LEARNING OUTCOMES

The design of the program was developed through discussions between the computer science and mathematics faculty and Centers for Cyber Security and CEN. Each student's plan of study should address a set of learning outcomes developed from these discussions. The learning outcomes answer the question: "What should a graduate of our data science program be able to do?"

- Build mathematical / statistical models and understand their power and limitations
- Design an experiment
- Use machine learning and optimization to make decisions
- Acquire, clean, and manage data
- Visualize data for exploration, analysis, and communication
- Collaborate within teams
- Deliver reproducible data analysis
- Manage and analyze massive data sets
- Assemble computational pipelines to support data science from widely available tools
- Conduct data science activities aware of and according to policy, privacy, security and ethical considerations
- Apply problem-solving strategies to open-ended questions
Unit 1
Chapter 2- Sec: 2.1 to 2.7 and Chapter 3- Sec: 3.1 to 3.6, 3.7, Self Study - Sec: 3.7.

Unit 2
Chapter 4- Sec: 4.1 to 4.4, 4.6 to 4.8, Self Study - Sec: 4.5

Unit 3
Chapter 5- Sec: 5.1 to 5.6

Unit 4
Chapter 8: 8.1 to 8.5, 8.7, 8.8, Self Study - Sec: 8.6

Unit 5
Chapter 6 – Sec: 6.1 to 6.7

TEXTBOOK:

REFERENCE BOOKS:
**Vector Spaces**: Vector spaces - Sub spaces - Linear independence - Basis – Dimension.


**Linear Transformations**: Positive definite matrices - Matrix norm and condition number - QR-Decomposition - Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation - Change of basis - Nilpotent transformations - Trace and Transpose, Determinants, Symmetric and Skew Symmetric Matrices, Adjoint and Hermitian Adjoint of a Matrix, Hermitian, Unitary and Normal Transformations, Self Adjoint and Normal Transformations, Real Quadratic Forms.

**Eigen values and Eigen vectors**: Problems in Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections. Similarity of linear transformations - Diagonalisation and its applications - Jordan form and rational canonical form.

**TEXT BOOKS**


**REFERENCES**:


**18PHY101  PHYSICS  3 0 0 3**

**UNIT 1**

*Units and measurements, Vectors*: fundamentals, *Motion in One Dimension*: Displacement, Velocity, and Speed, instantaneous, velocity and speeds ,acceleration, motion diagrams, constant acceleration, varying acceleration, freely falling body, kinematic equations.

*Motion in 2D and 3D*: The displacement, Velocity and acceleration vectors,Relative velocity and Relative acceleration Two dimensional motion with constant acceleration, Projectile motion ,horizontal range and maximum height.

**UNIT 2**
Newton’s laws of motion, inertia, torque, Newton’s law of universal gravitation applications & Free body diagrams, work and Kinetic energy, potential energy and conservation of energy momentum & collisions.

Circular motion, uniform circular motion, Non-uniform Circular motion tangential and radial acceleration Rotational of rigid body inertia, torque, Angular momentum.

UNIT 3
Kinematics of moving fluids, equation of continuity, Euler’s equation, Bernoulli’s theorem, viscous fluids, surface tension and surface energy, capillarity.

UNIT 4
Zeroth law of thermodynamics: Concept of temperature & its measurement, Triple point of water, Thermometers: constant volume, Constant pressure, Platinum resistance thermometry, Thermal expansion,


UNIT 5
Second law of thermodynamics: Kelvin Planck statements, Entropy and its variation external and internal combustion engines - Carnot engine: Steam engine, Stirling engine, Clausius statement of second law, Refrigerator, Equivalence of Kelvin-Planck and Clausius statement. Reversibility and irreversibility, Conditions for irreversibility. Irreversibility of second law of thermodynamics

TEXTBOOK:

REFERENCE BOOKS:


1. Young’s modulus – Uniform bending
2. Torsional Pendulum
3. Compound Pendulum
4. Coefficient of viscosity- Poiseuille’s method
5. Surface tension of liquid by capillary raise method
6. Thermal conductivity of bad conductor - Lee’s disc
7. Kundt’s tube
8. Specific heat capacity of a liquid by method of cooling.

Text Book: Laboratory manual supplied by the Department

18CSE 100  Problem Solving and Computer Programming  300  3

Unit 1
Conceptual introduction: topics in computer science, algorithms; modern computer systems: hardware architecture, data representation in computers, software and operating system; Installing Python; basic syntax, interactive shell, editing, saving, and running a script. The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages;

Unit 2
Conditions, boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation. Strings and text files; manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers

Unit 3
Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries. Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Recursive functions. Testing, Debugging, Exceptions, Assertions. Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects

TextBook

1. Installing Python environments
2. Using Python Interpreter to do basic operations like arithmetic computations.
3. Working with variables of different datatypes and using them in expressions.
4. Building stand alone Python scripts
5. Implementing logic requiring conditional expressions and looping
6. Working with strings using inbuilt functionalities of the datatype
7. Working with Python inbuilt datatypes like Lists, Tuples and Dictionaries
8. Working with modularity : Implementing functions and designing logic in a modular fashion
9. Implement unit testing measures assertions and exception handling
10. Use Python to model object oriented programming principles using various use cases.

TextBook

UNIT-1

Calculus of vector-valued functions: Vector-valued functions of a real variable-Algebraic operations. Components- Limits, derivatives and integrals-Applications to curves. Tangency-Applications to curvilinear motion-Velocity, speed and acceleration-The unit tangent, the principal normal -The definition of arc length.

Vol.1, Chapter 14- Sec. 14.1 to 14.10.

UNIT-2

Differential calculus of scalar and vector fields: Functions of $\mathbb{R}^n$ to $\mathbb{R}^m$.Scalar and vector fields-Open balls and open sets-Limits and continuity-The derivative of a scalar field with respect to a vector-Directional derivatives and partial derivatives-Partial derivatives of higher order-Directional derivatives and continuity-The total derivative-The gradient of a scalar field-A chain rule for derivatives of scalar fields- Applications to geometry. Level sets. Tangent planes

Vol.2, Chapter-8-Sec. 8.1 to 8.17.

UNIT-3

Line Integrals: Introduction-Paths and line integrals-Other notations for line integrals-Basic properties of line integral-Open connected sets. Independence of paths-The second fundamental theorem of calculus for line integrals-The first fundamental theorem of calculus for line
integrals-Necessary and sufficient conditions for a vector field to be gradient-Necessary conditions for a vector field to be gradient-Special methods for constructing potential functions.

Vol.2, Chapter-10-Sec 10.1 to 10.5, 10.10 and 10.11, 10.14 to 10.18.

**Unit-4**

Multiple Integrals: Introduction-Green’s theorem in the plane-Some applications of Green’s theorem-A necessary and sufficient condition for a two-dimensional vector field to be a gradient-Change of variables in double integral-Special cases of transformation formula.

Vol.2, Chapter-11-Sec. 11.19 to 11.22, 11.26 to 11.28.

**Unit-5**

Surface Integrals: Parametric representation of a surface-The fundamental vector product- The fundamental vector product as a normal to the surface-Surface integrals-Other notations for surface integrals-The theorem of Stokes-The curl and divergence of a vector field- Further properties of the curl and divergence-The divergence theorem (Gauss’ theorem)

Vol.2, Chapter-12-Sec. 12.1 to 12.4, 12.7, 12.9 to 12.15, 12.19 and 12.21.

**TEXTBOOKS:**


**REFERENCE BOOKS:**

1. Howard Anton “Calculus” John Wiley and Sons
**Relations and Their Properties:** Representing Relations, Closure of Relations, Partial Ordering, Equivalence Relations and partitions. (Sections: 7.1, 7.3 - 7.6)

**Advanced Counting Techniques and Relations:** Recurrence Relations, Solving Recurrence Relations, Generating Functions, Solutions of Homogeneous Recurrence Relations, Divide and Conquer Relations, Inclusion-Exclusion. (Sections: 6.1 - 6.6)

**Phase III**

**Graph Theory:** Introduction to Graphs, Graph Operations, Graph and Matrices, Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest Path Problem, Planar Graph, Graph Colorings and Chromatic Polynomials. (Sections: 8.1 - 8.8)

**TEXTBOOKS:**


**REFERENCES:**


**UNIT I MINIMIZATION TECHNIQUES AND LOGIC GATES**


**UNIT II COMBINATIONAL CIRCUITS**

UNIT III SEQUENTIAL CIRCUITS
Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –
Application table – Edge triggering – Level Triggering – Realization of one flip flop using other
flip flos – serial adder/subtractor- Asynchronous Ripple or serial counter – Asynchronous
Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable
counters – Design of Synchronous counters: state diagram- State table –State minimization –
State assignment - Excitation table and maps-Circuit implementation - Modulo–n counter,
Registers – shift registers - Universal shift registers – Shift register counters – Ring counter –
Shift counters - Sequence generators.

UNIT IV MEMORY DEVICES
Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –
EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle -
Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM
cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices –
Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable
Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

UNIT V SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS
Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic
State Machine – Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits:
Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines –
Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits. Design of
Combinational and Sequential circuits using VERILOG.

TEXT BOOK:
Pearson

REFERENCES:
1. R. H. Katz and G. Boriello, Contemporary Logic Design, 2nd Ed., Prentice Hall of India,
List of Experiments:

1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 and vice-versa.
3. Four-bit parity generator and comparator circuits.
4. Construction of simple Decoder and Multiplexer circuits using logic gates.
5. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
8. Realization of Universal Register using JK flip-flops and logic gates.
12. Realization of Ring counter and Johnson’s counter.
13. Construction of adder circuit using Shift Register and full Adder.

Unit 1


Unit 2

Applied Plotting, Charting & Data Representation in Python: Fundamentals of data reading, streams etc and using Pandas, Basic Charting using Matplotlib, Advanced plots, interactive plots and animated plots, Plotting with Pandas, Seaborn.

Unit 3

Python packages for accessing the Web Data: Regex, urlib, BeautifulSoup, Json, Retrieving and parsing webpages (Json, XML), REST API, Facebook and Twitter API. Connecting DB with Python: Reading and Writing, possible simple SQL queries.

TextBook

1. Installing external packages and using them in Python scripts
2. Work with NumPy, SciPy on solving simple mathematical problems
3. Implementing functionalities in Pandas to work with tabular data and do simple database operations on them
4. Implement various plotting and charting methods using packages like Matplotlib and its abstractions like Seaborn
5. Develop Python scripts that can retrieve data from the Web and do operations like parsing, searching, and formatting using packages like BeautifulSoup, urllib, Regex
6. Implement direct database access/manipulations by using Python scripts.

TextBook
Unit – I

Unit – II
Random variables, Probability Distributions and Probability mass functions, Cumulative Distribution functions, mathematical expectation, variance, moments and moment generating function.

Unit – III
Standard discrete distributions - Binomial, Poisson, Uniform, Geometric distributions, Negative binomial and Hypergeometric Distributions - Standard continuous distributions - Uniform, Exponential, Gamma, Beta and Normal distributions. Chebyshev’s theorem.

Unit-IV
Two dimensional random variables-Joint, marginal and conditional probability distributions for discrete and continuous cases, independence, expectation of two dimensional random variables - conditional mean, conditional variance, covariance and correlation.

Unit – V
Functions of one and two random variables. Sampling and sampling Distributions- t, F and Chi-square distributions – central limit theorem.

Textbooks:

Reference books:
Unit I

Introduction to optimization: classical optimization, Optimality criteria – Necessary and sufficient conditions for existence of extreme point.


Unit II


Sections 8.1 - 8.3 and 9.1 – 9.4

Unit-III


Unit IV

Nonlinear Equality Constrained Optimization- Introduction, Problems with equality constraints Problem Formulation, Tangent and Normal Spaces, Lagrange Condition

Sections 19.1 -19.6

Unit V

Nonlinear Inequality Constrained Optimization -Introduction - Problems with inequality constraints: Kuhn-Tucker conditions.

Sections 20.1, 20.2, 22.1 – 22.4

Text Book


Reference Books


18MAT 233  
Numerical Methods  
3 1 0 4

Unit 1
Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, system of nonlinear equations.

Solution of System of Linear Algebraic Equations, Gauss-Elimination, LU Decomposition and Gauss-Seidel, Conjugate gradient method.


Unit 2
Interpolation and Approximation: Lagrange, Newton’s Divided Difference, Newton’s Forward and Backward interpolations and cubic splines,

Unit 3
Differentiation and Integration: Numerical differentiation, Maxima and Minima, Numerical integration, Newton-Cotes formulas, Romberg integration, Gaussian integration,

Unit 4

Unit 5
Solutions of Partial Differential equations: Elliptic, Parabolic and Hyperbolic equations implicit and explicit methods.

TEXTBOOKS:
**REFERENCE BOOKS:**


**18CSC201 Data Structures 3 1 0 4**

**Unit 1**
Abstraction - Abstract data types; Data Representation; Elementary data types; Basic concepts of data Structures; Mathematical preliminaries - big-Oh notation; efficiency of algorithms; notion of time and space complexity; performance measures for data structures. ADT array - Computations on arrays - sorting and searching algorithms.

**Unit 2**
ADT Stack, Queue, list - array, linked list, cursor based implementations of linear structures. ADT Tree - tree representation, properties traversal of trees; ADT- Binary Trees – properties and algorithms, ADT Priority Queue - Heaps; heap-based implementations; applications of heaps - sorting; Search Tree - Binary search tree; balanced binary search trees - AVL tree; Applications of Search Trees - TRIE; 2-3-4 tree; concept of B-Tree. ADT Dictionary - array based and tree based implementations; hashing - definition and application.

**Unit 3**
Graphs: ADT- Data structure for graphs - Graph traversal- Transitive Closure- Directed Acyclic graphs - Weighted graphs – Shortest Paths - Minimum spanning tree – Greedy Methods for MST.

**TEXTBOOKS:**


**REFERENCES:**

Implementing Sample ADT, Templates - Stacks and Queues: Array implementation, Applications - Vector, Lists, using these STLs for other implementations -Linked list: Singly and Doubly Linked Lists Implementation, Linked Stacks, D-Queue, Circular Queue - Implementing STL: Sequences, Iterators - Trees: Binary search tree, Priority Queue, Heaps - Graphs: Graph Representations, Traversals (BFS, DFS) - Hashing: Hash Table creation, creating hash functions, dynamically resizing hash tables.

18CSC202 FOUNDATIONS OF DATA SCIENCE 2-0-2-3

Unit-1

Unit-2
Descriptive statistics – Central tendency, dispersion, variance, covariance, kurtosis, five point summary, Distributions, Bayes Theorem, Error Probabilities; Permutation Testing, Statistical Inference; Hypothesis Testing, Assessing Models, Decisions and Uncertainty, Comparing Samples, A/B Testing, P-Values, Causality.

Unit-3
Estimation, Prediction, Confidence Intervals, Inference for Regression, Classification, Graphical Models, Updating Predictions.

TEXT BOOKS

REFERENCES:
1. Data Visualization using plot, pie chart, bar chart, histogram and Box plot
2. Find the central measures for given data, like, mean, mode, median and deviations
3. Root finding
4. Gauss iteration methods
5. Power method for finding eigenvalues and eigenvectors
7. Interpolations.
8. Initial and Boundary value problems, solution of partial differential equations.

18MAT 241 Statistical Inference Theory 3-0-0-3

Unit-I

Unit II
Interval Estimation: Introduction - confidence Interval for mean of a Normal Distribution with Variance known and unknown - Confidence Interval for the two means of a Normal Distribution with Variance known and unknown, Confidence interval for one and two Population Proportions, Confidence interval for the variance and ratio of variances.

Unit-III
Inference theory - introduction to hypothesis testing - large sample tests for single mean and two means - large sample tests for single proportion and two proportions.

Unit-IV
Small sample tests for single mean and two means – paired t-test - test for single variance – test for equality of two variances.

Unit-V
Chi-square goodness of fit for Binomial, Poisson and Normal distributions, Independence of attributes, test for homogeneity, Non-parametric tests - sign test, signed rank test and Mann-Whitney U test.

Textbooks:

Reference books:

18MAT242 Introduction to Modern Algebra 3 0 0 3

Unit 1: Sets and Relations - Operations on Sets and their Properties, Partitions and Equivalence Relations, Binary Operations, Isomorphic Binary Structures - Injective and Surjective Mapping, Composition of Mappings and its Properties and Congruence Modulo of a given integer. (Chapters 0 to 3)

Unit 2: Definition and Examples of Groups, Elementary Properties of Groups, Finite Groups and Group Tables, Subgroups. Cyclic Groups, its Properties, its Structures and its Subgroups, Generating Sets. (Chapters 4 to 7)

Unit 3: Groups of Permutations, Cayley’s Theorem, Orbits, Cycles, Even and Odd Permutations, Alternating Groups. Cosets, Lagrange Theorem, Direct Products of Groups, Fundamental Theorem of Finitely Generated Abelian Groups. (Chapters 8 to 11)

Unit 4: Homomorphisms, Properties of Homomorphisms, Factor Groups, Normal Subgroups, Inner Automorphisms, Factor Group Computations and Simple Groups, Center and Commutator Subgroups. (Chapters 13 to 15)

Unit 5: Definition, Examples and Properties of Rings, Homomorphisms and Isomorphisms of Rings, Fields, Integral Domains, The Characteristic of a Ring, Fermat’s and Euler’s Theorems, The Field of Quotients, Rings of Polynomials. (Chapters 18 to 22)

TEXTBOOK:

REFERENCES:


**18CSC211 CONVEX OPTIMIZATION 3 0 0 3**

**Unit 1.** Introduction: Mathematical optimization, Least-squares and linear programming, Convex optimization, Nonlinear optimization.

Chapter 1.

**Unit 2**

Chapter-2

**Unit 3**

Chapter-3.

**Unit 4**

Chapter-4.

**Unit 5:**

TEXT BOOKS:

REFERENCES:


18CSC212 Design and Analysis of Algorithms 3 1 0 4

Unit 1
Introduction: Problem solving -- adding 2 n-bit numbers, multiplication as repeated addition. Running time analysis -- recall of asymptotic notation, big-oh, theta, big-omega, and introduce little-oh and little-omega. Worst case and average case

Basic design paradigms with illustrative examples -- incremental design (e.g., incremental sorting, interpolating polynomials), decremental design (e.g., GCD with discussion on input size, factorial), and pruning (e.g., order statistics). Divide and Conquer: Integer multiplication revisited with an efficient algorithm that motivates and leads into recurrences. Solving recurrences using recurrence trees, repeated substitution, statement of master theorem. Brief recall of merge sort and its recurrence. Median in worst case linear time.

Unit 2
Greedy Algorithms: Greedy choice, optimal substructure property, minimum spanning trees -- Prims and Kruskals, Dijkstra's shortest path using arrays and heaps, fractional knapsack, and Huffman coding (use of priority queue). Dynamic Programming: Integral knapsack (contrasted with the fractional variant), longest increasing subsequence, edit distance, matrix chain multiplication, and independent sets in trees.

Unit 3

Textbooks


References


18CSC213 Database Management Systems 3 1 0 4

Unit I


Unit II


Unit III

Relational database design – features of good relational designs – atomic domains and normal forms - 1NF, 2NF, 3NF, 4NF and BCNF – decomposition using functional dependencies - functional dependency theory – algorithm for decomposition -decomposition using multi-values dependencies – PJNF and DKNF. Over view of Transaction Management and Concurrency control

Text Book:


Reference Books

18CSC202     Design and Analysis of Algorithms Lab     0  0  2  1


18MAT289       Data Science  Lab –II: Inference Theory      0  0  2  1

1. Modern Algebra:
   - Problems in Set Theory
   - Verification of different relations (equivalence and partial order relations)
   - Problems in permutation groups

2. Inference Theory:
   - Discrete and Continuous distribution
   - Correlations
   - Testing of hypothesis

18CSC301     OPERATING SYSTEMS                               3 0 2 4

Unit 1

Unit 2

Unit 3

TEXTBOOK:


REFERENCES:


18MAT331 TRANSFORM TECHNIQUES

(Text Book 2: Sections: 11.1, 11.2, 11.7, 11.9)
Laplace Transforms, Inverse Transforms, Properties, Transforms of Derivatives and Integrals, Second Shifting Theorem, Unit Step Function and Dirac-Delta Function, Differentiation and Integration of Transforms. (Text book 2: Sections: 6.1, 6.2, 6.3, 6.4)

Introduction to DFT and FFT. Z-Transform: Simple properties.

**TEXTBOOK**


**REFERENCE BOOKS**


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**18CSC302 Number Theory and Information Security 3 1 0 4**

**Algorithms for integer arithmetic:** Divisibility, GCD, modular arithmetic, modular exponentiation, Montgomery arithmetic, congruence, Chinese remainder theorem, orders and primitive roots, quadratic residues, integer and modular square roots, prime number theorem, continued fractions and rational approximations.

**Representation of finite fields:** Prime and extension fields, representation of extension fields, polynomial basis, primitive elements, normal basis, optimal normal basis, irreducible polynomials, Root-finding and factorization algorithm, Lenstra-Lenstra-Lovasz algorithm.

**Elliptic curves:** The elliptic curve group, elliptic curves over finite fields, Schoof's point counting algorithm.

**Primality testing algorithms:** Fermat Basic Tests, Miller–Rabin Test, AKS Test.

**Integer factoring algorithms:** Trial division, Pollard rho method, p-1 method, CFRAC method, quadratic sieve method, elliptic curve method.

Quantum Computational Number Theory: Grover's algorithm, Shor's algorithm

Applications in Algebraic coding theory and cryptography.

TEXT BOOKS/REFERENCES:


18MAT332 Random Processes 3 0 0 3

Unit – I Introduction to Probability and Stochastic Processes:

Definition of Stochastic Processes, specification of Stochastic processes, Stationary processes–Markov Chains: definition and examples, higher transition probabilities, Generalization of Independent Bernoulli trails, classification of states and chains.
(Sections: 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4)

Unit – II Markov Processes with Discrete State Space:

Poisson process, Poisson process related distributions, properties of Poisson process, Generalizations of Poisson Processes, Birth and death processes, continuous time Markov Chains. (Sections: 4.1, 4.2, 4.3, 4.4, 4.5)

Unit – III Markov processes with continuous state space:


Unit – IV Renewal processes and theory:
Renewal process – Renewal processes in continuous time – Renewal equation – stopping time – Wald’s equation – Renewal theorems. (Sections: 6.1 to 6.5)

Unit – V Branching Processes:

Introduction, properties of generating functions of Branching process, Distribution of the total number of progeny, Continuous-Time Markov Branching Process, Age dependent branching process: Bellman-Harris process. (Sections: 9.1, 9.2, 9.4, 9.7, 9.8)

Text Book:

Book for Reference:

18CSC303 Database Design 3-1-0-4

Unit 1

Unit 2
Transactions Processing and Concurrency Control: Transaction Concept, Transaction model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability
Concurrency control: Lock-based protocols – Timestamp Ordering based control – Multiversion concurrency control – Locks, Database Recovery Techniques

Unit 3

TEXT BOOKS

REFERENCES


18CSC381 Database Management Systems Lab 0021

1) Working with objects using SQL for the following
   i. Data definition language: create, alter, grant, revoke, drop, truncate.
   ii. Data manipulation language: select, insert, update, delete.
   iii. Transaction control statements: commit, rollback, savepoint.

2) Constraints – Queries: Simple selection, projection and selection with conditions.

3) Functions: aggregate functions, group by, order by, date and conversion functions.

4) Set operators, joins, sub query: simple, nested, correlated, existence test, membership test, DDL and sub queries and DML and sub queries.

5) Working with other schema objects: view, sequence, index, synonym, cluster, lock, BLOB, CLOB, nested table, type.

6) PL/SQL programs, cursors, functions, procedures, packages, triggers, exception handling.

7) Front end tool: form creation, validation, trigger and report generation.

8) Mini Project.

18MAT333 Graph Analytics and Algorithms 3024

Unit 1
Trees: Trees, cut-edges and cut-vertices, spanning trees, minimum spanning trees, DFS, BFS algorithms.
Unit 2
Connectivity: Graph connectivity, k-connected graphs and blocks.

Unit 3

Unit 4

Unit 5

TEXTBOOKS

REFERENCES BOOKS
4. Graph Algorithms in Neo4j

18MAT334       Regression Analysis       3 1 0 4

Unit I

Unit II
Multiple Linear Regression: Multiple Linear Regression Models, Estimation of the Model Parameters, Hypothesis testing in Multiple Linear Regression, Confidence Interval on the Regression and Prediction of New observations.

Unit III

**Unit IV**
Polynomial regression models – polynomial models in one variable – Polynomial models in two or more variables – variable selection and model building – computational techniques for variable selection.

**Unit V**
Introduction to analysis of variance- one way and two way ANOVA – Analysis of variance in Regression: Response surface designs – Introduction to response surface methodology, Method of steepest accent, Analysis of second order response surface, experimental design for fitting response surfaces.

**Text Books/References:**


**18CSC313 THEORY OF COMPUTATION 3 1 0 4**

**Unit 1**
Automata and Languages: Chomsky hierarchy of languages, Introduction Finite Automata - Regular Expressions - Nondeterministic Finite Automata - equivalence of NFAs and DFAs – Minimization of DFA.

**Unit 2**
Regular Expressions - Non-Regular Languages - Pumping Lemma for regular languages.

**Unit 3**
Parse tree derivations (top-down and bottom-up) Context free languages – Chomsky normal form, GNF - Push Down Automata - Pumping lemma for context free language. CYK Algorithm, Deterministic CFLs. Ambiguous grammar, removing ambiguity, Computability
Theory: Turing Machines - Non-deterministic Turing Machines –CSG, Undecidability - PCP
Computation histories – Reducibility.

TEXTBOOK:

REFERENCES:

18CSC311       Machine Learning       3  0  2  4


Text books/ Reference books.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)

18CSC312 DATA VISUALIZATION 3 0 0 3

Unit 1
Introduction to Data Visualization – Classification of Visualization techniques – Structure and representation – Selection of a Visualization – Visualizations for high dimensional data – Graphics and computing.

Unit 2

Unit 3

TEXTBOOK

18CSC314 Ethics for Data Scientists 1 0 0 1

18CSC383 Machine Learning Lab 0 0 2 1

18CSC401 Parallel and Distributed Systems 3 1 0 4

Unit 1

Unit 2


Unit 3

System models : physical models, architecture models, operating system support. Distributed file systems – introduction- time and global states – synchronization of physical clocks – coordination and agreements: Mutual exclusion, election, consensus.

Text Books

2. Calvin Lin ,Larry Snyder, Principles of Parallel Programming, Pearson, 2009

References


18CSC402 Deep Learning 3 0 0 3

• Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.
• Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training.
• Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs
Convolutional Neural Networks: LeNet, AlexNet.
Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.
Recent trends: Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning
Applications: Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

Textbook:

References:
1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT press 2016
3. Pattern Recognition and Machine Learning, Christopher Bishop, 2007

18CSC404 Reinforcement Learning 3 0 0 3
Introduction: Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example- Tic-Tac-Toe.
Review of Markov process and Dynamic Programming.
Text Book:

References:
Unit 1


Unit 2


Unit 3

Hadoop Eco systems: Hive – Architecture - data type - File format – HQL – SerDe - User defined functions - Pig: Features – Anatomy - Pig on Hadoop - Pig Philosophy - Pig Latin overview - Data types - Running pig - Execution modes of Pig - HDFS commands - Relational operators - Eval Functions - Complex data type - Piggy Bank - User defined Functions - Parameter substitution - Diagnostic operator.

TEXTBOOK:


18CSC405 Data Security 3 0 0 3

Unit 1
Access control mechanisms in general computing systems; Authentication and authorization mechanisms- Passwords (Single vs Multifactor), Captcha, Single Sign-on- Oauth and Openid connect, Authentication Protocols (Kerberos, X.509).

Unit 2
Malwares and its protection mechanisms- Viruses, Worms, Trojans, Ransomware, Polymorphic malware, Antivirus, Firewall and Intrusion detection systems.

Unit 3
Networking Basics, Web, Email, and IP Security- SSL, TLS, WEP, SET, Blockchain, PGP, IPSEC.

Unit 4

Unit 5

Textbook:

References:

18CSC406 Software Engineering 3 1 0 4

Software process and lifecycle: Software Product, Software Processes, Study of different process models, Project Management Concepts, Planning and Scheduling, Team organization and people management.
Software requirement engineering: Software requirements, extraction and specification, Feasibility Studies, Requirements Modeling, object oriented analysis.
Risk Management: Metrics and Measurement, Estimation for software projects, software configuration management, Maintenance and Reengineering.
Software Testing: Unit testing, integration testing, black box and white box testing, regression testing, performance testing, object oriented testing. Verification and validation of Software:Software Inspections and Audit, Automated Analysis, Critical systems validation.
Self-Study:

Text Books: 1.Ian Sommerville, Software Engineering, Addison – Wesley
References:
2.Rajib Mall, Fundamentals of Software Engineering, Prentice Hall of India
3.Ivar Jacobson, Object Oriented Software Engineering A use case Approach, Pearson

18CSC407 Deep Learning for Natural Language Processing 3 0 2 4


TEXTBOOK:


REFERENCES:


18CSC441 Soft Computing 3 1 0 4

Unit I

Unit II
Fuzzy Logic: Introduction – the case of imprecision, the utility and limitation of fuzzy systems. Classical sets and Fuzzy sets: operations, properties and mapping.

Unit III
Classical relations and fuzzy relations: cardinality, operations, properties and composition – tolerance and equivalence relations. Properties of membership function, fuzzification and defuzzification. Logic and fuzzysystems. Fuzzy control systems – Aircraft landing control problems.

Unit IV

Text Books:
1) Kumar S. ‘Neural Networks – A classroom approach’, TMH, 20014.

Reference Books:

18CSC442 Cryptography 3 0 0 3

Stream ciphers: Pseudo-random generators, Attacks on the one time pad, Linear generators, Cryptanalysis of linear congruential generators, The subset sum generator.
Block ciphers: Pseudorandom functions and permutations (PRFs and PRPs), PRP under chosen plaintext attack and chosen ciphertext attack, Case study: DES, AES, modes of operation.

Message integrity: Cryptographic hash functions, message authentication code, CBC MAC and its security, Cryptographic hash functions based MACs, Authenticated Encryption-Authenticated encryption ciphers from generic composition.

Public key encryption: RSA, Rabin, Knapsack cryptosystems, Diffie-Hellman key exchange protocol, ElGamal encryption, Elliptic curve cryptography.

Digital signatures: RSA, ElGamal and Rabin’s signature schemes, blind signatures.


Network security: Certification, public-key infra-structure (PKI), secure socket layer (SSL), Kerberos.

TEXT BOOKS/REFERENCES:

5. Dan Boneh and Victor Shoup, A Graduate Course in Applied Cryptography, V4, 2017
Unit 1

Unit 2

Unit 3

TEXTBOOK:

REFERENCES:
Neighbor Search - Shingling of Documents - Similarity-Preserving Summaries of Sets - Locality-Sensitive Hashing for Documents - Distance Measures

Text Book

References
Tom White, Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale, O'Reilly Media; 4 edition, 2015.

**18CSC447 Data Compression 3 0 0 3**

**Unit 1**

**Unit 2**
Scalar and Vector Quantization: Scalar Quantization – Introduction, Uniform and Adaptive quantization. Vector Quantization- Introduction, Advantages, LBG, Tree vector quantization, Trellis coded quantization Audio Compression: Distortion criteria- Auditory perception, PCM, DPCM, ADPCM, Predictive coding- basic algorithm, Basic sub-band coding, MPEG Audio Coding

**Unit 3**

TEXTBOOKS:

REFERENCES:

18CSC453 Big Data Storage and Analysis 3 0 0 3

Unit 1

Unit 2

Unit 3
Serving Layer- Performance Metrics, Requirements and Design, ElephantDB. Speed Layer- Realtime Views, Cassandra basics, Query and Stream Processing, Apache Storm

TEXT BOOKS:

REFERENCES:

https://thrift.apache.org/
https://www.elephantsql.com/

18CSC449 IoT Workshop 3 0 0 3

Unit - 1
Introduction to IoT - IoT definition - Characteristics - Things in IoT - IoT Complete Architectural Stack - IoT enabling Technologies - IoT Challenges - IoT Levels - A Case Study to realise the stack.
Sensors and Hardware for IoT - Accelerometer, Proximity Sensor, IR sensor, Gas Sensor, Temperature Sensor, Chemical Sensor, Motion Detection Sensor. Hardware Kits - Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors (Lab Component)

Unit - 2
Protocols for IoT - infrastructure protocol IPV4/V6|RPL), Identification (URLs), Transport (Wi-Fi, Li-Fi, BLE), Discovery, Data Protocols, Device Management Protocols. - A Case Study with MQTT/CoAP usage. (Lab Component)
Cloud and Data analytics- Types of Cloud - IoT with cloud challenges - Selection of cloud for IoT applications - Fog computing for IoT - Edge computing for IoT - Cloud security aspects for IoT applications - RFM for Data Analytics - Case study with AWS / AZURE / Adafruit / IBM Bluemix (Lab Component).

Unit - 3
Case studies with architectural analysis:
IoT applications - Smart City - Smart Water - Smart Agriculture - Smart Energy - Smart Healthcare - Smart Transportation - Smart Retail - Smart waste management. (Lab Component - As a project)

Text and Reference Books
18CSC450  
Introduction to Embedded Systems  

Unit 1  
Architecture of Microprocessors: General definitions of computers, micro-processors, micro controllers and digital signal processors.  
Overview of Microcontrollers- Introduction to 8051 microcontroller, General Architecture of a MCU and more specific to 8051 family MCUs, Pin diagram of 8051 MCU and various control signals, Various addressing modes of 8051, 8051 Instruction Set and Programming -Data Movement, Arithmetic & Logical, Control instructions with example programs, 8051 Interfacing with peripherals - Simple IO devices and sensor devices interfacing with 8051 MCU, Timer / counter modules and interrupts in 8051, RS232 based serial Communication using 8051

Unit 2  
ARM Architecture: RISC Machine, Architectural Inheritance, Programmers model. ARM Organization and Implementation. 3 Stage pipeline, 5 Stage pipeline, ARM Instruction execution, ARM Implementation, Co-processor interface, ARM Assembly language Programming, Data processing instructions, Data Transfer Instructions, Control flow instructions, Architectural support for high level programming, Thumb Instruction set.

Unit 3  

Text Book:  

References:  
2) Kenneth Ayala - The 8051 Microcontroller & Embedded Systems Using Assembly and C 1st Edition

**18CSC451  INFORMATION RETRIEVAL  3 0 0 3**

Unit 1
Boolean Retrieval – The term vocabulary and postings lists – Dictionaries and tolerant retrieval –
Index construction – Index compression – Scoring, term weighting and the vector space model –
Evaluation in Information retrieval.

Unit 2
Relevance feedback and query expansion – XML retrieval – Probabilistic information retrieval –
Text classification – Vector space classification – Clustering – Matrix decomposition and latent
semantic indexing.

Unit 3
Web search basics – Web crawling and indexes – Link analysis.

**TEXTBOOK:**
Manning C D., Raghavan P a ndSchutze H., “Introduction to Information Retrieval”, Cambridge
University Press, 2008

**REFERENCES:**
2. David A.Grossman and OphirFrieder,”Information Retrieval: Algorithms and

**18CSC452  Social Network Analytics  3 0 0 3**

**Unit 1: Online Social Networks (OSNs)**

Introduction - Types of social networks (e.g., Twitter, Facebook), Measurement and Collection of Social Network Data. Techniques to study different aspects of OSNs -- Follower-followee
dynamics, link farming, spam detection, hashtag popularity and prediction, linguistic styles of
tweets. Case Study: An Analysis of Demographic and Behaviour Trends using Social Media: Facebook, Twitter and Instagram

**Unit 2: Fundamentals of Social Data Analytics**

Introduction - Working with Social Media Data, Topic Models, Modelling social interactions on
the Web – Agent Based Simulations, Random Walks and variants, Case Study: Social Network
Influence on Mode Choice and Carpooling during Special Events: The Case of Purdue Game Day

Unit 3 : Applied Social Data Analytics


Text and Reference Literature


18CSC454   Probabilistic Graphical Models   3 0 0 3

The aim of this course is to develop the knowledge and skills necessary to effectively design, implement and apply these models to solve real problems. The course will cover (a) Bayesian and Markov (MRF) networks; (b) exact and approximate inference methods; (c) estimation of both the parameters and structure of graphical models.


Reference Book:

**19CSE Computer Networks 3 0 0 3**


**MEDIA ACCESS & INTERNETWORKING**: Media access control – Ethernet (802.3) – Wireless LANs – 802.11 – Bluetooth – Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP)

**ROUTING**: Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM)


**APPLICATION LAYER**: Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP.

**TEXT BOOK**:  

**REFERENCES**:  

**18MAT446 COMPUTATIONAL GEOMETRY 3 0 0 3**

Convex hulls: construction in 2d and 3d, lower bounds; Triangulations: polygon triangulations, representations, point-set triangulations, planar graphs; Voronoi diagrams: construction and applications, variants; Delaunay triangulations: divide-and-conquer, flip and incremental algorithms, duality of Voronoi diagrams, min-max angle properties; Geometric searching: point location, fractional cascading, linear programming with prune and search, finger trees,
concatenable queues, segment trees, interval trees; Visibility: algorithms for weak and strong visibility, visibility with reflections, art-gallery problems; Arrangements of lines: arrangements of hyperplanes, zone theorems, many-faces complexity and algorithms; Combinatorial geometry: Ham-sandwich cuts, Helly's theorems, k-sets, polytopes and hierarchies, polytopes and linear programming in d-dimensions, complexity of the union of convex sets, simply connected sets and visible regions; Sweep techniques: plane sweep for segment intersections, Fortune's sweep for Voronoi diagrams, topological sweep for line arrangements; Randomization in computational geometry: algorithms, techniques for counting; Robust geometric computing; Applications of computational geometry.

References

4. Lecture Notes by David Mount.

18MAT 441 Advanced Algebra

Maximal Ideals, the Field of Quotients of an Integral Domain, Euclidean Rings, Principal Ideal, Unit Element, Greatest Common Divisor, Prime Elements, Unique Factorization Theorem. (Sec. 3.5 to 3.7)

The ring of Gaussian integers, Fermat’s Theorem, Polynomial Rings – F[x], Degree of a Polynomial, The Division Algorithm, Principal Ideal Ring, Irreducible Polynomial a principal ideal ring, Irreducible polynomial. (Sec. 3.8 to 3.9)

Sub Fields, Field Extensions, Finite Extensions, Algebraic Extensions and Their Properties. The Transcendence of ‘e’. (Sec. 5.1 to 5.2)

Roots of Polynomials, Remainder Theorem, Splitting Field and its Uniqueness, The concept of constructible numbers and its Applications, Distinct and Multiple Roots, Simple Extension of a Field. (Sec. 5.3, 5.4, 5.5).

TEXTBOOK:


REFERENCES:

Unit 1
Review of differential equations (order, degree, linear, nonlinear, implicit and explicit form of solution, general solutions, particular solution, singular solution). Exactness, nonexact equations reduce to exact form.
Part I: 1.1-1.9, 2.12-2.22 (5 hours)
Equations solvable for \( \frac{dy}{dx} \), \( y \), \( x \), equations in Clairaut’s form, equations reducible to Clairaut’s form.
Part I: 4.1-4.11 (4 hours)

Unit 2
Part I: 5.1-5.5, 6.1-6.3, 1.12,1.13, 5.26-5.27, 7.1-7.5 (9 hours)

Unit 3
Conversion of nth order differential equation to n first order differential equations, homogeneous linear system with constant coefficients, fundamental matrices, complex eigenvalues, repeated eigenvalues. simultaneous linear differential equations with constant coefficients, simultaneous linear differential equations with variable coefficients,
PART I: 8.1-8.3, 2.1- 2.7(8 hours)

Review of partial differential equations (order, degree, linear, nonlinear).

Unit 4
Formation of equations by eliminating arbitrary constants and arbitrary functions. General, particular and complete integrals. Lagrange’s linear equation, Charpit’s method, Methods to solve the first order partial differential equations of the forms \( f(p,q) = 0 \), \( f(z,p,q) = 0 \), \( f_1(x,p) = f_2(y,q) \) and Clairut’s form \( z = px + qy + f(p,q) \) where \( p = \frac{\partial z}{\partial x} \) and \( q = \frac{\partial z}{\partial y} \).
Part III: 1.1 – 1.5, 2.3-2.12, 3.1-3.2, 3.7-3.8, 3.10-3.18 (13 hours)

Unit 5
Part III: 4.1-4.12 (13 hours)

TEXTBOOKS:
References:

18MAT448 Theory of Sampling and Design of Experiments for Data Science 3-0-0-3

Unit I
Simple random sampling, Stratified random sampling, systematic random sampling - estimation of the population mean, total and proportion, properties of estimators, various methods of allocation of a sample, comparison of the precisions of estimators under proportional allocation, optimum allocation - Comparison of systematic sampling - Simple random sampling and stratified random sampling for a population with a linear trend.

Unit II
Cluster sampling – bootstrap sampling – jack knife sampling – bias and variance of estimates - Acceptance sampling for attributes, single sampling, double sampling, measuring performance of the sampling plans- OC, AOQ, ASN, ATI curves.

Unit III
Planning of experiments, Basic principles of experimental design, uniformity trails, analysis of variance, one-way, two-way and three-way classification models.

Unit IV
Completely randomized design (CRD), randomized block design (RBD) Latin square design (LSD) and Graeco-Latin square designs,

Unit V
Factorial experiments, 2^n and 3^n factorial experiments, analysis of 2^2, 2^3 and 3^2 factorial experiments, Yates procedure, confounding in factorial experiments, fractional factorial design.

References:
Unit I

Unit –II
Basic concept of quality control, process control and product control -Process and measurement system capability analysis - Area properties of Normal distribution. Statistical process control, theory of control charts, Shewhart control charts for variables-$\bar{x}$, R, s charts, attribute control charts - p, np, c, u charts, modified control charts.

Unit III

Unit IV
Acceptance sampling for attributes, single sampling, double sampling, multiple sampling and sequential sampling plans, rectifying inspection plans, measuring performance of the sampling plans- OC, AOQ, ASN, ATI curves.

Unit V
Taguchi methods: Meaning of Quality, Taguchi’s loss function, Introduction to orthogonal arrays – test strategies, steps in designing, conducting and analyzing an experiment, parameter and tolerance design: control and noise factors, signal to noise ratios, experimental design in Taguchi Methods, orthogonal arrays and parameter Design.

TEXT AND REFERENCE BOOKS
Multivariate Data: Random Vector: Probability mass and density functions, Distribution function, Mean vector & Dispersion matrix. Multivariate and Bivariate normal distributions.


Multiple correlation, partial correlation, hypothesis tests for multiple and partial correlations and canonical correlation

Time series as a discrete parameter stochastic process, Auto - covariance, Auto-correlation functions and their properties, moving average models, autoregressive models, Autoregressive Moving Average models.

Text Books:

References:

18MAT445 WAVELETS


Unit-II Construction of Wavelets on \( \mathbb{Z}_N \), The First Stage Construction of Wavelets on \( \mathbb{Z}_N \), The Iteration Step. Examples and Applications, \( L_2(\mathbb{Z}) \).

Unit-III Complete Orthonormal Sets in Hilbert Spaces, \( L_2([-\pi, \pi]) \) and Fourier Series, The Fourier Transform and Convolution on \( L_2(\mathbb{Z}) \), First-Stage Wavelets on \( \mathbb{Z} \).

Unit-IV The Iteration Step for Wavelets on \( \mathbb{Z} \), Implementation and Examples.
Unit-V $L_2(\mathbb{R})$ and Approximate Identities, The Fourier Transform on $\mathbb{R}$, Multiresolution Analysis and Wavelets, Construction of Multiresolution Analyses, Wavelets with Compact Support and Their Computation.

References:

18MAT447 QUEUING THEORY AND INVENTORY CONTROL 3-0-0-3

Unit I
Inventory concept – Components of Inventory model.

Unit II
Deterministic Continuous Review model - Deterministic Periodic Review model.

Unit III
The classical EOQ – Non zero lead time – EOQ with and without shortages.

Unit IV
Deterministic Multiechelon Inventory models for supply chain management.

Unit V
A stochastic continuous review model – A stochastic single period model for perishable products.

TEXT BOOKS

18MAT453 SIX SIGMA QUALITY ANALYSIS 3 0 0 3

Unit 1

Unit 2
Quality Circles - 7 Quality Control tools - 7 New Quality Control tools.

Unit 3
ISO 9000 Quality system Standards - Project Planning, Process and measurement system capability analysis - Area properties of Normal distribution.

Unit 4

Unit 5
Taguchi methods. Loss functions and orthogonal arrays and experiments.

TEXT AND REFERENCE BOOKS

18MAT450 Data Analytics in Computational Biology 3 0 0 3

Introduction to Bioinformatics - applications of Bioinformatics - challenges and opportunities - introduction to NCBI data model- Various file formats for biological sequences.

Bioinformatics resources – Importance of databases - Biological databases- Primary & Secondary databases (Genbank, EMBL, DDBJ, Swiss Prot, PDB, NDB, BLOCKS, Pfam, ProSITE, etc.).

Sequence alignment methods: Sequence analysis of biological data-Significance of sequence alignment- pairwise sequence alignment methods- Use of scoring matrices and gap penalties in sequence alignments- PAM and BLOSUM Scoring Matrices. Introduction to Dynamic

Multiple sequence alignment methods – Tools and application of multiple sequence alignment. Sequence alignment tools (BLAST, FASTA, CLUSTAL-W/X, MUSCLE, TCOFFEE), Variants of BLAST (BLASTn, BLASTp, PSIBLAST, PHI-BLA

Phylogenetic analysis algorithms: Maximum Parsimony, UPGMA, Transformed Distance, Neighbors-Relation, Neighbor-Joining, jackknife, Probabilistic models and associated algorithms such as Probabilistic models of evolution and maximum likelihood algorithm, Bootstrapping methods, use of tools such as PHYLIP, MEGA, PAUP.

References/ Textbooks


18MAT451 Computer Aided Drug Designing 3 0 0 3

Introduction to Molecular Modeling: Molecular Modeling and Pharmacoinformatics in Drug Design, Phases of Drug Discovery, Target identification and validation

Protein Structure Prediction and Analysis: Protein Structure prediction methods: Secondary Structure Prediction, Tools for Structure prediction; Protein structural visualization; Structure validation tools; Ramachandran Plot.


Multivariate Statistical methods in QSAR - Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCR). Regression analysis tools - Principal Component Regression (PCR), Partial Least Squares (PLS) - Case studies.

High Throughput / Virtual screening- Introduction, Basic Steps, Important Drug Databases, Designing Lipinski's Rule of Five, ADMET screening

Docking Studies- Target Selection, Active site analysis, Ligand preparation and conformational analysis, Rigid and flexible docking.
Molecular visualization tools: RasMol and Swiss-Pdb Viewer

Molecular docking tools: AutoDock and ArgusLab.

References/ Textbooks


18MAT442 ADVANCED BIG DATA ANALYTICS 3-0-0-3

Unit - I
How MapReduce Works - Anatomy of a MapReduce Job Run, Failures, Shuffle and Sort, Task Execution

Unit -II
MapReduce Types and Formats - MapReduce Types, Input Formats, output formats,

Unit- III
MapReduce Features- Counters, Sorting, Joins, Side Data Distribution

Unit -IV
Simple analytics using MapReduce, Calculating frequency distributions and sorting using MapReduce, Calculating histograms using MapReduce, Calculating scatter plots using MapReduce

Unit – V
Hierarchical clustering, Clustering algorithm to large dataset, classification using Navie bayes classifier, other applications

Text Books/References:
UNIT I
Introduction and Bayesian Decision Theory– Pattern recognition systems – the design cycle – learning and adaptation – Bayesian decision theory – continuous features – Minimum error rate classification – discriminant functions and decision surfaces – the normal density based discriminant functions.

UNIT II

UNIT III

UNIT IV

UNIT V

References: