Objects - File pointers - Disk I/O with member functions.

15XT26 MATHEMATICAL COMPUTING AND STATISTICAL PACKAGES LAB

1. Programs on differentiation and integration.
2. Finding Fourier series.
5. Conformal mappings of standard functions.
6. Implementation of classification and tabulation of data and Graphical and diagrammatic presentation of data.
7. Perform calculations that measure the central tendency and dispersion of data and implementation of measures of Skewness, moments and kurtosis.
8. Determination of point and interval estimates.
10. Solving the problems based on Time series analysis and forecasting and implementing statistical quality control charts. Implementations using mathematical packages like SPSS, MATLAB, MATHEMATICA, MAPLE, or R.

Total P: 60

**15XT27 DATA STRUCTURES LAB**

Implementation of the following problems:

1. Sparse and dense Matrix operations using arrays.
2. Linked Lists: Singly linked, Doubly linked and Circular lists.
4. Problems using Queues.
5. Linked Stacks and Queues.
7. Binary trees and Threaded trees (with graphical representation).
8. Problems related to sorting and searching algorithms.

Total P: 60

**15XT28 OBJECT ORIENTED PROGRAMMING C++ LAB**

1. Arithmetic operations using array of objects and dynamic data members.
2. Creation of a class having read-only member function and processing the objects of that class.
3. Creation of a class which keeps track of the member of its instances. Usage of static data member, constructor and destructor to maintain updated information about active objects.
4. Illustration of a data structure using dynamic objects.
5. Usage of static member to count the number of instances of a class.
6. Illustration for the need of default arguments.
7. Usage of a function to perform the same operation on more than one data type.
8. Creation of a class with generic data member.
9. Overloading the operators to do arithmetic operations on objects.
10. Acquisition of the features of an existing class and creation of a new class with added features in it.
11. Implementation of run time polymorphism.
12. Overloading stream operators and creation of user manipulators.
13. Implementation of derived class which has direct access to both its own members and the public members of the base class.
14. Implementation of Streams to store and maintain Library system, with the features of Book Issue and Book Return.

Total P: 60

**SEMESTER – 3**

**15XT31 STOCHASTIC PROCESSES**


GENERAL QUEUEING MODELS: Single and Multiserver Poisson Queues - Single Server Queue with Poisson input and general service M / G/1 – General input and exponential service – G/M/1 Queueing model. (9+6)


BROWNIAN MOTION: First Passage time distribution – The maximum of a Brownian Motion – The Zeros of Brownian Motion – Brownian Motion with Drift - Geometric Brownian Motion. (4+3)

Total L:45 + T:30 = 75
**15XT32 GRAPH THEORY**

**BASIC CONCEPTS:** Graphs - directed and undirected, subgraphs, graph models, degree of a vertex, degree sequence, Havel-Hakimi theorem, Hand-shaking lemma. Connectivity, walk, path, distance, diameter. Isomorphic graphs. Common classes of graphs – regular, complete, Petersen, cycle, path, tree, k-partite, planar, hypercube. Spanning trees – Matrix tree theorem, graph decomposition. (12)

**CONNECTIVITY:** Vertex and edge connectivity, Vertex and edge cuts, relationship between vertex and edge connectivity, bounds for connectivity. Harary’s construction of k-connected graphs. (12)

**EULERIAN AND HAMILTONIAN GRAPHS:** Eulerian graphs, Route inspection problem, Hamiltonian graphs, Dirac’s and Ore’s theorems, Gray codes, Walecki’s construction. (12)

**MATCHING, VERTEX-COLORING AND DOMINATION:** Matching, Perfect matching, Bipartite matching, Hall’s theorem- Vertex-coloring – upper chromatic number, bounds using clique number, $\Delta(G)$, Welsh – Powell theorem. Dominating set, domination number, bounds. Applications of the above concepts to networks. (12)

**RANDOM GRAPHS:** Random graph – Definitions of $G(n, p)$ and $G(n, M)$ models. Ramsey number – definition, Erdos theorem, n-existentially closed graphs, asymptotically almost surely graphs and their existence theorem. Expectation and the first moment method, variance and second moment method, threshold function. Web graph models, applications to social networks. (12)

**TEXT BOOKS:**

**REFERENCES:**

**Total L : 60**

**15XT33 ABSTRACT ALGEBRA**

**ALGEBRAIC STRUCTURES:** Groups - Definition and Example, Properties of Groups, Permutation Groups, Symmetric Groups, Cyclic Groups. (8)

**SUBGROUPS AND NORMAL SUBGROUPS:** Subgroups – Definition, Cosets and Lagrange’s theorem, Homomorphism, Isomorphism, Automorphism – Cayley’s theorem – Normal subgroups – Factor group – Fundamental theorem of group homomorphism. (10)

**GROUPS AND CODING:** Coding of Binary information and Error detection – Group codes – Decoding and Error correction. (6)

**RINGS:** Definition and Properties – Subrings, Ring of Quaternions, Integral domain - Homomorphism – Ideals and Quotient Rings – Euclidean ring - Unique factorization theorem, Domain of Gaussian Integers. Polynomials Rings – Properties, Division -Algorithm, Factorization of Polynomials – Primitive polynomials. (10)

**FIELDS:** Definition – subfields - Finite fields – structure of Finite field, GF ($2^n$). (7)

**GEOMETRIC CONSTRUCTIONS:** Constructible numbers, circle and squares. (4)

**Total L : 45**
15XT34 ADVANCED DATA STRUCTURES

4 0 0 4

INTRODUCTION: Algorithms – Overview of analysis of algorithms – best case, worst case and average case complexities-, Amortized time complexity. (8)

HASH TABLES: Dictionaries – Dictionary ADT, Hash functions – Collision handling schemes - Separate chaining, Linear probing, Quadratic probing, Double Hashing – Load factor and rehashing. (8)


MULTIWAY SEARCH TREES: Indexed Sequential Access – m-way search trees – B-Tree – Searching, insertion and deletion - B+ trees – Tries - dictionary applications. (8)


DATA STRUCTURES FOR DISJOINT SETS: Disjoint set operations-linked list representation of disjoint sets, disjoint set forests, tree representation, union by rank, find by path compression and rehashing. (8)

GRAPHS: Definition – Representations (Adjacency matrix, packed adjacency list and linked adjacency list) – Network representation, shortest path- Dijkstra’s algorithm - applications of shortest paths, Graph search methods (Breadth first and depth first traversals)- Applications of depth first search-biconnectivity- finding strong components. (6)

TEXT BOOKS:

REFERENCES:

15XT35 COMPUTER ORGANIZATION AND ASSEMBLY LANGUAGE PROGRAMMING

3 0 0 3

DATA REPRESENTATION: Data types - Fixed point and floating point number representation (IEEE format) - Representation of signed numbers – arithmetic operation on signed numbers - Alphanumeric data representation. (4)

REGISTER TRANSFER AND MICRO OPERATIONS: Register transfer language - Inter register transfer - Arithmetic micro operations - Logic micro operations - Shift micro operations - Control functions. (3)


CENTRAL PROCESSING UNIT: Processor Bus organization - Stack organization - Instruction formats - Data transfer and manipulation — Multiprocessor Organization - RISC and CISC machine characteristics – Control Unit Design -Hardwired and micro programmed control (5)

MEMORY INTERFACING: Memory hierarchy - Main memory: RAM and ROM address spaces - - Cache memory – Cache Hit rate – Hit and Miss Ratio – Associative memory - Memory Interleaving. (5)
PERIPHERAL DEVICES INTERFACING: I/O interface - I/O bus versus memory bus - Isolated I/O versus Memory - Mapped I/O - Example of I/O interface – DMA - Input-Output processor. (6)

INTRODUCTION TO MICROPROCESSORS: Evolution of Microprocessors - Microprocessor based systems– Examples -Instruction Level Parallelism. (4)

INTEL 8086/88 PROCESSOR: Functional units of 8086 – Pipelining in 8086 - Addressing modes – Instruction format - Instructions - assembler directives – Construction of Machine code –Data Transfer and Data Manipulation Instructions (6)

ASSEMBLY LANGUAGE PROGRAMMING: Programs for multi precision addition, subtraction- Block moves- Array processing - String processing- Procedures and Interrupts - Interrupt Service Routines. (6)

TEXT BOOKS:

REFERENCES:

15XT36 PYTHON PROGRAMMING LAB

Exercises pertaining to the following outlines are to be experimented using Python:
1. Write a program that asks the user about textbook prices and reports how overpriced the textbooks are.
2. Create a new function called clubhouseAnimate(objlist ) that loops through the window objects in the list and randomly switches them to either yellow (200, 190, 100) or dark (40, 50, 60). You can use a slice like mylist[1:] to loop over all the elements in a list except the first one.
3. Create a main function that creates a GraphWin, calls clubhouseInit and assigns its return value to a variable like cbhouse. Then loop over the variable and call the draw method on each primitive object. Then call the getMouse and close methods of your GraphWin object. Test your clubhouse.
4. Problems to practice various image drawing functions.
5. Problems to practice lists and objects collections.
6. Problems to practice python function and parameters.
7. Problems to practice classes, dictionaries and inheritance.
8. Problems to practice command line arguments.
9. Problems to create your own Python module packages containing functions and data.
10. Problems to Import your own and other Python modules and use contained objects.
11. Problems to understand the use of local, global and built-in names within functions.

Total P:60

15XT37 ADVANCED DATA STRUCTURES LAB

Implementation of the following problems:
2. Applications of binary search tree and its operations.
3. AVL tree including all rotations.
5. Disjoint set operations and some applications.
6. Problem using heap data structure.
7. Problems related to graphs and graph traversals.
8. Real time problem using shortest path algorithm.

Total P:60
15XT38 ASSEMBLY LANGUAGE PROGRAMMING LAB

1. Implementing the functionality of AND, OR and NOT gates.
2. Conversion of data between different number systems.
3. Arithmetic operations of binary numbers using both one’s complement and two's complement arithmetic.
4. Implement parity bit generation for a n-bit binary data.
5. Practice on the DEBUGGER and 8086 Emulator Tool.
6. Conversion of BCD numbers into ASCII characters and vice versa.
7. Multiprecision addition and subtraction.
8. Packing and unpacking of BCD digits.
9. Programs on Logical and Arithmetic Instructions.
10. Implementation of Control Structures (FOR, LOOP, IF.. THEN, DO.. WHILE etc.).
11. Programs using Arrays and Strings.
12. Programs using Special Instructions DAA, XCHG, CMPSW etc.
13. Programs using interrupt functions for input and output.

Total P:60

SEMESTER – 4

15XT41 LINEAR ALGEBRA AND NUMERICAL ANALYSIS


VECTOR SPACES: Vector spaces and subspaces – Linear combination, Span, Linear independence and dependence - Null space, Column space, and Row space – Basis and dimension of a vector space – Rank and nullity. Applications to coding theory. (10+7)

LINEAR TRANSFORMATION: Introduction to linear transformations – General Linear Transformations – Kernel and range – Linear Transformations from R^2 to R^2– Change of basis. (6+4)


Total L:45+T:30 = 75

TEXT BOOKS:

REFERENCES:

15XT42 SOFTWARE ENGINEERING

SOFTWARE PLANNING: Software Project Estimation - Different techniques of Project cost estimation Decomposition techniques - COCOMO & PUTNAM models.


REFERENCES:

REFERENCES:

15XT43 OPTIMIZATION TECHNIQUES

LINEAR PROGRAMMING: Graphical method for two dimensional problems – Central problems of Linear Programming – Definitions – Simplex Algorithm – Phase I and Phase II of Simplex Method.

CONVEX OPTIMIZATION: Convex sets and cones- Convex functions- Convex optimization problems- linear and quadratic programs; second-order cone and semi-definite programs; quasi-convex optimization problems; vector and multi-criterion optimization.


INTEGER PROGRAMMING: Gomory cutting plane methods for all integer and mixed integer programming problems - Branch and Bound method (Land – Dool and Dakin algorithms) – Zero-One Implicit enumeration Algorithm.


PERT: Arrow networks - Time estimates - Earliest expected time, latest allowable occurrence time and slack of events - Critical path - Probability of meeting scheduled date of completion of project.

REFERENCES:

REFERENCES:

15XT44 OPERATING SYSTEMS

15XT45 COMPUTER NETWORKS AND TCP/IP

3 0 0 3

INTRODUCTION: Network goals - Applications of Networks - Design issues for the layers - OSI Reference Model - Types of Network - Network Topologies- Analog and Digital data transmission- Data encoding- Bandwidth and data rate-.Bit Rate, Baud Rate- Sampling Rate.


DATA LINK CONTROL AND PROTOCOLS: Line Discipline - Flow Control - Sliding Window Protocol - Error Control - Automatic Repeat Request – Stop and wait - ARQ - Go back by n ARQ - Selective Reject ARQ.


ROUTING AND CONGESTION CONTROL: Distance vector routing _ Link state Routing – RIP – OSPF- Congestion control- TCP congestion control- Rate limiting and traffic shaping.

APPLICATIONS: FTP, SMTP - MIME Format, DNS, HTTP- Content distribution networks.
TEXT BOOKS:

REFERENCES:

15XT46 OPTIMIZATION TECHNIQUES WITH R LAB
0042
1. Solving inequalities using Simplex, Two-phase, Dual simplex methods, Revised simplex method.
2. Finding initial basic feasible solution using (i) North-West corner rule(ii) Matrix minimum and (iii) Vogel’s approximation method and also perform optimality test using MODI method.
4. Gomory’s cutting plane methods for all IPP and mixed IPP.
6. Critical path for the given PERT and CPM networks.

15XT47 OPERATING SYSTEMS LAB (LINUX)
0042
Linux - History - General structure - Unix file system - file abstraction, directories, mount points, implementation details - Processes: memory image, life cycle, start of day. The shell: basic operation, commands, standard I/O, redirection, pipes, signals. Character and block I/O. Process scheduling:
1. Overview of an Operating System, Boots and Shutdown
2. UNIX File System Commands
3. UNIX Commands
4. SHEL Programming
5. Programs using UNIX System Calls
6. Process Creation and Execution
7. Thread Creation and Execution
8. Process/Thread Synchronization using semaphore
9. Developing Application using Inter Process communication (using sharedmemory, pipes or message queues)
10. Implementation of Memory Management Schemes
11. Creating Linux Modules

TEXT BOOKS:

REFERENCES:

15XT48 COMPUTER NETWORKS AND TCP/IP LAB
0042
1. Familiarize with NS2 simulator
2. Implement Hamming code and CRC check using TCL/Tk or Python
3. Implement a primitive email server
4. Familiarize with packet capturing tools in Java and Wireshark
5. Implement a simple firewall system
6. Analyse the existing routing protocols and implement any one of them
7. Write a program where a single entity can communicate with other entities by using IP-multicasting.
8. Assignments using the network simulator

Total P:60

SEMESTER– 5

15XT51 THEORY OF COMPUTING
4 0 0 4


PUSH DOWN AUTOMATA: Definition – Acceptance by final state and empty stack – Equivalence of acceptance by final state and empty stack – Equivalence of PDA and CFL – Definition of DPDA - pumping lemma.


Total L:60

TEXT BOOKS:

REFERENCES:

15XT52 COMPUTATIONAL NUMBER THEORY AND CRYPTOGRAPHY
4 0 0 4


SYMMETRIC KEY CRYPTOGRAPHY: Stream cipher – LFSR stream cipher, Block ciphers – DES – AES– Modes of operation.


AUTHENTICATION AND KEY DISTRIBUTION PROTOCOLS: Data origin authentication and entity authentication, challenge and response-certificates. Schnorr identification scheme, zero knowledge protocol, Diffie-Hellman key pre-distribution, session key distribution – The Needham Schroeder scheme, Kerberos, Diffie- Hellman key agreement scheme, man in the middle attack, station to station key agreement protocol.

Total L:60
**15XT53 DATABASE DESIGN**

**3 0 0 3**


**DATA MODELS**: Introduction – Data Associations – entities, attributes, relationships – Entity Relationship data models and ERDiagrams(ERD) – Generalization – Aggregation – Conversion of ERD into tables – Applications – Introduction to Network and Hierarchical data models.


**RELATIONAL DATABASE MANIPULATION**: Structured Query Language (SQL) - Basic data retrieval – SQL Joins - Views and update - Query Processing.


**DATABASE SECURITY, INTEGRITY AND CONTROL**: Security and Integrity threats – Access Controls and measures, Defense mechanisms-Transaction management, and concurrency control mechanisms.

**TEXT BOOKS**:  

**REFERENCES**:  

**15XT54 DESIGN AND ANALYSIS OF ALGORITHMS**

**3 0 0 3**

**INTRODUCTION**: Fundamentals of algorithmic problem solving, deciding an appropriate data structure and algorithm design technique – Methods of specifying an algorithm – proving the correctness – analyzing an algorithm, Asymptotic notations, Recurrences – Master theorem.

**DIVIDE AND CONQUER**: Quick sort , Merge sort, Integer multiplication, Strassen’s matrix multiplication, closest pair.

**GREEDY METHOD**: Optimal caching, minimum cost spanning tree. (Kruskal and Prim’s algorithms) , topological sorting, Huffman codes and data compression.

**DYNAMIC PROGRAMMING**: Principles of dynamic programming – 0/1 knapsack problem, all pairs shortest problem, optimal binary search trees.


**NP AND COMPUTATIONAL INTRACTABILITY**: Basic concepts – Polynomial time reductions, efficient certification and NP, NP hard and
NP complete problems – CO-NP and the asymmetry of NP, Examples, PSPACE-some hard problems in PSPACE- Proving problems PSPACE – complete.


**REFERENCES:**

**15XT56 JAVA PROGRAMMING LAB**

**JAVA PROGRAMMING:** Introduction - Data Types - Operators - Declarations - Control Structures - Arrays and Strings - Input/Output- Java Classes - Fundamentals - Methods - Constructors - Scope rules - this keyword - object based vs oriented programming – Inheritance- Reusability - Composing class - Method overloading - Abstract classes - Virtual Functions.

**PACKAGES AND INTERFACES:** Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface - Applying Interface - Variables in Interfaces.

**EXCEPTION HANDLING:** Fundamentals - Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested Try statements - Throw - Throws - Java Built-In Exception - Creating your own subclasses.

**MULTI THREADED PROGRAMMING:** Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Main thread - Creating the Thread - Synchronization - Interthread Communication - Deadlock.

**I/O, APPLETS:** I/O basics - Stream - Stream Classes - Predefined stream - Reading/Writing console input - Applet fundamentals - Native methods.- GUI Components - Applets - Java Scripts –Swing.

**NEW FEATURES IN J2SE V5.0:** Generics – Enhanced for Loop – Autobox – Auto unboxing – Enums – Varargs – Static import – Annotations – Collections Frame works – List – Set - Map

**TEXT BOOK:**

**REFERENCES:**

**PRACTICALS:**
1. To create runtime polymorphism using abstract class, interface.
2. To create callback feature using interface.
3. To create a program for interface inheritance.
4. To implement a user defined package.
5. To implement a user defined checked exception and unchecked exception.
6. To create threads, thread groups.
7. To create inter-thread communication using shared memory, piper stream.
8. To implement socket connections (UDP, TCP).

**15XT57 RDBMS LAB**

Implement the following problems using SQL – ORACLE, SQL SERVER:

1. Working with DDL commands in SQL
2. Working with DML commands to construct / update / fetch records from single / multiple tables
3. Working with PL/SQL – Functions, Stored procedures, Triggers etc.
4. Develop a Package using RDBMS features.
List of experiments (Problem Sheets) will be given and Package (using appropriate Front-End) will be developed.

**15XT58 DESIGN AND ANALYSIS OF ALGORITHMS LAB**

Implement the following:
1. Problem using closest pair algorithm.
2. Prim’s minimum cost spanning tree.
3. Kruskal’s minimum cost spanning tree using min heap data structure, union and find operation.
4. Problem related to topological sorting.
5. Application of all pairs shortest path problem.
6. Optimal binary search tree.
7. Optimal caching.

**SEMMESTER – 6**

**15XT61 MACHINE LEARNING**


Decision tree – Linear Discriminant Analysis - Model selection and feature selection - Evaluating and debugging learning algorithms-

Maximum likelihood estimation – parametric classification.


**UNSUPERVISED LEARNING** – Clustering - K-means – EM - Mixture of Gaussians - Factor analysis - PCA (Principal components analysis) - ICA (Independent components analysis) – Cluster validity measures.


**SEMI SUPERVISED LEARNING** – Introduction – Taxonomy - Graph based methods - collective classification – label propagation - TransductiveSVM.

**TUTORIAL PRACTICE:**
1. Download the datasets from UCI machine learning repository / www.kaggle.com for classification and clustering.
2. Implement the following Classification algorithms for the above datasets.
   a. Naïve Baye’s Algorithm
   b. Decision tree
   c. SVM
   d. K nearest neighbor
   e. Neural network
3. Do tenfold cross validation experiments and statistical validation using t-test and ANOVA.
4. Implement different clustering techniques.
5. Collective classification
6. Reinforcement learning
7. Statistical validation of techniques using ANOVA and t-test.

**TEXT BOOKS:**
REFERENCES:

15XT62 COMPUTER GRAPHICS AND VISUALIZATION

GRAPHICS INPUT - OUTPUT DEVICES: Raster scan Displays - Random scan displays - Direct view storage tubes - Flat panel displays - Mouse - Track Ball - Joy Stick - Digitizers - Touch panels - LCD. Graphical User Interface and Interactive Input Methods: The user dialog - Input of graphical data - Input function - Interactive picture construction techniques - Virtual reality environments. (4)


RASTER GRAPHICS: Fundamentals: generating a raster image, representing a raster image, scan converting a line drawing, displaying characters, speed of scan conversion, natural images - Solid area scan conversion: Scan conversion of polygons, Y-X algorithm, properties of scan conversion algorithms - Interactive raster graphics: painting model, moving parts of an image, feedback images. (8)

CURVES AND SURFACES: Parametric representation of curves - Bezier curves - B-Spline curves - Parametric representation of surfaces - Bezier surfaces - Curved surfaces - Ruled surfaces - Quadric surfaces – Concatenation of two curve segments – Order of Continuity.(5)

IMAGE PROCESSING FUNDAMENTALS: Sampling and Quantization, Image Enhancement - Histogram Processing, Filtering, Edge Detection, Image Transforms. (8)

THREE DIMENSIONAL GRAPHICS: 3D transformations - Viewing 3D graphical data - Orthographic, oblique, perspective projections - Hidden lines and hidden surface removal. (4)

FRACATL-GEOMETRY METHODS: Tiling the plane - Recursively defined curves - Koch curves - C curves - Dragons - Space filling curves - Fractals - Grammar based models - Graftals - Turtle graphics - Ray tracing. (4)

TEXT BOOKS:

REFERENCES:

15XT63 PRINCIPLES OF COMPILER DESIGN

SYSTEMS PROGRAMMING : Language Processors – Data Structures for Language Processing – Introduction to Assemblers, Macro processors, Interpreters - Linkers and Loaders - its need and working. (7)

COMPILERS – Introduction – phases of a compiler – Bootstrapping – Compiler writing tools. (2)

LEXICAL ANALYSIS: Role of a Lexical Analyzer – Finite Automata – Regular Expressions to Finite Automata – Minimizing the number of states of a Deterministic Finite Automata – Implementation of a lexical analyzer. (6)

PARSING TECHNIQUES: Context free grammars – Derivations and parse trees – Ambiguity – Capabilities of context free grammars. Top down and bottom up parsing – Handles – Shift reduce parsing – Operator precedence parsing – Recursive descent parsing -Predictive
AUTOMATIC PARSING TECHNIQUES: LR parsers – Canonical collection of LR(0) items – Construction of SLR parsing tables – LR(1) sets of items construction.

SYNTAX DIRECTED TRANSLATION AND INTERMEDIATE CODE: Semantic actions – Implementations of syntax directed translators – Postfix notation, Quadruples, triples , indirect triples –Methods of translation of assignment statements, Boolean expression and control statements - Representing information in a symbol table.

CODE OPTIMIZATION: Introduction to code optimization – basic blocks – DAG representation – error detection and recovery - code generation.

TEXT BOOKS:

REFERENCES:

15XT64 SECURITY IN COMPUTING


DATABASE SECURITY: Security Requirements – Reliability and Integrity – Sensitive data – Multilevel Databases - Privacy in Databases – Inference - Privacy aspects of data mining.


TEXT BOOKS:

REFERENCES:

15XT66 COMPUTER GRAPHICS AND VISUALIZATION LAB

1. Drawing a line, circle using algorithms.
2. Implementation of 2D Transformations (translation, scaling, rotation).
3. Window – viewport simulation with various aspect ratios.
4. Polygon clipping and line clipping using algorithms.
5. Drawing a 2D curve using Bezier generation.
6. Drawing a 2D curve using B-Spline generation.
7. Model a primitive (car/ Aircraft) with OpenGL API.
8. Simulate the primitive.
9. Animate the primitive.

Note: Algorithms in Computer Graphics have to be implemented by the student using C++/OpenGL. (Wherever applicable).

Total P: 60

15XT67 COMPILER DESIGN LAB

1. Implementation of Transition diagram to strip off comment statements from a given source file.
2. Design and Implementation of a Symbol Table Manager.
3. Implementation of following parsing algorithms.
   a. Recursive descent Parser
   b. Shift reduce parser
   c. Operator Precedence Parser
4. Implementation of the Syntax directed translation Engine to
   a. Simulate Desk Calculator.
   b. Generation of Postfix code.
   c. Post and Pre Code Optimizer.
5. Using LEX and YACC under UNIX environment for compiler design related problems.
7. Case study: Working with following open source compilers.
   open jdk, gcc.

Total P: 60

15XT68 SECURITY IN COMPUTING LAB

1. Design of a Client server application for a basic cryptosystem.
2. Performing a frequency analysis attack on a cipher text enciphered with Affine cipher.
3. Detection of a Buffer overflow attack.
4. Packet Sniffing using Wireshark Tool to perform the traffic analysis attack.
5. Generation of keys using pseudorandom generators.
6. Key distribution using RSA (KDC) – Key hacking.
8. Authentication of File transfer using Hashing / Message digest.
12. Port scanning tools.
13. Performing attacks and testing with attack tools.

Total P: 60

SEMESTER – 7
15XTP1 PROJECT WORK 1 – INDUSTRY / RESEARCH PROJECT

SEMESTER – 8

15XT81 GAME THEORY

INTRODUCTION: Game theory the theory of rational choice – Interacting decision makers. (2)

NASH EQUILIBRIUM: Strategic games – Best response – Dominance – Examples from economics, business, environment, military - Symmetric games and symmetric equilibria. Illustrations: Cournot’s model of oligopoly, Electoral competition. (7)


EXTENSIVE GAMES WITH PERFECT INFORMATION: Strategies and outcomes – Nash equilibrium – Subgame perfect equilibrium - Stackelberg’s model of duopoly, Buying votes – Illustrations: Entry into a monopolized industry, Electoral competition with strategic voters, Committee decision making. (7)

GAMES WITH IMPERFECT INFORMATION: Bayesian games – Examples – Strategic information – Transmission – Agenda Control with imperfect Information – Signaling games - Education as a signal of ability. (8)


Total L:45

TEXT BOOKS:

REFERENCES:

15XT82 PARALLEL AND DISTRIBUTED COMPUTING


PARALLEL COMPUTER MEMORY ARCHITECTURES: Shared Memory - Distributed Memory - Hybrid Distributed-Shared Memory Multiprocessors: Communication and Memory issues - Message Passing Architectures - Vector Processing and SIMD Architectures. (5)

PARALLEL PROGRAMMING MODELS: Overview - Shared Memory Model - Threads Model - Message Passing Model - Data Parallel Model - Other Models. (4)


PRAM ALGORITHMS & BSP: PRAM model of computation- Work-Time formalism and Brent’s Theorem; algorithm design techniques-parallel prefix, pointer jumping, Euler tours, divide and conquer, symmetry breaking; survey of data-parallel algorithms; relative power of PRAM models - Bulk synchronous parallel model. (6)

HIGH PERFORMANCE COMPUTING ARCHITECTURES - Latency Hiding Architectures - Multithreading Architectures - Dataflow 32
Architectures - **GPGPU Architecture**- Overview of basic Accelerators /GPU / GPGPU and its programming model – CUDA - OpenCL. (8)

**DISTRIBUTED COMPUTING:** Introduction -- Definitions, motivation - Communication Mechanisms - Communication protocols,-RPC-RMI. **Hadoop Architecture:** History of Hadoop-Hadoop Background-Architecture-Hadoop and RDBMS-Subprojects-Distributions-Documentation. **Hadoop Distributed File System (HDFS):** HDFS Clusters – NameNodes, Data Nodes & Clients - MapReduce >>Processing & Generating large data sets, Map functions, Programming MapReduce using SQL / Bash / Python, Parallel Processing, Failover. (9)

**TEXT BOOKS:**

**REFERENCES:**

**15XT83 MATHEMATICAL MODELLING**

**INTRODUCTION TO MODELING:** Modeling process, Overview of different kinds of model. (3)

**EMPIRICAL MODELING WITH DATA FITTING:** Error function, least squares method; fitting data with polynomials and splines. (4)

**CAUSAL MODELING AND FORECASTING:** Introduction, Modeling the causal time series, forecasting by regression analysis, predictions by regression. Planning, development and maintenance of linear models, trend analysis, modeling seasonality and trend, trend removal and cyclical analysis, decomposition analysis. Modeling financial time series. Econometrics and time series models. Non seasonal models: ARIMA process for univariate and multivariate. (8)

**PORTFOLIO MODELING AND ANALYSIS:** Portfolios, returns and risk, risk-reward analysis, asset pricing models, mean variance portfolio optimization, Markowitz model and efficient frontier calculation algorithm, Capital Asset Pricing Models (CAPM). (8)

**STOCHASTIC CALCULUS:** Brownian motion, martingales, Itô’s formula, Itô integral, risk-neutral measure, SDE; Risk-neutral measure, Girsanov's theorem for change of measure. (7)

**MODELING WITH BIOINFORMATICS:** Introduction, Biological data- types, mode of collection, documentation and submission. Sequence alignment- Definition, significance, dot matrix method, dynamic programming- Global and local alignment tools, scoring matrices and gap penalties. Multiple sequence alignment: Iterative methods. Hidden Markovian models, statistical methods, position specific scoring matrices. (15)

**TEXT BOOKS:**

**REFERENCES:**

Total L: 45

33
1. Basic Master – Worker program and send messages.
2. Write a program to find the summation of largest number in a very larger array of integers. (The contents of the array should be equally distributed to all processes).
3. Write a parallel program in SPMD to calculate the PI value using integral approximation method.
5. Select your own choice of very dense computational problem having divide and conquer method and implement it in parallel algorithm. And produce the performance chart with 2, 4, 6 and 8 nodes.

Total P: 60

**15XT87 OPEN SOURCE SOFTWARE LAB**

**INTRODUCTION:** Proprietary Software, Free Software, Open Software, Licenses, Version Control, Explore GitHub – GitHub Workflows, Git Basics, Git Branching, Git on the Server, Distributed Git, Git Tools, Customizing Git.

**PYTHON PROGRAMMING LANGUAGE:** Basic Syntax, Functions, Conditionals and Recursion, Iteration, Strings, Lists, Dictionaries, Tuples, Files, Classes and Objects, Inheritance, CGI, Multithreading, Networking, Python GUI - Tkinter, Distributing Python Modules, Python Standard Library, Django Framework.


**RUBY ON RAILS:** Scaling Rails, rails server, Deploying – Heroku Setup, User Resource, Microposts Resource, Static and Slightly Dynamic Pages, Rails Flavoured Ruby, Filling in the Layout, Modeling Users, Sign Up, Sign In, Sign Out, Updating, Showing, Deleting Users, User Microposts, Following Users.

**TEXT BOOKS:**


**REFERENCES:**


**PRACTICALS:**

1. Discovering the GitHUb collaboration platform.
2. Lab assignments using NumPy/SciPy, SQLAlchemy, PyTables, PyQt, TreeDict, Sage.
3. Lab exercises in Ruby.

TotalP: 60

**15XT88 RESEARCH SPECIALIZATIONLAB**

**SEMMESTER - 9**

**15XT91 INFORMATION RETRIEVAL**

**INTRODUCTION:** Overview of IR Systems - Historical Perspectives - Goals of IR - The impact of the web on IR - The role of artificial intelligence (AI) in IR.

**TEXT REPRESENTATION:** Statistical Characteristics of Text: Zipf's law; Porter stemmer; morphology; index term selection; using thesauri. Basic Tokenizing, Indexing: Simple tokenizing, stop-word removal, and stemming; inverted indices; Data Structure and File
Organization for IR - efficient processing with sparse vectors. (6)


QUERY PROCESSING: Query Operations and Languages- Query expansion; Experimental Evaluation of IR: Performance metrics: recall, precision, and F-measure. (5)

TEXT CATEGORIZATION AND CLUSTERING: Categorization : Rocchio; Naive Bayes, kNN; Clustering: Agglomerative clustering; k-means; Expectation Maximization (EM); Dimension Reduction: LSI, PCA. (6)

INFORMATION FILTERING TECHNIQUES: introduction to Information Filtering, Relevance Feedback - Applications of Information Filtering: RECOMMENDER SYSTEMS: Collaborative filtering and Content-Based recommendation of documents and products. (6)

WEB SEARCH: IR Systems and the WWW - Search Engines: Spidering, Meta Crawlers; Link analysis: Hubs and Authorities, Google PageRank, Duplicate Detection. (5)

INFORMATION EXTRACTION AND INTEGRATION: Extracting data from text; Basic Techniques: NE Recognition, Co-reference Resolution, Relation Extraction, Event Extraction; Extracting and Integrating specialized information on the web, Web Mining and Its Applications. (6)

REFERENCES:

15XT92 SOFTWARE PATTERNS

INTRODUCTION TO PATTERNS: Reusable object oriented software, Motivation, Best design practices of object oriented software, Coupling and Cohesion, Types of Cohesion and Coupling, Benefits of patterns, Definition of a Pattern, Types, Pattern description, Pattern Language, IDIOMS, Framework, Architecture. (6)


REFERENCES:

15XT93 DATA MINING

3 0 0 3

INTRODUCTION: Motivation for Data Mining – Importance – Definition – Kinds of data for Data Mining – Data Mining functionalities – Patterns – Classification of Data Mining Systems – Major issues in Data Mining-Overview of Data Mining Techniques. (5)

DATA PREPROCESSING: Types of data, Data cleaning-Smoothing, Handling missing values- Data Reduction –PCA, LDA- Feature subset selection –Chi square ($\chi^2$) and Information Gain- Sampling methods (7)

MINING FREQUENT PATTERNS, ASSOCIATIONS AND CORRELATIONS: Basic concepts – Efficient and Scalable Frequent Itemset Mining methods – Apriori, FP Tree. (6)

CLASSIFICATION AND PREDICTION:Overview of Classification techniques – Ensemble Learning-bagging, boosting, cascading stacking- Dealing with Class imbalance- Semi supervised learning. (6)

CLUSTER ANALYSIS: Cluster Analysis – Types of data in Cluster Analysis – Distance measure for numerical and non-numerical data- A categorization of major clustering methods – density based methods –DBSCAN, OPTICS, DENCLUE- Outlier analysis. (6)

MINING DSTREAMS: Challenges-Mining time- Series databases and sequence data – Stationary data stream learning- Hoeffding trees- Evolving data stream mining. (5)

MINING MASSIVE DATA SETS-Challenges- Distributed file system – Introduction to Map Reduce – Mining high dimensional association rules-CARPENTER-classifying high-dimensional data- PLANET- clustering high-dimensional Data-BIRCH-Distributed Data Mining. (6)

APPLICATIONS AND TRENDS IN DATA MINING: Spatial Data Mining – Graph Mining- Web Mining – Text Mining. (4) Total L:45

TEXT BOOKS:

REFERENCES:

15XT96 INFORMATION RETRIEVAL LAB

0 0 4 2

PRACTICALS:
1. Different retrieval models namely Boolean, Vector space and Probability based retrieval.
2. Query refinement techniques.
3. Evaluation of the retrieval algorithms.
4. Dimension Reduction techniques.
5. Classification and Clustering techniques.
6. Recommender systems- Collaborative and Content Based Filtering.
7. Information Extraction techniques.
8. IR on structured data bases.
9. Web based retrieval - Link based retrieval, combining content and link information.
10. Web mining - usage mining, structure mining, content mining.

Total P:60

15XT97 SOFTWARE PATTERNS LAB

0 0 4 2

PRACTICALS:
1. ATM Simulation – Singleton pattern.
2. Image Viewer Application – Bridge pattern.
3. Address Book Maintenance – Prototype pattern.
4. US, Canada Tax and Freight charges – Factory Method pattern.
5. The Fast Food Franchise – Builder pattern.
8. Refactoring Tool Usage.
15XT98 DATA MINING LAB

PRACTICALS:
1. Familiarize with tools like WEKA and statistical package like R.
2. Getting to know your Data – Feature Selection.
3. Decision Trees.
4. Other Classification Methods.
5. Ensemble Learning.
6. Clustering.
8. Analyzing data with log linear models and graphical models using R.
9. Handling massive data using map reduce.
10. A Package using data mining techniques preferably research papers.

SEMESTER – 10

15XTP2 PROJECT WORK II – INDUSTRY / RESEARCH PROJECT

ELECTIVES

15XTE1 PRINCIPLES OF PROGRAMMING LANGUAGES


TUTORIAL PRACTICE:
1. Language tools like Lex and YACC.
2. Inter – Intra sequence control mechanism.
5. List Operations in Prolog.
6. Fact finding & Theorem proving in Prolog.
7. Recursive functions in Functional programming language.
8. Expression evaluation in functional programming language.

TEXT BOOKS:

REFERENCES:

15XTE2 MULTI PARADIGM PROGRAMMING LANGUAGES

INTRODUCTION: The need for multiple paradigms – Terms and concepts Design, Analysis, Domains and Families – Commonality and variability analysis - Multi-paradigm design and programming languages.


APPLICATION AND SOLUTION DOMAIN ANALYSIS: The big picture analysis, Domain analysis and beyond – Sub domains in domain analysis. C++ Solution domain overview.


Multi-paradigm programming languages and Programming in C++ and Oz and Case Studies Text editor and language translator.

TUTORIAL PRACTICE:
Implementation of Multi paradigm programming concepts using Standard C++:
1. Implementation of Abstraction using classes and templates.
2. Implementation of Generic programming : Containers.
   - Reading and sorting integers and floating point numbers
   - Function objects
3. Implementation of class hierarchies and interfaces.
4. Implementation of Multiprogramming paradigm.
   - handling polymorphic objects.

TEXT BOOKS:

REFERENCE:

15XTE3 PROGRAM SEMANTIC ANALYSIS

INTRODUCTION: A Simple Imperative Programming Language - Notion of state of a program in execution (process) using Finite State
ANALYZING ASSIGNMENT STATEMENTS: Deriving strongest postcondition from a given pre-condition - and deriving weakest pre-condition from a given post-condition. Dealing with loops: loop invariants - Appropriateness of loop-invariants for proving desired - Post-conditions of programs – Abstract syntax and semantics of loop in ML – Parsing loop.

FORMAL INTRODUCTION TO HOARE LOGIC: syntax and semantics - Notions of partial and total correctness - Axioms and basic inference rules for partial correctness proofs in Hoare logic.

FIXPOINT THEORY: Undefined operations and infinite loops – Recursively defined mappings – Continuous functions and strict extensions of functions.

STRENGTHENING AND WEAKENING OF CONSTRAINTS: Weakest pre-conditions and strongest post-conditions - using Hoare logic proofs - Incompatibility of the strongest loop invariant in sequential programs - reduction from halting problem of Turing machines - Translating programs (with recursive function calls) manipulating variables of finite-domain types to push-down automata.

ANALYSIS OF PROGRAMS WITH VARIABLES OF FINITE-DOMAIN TYPES: Reducing proof obligations in Hoare logic to state Reachability in an appropriate push-down automaton (PDA) - Deciding state Reachability in PDA by checking non-emptiness of an appropriate context-free language - PDA and CFG based techniques for proving properties of programs.

OPERATIONAL SEMANTICS: Proof-theoretical semantics – Declarations of data structures – Procedures and functions – Objects and classes – Continuations and jumps.

TRANSLATING PROGRAMS: The Formal language to corresponding Boolean programs - Semantics preserving syntactic transformations. Translating assignment statements in original program to parallel assignments to predicate-tracking Boolean variables in a Boolean program- Translating procedure call-free programs in a C-like language to Boolean programs. Discovering traces of a Boolean program from corresponding push-down automation or context-free grammar.

TUTORIAL PRACTICE:
1. Study on using a static checkup for the verification of code written in a high level Programming Languages.
2. Implementation of Algebraic semantics.
3. Implementation of fixed point identity in recursion in the Lambda calculus.
4. Implementation of action semantics of a calculator.
5. Formal verification using Hoare Logic with updates for a simple while - language.
6. Proving Program correctness with Hoare’s Logic for programs with procedures

REFERENCES:

15XTE4 NATURAL LANGUAGE PROCESSING


LEXICAL LEVEL: Error-tolerant lexical processing (spelling error correction) - Transducers for the design of morphologic analyzers – Features - Towards syntax: Part-of-speech tagging (Brill, HMM) - Efficient representations for linguistic resources (lexica, grammars...) tries and finite-state automata.

SYNTACTIC LEVEL: Grammars (e.g. Formal/Chomsky hierarchy, DCGs, systemic, case, unification, stochastic) - Parsing (top-down, bottom-up, chart (Earley algorithm), CYK algorithm) - Automated estimation of probabilistic model parameters (inside-outside algorithm) - Data Oriented Parsing - Grammar formalisms and treebanks - Efficient parsing for context-free grammars (CFGs) - Statistical parsing and probabilistic CFGs (PCFGs) - Lexicalized PCFGs.


NATURAL LANGUAGE GENERATION: content determination - sentence planning - surface realization. (3)


TUTORIAL PRACTICE:
1. Implementing word similarity.
2. Implementing simple problems related to word disambiguation.
3. Simple demonstration of part of speech tagging.
4. Lexical analyzer.
5. Semantic analyzer.

Total L:45+T:30 = 75

TEXT BOOKS:

REFERENCES:

15XTE5 RANDOMIZED ALGORITHMS

INTRODUCTION: Randomized algorithms, randomized quick sort, Karger’s min-cut algorithm Las Vegas and Monte Carlo algorithms, computational models and complexity classes. (5)

MOMENT, DEVIATION AND TAIL INEQUALITIES: Occupancy problem, Markov and Chebyshev inequalities- randomized selection-coupon collector’s problem, the Chernoff bound- routing in a parallel computer- a wiring problem. (7)

PROBABILISTIC METHODS: Overview of the method-maximum satisfiability - finding a large cut .Expander graphs. (5)

MARKOV CHAINS AND RANDOM WALKS: Markov chains, Random walk on graphs - connectivity in undirected graphs – Expanders and rapidly mixing random walks. (6)

DATA STRUCTURES AND GRAPH ALGORITHMS: Random Treaps, hashing – hash tables – perfect hashing, skip lists - Fast min-cut. (6)

ONLINE ALGORITHMS: Paging problem-adversary models- paging against an oblivious adversary-relating the adversaries-the adaptive online adversary. k-server problem. (5)

PARALLEL AND DISTRIBUTED ALGORITHMS: Sorting on a PRAM – Maximal Independent sets. (4)

NUMBER THEORETIC ALGORITHMS: Polynomial roots and factoring, primality testing. (3)

DERANDOMIZATION: The method of Conditional Probabilities – Derandomizing max-cut algorithm – Constructing pairwise independent values modulo a prime - Pairwise independent – large cut. (4)

TUTORIAL PRACTICE:
1. Implementation of randomized quick sort and solve real time problems using it.
2. Find solution for s-t min-cut problem adapting min cut algorithm.
3. Implementation of randomized selection and problems related to it.
4. Implementation of treap data structure.
5. Problems using randomized hash table.
6. Implement the shortest path and fast min-cut algorithms.
7. Implementation of randomized primality testing.
8. Implement the K-server on-line algorithms.

Total L:45+T:30 = 75
15XTE6 APPROXIMATION ALGORITHMS

Introduction: Definition-performance ratios, vertex-cover problem. (4)

COMBINATIONAL ALGORITHMS: lower bounding techniques and Metric TSP, multiway cut problem, the minimum k-cut problem, FPTAS for knapsack, greedy algorithms for Makespan-PTAS for minimum Makespan, Euclidean TSP. (10)

LINEAR PROGRAMMING RELAXATIONS: LP-duality, min-max relations and LP-duality, rounding applied to vertex cover-simple rounding algorithm-randomized rounding, primal dual method and vertex cover. (9)

CUTS, METRICAL RELAXATIONS AND EMBEDDINGS: multiway cut, sum multicommodity flow, some applications of multicut, rounding for Sparsest Cut via L1 Embeddings. (8)

SEMIDEFINITE PROGRAMMING: Strict quadratic programs and vector programs, properties of positive semidefinite matrices, the semidefinite programming problem, randomized rounding algorithm, improving the guarantee for MAX-2SAT. (7)

HARDNESS OF APPROXIMATION: reduction, graphs, and hardness factors, the PCP theorem, hardness of MAX-3SAT. (7)

TUTORIAL PRACTICE:
1. Implementation of vertex-cover algorithm.
2. Implementation of Greedy algorithm for makespan.
3. Problems related to Euclidean TSP.
4. Implementation of different algorithms with rounding.
5. Implementation of applications of multicut.

TEXT BOOKS:

Total L:45+T:30 = 75

15XTE7 NETWORK ALGORITHMICS


ROUTER ALGORITHMICS: Exact match lookup – Prefix match look ups – Packet Classification – Switching – Scheduling packets – Computing traffic matrices. (15)

NETWORK SECURITY: Searching for multiple strings in packet payloads – IP trace back via probabilistic marking and logging – Detecting worms. (10)
TUTORIAL PRACTICE:
1. Implementation of CRC using a fast implementation technique.
2. Implementation of IP prefix lookup using lulea tries.
3. Implementation of binary search on prefixes.

Total L:45+T:30 = 75

TEXT BOOKS:

REFERENCES:

15XTE8 WIRELESS NETWORKS


WLAN TECHNOLOGIES: wireless network architectures, 802.11 PHYs, 802.11 MAC, WPA and 802.11i, Security, 802.11e, MAC Enhancements for Quality of Service, Related Wireless Standards (Hyperlan, HomeRF, Bluetooth, Zigbee, Wireless USB), WiFi and WiMAX Standards.


FUTURE TRENDS: Emerging WLAN Related Technologies, 802.11 Trends, Cellular, 802.16, 802.20, 802.22, UWB, Cognitive Radios, RFID, 4G, and Data Communications Convergence.

TUTORIAL PRACTICE:
1. Study of NS-2 simulator.
2. Simulation of a IEEE 802.11 LAN under various conditions using NS-2 simulator.
4. Simulation of different routing protocols using simulators.
5. Simulation of TCP over error-prone wireless network using NS-2 simulator.
6. Development of Mobile application using blue tooth.

Total L:45+T:30 = 75

TEXT BOOKS:
REFERENCES:

15XTE9 SOCIAL NETWORK ANALYSIS

INTRODUCTION: Motivation - different sources of network data - types of networks - tools for visualizing network data - review of graph theory basics. (9)

GRAPH THEORETIC PROPERTIES OF SOCIAL NETWORKS: Notions of centrality - Strong and weak ties – Homophily - Structural Balance. (5)

DYNAMIC PROPERTIES OF NETWORKS: Information diffusion - networks effects on information diffusion - maximizing influence spread - power law and heavy tail - preferential attachment models - small world phenomenon - cascading behavior on networks - Epidemics. (11)

BEHAVIORAL PROPERTIES ON NETWORKS: Network economics - Bargaining and power in networks - Sponsored search markets. (10)

MINING GRAPHS: Community and cluster detection: random walks - spectral methods - link analysis for web mining. (10)

TUTORIAL PRACTICE:
1. Getting acquainted with UCINET and Netdraw.
2. Implementing graph-theoretic/social network metrics using UCINET.
3. Working with Visualization, Ego networks, Centrality, Community Detection etc.

Total L:45+T:30 = 75

TEXTBOOK:

REFERENCES:

15XTEA ADVANCED COMPUTER GRAPHICS


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**TUTORIAL PRACTICE:**

Implement the following using OpenGL:

1. Using glRect function, draw
   a) A flurry
   b) A checkerboard
2. Write the window to view port mapping functions, and use it to draw the sine curve in real world coordinates.
3. Using user defined lineTo and moveTo functions, plot the Fibonacci series.
4. Write the Canvas class and it’s supporting classes. Use the Canvas class to draw a simple meander.
5. Write functions to change the background and foreground colors.
6. Write a function to draw an n-sided polygon (using the basic Canvas class and line To and move To functions)
7. Write a program to draw the Sierpinski gasket.
8. Write a program to draw the graph of a given mathematical function f(x).
9. Write a program to read a data file that contains a collection of Polygons in the appropriate format and draw each polyline.
10. Write a parameterized function to display a house and call it a number of times by passing different values to form a village.
11. Write a program that displays a colored triangle and rectangle and rotates them at different angles along two axis.

**TEXT BOOKS:**


**REFERENCES:**


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**15XTEB  COMPUTER VISION AND IMAGE ANALYSIS**

**OVERVIEW:** Computer Imaging Systems: Image formation and Sensing, Color representation, Image Acquisition, Image digitization, Noise, Image Representation. (4)

**DIGITAL IMAGE ANALYSIS:** Preprocessing, Binary Image Analysis, Edge detection - First order derivative, Second order detection, Color edge detection, Pyramid edge detection, Edge linking and boundary detection, Segmentation - Region based segmentation, clustering techniques, boundary detection, thresholding. (8)

**IMAGE ENHANCEMENT:** Gray-Scale Modification, Image Sharpening, Image Smoothing - Noise Models, Noise removal using spatial filters, frequency domain filters, Geometric transforms, Image Reconstruction. (6)

**IMAGE TRANSFORMS:** Overview of discrete transforms, Fourier Transform, Discrete Cosine transform, Discrete Haar transform, Principal components transform, Discrete Wavelet Transform, Filtering. (6)

**IMAGE FEATURE ANALYSIS:** Overview, Feature Extraction - Shape, histogram, color, spectral, textural features, feature Analysis. Image Compression - Overview, Lossless compression methods, lossy compression. (5)

**MORPHOLOGICAL OPERATIONS** - Binary Dilation, Erosion, Opening and Closing, Hit-or-Miss Transform, Basic Morphological Algorithms, Extension to Gray-Scale Images. (4)

**IMAGE COMPRESSION** - Basic requirements, Types of compression, Coding Algorithms. (4)

**APPLICATIONS** – CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends - super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS. (8)

**TUTORIAL PRACTICE:**

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**Total L:45+T:30 = 75**
1. Implementation of Image segmentation and edge detection.
2. Implementation of feature extraction.
3. Implementation of image classification and clustering.
4. Developing simple image analysis applications

**TEXT BOOKS:**

**REFERENCES:**

15XTEC  DATA COMPRESSION  3 2 0 4

**DATA COMPRESSION LEXICON:** Introduction to Data Compression - Dawn Age - Coding - Modeling - Ziv and Lempel - Lossy Compression.


**ADAPTIVE HUFFMAN CODING:** Adaptive Coding - Updating the Huffman Tree - The Code.

**ARITHMETIC HUFFMAN CODING:** Arithmetic Coding - The Code.


**SLIDING WINDOW COMPRESSION:** LZ77 Algorithm - LZSS Compression - Compression Code.

**DICTIONARY-BASED COMPRESSION:** LZ78 Compression and Decompression algorithms – LZW Compression and Decompression algorithms – LZW Compression and Decompression – LZAP Compression and Decompression.

**SPEECH COMPRESSION:** Digital Audio Concepts - Lossless Compression of Sound.

**VIDEO COMPRESSION:** JPEG Compression – Discrete Cosine Transforms – Coefficient quantization.

**TUTORIAL PRACTICE:**
1. Implement Shannon Fano algorithm and Huffman algorithm.
2. Design compression and decompression program using adaptive Huffman coding.
3. Implement arithmetic coding algorithm.
4. Design compression program using statistical modeling upto 3 order.
5. Design compression and decompression program using L277 algorithm.

**TEXT BOOK**

**REFERENCES:**

15XTED  SEMANTIC WEB  3 2 0 4

**INTRODUCTION TO SEMANTIC WEB:** Today’s Web - From Today’s Web to the Semantic Web - Examples - Semantic Web Technologies - A Layered Approach.

**DESCRIBING STRUCTURED WEB DOCUMENTS USING XML:** Introduction to Markup languages - The XML Language - Structuring - Namespaces - Addressing and Querying XML Documents - Processing.

**DESCRIBING WEB RESOURCES IN RDF:** Introduction to RDF - Basic Ideas - RDF: XML-Based Syntax - RDF Schema: Basic Ideas.
RDF Schema - An Axiomatic Semantics for RDF and RDF Schema - A Direct Inference System for RDF and RDFS - Querying in RQL.

WEB ONTOLOGY LANGUAGE: OWL Introduction - The OWL Language - Examples - OWL in OWL - Future Extensions.


APPLICATIONS: Horizontal Information Products - Data Integration - e-Learning - Web Services - Other Scenarios.


TUTORIAL PRACTICE:
2. Creating XML DTD and XSD for the given XML document.
3. Design a XSLT to display the XML document (given as input) based on the constraints given.
4. Generate an RDF graph.
5. Create an RDFS ontology (in triple or graph notation).
6. Write an RDF/XML encoding for the given situation.
8. A Package to implement the techniques.

TEXT BOOK:

REFERENCES:

15XTEE CLOUD COMPUTING


GRID, CLUSTER AND UTILITY COMPUTING: Introduction, Architecture, Pros & Cons, Real time applications.


ADVANCED WEB TECHNOLOGIES: AJAX and Mashup – Programming examples using applications.

MAP REDUCE PARADIGMS: Introduction, GFS Architecture, HDFS Architecture, Hbase, Google big Table, Amazon’s (key value) pair storage and Microsoft’s Azure infrastructure, Map reduce programming examples.

CLOUD COMPUTING FRAMEWORK: Amazon EC3, S3 storage revolves, Aneka frame work, IBM blue Cloud.

APPLICATIONS: Distributed search engine and distributed data mining in the cloud.

TUTORIAL PRACTICE:
1. Parallel programming using pvm on Linux platform.
2. Develop web services using Eclipse or similar tools.
3. Virtualization (VM Ware, VCloud, Hyper V)
4. Develop a Mashup website based on 2 or more existing websites.
5. Build Private cloud compatible with AWS API using Eucalyptus
6. Build Cloud platform using Openstack
7. Package development using tools supported by cloud providers as a free service.

Total L:45+T:30 = 75

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INTRODUCTION: Past, present, future; the pervasive computing market, m-Business, challenges and future of pervasive computing - modelling key for pervasive computing - pervasive system environment interaction - architectural design for pervasive system, application examples of pervasive computing: Healthcare, Tracking, emergency information systems, home networking appliances and entertainment. (5)

DEVICE TECHNOLoGY FOR PERVASIVE COMPUTING: Hardware, computing devices and their characteristics - pervasive information access devices - smart identification, smart card, labels, tokens - embedded controls, smart sensors, actuators - human-machine interfaces, Biometrics - Various operating systems for pervasive devices. (4)


APPROACHES FOR DEVELOPING PERVERSIVE APPLICATIONS: Categorization - smart services for pervasive application development - developing mobile applications - presentation transcoding - device independent view component - heterogeneity of device platforms - Context Awareness and Mobility to build pervasive applications. (8)

CONTEXT AWARE SYSTEMS: Modelling - mobility awareness - spatial awareness - temporal awareness - ICT system awareness - Intelligent Systems - basic concepts - autonomous systems - reflective and self-aware systems - self management and autonomic computing - complex systems. (8)

LOCATION AWARE SYSTEMS: Basic concepts - location modelling - Introduction to location management - DNS Server, server process, client process - location update - location inquiry - location management cost - network topology - mobility pattern, memory less movement model, Markovian Model, Shortest distance model, Gauss-Markov model, Activity Based Model, Mobility Trace, Fluid-flow Model, Gravity Model. (7)

Location dependent information system - location dependent data - location aware queries - location dependent queries - moving object database queries - query transition steps in LDQ processing. (6)

TUTORIAL PRACTICE:
1. Create application with onClick, onKeyDown, onFocusChanged Event Handlers.
2. Create application with Toast Notifications.
3. Create application with Android's Advanced User Interface Functions.
5. Create application to Create, Modify and Query an SQLite Database.
6. Create application that Works with an Android Content Provider.
7. Create application that performs Data Storage and Retrieval from Android External Storage.
8. Create Location-Aware application that uses Proximity Alerts and Google Maps API.
9. Implementation of small packages to demonstrate all APIs.

Note: All implementations using android.

Total L:45+T:30=75


PARALLEL AND DISTRIBUTED DATA BASES: Architecture of parallel databases – Parallel query evaluation, Paralyzing individual operations, Parallel query optimization - Homogeneous and Heterogeneous databases - Architecture of distributed data bases - Storing data in distributed data bases - Distributed query processing - Distributed Transactions.


NoSQL DATABASES: Big Data and Challenges, NoSQL data models – Key value pair - DynamoDB, Column store - BigTableHbase, Document oriented store- MongoDB –Graph data bases – Neo4g – Apache Hadoop.

TUTORIAL PRACTICE:

Programming exercises are given in the following topics:
1. Query optimization.
2. Object relational databases.
3. Parallel/Distributed databases.
4. Spatial databases.
5. MongoDB, AmazonDB.
6. BigTable, Hbase.
7. Hadoop.

Total L:45+T:30 = 75

TEXT BOOKS:

REFERENCES:

SOFTWARE DEVELOPMENT PROCESS:


ECONOMICS OF DEFECT REMOVAL DESIGN: Defects - Product Quality - Process Quality.

TEAM SOFTWARE PROCESS

CAPABILITY MATURITY MODEL: Structure - Interpretation - Usage - Key process areas for various levels.

TUTORIAL PRACTICE:
1. Time Measurement Assignment.
2. PSP Programming Assignment.
3. Assessing the Quality of the Student’s PSP Data and recording observations in the specified format.
4. Estimating the size of the program using PSP Techniques.
5. Design Review.
10. TSP Inspection.

**Text Books:**

**References:**

REFERENCES:

OPEN ELECTIVES

15XTO1   COMPUTATIONAL FINANCE   3 2 0 4

INTRODUCTION : Law of one price – Risk neutral pricing – Arbitrage and Hedging – Financial Products and capital markets – Futures, Forwards and options – Options pricing problem and three types of solutions. (3)

MATHEMATICAL PRELIMINARIES : Conditional expectation – Sigma Algebra – Filtrations, Time series analysis - Covariance stationary – autocorrelations - MA(1) and AR(1) models, Stochastic Calculus - Random walk – Brownian motion – Martingales – Ito’s Lemma. (12)

PORTFOLIO THEORY - Introduction - Portfolio theory with matrix algebra - Review of constrained optimization methods, Markowitz algorithm, Markowitz Algorithm using the solver and matrix algebra – Portfolio choice and linear pricing – Statistical analysis of efficient portfolios. (10)


TUTORIAL PRACTICE:
1. Problems using Capital Asset Pricing model.
2. Problems using Auto correlation.
3. Plot time series data and find outliers
4. Problems using Autoregressive models
5. Problems using Moving average models
6. Monte Carlo Simulation of options pricing

Total L: 45+T:30 = 75

REFERENCES:

15XTO2 COMPUTATIONAL GEOMETRY   3 2 0 4

MATHEMATICAL & GEOMETRICAL REVIEW: Algorithm analysis – sorting, binary search, balanced binary search, divide and conquer, plane sweep, Kd-trees, Dijkstra’s algorithm, points, lines and planes, basic geometric objects – polygons, polytopes, convexity, graphs - vertex coloring, planar, Euler’s formula. (2)

CONVEX HULLS: Definition, lower bounds, algorithms - Graham’s scan, divide and conquer, Jarvis march, 3D hulls. (5)
LINE SEGMENT INTERSECTION: Plane sweep algorithm, Doubly-connected edge list, computing overlay of two subdivisions, Map overlay algorithm, half-plane intersection, arrangements of lines.  

POLYGON TRIANGULATION: Art gallery problem – introduction, triangulation, bounds, partition into monotone pieces, triangulating monotone polygon, placement of guards.  

ORTHOGONAL RANGE SEARCHING: 1-D and 2-D range searching, rangetrees.  

VORONOI DIAGRAMS: Properties, beach line, computing Voronoi diagram, Delaunay triangulations, computing Delaunay triangulations.  

ROBOT MOTION PLANNING: Work space and configuration space, point robot, free space, Minkowski sums for convex and nonconvex polygons, translational motion planning, motion planning with rotations, Point location and trapezoidal maps. Visibility graphs - Shortest paths for a point robot, computing visibility graph, shortest paths for a translating polygonal robot.  

TUTORIAL PRACTICE:  
Implementation of algorithms for the following problems.  
1. Convex hull problems.  
2. Line and half plane intersections.  
3. Map overlay problems using Doubly-connected edge list.  
4. Triangulation and Art gallery problem.  
5. Orthogonal range searching (1D and 2D) using Kd-trees.  
7. Translational algorithms for robot motion planning.  

Total L:45+T:30 = 75  

TEXT BOOKS:  

REFERENCES:  

15XTO3 DATA SCIENCE 3 2 0 4  

INTRODUCTION TO DATA SCIENCE : Data wrangling, cleaning, and sampling to get a suitable data set - Mathematics for understanding the data – Descriptive statistics : Visualizing Data - Central Tendency –Variability –Standardizing -Normal Distribution -Sampling Distributions.  

DATA MANIPULATION AT SCALE : Parallel databases, parallel query processing, in-database analytics, MapReduce, Hadoop, Key-value stores and NoSQL; tradeoffs of SQL and NoSQL.  


COMMUNICATING RESULTS : Visualization - descriptive statistics and visualisations, privacy, ethics – multivariate visualization.  

SPECIAL TOPICS : Graph Analytics: structure, traversals, analytics, PageRank, community detection, recursive queries, Semantic web.  

CASE STUDY : Community Detection – Collaborative Network – Opinion mining – Co-citation network .  

TUTORIAL PRACTICE:  

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1. Introduction to R and problems using R.
2. Collect datasets from Kaggle and Data Analysis.
3. Implementation of various predictive models.
4. Generate the results using Confidence levels.
5. Implementation of SVD.

**TEXT BOOK:**

**REFERENCES:**
5. Matthew A. Russell,”Mining the Social Web: Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites”, O'Reilly Media, 2013.

**15XTO4 DATA VISUALIZATION**

**INTRODUCTION:** Information visualization – Theoretical foundations – Information visualization types – Design principles - A framework for producing data visualization

Static data visualization – tools – working with various data formats

Dynamic data displays : Introduction to web based visual displays – deep visualization – collecting sensor data – visualization – D3 framework - Introduction to Many eyes and bubble charts

Maps – Introduction to building choropleth maps

Trees – Network visualizations – Displaying behavior through network graphs

Big data visualization – Visualizations to present and explore big data – visualization of text data and Protein sequences

**TUTORIAL PRACTICE:**

Note : Explore softwares like R, Python, Google Vision, Google Refine, and ManyEyes ; Data sets are available on Gap minder, Flowing data

1. Visualization of static data.
2. Visualization of web data.
3. Visualization of sensor data.
4. Visualization of protein data.

**TEXT BOOK:**

**REFERENCES:**

**15XTO5 PRINCIPLES OF MANAGEMENT AND BEHAVIOURAL SCIENCES**

**PRINCIPLES OF MANAGEMENT:** Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling. Organizational Environment – Social, Economic, Technological and Political. Corporate Social Responsibility - Case discussion.
INDUSTRIAL AND BUSINESS ORGANIZATION: Growth of Industries (Small Scale, Medium Scale and Large Scale Industries). Forms of Business Organizations. Resource Management – Internal and External Sources (8)

ORGANIZATIONAL BEHAVIOUR: Significance of OB, Impact of culture on organization. Role of leadership and leadership styles. Personality and Motivational Theories. Attitudes, Values and Perceptions at work - Case discussion (8)

GROUP BEHAVIOUR: Group dynamics, Group formation and development, group structure and group cohesiveness. Informal organization – Sociometry – Interaction analysis – Exercises (8)


HUMAN RESOURCE MANAGEMENT: Objectives and Functions, Selection and Placement, Training and Development – Conflict management – Stress management – Human resource management in global environment - Human resource information system (HRIS) - Case discussion. (8)

TUTORIAL PRACTICE:
1. Case study on human resource information system.
2. Case study on organizational behavior.
3. Case study on human resource information system.
4. Case study on organizational behavior.

Total L: 45 + T: 30 = 75

TEXT BOOKS:

REFERENCES:

15XTO6 ENTREPRENEURSHIP 3 2 0 4

INTRODUCTION TO ENTREPRENEURSHIP: Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance or Entrepreneurship. Seminar in R5 & R6. (5)


DEVELOPING AN EFFECTIVE BUSINESS MODEL: The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. (5)

APPRAISAL OF PROJECTS: Importance of Evaluating Various options and future investments- Entrepreneurship incentives and subsidies – Appraisal Techniques. (8)

FORMS OF BUSINESS ORGANIZATION: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. (4)


THE MARKETING FUNCTION: Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. (5)

INTELLECTUAL PROPERTY PROTECTION AND ETHICS: Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges. (4)

TUTORIAL PRACTICE:
Case studies

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TEXT BOOKS:


REFERENCES:


15XTO7 INFORMATION THEORY AND ERROR CONTROL CODING


CONTINUOUS CHANNELS: Definitions of different entropies – Mutual information – Maximization of the entropy of a continuous random variable – Entropy maximization problems – channel capacity under the influence of additive white Gaussian noise – parallel Gaussian channel.


TUTORIAL PRACTICE:
1. Finding mutual information, entropy and conditional entropy of a channel.
2. Implementation of various encoding and decoding algorithms.

REFERENCES:


15XTO8 COMPUTATIONAL COMPLEXITY THEORY

INTRODUCTION: The computational model – Modeling computation and efficiency – Review of Turing machines – Universal Turing machines – Uncomputable functions – Deterministic time and the class P.
COMPLEXITY CLASSES - P, NP, NP Complete, NP-Hard - P vs NP - NP completeness - Relation between NP and NP completeness - The cook Levin theorem - The web of reductions - Decision vs Search - coNP, EXP and NEXP

DIAGONALIZATION - Time hierarchy theorem - Space hierarchy theorem - non deterministic time hierarchy theorem - Oracle machines - Space complexity - Configuration graphs - Some space complexity classes - PSPACE completeness - NL Completeness.

POLYNOMIAL HIERARCHY AND ALTERNATIONS - The classes \( \Sigma_p^p \) and \( \Pi_p^p \) - The polynomial hierarchy - Alternating turing Machines - Time versus alternations - Defining the hierarchy via oracle machines

CIRCUITS - Boolean circuits - Karp Lipton theorem - Circuit lower bounds

RANDOMIZED COMPUTATION - Probabilistic Turing Machines (PTM) - Examples - RP(Randomized Polynomial), BPP (Bounded Error probabilistic polynomial), Complement Randomized Polynomial (Co-RP) - Probabilistic Polynomial (PP) - Randomized logarithmic space polynomial time (RL) - Related problems.

COUNTING PROBLEMS - Counting classes - Complexity of counting problems - An approximate comparison procedure - Constructing A-Comp - Non-Uniform Classes - Oracles - Relativization

APPLICATIONS - Randomized decision tree - Pseudo random number generators

TUTORIAL PRACTICE:
1. Implementation of finding a solution to different classes of problems
2. Implementation of randomized decision tree

TEXT BOOKS:

REFERENCES: