TUMKUR UNIVERSITY
Department of Studies & Research in Mathematics

M.Sc. in

Industrial Mathematics and Applied Computing-Syllabi

(Academic Year 2023-24)

Choice Based Credit System (CBCS)
Semester Scheme

Choice Based Credit Systems (CBCS) –Semester Course

M. Sc. in Industrial Mathematics and Applied Computing

Name of the Course: M. Sc. in Industrial Mathematics and Applied Computing
Program Overview

The M.Sc. program in Industrial Mathematics and Applied Computing, spanning two years, stands out as a distinctive offering. It offers students intensive education in computational science, mathematics, and statistics, emphasizing the application of these disciplines in modeling, simulation, and solving industry-related challenges. This prestigious program, renowned for over two decades, consistently attracts high-caliber students and industry-leading companies. The curriculum is designed to instill robust fundamentals in linear algebra, statistics, optimization, data analysis, visualization, numerical methods, and programming. Through collaborative teamwork, students can cultivate their ability to effectively convey their mathematical and technical knowledge.

Medium of Instruction: The medium of instruction shall be English.
Duration: The M.Sc. Degree Course is of two years duration, spread over four semesters.
Eligibility Criteria:

1. Students who have successfully completed their B.Sc, BE, BCA, or BA degrees are eligible.
2. Students must complete and submit the undertaking form. The undertaking statements are as follows:
   - Students taking this course are not eligible to apply for teaching positions at schools, colleges, or universities.
   - This course is primarily focused on corporate career opportunities.

Attendance: Every student must have at least 75% attendance in each of the courses (Theory & Practical) in each semester.
Abbreviated Course Subject Codes:

CPT: Core Paper Theory	**CPP:** Core Paper Practical
OEPT: Open Elective Paper	**SPT:** Special Paper Theory

Special Paper Theory (SPT) Selection:

One Special Paper Theory (SPT) has to be chosen from the given Special papers in I, II, III and IV – Semester M.Sc., **Industrial Mathematics and Applied Computing,** as per the availability of faculties in respective specialization.
Computer Programming Practicals:
In I Semester, CPP- 1.6.2, II Semester CPP -2.4.2, III Semester CPP - 3. 4. 2 and in IV Semester CPP – 4.3.2 each student will have 4 hours of Practical per week. Practical classes will be conducted in batches of approximately 15 students in each batch.

Examination & Dissertation: Shall be followed as per Tumkur University CBCS regulation.

Internal Assessment Marks allotment **Total =30 Marks**

1st Test for 20 Marks + 2nd Test for 20 Marks Average of two tests = **20 Marks**

Seminar/ Assignment/Attendance/Extra activities = **10 Marks**

Internal Assessment Marks allotment for Paper of 50 marks

One theory based test and **One** laboratory test should be conducted for 10 Marks.

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M. Sc., Mathematics - Choice Based Credit System (CBCS)- Course Contents

I Semester

Sl. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						IA	Semester End Examn.	Total Marks
1	CPT-1.1	Algebra	4	4	3 Hrs	30	70	100
2	CPT-1.2	Mathematical Analysis	4	4	3 Hrs	30	70	100
3	CPT-1.3	Discrete Mathematical Structure	4	4	3 Hrs	30	70	100
4	CPT-1.4	Probability and Statistical Methods-I	4	4	3 Hrs	30	70	100
5	SPT-1.5(A)	Foundation of Mathematics	4	4	3 Hrs	30	70	100
	SPT-1.5(B)	Transformation Techniques						
	SPT-1.5(C)	Financial Mathematics						
6	CPT-1.6.1	R-Language	4	2	2 Hrs	10	40	50
	CPP-1.6.2	R- Programming	2	2	3 Hrs	10	40	50
		Total	**26**	**24**				**600**

II Semester

Sl. No.	Paper	Title of the paper	Instruction Hrs per Week	No. of Credits	Duration of the Exam.	Marks		
						IA	Semester End Examn.	Total Marks
1	CPT-2.1	Linear Algebra	4	4	3 Hrs	30	70	100
2	CPT-2.2	Numerical Simulations of Differential Equations	4	4	3 Hrs	30	70	100
3	CPT-2.3	Probability and Statistical Methods-II	4	4	3 Hrs	30	70	100
4	CPT-2.4. 1	Python Language	2	2	2Hrs	10	40	50
	CPP-2.4 .2	Python lab	4	2	3 Hrs	10	40	50
5	SPT-2.5(A)	Combinatorics and Number Theory	4	4	3 Hrs	30	70	100
	SPT-2.5(B)	Applied Integral Equations						
	SPT-2.5(C)	Operations Research						

6	OEPT-2.6.1*	Python Programming	4	4	3Hrs	30	70	100
	OEPP-2.6.2*	Python Lab	4	2	3Hrs	10	40	50
		Total	**30**	**26**				**650**

*To be offered to other departments.

III Semester

Sl. No.	**Paper**	**Title of the paper**	**Instruction Hrs per Week**	**No. of Credits**	**Duration of the Exam.**	**Marks**		
						IA	**Semester End Exam.**	**Total Marks**
1	CPT-3.1	Complex Analysis	4	4	3 Hrs	30	70	100
2	CPT-3.2	Design and Analysis of Algorithm	4	4	3 Hrs	30	70	100
3	CPT-3.3	Software Engineering	4	4	3 Hrs	30	70	100
4	CPT-3.4. 1	Java Programming	4	4	3Hrs	30	70	100
	CPP-3. 4. 2	Java Programming Lab	4	2	3 Hrs	10	40	50
5	SPT-3.5(A)	Dynamical System	4	4	3 Hrs	30	70	100
	SPT-3.5(B)	Advanced Graph Theory						
	SPT-3.5(C)	Fuzzy Sets and Fuzzy Logics						
6	OEPT-3.6.1*	Statistical Techniques	4	4	3hrs	30	70	100
	OEPP-3.6.2*	R-Programming (Basedon-OEPT-3.6.1)	4	2	3hrs	10	40	50
		Total	**28**	**28**				**700**

*To be offered to other departments

IV Semester

Sl. No.	**Paper**	**Title of the paper**	**Instruction Hrs per Week**	**No. of Credits**	**Duration of the Exam.**	**Marks**		
						IA	**Semester End Examn.**	**Total Marks**
1	CPT-4.1	Multivariate Analysis	4	4	3 Hrs	30	70	100
2	CPT-4.2.1	Coding Theory	4	4	3 Hrs	30	70	100

3	CPT-4.3.1	Machine Learning and Artificial Intelligence	4	4	3Hrs	30	70	100
	CPP-4.3.2	Lab (Based on CPT-4.3.1)	4	2	3Hrs	10	40	50
4	SPT 4.4 (A)	Applied Linear Algebra	4	4	3 Hrs	30	70	100
	SPT 4.4 (B)	Computer Aided Geometric Design						
	SPT 4.4 (C)	Computer Networking						
4	CPD	Project	4	4	---	30 **(Viva-voce)**	70	100
5	CPD	Internship/MOOC Course	--	2				50
		Total	**24**	**24**				**550**

IA: Internal Assessment **CPT:** Core Paper Theory **CPP:** Core Paper Practical
SPT: SpecialPaper Theory **CPD:** Core paper Dissertation **OEPT:** Open Elective Paper Theory

FIRST SEMESTER

CPT-1.1: ALGEBRA

UNIT I

Groups: Definitions and Examples, Simple properties of Groups based on axioms, Order of an Element Definition, properties and Examples, Subgroups: Subgroups, Definition and Examples, Necessary and sufficient conditions for a Subgroups, Properties of Subgroups, Cyclic groups :Cyclic groups, Definitions and Examples, Properties of cyclic Group.

UNIT II

Permutation groups: Definition and Examples, Permutation as composition of function, Definition of S, and discussion of Ss in detail, Cycles, Transpositions, Every Permutation is a product of disjoint cycles, Homomorphism and Isomorphism: Definitions and Examples, Simple Properties, Isomorphism Definition and Examples, Fundamental theorem of homomorphism and its applications, Cayleys theorem.

UNIT III

Cosets and Langrange theorem: Cosets- Definition, Examples and Properties, Lagranges theorem and its corollaries, Normal Subgroups, Definition and Examples, Properties of Normal Subgroups, Simple Groups, A_n is Simple for n=5 (without proof), Factor Group, Definition and Examples, Properties of Factor groups, Sylows theorems: Sylows theorems: Class Equations, Conjugate of an element-Definition and Examples, Conjugacy relation is and equivalence relation, Conjugacy Class, Normalizer, Centralizer, Center of a group, Class equation, a belongs to Z (G) iff N (a) = G, Center of a p-group is nontrivial, Every group of order p-square is abelian, Cauchys theorem (Statements only), Sylows theorems (without proofs) - only problems,

UNIT IV

Symmetry Groups: Isometries, Classification of Finite Plane symmetry, Classification of Finite Groups of Rotations in R3, Symmetry and Counting: Symmetry and Counting: Introduction, Burnsides Theorem, Applications of Burnside Theorem, Group Action, Introduction to Algebraic Coding Theory: Linear codes, Parity check matrix, Decoding, coset decoding.

REFERENCE BOOKS:

1. Joseph Gallian: Contemporary Abstract Algebra (Fourth Edition, Narosa Publication)
2. J.B. Fraleigh: Abstract Algebra, 5th edition
3. I.S. Luthar and L.B.S. Passi: Algebra (Volume 1) Groups (Narosa Publishing House) (4) IN. Herstein: Topics in Algebra (Wiley -Eastern Ltd)
4. M. Artin: Algebra (Prentice Hall)
5. N.S. Gopala Krishnan: University Algebra (Wiley-Eastern Ltd)

CPT-1.2: MATHEMATICAL ANALYSIS

UNIT I

Metric Spaces and its Topology:
Metric Spaces Definition and Examples, k-cells, convex sets, open closed ball, properties, Definition: Neighborhood, limit point, isolated points, closed sets, interior points, open sets, perfect sets bounded sets, dense sets, examples and properties, Definition: Open cover, compact sets, examples and properties. Theorem of Weirstrass, Connected sets, definition of separated sets, connected sets and properties.

UNIT II

Numerical Sequences and series: Convergent Sequences, Definition and Examples Properties**,** Subsequences: Definition and properties**,** Cauchy Sequences: Definition, Examples and properties, Definition of complete metric**,** space, examples, Definition of Monotonic Sequences and its properties**,** Upper and lower limits, Definition, examples and properties**,** Convergence of some special sequences**,** Series: Definition, examples and properties, series of non-negative terms, Cauchy's**,** condensation test and examples**,** The Number e**,** Root and ratio tests, examples**,** Power series, Definition, radius of Convergence, examples and properties**,** Summation by parts, absolute convergence

UNIT III

Continuity: Limits of functions: Definition, examples and properties**,** Continuous functions, Definition, examples and properties, Continuity and Compactness**,** Bounded Set: Definition**,** Continuous image of a compact set is compact and related properties**,** Definition of Uniform Continuity and related properties**,** Continuity and Connectedness: continuous image of connected set is connected and related properties**,** Discontinuities, Definition, examples**,** Monotonic functions, Definition examples and properties
Differentiation: Derivative of a real function, Definition examples and properties**,** Mean Value Theorem**,** Continuity of derivatives, Taylor's theorem**,** Differentiation of a vector valued function

UNIT IV

Riemann Stieljes Integral: Definition and existence of the integral, related properties**,** Properties of the integral**,** Integration and differentiation**,** Integration of vector valued functions
Sequences and series of function: Discussion of main problem- with examples**,** Uniform convergence: Definition and properties**,** Uniform convergence: and continuity**,** Uniform convergence: and integration**,** Uniform convergence: and differentiation

REFERENCE BOOKS:

1. Walter Rudin: Principles of Real Analysis, (3rd Edition, Tata McGraw Hill Publication)
2. T. M Apostol: Mathematical Analysis, 2nd ed. Narosa, 1988
3. S. Goldberg: Methods of Real Analysis, OUP, 1970

CPT-1.3: DISCRETE MATHEMATICAL STRUCTURE

UNIT I.

Logic: Introduction, Proposition, Simple proposition, Compound proposition, Truth value, Prepositional Calculus, operators, Conjunction, Disjunction, Conditional statement, Bi conditional statement, converse, contra positive and Inverse.
Predicates and Quantifiers: Introduction, Universal quantifier, existential quantifier, counter example, negating quantifiers, nested quantifier, order of quantifiers, truth value of quantifier.
Methods of proof: Introduction, theorem, proof, rules of inference, argument, valid argument, invalid argument, direct method of proof, indirect method of proof, rules of inference for quantified statements.

UNIT II

The Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients, Applications of Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations.
Definition and types of relations. Representing relations using matrices and digraphs. Closures of relations, Paths in digraphs, Transitive closures. Warshall's Algorithm.

UNIT III

Partial Ordered sets, Hasse diagrams, Isomorphism, Extremal elements in poset, Lattice, Distributive lattice, Complemented lattice, Boolean lattices, Boolean Algebras, Boolean functions, Logic Gates, Minimization of Circuits.

UNIT IV.

Introduction to graph theory, types of graphs, Subgraphs, Degree, Distance, Standard graphs, Bipartite graph, Regular graph, Complement of a graph, Graph isomorphism, Graph Operations. Eulerian and Hamiltonian graphs, Traveling Salesman's Problem.
Trees, Characterization of trees, Eccentricity, Radius, Diameter and Centre. Rooted trees, Binary trees, Spanning trees, Minimal Spanning trees. Prims and Kruskul Algorithms. Covering and independence number of a graph.

REFERENCE BOOKS:

1. C. L. Liu: Elements of Discrete Mathematics, Tata McGraw-Hill, 2000.
2. F. Harary: Graph Theory, Addition Wesley, 1969.
3. G. Chartrand and P. Zhang. Introduction to Graph Theory, Tata McGraw-Hill, 2006.
4. N. Chandrasekaran and M. Umaparvathi: Discrete Mathematics, PHI, New Delhi, 2010.
5. J. A. Bondy and U. S. R. Moorthy: Graph theory with applications. Elsevier Sc., 1982.
6. Kenneth Rosen: WCB McGraw-Hill, 6^{th} ed., 2004.

CPT-1.4: PROBABILITY & STATISTICAL METHODS-I

UNIT I

Introduction to Probability:-Classical definition, Empirical definition and Axiomatic definition ,Addition theorem for Probabilities and related problems, Mutually Exclusive Events and related problems, Independent Events, Conditional Probability and related problems, Theorem of Inverse Probabilities (known as Baye's Theorem) and related problems. Random Variables:-What is a Random Variable, Probability distribution of a Discrete Random Variable & related problems, Probability distribution of a Continuous Random Variable & related problems, Distribution Function and related problems, Moments, Inequalities regarding Moments ,Moments of a Symmetric Probability Distribution , Factorial Moments and related problems. Markov's Inequality and Chebychev's Inequality.

UNIT II

Generating Functions :-Probability Generating Function, Moment Generating Function , Factorial Moment Generating Function , Cumulant Generating Function ,Characteristic Function Expectation and Variances:-Definition of Expectation, Theorems on Expectation and its related problems. Variance in terms of Expectation and related problems. Covariance in terms of Expectation and related problems. Variance of a Linear Combination. Introduction to Joint and Marginal Probability Distributions.

UNIT III

Discrete Probability Distributions:-Binomial Distribution and related Problems Poison Distribution and related Problems. Geometric Distribution, Loss of Memory Property and related problems. Discrete Uniform Distribution, Mean, Variance and related Properties. Negative Binomial Distribution and related problems. Hypergeometric Distribution (Positive and Negative) and related problems Continuous Probability Distributions :- Continuous Uniform Distribution and related problems .Exponential Distribution, Loss of Memory Property and related problems .Normal Distribution, Standard Normal Variate and its related problems .Introduction to Gamma Distribution .Introduction to Chi- Square distribution, some properties and related problems .Introduction to Student t distribution and related problems .Introduction to Snedecor's F distribution and related problems.

UNIT IV

Correlation and Regression Analysis: - Introduction and Scatter Diagrams, Karl Pearson's Coefficient of Correlation, Properties and Problems ,Spearmen's Rank Correlation Coefficient. Method of Concurrent Deviations, Interpretation of r and Probable Error. Linear Regression, Lines of Regression , Theorems on Regression Coefficients, Problems based on it. Yule's Rule, Order of Regression Coefficients Partial Regression Coefficients' and its various properties ,Equation of Regression planes in 3 variable case and Generalization to n variables ,Variance of the Residual and the standard error of the estimate ,Introduction to Coefficient of Multiple Correlation ,Introduction to Coefficient of Partial correlation, Relation between the Multiple and Partial Correlation Coefficient. Note: Some assignments like Fitting of Distributions, Correlation and Regression Analysis to be implemented using R Statistical Programming Language.

REFERENCE BOOKS:

1. Probability and Statistics for Scientists and Engineers: Walpole Myers & Ye
2. Mathematical Statistics: Parimal Mukhopadhyay
3. Probability & Statistics with Reliability, Queuing and Computer Science Applications: Agarwal
4. Probability and Statistics for Engineers: Richard Gupta , C B Gupta

SPT-1.5(A): FOUNDATION OF MATHEMATICS

UNIT I

Differentiation: Definitions in math: notation, linear and non-linear functions, formulas, rules: sum and difference rule, product rule, quotient rule, chain rule, applications, solved examples, properties.

UNIT II

Integration: Definitions, integral calculus, integrals: definite integrals, indefinite integrals, integration formulas and properties.

UNIT III

Introduction to topology: Boundedness, open and closed set, boundary of closed set, interior and closure.

UNIT IV

Matrix and determinants: Definition, types of matrices, eigen vectors, eigen values, inverse matrix, Cayley-Hamilton theorem, transpose of a matrix, properties. Determinants: definition, rules, properties and examples.

REFERENCE BOOKS:

1. S. L. Ross: Differential equations, 3rd ed., John Wiley & Sons, New York, 1984
2. H.T. Davis:Introduction to nonlinear differential and integral equations, Dover Pub.1962
3. Gilbert Strang: Linear Algebra and its applications.
4. J. L. Kelly: General Topology, Van Nostrand, 1955.

SPT-1.5(B): TRANSFORMATION TECHNIQUES

UNIT I

Fourier Series: Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value - Parseval's identity – Harmonic analysis.

UNIT II

Fourier transform: Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity, Finite Fourier transforms.

UNIT III

Laplace Transforms: Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

UNIT IV

Z - Transforms: Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

REFERENCE BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.
3. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
4. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
5. James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.

SPT-1.5(C): FINANCIAL MATHEMATICS

UNIT I:

Basic Financial Calculations: Introduction, financial securities- zero coupon bond, fixed interest, index linked securities etc.; the time value of money; nominal Vs. real interest, deflationary conditions; accumulating factors, force of interest, compound interest functions.

UNIT II:

Annuities and Equation of Value Discounting and Accumulation: discrete and continuous cash flows; level annuities, deferred and increasing/decreasing annuities, equation of value and yield on transaction, probability of cash flows, higher discount, loan schedules; consumer credit: flat rate and APRs.

UNIT III:

Capital Budgeting Techniques and Compound Interest Problems Introduction to financial statement, assessing financial performance, net present value, internal rate of return, payback period; projects with different lives; money and time weighed rate of return; fixed interest securities, uncertain income securities, equities, valuing a loan with allowance for capital gains and indexation.

UNIT IV:

Arbitrage, Forward Contracts, and Term Structure of Interest Rationale for no arbitrage assumption; forward contracts, calculating the forward price for a security with known dividend yield; hedging, fixed cash income; Discrete time and continuous time rates; continuous time spot rates and forward rates; instantaneous forward rates; theories of time; term structure of interest rates; yield curve; yields to maturity; convexity and immunization; interest rate risk..

REFERENCE BOOKS:

1. Ross, S.M., (1 9 9 9) : An Introduction to Mathematical Finance, Cambridge University Press, Norton, London.
2. Martin, P.G. and Michael B., (1991): Applied Financial Mathematics, Prentice Hall.
3. Baxter, M. and A. L. Rennie, (1 9 9 6) : Financial Calculus, Cambridge University Press.
4. Karatzas, L. and Shreve S.E., (1998): Methods of Mathematical Finance , Springer.
5. Watsham T.J .and Perramore. K . ,(1997): Quantitative Methods in Finance, International Thomson Business Press.

CPT- 1.6.1: R-LANGUAGE

UNIT I

Introduction to R:What is R? – Why R? – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments – Handling Packages in R: Installing a R Package, Few commands to get started: installed.packages(), package Description(), help(), find.package(), library() - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA, Inf and –inf.

UNIT II

R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame – R - Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables - R Operators: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators - R Decision Making: if statement, if – else statement, if – else if statement, switch statement – R Loops, control statement: break statement, next statement.

UNIT III

R-Function : definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, R-Strings – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower() - R Vectors
R List - Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector - R Matrices – Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- R Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements - R Factors –creating factors, generating factor levels gl().

UNIT IV

Data Frames –Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() functions - Extract Data from Data Frame, Expand Data Frame: Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge() – Melting and Casting data melt(), cast(). Loading and handling Data in R: Getting and Setting the Working Directory – getwd(), setwd(), dir() - R-CSV Files - Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply() - Writing into a CSV File – R -Excel File – Reading the Excel file

REFERENCE BOOKS:

1. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017.
2. Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018.
3. Tutorials Point (I) simply easy learning, Online Tutorial Library (2018), R Programming, Retrieved from https://www.tutorialspoint.com/r/r_tutorial.pdf.
4. Andrie de Vries, Joris Meys, R for Dummies A Wiley Brand, 2nd Edition, John Wiley and Sons, Inc, 2015.

CPP- 1.6. 2 : R-PROGRAMMING LAB

LIST OF PROGRAMS

1. Write a program to check whether a year (integer) entered by the user is a leap year or not?
2. Write a program that prints the grades of the students according to the marks obtained.
   The grading of the marks should be as follows.

Marks	**Grades**
800-1000	A+
700 – 800	A
500 – 700	B+
400-500	B
150 – 400	C
Less than 150	D

3. Write an R program to make a simple calculator that can add, subtract, multiply and divide using switch cases and functions.
4. Write a program to perform searching within a list (1 to 50). If the number is found in the list, print that the search is successful otherwise print that the number is not in the list.
5. Operations on vectors and matrices(addition, subtraction, multiplication)
6. Data Range, Frequencies, Mode, Mean and Median: Mean Applying Trim Option, Applying NA Option, Median - Mode, Standard Deviation , Correlation.
7. R –Pie Charts: Pie Chart title and Colors – Slice Percentages and Chart Legend, 3D Pie Chart , R Histograms – Density Plot, R – Bar Charts: Bar Chart Labels, Title and Colors.
8. Creating and manipulating data frames.
9. Univariate probability distributions
10. Applications of binomial distribution and fitting binomial distribution.
11. Applications of Poisson distribution and its fitting.
12. Computation of probabilities based on negative binomial, geometric and discrete uniform distributions.
13. Applications of Normal distribution and its fitting.
14. Computation of probabilities based on rectangular and exponential distributions.
15. To fit the straight line and second degree curve for the given data on pairs of observations.

SECOND SEMESTER (CBCS)

CPT-2.1: LINEAR ALGEBRA

UNIT I

System of linear equations, LU decomposition method, Vector spaces: Subspaces, linear independence and dependence, Basis and dimension of a vector space, Quotient spaces.

UNIT II

Linear transformations: Rank and nullity of a linear transformation, Matrix of linear transformation, Change of basis, Geometric linear transformation of R^2 andR^3. (13 hrs)

UNIT III

Eigen values and Eigen vectors of a linear transformation: Cayley Hamilton theorem, Diagonalization, Inner product spaces, Cauchy Schwartz inequality, Orthonormal vectors, orthogonal complements, Gram Schmidt Orthogonalization process, Normal unitary, self adjoint operators, QR factorization. (13hrs)

UNIT IV

Quadratic forms, Orthogonal reduction, Discrete Fourier transform, Complementary subspaces, Range – null space decomposition, Singular value decomposition, Orthogonal projection, Least square solutions, Perron- Frobenius theory; Positive matrices, non-negative matrices, stochastic matrices and applications to Markov chains. (13hrs)

REFERENCE BOOKS:

1. Kenneth Hoffman and Ray Keenze: Linear Algebra.
2. Gilbert Strang: Linear Algebra and its applications.
3. David Lay: Linear Algebra; Mathematical Elements of Computer Graphics
4. S. S Grewal: Higher engineering mathematics

C.P.T-2.2: NUMERICAL SIMULATIONS OF DIFFERENTIAL EQUATIONS

UNIT I

Numerical Solution of Ordinary Differential Equations: Euler method, Single Step methods: Runge-Kutta methods of second and fourth order for simultaneous and higher order differential equations. Multi step methods: Adam Bashforth's, Adam Moulton's and Milne's predictor-corrector methods,(Convergence and Truncation error for the above methods). Boundary Value problems: Second order finite difference method, linear shooting method.

UNIT II

Elliptic Equations: Finite difference approximations to derivatives. Difference methods for Elliptic partial differential equations –Laplace and Poisson's equations.

UNIT III

Difference methods for parabolic equations in one-dimensional space- Schmidt, Laasonen, Crank-Nicolson formulae, Gauss-Seidal iterative scheme for Crank-Nicholson method. Stability and convergence analysis for Schmidt and Crank–Nicolson methods. Explicit finite difference schemes for hyperbolic equations in one dimensional space. Stability of explicit finite- difference method. Implicit method.

UNIT IV

Finite element method: types of integral formulations, one and two dimensional elements, Galerkin formulation, application to Dirichlet and Neumann problems.

REFERENCE BOOKS:

1. I.N. Sneddon : Elements of Partial Differential Equations ,
2. Tyn Myint-U and Lokenath Debnath: Linear Partial Differential Equations for Scientists and Engineers
3. M. K. Jain, S. R. K.Iyengar and R. K. Jain : Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd. 3rd Ed. 1993.
4. Burden R. and Faires J. D. : Numerical Analysis, P.W.S. Kent Pub. Co. 4th Ed., Boston, 1989.
5. Atkinson K. E. : An Introduction to Numerical Analysis, 3rd Ed.,John Weiley and Sons, 1989.
6. S. C. Chapra, and P. C. Raymond: Numerical Methods for Engineers, Tata McGraw Hill, New Delhi, 2000.

CPT-2.3: PROBABILITY & STATISTICAL METHODS-II

UNIT I

Parametric Tests: Statistical Hypothesis: Simple and Composite, Null Hypothesis and Alternative hypothesis, Types of Errors in Testing of hypothesis, Level of Significance, Critical Regions, One Tailed and Two tailed tests, P value or Probability value of a Test Statistic, Procedure of Testing of hypothesis and problems related to it, Procedure of P-Value Estimation and problems related to it, Size and Power of a test. Most Powerful (M.P.) level alpha test of simple null hypothesisagainst a simple Alternative, Statement of Neyman Pearson Lemma for constructing the M.P.Power function of a test, power curve, definition of uniformly most powerful (UMP) level alpha test for one side alternative and related example. Large Sample Tests:Introduction to concept of Sampling Distribution of a Statistic, Sampling of Attributes: Test for Single Proportion and related problems, Test of Significance for Difference of Proportions and related problems, Sampling of Means: Test of Significance for a Single Mean and relatedproblems, Test of Significance for Difference of Means and relatedproblems, Test of Significance for the difference of Standard deviations and related problems.

UNIT II

Chi square distribution: Applications of Chi-square Distribution, Chi-square test for Goodness of Fit and its conditions for validity, Chi-Square Test for Independence of Attributes, Introduction to Degrees of Freedom, Its use in 2X2 and 2Xk contingency tables, Test for equality of several Proportions, Chi-square test for Population Variance. Small Sample Tests: Critical Values and Applications of t distribution, Test for a Single Mean, Confidence Interval for difference of two means, Paired t test for difference of two Means, T-test for significance of an Observed Sample Correlation, coeffecient, Fisher's Z Transform, F Statistic and Critical Values of F distribution, Applications of F distributions and its Applications, F-test for Equality of Population Variances, Relation between t, F and Chi-square Distributions.

UNIT III

Non Parametric Methods: Introduction to Non Parametric Tests, Advantages and Limitations, Concept of Distribution Free Statistic, Sign Test: Single Sample Sign Test, Single Sample Sign Test (Large Sample), Single Sample Sign Test (Small Samples), Paired Sample Sign Test, Wilcoxon Signed Rank Test: Signed Ranks, Single Sample Wilcoxon Signed Rank Test (Small Sample n<=30), Wilcoxon Signed Rank Test for Matched Pairs, Wilcoxon Signed Rank Test (Large Samples), Mann Whitney Test: U Statistics, Mann Whitney Test for Independent Samples (Small Samples), Mann Whitney Test for Independent Samples (LargeSamples) Likelihood Ratio Tests: Notion of Likelihood Ratio Test (LRT), Construction of LRT for means of normal distribution (one and two sided):when variance is known, When variance is unknown,

Construction of LRT for variance of normal distribution (one and two sided): When mean is known, when mean is unknown, LRT for parameters of Binomial and Exponential distribution fortwo sided alternatives only, LRT as a function sufficient statistics: Statement of Asymptotic Distribution of -2 log lambda(x)

UNIT IV

Analysis of Variance (ANNOVA):
One Way Classification: Mathematical Model, Statistical Analysis of the above model, Hypothesis Testing for more than Two Means and relatedproblems, Two Way Classification: Mathematical Model and Underlying Assumptions, Statistical Analysis of the Above Model, Problem Based on it

REFERENCE BOOKS:

1. Probability and Statistics for Scientists and Engineers: Walpole Myers & Ye
2. Mathematical Statistics: Parimal Mukhopadhyay
3. Probability & Statistics with Reliability, Queuing and Computer Science Applications: Agarwal
4. Probability and Statistics for Engineers: Richard Gupta , C B Gupta

CPT-2.4.1: PYTHON LANGUAGE

UNIT I

Python Introduction: What is Python? , Features, History, Version, Applications, Install Python, Python Path, Python Example, Execute Python, Variables, Keywords, Identifiers, Literals, Operators, Comments, Control Statement: if, if-else if, nested if, for loop, while loop, do-while, break, continue, pass.

UNIT II

Python Strings, Basic Operators, Membership Operators, Relational Operators, Slice Notation, String functions and Methods, Python Data Structures, List, Tuple, Dictionary, Array.

UNIT III

Python Functions- Built-in Functions, User defined Functions, Invoking a Function, Use of Sympy package, Symbols, Recursion - Recursive Solutions for Problems on Numeric Data, Recursive Solutions for Problems on Strings, Recursive Solutions for Problems on Lists,

Problem of Tower of Hanoi. Files and Exceptions - File Handling, Writing Structures to a File, Errors and Exceptions, Handling Exceptions Using try…except, File Processing Example.

UNIT IV

Python OOPs, OOPs Concepts, Object Class, Constructors, Inheritance, Multilevel Inheritance, Multiple Inheritance, Python Files I/O, Input from Keyboard, File Handling, Attributes of File, Modes of File, File Handling Methods, Python Modules-What is a Module, Importing a Module, Built in Modules in Python, Package.

REFERENCE BOOKS:

1. Beginning-Python, Second Edition by Magnus Lie Hetland
2. The Complete Reference Python by Martin C. Brown
3. Head First Python by Patrick Barry
4. Learning Python, O'Reilly by Mark Lutz
5. Python in a Nutshell, O'Reilly by Alex Martelli

CPP-2.4.2: PYTHON PROGRAMMING LAB

1. **Data Visualization** : Standard plots (2D, 3D), Scatter plots, Slope fields, Vector fields, Contour plots, stream lines, Manipulating and data visualizing data with Pandas.
2. Write a program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
3. Write a Python program to display the first ‘n’ terms of Fibonacci series.
4. Write a Python program to find factorial of the given number.
5. Write a Python program to calculate the sum and product of two compatible matrices.
6. Calculus, Differential Equations, Series expressions.
7. Algorithm, Gauss Elimination Method, Jacobi's Method, Gauss-Seidel's Method, Linear System Solution in NumPy and SciPy & Summary.
8. Program to solve initial value problem using Euler Method.
9. Program to solve initial value problem using Euler Modified Method.
10. Program to find solution of initial value problem using RungeKutta II order Method.
11. Program to find solution of initial value problem using RungeKutta IV order Method.
12. Program to find solution of initial value problem using Predictor-Corrector method.
13. Program to find solution of initial value problem using Milne’s Method.
14. Program to find value of the function using Lagrange Interpolation Method.
15. Linear and non-Linear mathematical Model(**Case Studies)** – Growth and decay, Half-life, Computational Models with Quadratic Growth, Lotka-Volterra predator-prey model, competition models, Concentration of a Nutrient

SPT- 2.5(A): COMBINATORICS AND ELEMENTARY NUMBER THEORY

UNIT I

Introduction, The Division Algorithm, Gcd and Lcm, The Euclidean Algorithm, Primes and their properties, Infinitude of primes, The Fundamental Theorem of Arithmetic, The Prime Number, Fermat and Mersenne numbers. Farey series, Farey dissection of the continuum, Irrational numbers-Irrationality of m^{th} root of N, e and π.

UNIT II

Congruences: Fermat's theorem, Euler's theorem and Wilson's theorem; Fermat's quotients and their elementary consequences; solutions of congruences; Chinese remainder theorem; Euler's phi-function.
Congruence modulo powers of prime; primitive roots and their existence; quadratic residues; Legendre symbol, Gauss' lemma about Legendre symbol; quadratic reciprocity law; proofs of various formulations; Jacobi symbol.

UNIT III

Diophantine Equations Solutions of ax + by = c, x2 + y2 = z2 , x4 + y4 = z2 ; properties of Pythagorean triples; sums of two, four and five squares; assorted examples of diophantine equations.

UNIT IV

Continued Fractions - Finite continued fractions, Convergent of a continued fraction, Continued fractions with positive quotients. Simple continued fractions, The representation of an irreducible rational fraction by a simple continued fraction. The continued fraction algorithm and Euclid's algorithm. The difference between the fraction and its convergent, Infinite simple continued fractions, the representation of an irrational number by an infinite continued fraction, Equivalent numbers and periodic continued fractions, some special quadratic surds.

REFERENCE BOOKS:

1. G. H. Hardy and E. M. Wright - An introduction of Topology of Numbers.
2. G. E. Andrews - Encyclopedia of Mathematics and its applications.
3. Niven and Zuckarman: Elementary Number Theory.
4. Bruce C Berndt: Ramanujan's notebooks, Volumes 1 to 5.
5. T. M. Apostol: Introduction to Analytic Number Theory, Narosa Pub. House, New Delhi.

SPT-2.5(B) : APPLIED INTEGRAL EQUATIONS

UNIT I

Classification of Liner Integral Equations : Fredholm, Volterra, Integro-Differential Equations, Singular Integral Equations, Converting Integral Equation to ODE and vice-versa. Volterra Integral equations - Resolvent Kernel of Volterra Integral equation. Differentiation of some resolvent kernels - Solution of Integral equation by Resolvent Kernel - The method of successive approximations - Convolution type equations - Solution of Integro-differential equations with the aid of the Laplace Transformation – Volterra integral equation of the first kind-Euler integrals-Abel's problem-Abel's integral equation and its generalizations.

UNIT II

Fredholm Integral Equations : Fredholm integral equations of the second kind – Fundamentals – The Method of Fredholm Determinants - Iterated Kernels constructing the Resolvent Kernel with the aid of Iterated Kernels - Integral equations with Degenerated Kernels. Hammerstein type equation – Characteristic numbers and Eigen function and its properties.

UNIT III

Introduction – The Method of Variations in Problems with fixed Boundaries: Definitions of Functionals –Variation and Its properties - Euler's'equation- Fundamental Lemma of Calculus of Variation – The problem of minimum surface of revolution - Minimum Energy Problem Brachistochrone Problem - Variational problems involving Several functions - Functional dependent on higher order derivatives - Euler Poisson equation.

UNIT IV

Functional dependent on the functions of several independent variables - Euler's equations in two dependent variables – Variational problems in parametric form-Applications of Calculus of Variation-Hamilton's principle - Lagrange's Equation,Hamilton's equations.

REFERENCE BOOKS:

1. A. M. Wazwaz, A First course in integral equations (World Scientific,1997)
2. A. J. Jerri, Introduction to Integral Equation with Applications (1999) (Wiley Interscience).
3. M. Krasnov, A. Kiselev, G. Makarenko, problems and exercises in integral equations (1971).
4. S. Swarup ,ˆ integral equations, (2008).
5. Elsgolts, differential equations and the calculus of variations by, mir publishers, Moscow.

SPT- 2.5(C): OPERATIONAL RESEARCH

UNIT I

Revised Simplex Method, Parametric Linear Programming, Linear Fractional Programming, Duality Theorem, Dual Simplex Methods, Post-Optimal Analysis.

UNIT II

Integer Programming Problems, Solutions methods of integer programming problem, Branch and Bound Technique, Cutting plane algorithm, game theory, games without saddle point, mixed strategy, algebraic method, graphical method, dominance property, solution ofa game by L.P. method.

UNIT III.

Introduction to Transportation Problem, Initial Basic Feasible solution, Moving towards Optimality, Degeneracy in Transportation Problems, Unbalanced Transportation Problem, Assignment Problems, Job Sequencing.

UNIT IV

Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1. Non Linear programming problems, Necessary and sufficient conditions for extrema, Constrained extremal problems, Kuhn Tucker conditions, Quadratic Programming**.** Dynamic Programming, Solution of LPP by Dynamic programming.

REFERENCE BOOKS:

1. .Hamdy A Taha: Operations Research, Prentice Hall of India, 1995.
2. .KantiSwarup, P. K. Gupta, ManMohan: Operations Research, Sultan Chand & Sons,1995.
3. .G Hadley: Linear Programming, Narosa Publishing House, 2002.
4. .K. V. Mittal and C. Mohan: Optimization Methods in Operation Research & SystemAnalysis, New Age Publishers, 1996.

OEPT-2.6.1 : PYTHON PROGRAMMING

UNIT I

Python Introduction: What is Python? , Features, History, Version, Applications, Install Python, Python Path, Python Example, Execute Python, Variables, Keywords, Identifiers, Literals, Operators, Comments, Control Statement: if, if-else if, nested if, for loop, while loop, do-while, break, continue, pass.

UNIT II

Python Strings, Basic Operators, Membership Operators, Relational Operators, Slice Notation, String functions and Methods, Python Data Structures, List, Tuple, Dictionary, Array.

UNIT III

Python Functions- Built-in Functions, User defined Functions, Invoking a Function, Use of Sympy package, Symbols,

UNIT IV

Python OOPs, OOPs Concepts, Object Class, Constructors, Inheritance, Multilevel Inheritance, Multiple Inheritance, Python Files I/O, Input from Keyboard, File Handling, Attributes of File, Modes of File, File Handling Methods, Python Modules-What is a Module?, Importing a Module, Built in Modules in Python, Package.

REFERENCE BOOKS:

1 Beginning-Python, Second Edition by Magnus Lie Hetland
1. The Complete Reference Python by Martin C. Brown
2. Head First Python by Patrick Barry
3. Learning Python, O'Reilly by Mark Lutz
4. Python in a Nutshell, O'Reilly by Alex Martelli

OEPP-2.6.2 : PYTHON PROGRAMMING LAB

LIST OF PROGRAMS

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. Write a Python program to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user.
   Assign grades according to the following criteria:
   Grade A: Percentage >=80
   Grade B: Percentage>=70 and <80
   Grade C: Percentage>=60 and <70
   Grade D: Percentage>=40 and <60
   Grade E: Percentage<40
3. Write a program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
4. Write a Python program to display the first 'n' terms of Fibonacci series.
5. Write a Python program to find factorial of the given number.
6. Write a Python program to solve quadratic equation.
7. Write a Python program to find greatest of three numbers.
8. Write a Python program to find sum of the following series for n terms:
   1 – 2/2! + 3/3!- - - n/n!.
9. Write a Python program to read n integers and display them as a histogram.
10. Write a Python program to display sine, cosine, polynomial and exponential curves.
11. Write a Python program to plot a graph of people with pulse rate p vs. height
    h. The values of p and h are to be entered by the user.
12. Write a Python program to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is the time in hours.
13. Sketch a graph for t vs. m, where t>=0.
    Input initial velocity and acceleration, and plot the following graphs depicting
    equations of motion:
    i. velocity wrt time (v=u+at)
    ii. distance wrt time (s=u*t+0.5*a*t*t)
    iii. distance wrt velocity (s=(v*v-u*u)/2*a)
14. Write a program to sort the (name, age, height) tuples by ascending order where name is string, age and height are numbers. The tuples are input by console. The sort criteria is:
    1: Sort based on name;
    2: Then sort based on age; 3: Then sort by score.
15. Write a program to compute the frequency of the words from the input. The
    output should output after sorting the key alphanumerically.

THIRD SEMESTER (CBCS)

CPT 3.1: COMPLEX ANALYSIS

UNIT I

Complex Numbers and Topology of complex plane: Algebra of complex numbers, roots of unity and related problems, Extended complex plane: Stereographic projection and chordal metric (Introduction), theorems and problems.

UNIT II

Analytic Functions: Functions, Limits and continuity of complex functions, differentiability: definitions and properties, complex logarithmic, definitions and its related problems, zeros of an analytic functions, related examples.

UNIT III

Complex Integration: curves in the complex plane, basic properties of complex integrals, winding number or index number and related theorems, Cauchy Goursat theorems (statements only), homotopy and homotopy version of Cauchy theorems, Moreras theorem, Cauchy integral formula theorems and its related problems, maximum modulus principal and maximum modulus theorems and its related problems, Schwarz lemma, Mobius transform, cross ratio (definition of modulus Mobius transform), Liouvilles theorem and its applications.

UNIT IV

Classification of singularities: Isolated and non-isolated singularities, removable singularities and its related examples, poles: definitions and examples, essential singularities and Casorati Weierstrass theorem, Calculus of residues: Residue at Finite point, Cauchy residues theorem and evaluation of real integrals, Argument principal and Rouches theorem.

REFERENCE BOOKS:

1. S. Ponnuswamy: Foundations of Complex Analysis (Narosa Publishing House 4t reprint)
2. Elais M Stein and Rami Shakarchi: Complex Analysis: (Princeton Lecture Series in Analysis)
3. John Conway: Functions of Complex Variable (Springer GTM Series)
4. J. W Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill, 1996
5. H. S. Kasana, Complex Variables: Theory and Applications, PHI, 2000

CPT- 3.2: DESIGN AND ANALYSIS OF ALGORITHMS

UNIT I

Introduction to Algorithms: Meaning of space and time complexity, illustrations with simple examples. Introduction to growth functions, Asymtotic notation: Big-oh, little-oh, big-omega, littleomega, theta functions, illustrations. Inter-relations between different growth functions and comparison. Basic data structures: Lists, Stacks, Queues, Trees, Graphs, Heaps, examples and applications.

UNIT II

Searching, Sorting and Selection: Selection search, binary search, insertion sort, merge sort, quick sort, radix sort, counting sort, heap sort. Median finding using quick select, Median of Medians, Graph Algorithms: Depth-First search, breadth-first search, backtracking, branch-and-bound, etc.

UNIT III

Greedy Algorithms: General characteristics of greedy algorithms, Greedy scheduling algorithms, Dijkstra's shortest path algorithms (graphs and digraphs), Kruskal's and Prim's minimum spanning tree algorithms.

UNIT IV

Dynamic Programming: Elements of dynamic programming, the principle of optimality, the knapsack problem, dynamic programming algorithms for optimal polygon triangulation, optimal binary search tree, longest common subsequence, chained matrix multiplication, all pairs of shortest paths (Floyd's algorithm). Introduction to NP-completeness, Polynomial time reductions, verifications, verification algorithms, classes P and NP, NP-hard and NP-complete problems.

REFERENCE BOOKS:

1. T. Cormen, C. Leiserson, R. Rivest & C. Stein, Introduction to Algorithms, MIT Press, 2001.
2. David Harel, Algorithms, The spirit of Computing, Addison-Wesley, Langman, Singapore, Pvt. Ltd. India, 2000.
3. Baase S and Gelder, A.V, Computer Algorithms, Addition - Wesle Langman Singapore, Pvt. Ltd. India, 2000.
4. Garey, M.R. and Johnson, D.S, Computers and Intractability: A Guide to the Theory of NPCompleteness, W. H. Freeman, San Francisco, 1976.
5. R. Sedgewick, Algorithms in C++, Addison- Wesley, 1992.

CPT-3.3: SOFTWARE ENGINEERING

UNIT I

Introduction: Definition of Software, Software Engineering, Software Products and Software process, Process models: Waterfall modal, Evolutionary Development, Bohemia's Spiral model, Overview of risk management, Process Visibility, Professional responsibility. Computer based System Engineering: Systems and their environment, System Procurement, System Engineering Process, System architecture modelling. Human Factors, System reliability Engineering. Requirements and Specification: The requirement Engineering Process, The Software requirement document, Validation of Evolution of requirements, Viewpoint – oriented & method based analysis, system contexts, Socialorganizational factors. Data flow, Semantic, Objects, models, Requirement Specification, Nonfunctional requirement.

UNIT II

Software Prototyping : Prototyping in software process, Prototyping techniques, User interface prototyping. Software Design: Design Process, Design Strategies, Design Quality, System Structuring control models, Modular decomposition, Domain Specific architecture. **Object Oriented & function oriented design:** Objects, object Classes and inheritance Object identification, an object oriented design example, Concurrent Objects, Data flow design Structural decomposition, Detailed Design, A Comparison of design Strategies. User interface design: Design Principles, User System interaction, Information Presentation, User Guidance, Interface Evaluation.

UNIT III

Software Reliability and Reusability: Software reliability metrics , Software reliability Specification , Statistical testing, Reliability Growth modeling, Fault avoidance & tolerance, Exception handling & defensive programming , Software development with reuse, Software' development for reuse, Generator based reuse, Application System Portability.

UNIT IV

Software Verification and Validation: The testing Process , Test Planning & Strategies, White Box, Black Box , Structural, interface testing, Program inspections , Mathematically based verification, Static analysis tools, Clean room software development. Management Issues: Project management, Quality management, Software cost estimation, Software maintenance.

REFERENCE BOOKS:

1.IanSommerville – Software Engineering, 9th Edition, Pearson Education Ltd, 2010.
2. Roger S. Pressman – Software Engineering, A Practitioner's approach, 7th Edition,McGRAW-Hill.
3. PankajJalote, "An integrated approach to Software Engineering", 3rd Edition, NarosaPublishing House.

CPT-3.4.1: JAVA PROGRAMMING

UNIT I

Fundamentals Of Oops & Overview of Java Language: Introduction, Object Oriented paradigm, Basic Concepts of OOP, Benefits of OOP, Applications of OOP, Java features: OVERVIEW OF JAVA LANGUAGE: Introduction, Simple Java program structure, Java tokens, Java Statements, Implementing a Java Program, Java Virtual Machine, Command line arguments. **Programming Basics:** Constants, variables & data types, Symbolic Constants, Type casting, Standard Default values. Operators & Expressions: Arithmetic operators, bitwise operators, relational operators, assignment operator, ternary operator. Logical expression. Decision making & Branching: Introduction, conditional statement, the switch statement, the conditional operator. Looping.

UNIT II

Classes, Objects & Methods: Introduction, Defining a class, Adding variables, Adding methods, Creating objects, Accessing class members, Constructors, Method overloading, Static members, Nesting of methods;

UNIT III

Inheritance Interfaces and Packages: Extending a class, Overriding methods, Final variables and methods, Final variables, methods and classes, Finalizer method, Abstract methods and classes;
Arrays, Strings and Vectors: Arrays, One-dimensional arrays, Creating an array, Two – dimensional arrays, Strings, Vectors, Wrapper classes; Interfaces: Multiple Inheritance: Introduction, Defining interfaces, Extending interfaces, Implementing interfaces, Assessing interface variables;
Packages: Introduction, Java API Packages, Using System Packages, Naming conventions, Creating Packages, Accessing a Package, using a Package.

UNIT IV

Multithreaded Programming& Exception: Introduction, Creating Threads, Extending the Threads, Stopping and Blocking a Thread, Lifecycle of a Thread, Using Thread Methods, Thread Exceptions, Thread Priority, Synchronization, Exception: Types of errors, Compile time errors, Runtime errors, Exceptions, Exception handling, Multiple Catch Statements, Using finally statement, Throwing our own Exception.

REFERENCE BOOKS:

1. E.Balaguruswamy, Programming with JAVA, A primer, 3e, TATA McGraw-Hill Company. 2. Herbert Schildt: Java
2. The complete Reference , 7th Edition, Tata McGraw Hill, 2007. 3.Programming in Java by SachinMalhotra, OXFORD University Press
3. John R. Hubbard, Programming with Java, Second Edition, Schaum's outline Series, TATA McGraw-Hill Company. Deitel&Deitel. Java TM: How to Program, PHI (2007)
4. Java Programming: From Problem Analysis to Program Design- D.S Mallik

CPP-3.4.2: JAVA PROGRAMMING LAB

LIST OF PROGRAMS:

1. Write a Java program to find the GCD of number.

2. Write a JAVA Program to demonstrate Constructor for calculating area of rectangle.

3. Write a JAVA Program to demonstrate Method Overloading.

4. Write a program in Java for String handling which performs the following:

i) Reverses the contents of a string given on console and

ii) converts the resultant string in upper case.

5. Write a JAVA Program on interfaces to calculate the area of a rectangle and triangle.

6. Write a JAVA Program to Design a simple calculator using Switch Statement

7. Write a program to calculate area and perimeter of a rectangle using Super keyword.
8. Write a program to sort given Strings.
9. Design student application form and store in database and display.
10. Program to find the numerical solution of Laplace equation by Jocobi's method.
11. Program to find the numerical solution of Laplace equation by Gauss-Seidel method.
12. Program to find the numerical solution of Heat equation by Schmidt method.
13. Program to find the numerical solution of Heat equation by Crank-Nicolson method.
14. Program to find the numerical solution of wave equation using Finite difference method

SPT- 3.5(A): DYNAMICAL SYSTEMS

UNIT I

Linear and Non-Linear systems-Phase portraits, fixed points and linearization, Existence and uniqueness of solutions, Fixed points and Linearization, Stability of equilibria,
Conservative and reversible systems, Liapunov stability theory. Limit cycles and periodic solution- introduction, ruling out closed orbit.

UNIT II

Linear and nonlinear discrete systems- Examples of discrete systems, Fixed points and cobweb, logistic map, Liapunov Exponent, quadratic maps. Poincare section, Henon map, strange attractors

UNIT III

Introduction of Bifurcations, Bifurcation of Ordinary differential equations of one and two dimention- Saddle-node bifurcation, Transcritical bifurcation, Pitchfork bifurcation, Hopf bifurcation, global bifurcation of cycles, Bifurcation of Map.

UNIT IV

Chaos. Logistic map, Lyapunov exponents, chaotic attractors, Lorenz equations. Need for chaos control, the OGY method, PC method, optimal control, Adaptive control,
Non-feedback control, Feedback control.

REFERENCE BOOKS:

1. Lakshmanan, M. and Rajasekar, S., Nonlinear Dynamics: Integrability, Chaos and Patterns, Springer Verlag, 2003.
2. Strogatz, S., Nonlinear Dynamics and Chaos. Reading, MA: Addison-Wesley, 1994. 3. Edward, O., Chaos in Dynamical systems, 2nd ed. Cambridge, UK, 2002.
3. Lakshmanan, M. and Murali K., Chaos in Nonlinear Oscillators: Controlling and Synchronization, World Scientific, 1996.
4. Parker, T. S., and L. O. Chua. Practical Numerical Algorithms for Chaotic Systems. New York, NY: Springer-Verlag.
5. Guckenheimer, J., and P. Holmes. Nonlinear Oscillations, Dynamical Systems and Bifurcations of Vector Fields. New York, NY: Springer-Verlag, 2002.

SPT- 3.5(B): ADVANCED GRAPH THEORY

UNIT I

Covering and independence number (vertex and edge version). Connectivity- cut vertex, cut edge (bridge), blocks, vertex connectivity, edge connectivity and some external problems, Menger's theorem, properties of n-connected graphs with respect to vertices and edges.

UNIT II

Planarity, Plane and Planar graphs, Euler Identity, Non planar graphs, Maximal planar graph Outer planar graphs, Maximal outer planar graphs, Characterization of planar graphs, Geometric dual, Genus and Crossing number.

UNIT III

Colorings, Vertex Coloring, Color class, n-coloring, Vertex Chromatic number of standard graphs, Bichromatic graphs, Colorings in critical graphs, Relation between chromatic number and clique number/independence number/maximum degree, Edge coloring, Edge chromatic number of standard graphs, Coloring of a plane map, Four color problem, Five color theorem, Uniquely colorable graph. Chromatic polynomial.

UNIT IV

Directed graphs- preliminaries of digraph, oriented graph, in-degree and out-degree, elementary theorems, types. Tournament, cyclic and transitive tournament, spanning path in a tournament, tournament with a Hamiltonian path, strongly connected tournaments.

REFERENCE BOOKS:

1. F. Harary: Graph Theory, Addison -Wesley,1969
2. G. Chartrand and P. Zhang: Introduction to Graph Theory. McGraw-Hill Intrn. Ed., 2005.
3. J. A. Bondy and V.S.R.Murthy: Graph Theory with Applications, Macmillan, London.
4. D. Cvetkovic, M. Doob, I. Gutman and A. Torgasev, Recent Results in Theory of Graph Spectra, Annulus of Discrete Mathematics, No.36. Elsevier Science, Pub.BV.1991.
5. N.Deo: Graph Theory: PHI Pvt. Ltd. New Delhi, – 1990
6. T.W. Haynes, S.T. Hedetneime and P. J. Slater: Fundamental of Domination in graphs, Marcel Dekker. Inc. New York.1998.
7. J. Gross and J. Yellen: Graph Theory and its application, CRC Press LLC, BR, Florida, 2000.

SPT- 3.5(C): FUZZY SETS AND FUZZY LOGICS

UNIT I

Basic Concepts of Fuzzy Sets: Crisp set, Fuzzy sets, types of Fuzzy sets, basic, concepts, properties of a α-cuts, representation of Fuzzy sets, extenstion principle of Fuzzy sets, standard fuzzy operations.

UNIT II

Operations on Fuzzy Sets: Types of operations Fuzzy complements, Fuzzy intersections, t-norms. Fuzzy unions; t-co-norms, combinations of operations, aggregation operations.

UNIT III

Fuzzy Arithemetic: Fuzzy numbers. Linguistic variables. Arithematic operations on Fuzzy numbers. Lattice of Fuzzy numbers, Fuzzy equations.

UNIT IV

Fuzzy Relations: Crisp versus fuzzy relation, Projections and cylindric extensions, Binary fuzzy relations, Binary relations on a single set, fuzzy equivalence relations, fuzzy compatibility relations, fuzzy ordering relations.

REFERENCE BOOKS:

1. George J. Klir and Yuan Fuzzy sets and Fuzzy logic, Theory and Applications. PHI.
2. George J. Klir and Tina A. Fotger: Fuzzy sets uncertainty and information. PHI, 1994
3. Kaufmann, A., Introduction to the Theory of Fuzzy subsets-vol. Academic press, 1975
4. B. Kosko & others, Fuzzy logic with engineering Applications. PHI.
5. H. J. Zimmermann: Fuzzy Set Theory and its Applications, 3rd Ed. Kluwer Acad., 1992.

OEPT 3.6.1: STATISTICAL TECHNIQUES

UNIT I

Various approaches of probability: classical, frequency and axiomatic, rules on probability, conditional probability, independence, Bayes' theorem. Univariate random variables: discrete and continuous, distribution functions and their properties, probability mass and density functions, expectation & moments, moment generating function & its properties. Multiple random variables: joint distributions, marginal and conditional distributions. Discrete probability distributions: Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric and Poisson distribution. Continuous probability distributions: Uniform, Exponential, Gamma, Normal & Log-normal distribution.

UNIT II

Statistical Terminology: Inferential statistics, population, sample, parameter, statistic, random sample, sampling techniques. Summarizing and Exploring Data: Concept of frequency distribution, measures of central tendency, moments, measures of dispersion/variability, measures of skewness and kurtosis. Introduction to R-software, different aspects of probability distribution and analysis of data in R.

UNIT III

Sampling distributions, basic concepts of inference (estimation & hypothesis testing), point estimation & interval estimation. Null and alternate hypothesis, simple & composite hypotheses, critical region, N-P lemma, tests for mean, variance and proportion in one and two sample problems. Chi-square goodness of fit test. Introduction to non- parametric test, Contingency table, test of independence.

UNIT IV

Simple linear regression, least squares fit and correlation analysis. Tests for slope & correlation, prediction problem residual plots. Multiple linear regression. Analysis of Variance. Statistical models in R.

REFERENCE BOOKS:

1. 1.Probability and Statistics in Engineering by Hines, Montgomery, Goldsman & Borror. Wiley Student Edition.
2. .An Introduction to Probability and Statistics by Rohatgi and Saleh. Wiley Student Edition.
3. An Introduction to Mathematical Statistics and its Applications by Larsen & Marx. Pearson.
4. Introduction to Probability Models by Sheldon M. Ross, Academic Press.
5. Probability and Statistics by Spiegel, Schiller and Srinivasan. Tata McGraw-Hill Pub. Co. Ltd.
6. Introduction to Probability and Statistics by J. Susan Milton & J.C. Arnold, 4th Ed., Tata McGraw-Hill Pub. Co. Ltd.

OEPP-3.6.2: R PROGRAMMING (BASED ON OEPT-3.6.1)

LIST OF PROGRAMS

1. Write an R program to make a simple calculator that can add, subtract, multiply and divide using switch cases and functions.
2. Write a program to perform searching within a list (1 to 50). If the number is found in the list, print that the search is successful otherwise print that the number is not in the list.
3. Operations on vectors and matrices(addition, subtraction, multiplication)
4. Data Range, Frequencies, Mode, Mean and Median: Mean Applying Trim Option, Applying NA Option, Median - Mode, Standard Deviation , Correlation.
5. R –Pie Charts: Pie Chart title and Colors – Slice Percentages and Chart Legend, 3D Pie Chart , R Histograms – Density Plot, R – Bar Charts: Bar Chart Labels, Title and Colors.
6. Creating and manipulating data frames.
7. Univariate probability distributions
8. Applications of binomial distribution and fitting binomial distribution.
9. Applications of Poisson distribution and its fitting.
10. Computation of probabilities based on negative binomial, geometric and discrete uniform distributions.
11. Applications of Normal distribution and its fitting.
12. Computation of probabilities based on rectangular and exponential distributions.
13. To fit the straight line for the given data on pairs of observations.
14. To fit the second degree curve for the given data.
15. To fit the curve of the type b $Y=aX^b$ for the given data on pairs of observations.

FOUTH SEMESTER (CBCS)

CPT-4.1: MULTIVARIATE ANALYSIS

UNIT I

Multivariate normal distribution– Marginal and conditional distributions – characteristic function. Maximum likelihood estimation of the parameters of Multivariate Normal and their sampling distributions – Inference concerning the mean vector when covariance matrix is known

Generalized variance - Wishart distribution (statement only) – Properties of Wishart distribution - Test for covariance matrix – Test for equality of covariance matrices.

UNIT II

Total, Partial, Multiple correlation in the Multivariate setup – MLEs of Total, Partial and Multiple correlation coefficients. Sampling distributions of Total and Multiple Correlation in the null case.Hotelling T2 statistic, derivation and its distribution - Uses of T2 statistic - relation between T2 and D2 - MahalanobisD2 statistic and its distribution

UNIT III

Classification problems - Classification into one of two populations (known and unknown dispersion matrix) - Classification in to one of several populations – Fisher's Linear discriminant function**.**

UNIT IV

Principal components – properties, Extraction of Principal components and their variances Canonical correlation – Estimation of canonical correlation and variates. Factor analysis - Mathematical model- Estimation of Factor Loadings — Concept of factor rotation – Varimax criterion.

REFERENCE BOOKS:

1. Anderson, T.W(2003) : An Introduction to Multivariate Statistical Analysis, Wiley Eastern Ltd.
2. Johnson, R. A and. Wichern D.W (2007): Applied Multivariate Statistical Analysis, 6 /e, Prentice-Hall of India Private Ltd., New Delhi.
3. Giri, N.C(1977): Multivariate Statistical Inference, Academic Press, NY
4. Morrison, F(1985): Multivariate Statistical Methods, McGraw Hill Book Company.

CPT-4.2: CODING THEORY

UNIT I

Error detection: correction and decoding: Communication channels, Maximum likelihood decoding, Hamming distance, Nearest neighbour / minimum distance decoding, Distance of a code.

UNIT II

Linear codes: Finite fields with examples , Vector spaces over finite fields, Linear codes, Hamming weight, Bases of linear codes, Generator matrix and parity check matrix, Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes, Cosets, Nearest neighbour decoding for linear codes, Syndrome decoding.

UNIT III

The main coding theory problem Idea of bounds Gilbert - Varshamov bound, Hamming bound , Binary Hamming codes, q-ary Hamming.

UNIT IV

Cyclic codes: Definitions, Generator polynomials, Generator and parity check matrices, Decoding of cyclic codes, Burst-error-correcting codes

Some special cyclic codes: BCH codes, Definitions, Parameters of BCH codes, Decoding of BCH codes, Reed Solomon codes, quadratic residue codes (definition and examples only)

REFERENCE BOOKS:

1. San Ling and Chaoing Xing, Coding Theory - A First Course.
2. Lidl and Pilz, Applied Abstract Algebra - 2nd Edition
3. J. H. Van Lint Introduction to Coding Theory, Third Edition

CPT-4.3.1 : MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

UNIT I

Introduction, Machine learning definition, importance of machine learning, machine learning framework, types of machine learning, relation to other fields, examples of machine learning applications, designing a learning system, issues in machine learning.

UNIT II

Introduction to Supervised Learning, Decision tree-based classifier, Bayesian theory-based classifier, Neural network-based classifier, Nearest neighbor classifier,

Support vector classifier, performance evaluation. Introduction to Unsupervised Learning, Clustering methods,

UNIT III

Criteria functions for Clustering, Similarity measures, Component analysis, Low dimensional analysis and multidimensional scaling

UNIT IV

Additional topics, Reinforcement learning, Genetic algorithms, Analytical learning, Ensemble of classifiers, Design and analysis of machine learning experiments.

REFERENCE BOOKS:

1. Machine Learning: a Probabilistic Perspective by Kevin Patrick Murphy, MIT Press, March2014.
2. Introduction to Machine Learning by Alex Smola and S.V.N. Viswanathan, Cambridge UniversityPress.
3. Understanding Machine Learning: From Theory to Algorithms by Shai Shalev-Schwartz and ShaiBen-David
4. Published 2014 by Cambridge University Press

CPP-4.3.2: MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE LAB

Minimum System requirements:

- Processors: Intel Atom® processor or Intel® Core™ i3 processor.
- Disk space: 1 GB.
- Operating systems: Windows* 7 or later, macOS, and Linux.
- Python* versions: 2.7.X, 3.6.X.,3.8.X

LIST OF PROGRAMS

1. Write a Program to Implement Breadth First Search.
2. Write a Program to Implement Depth First Search
3. Write a program to implement Hill Climbing Algorithm
4. Write a program to implement A* Algorithm
5. Write a program to implement Tic-Tac-Toe game
6. Implementation of Python basic Libraries such as Math, Numpy and Scipy
7. Implementation of Python Libraries for ML application such as Pandas and Matplotlib
8. Creation AND Loading different datasets in Python.
9. Write a python program to compute Mean, Median, Mode, Variance and Standard Deviation using Datasets
10. Implementation of Find S Algorithm
11. Implementation of Candidate elimination Algorithm
12. Write a program to implement simple Linear Regression and Plot the graph

SPT-4.4(A): APLIED LINEAR ALGEBRA

UNIT I

Vector Spaces (10 Lectures), Definitions & Examples, Simple properties of Vector Spaces, Subspaces: Definitions, Examples, Necessary and Sufficient conditions, Sum, Intersection of Subspaces, Quotient Space, Linear Span: Definitions & Properties, Linear Dependence & Independence: Definitions, examples & properties, Basis and dimension of a vector space, Dimension of subspaces, Dimension of quotient space, Coordinates relative to a basis, coordinate vector, coordinate matrix

UNIT II

Linear Transformations (6 Lectures), Definitions, Examples and Simple properties, Representation of a linear transformation as a matrix, change of basis, Rank-Nullity theorem, Algebra of linear transformations, Eigen values & Eigenvectors of a Linear Transformation (6 Lectures), Definitions and Examples, Eigen values & Eigen vectors of a square matrix, Properties, Cayley Hamilton theorem,
Diagonalization

UNIT III

Inner Product Spaces (6 Lectures), Definitions & Examples, properties, Cauchy-Schwarz inequality, Orthonormal vectors, Orthogonal Complements, Orthonormal sets and bases, Gram Schmidt orthogonalization process, Two-dimensional Transformations, Representation of Points, Transformations and Matrices, Transformation of Points, Rotation, Reflection, Scaling, Combined Transformations, Transformation of the Unit Square, Solid, Body Transformation, Rotation, reflection and scaling as linear transformations, Translations and Homogeneous Coordinates, Rotation About an Arbitrary Point, Reflection through, an arbitrary Line, Projection - A Geometric Interpretation of Homogeneous Coordinates, Overall Scaling, Points at Infinity, Transformation Conventions.

UNIT IV

Three Dimensional Transformations (8 Lectures): Three-Dimensional Scaling, Three-Dimensional Shearing, Three-Dimensional Rotation, Three-Dimensional, Reflection, Three-Dimensional Translation, Multiple Transformations, Rotations about an Axis Parallel to a coordinate axis, Rotation about an Arbitrary Axis in space, Reflection through an Arbitrary Plane. A_ne and Perspective Geometry, Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformations, Techniques for generating perspective views, Vanishing points, Plane Curves, Curve representation, non-parametric curves, parametric curves, Parametric representation of a circle, parametric representation of an Ellipse, parametric representation of a parabola, parametric representation of a Hyperbola, A procedure for using conic sections. The general conic equations.

REFERENCE BOOKS:

1. Gilbert Strang: Linear Algebra and its applications (Fourth edition)
2. K. Hoffman and Ray Kunje : Linear Algebra (Prentice -Hall of India private Ltd.)
3. D.F. Rogers, J. Alan Adams : Computer Graphics, Second Edition McGraw-Hill Publishing Company.
   M. Artin : Algebra (Prentice -Hall of India private Ltd.)
4. A.G. Hamilton : Linear Algebra (Cambridge University Press),1989.
5. N.S. Gopala Krishnan : University algebra (Wiley Eastern Ltd.).
6. J.S. Golan : Foundations of linear algebra (Kluwer Academic publisher),1995.

SPT-4.4(B): COMPUTER AIDED GEOMETRIC DESIGN

UNIT I

Introduction to Computer Networks: Data Communication, characteristics of data communication, components, data representation, data flow, Computer Networks :· goals and applications, Network Hardware: broadcast and point-to-point, Network Topologies: mesh, star, bus, ring, hybrid, Network Types: LAN, MAN, WAN, Wireless Networks, Home Networks, Protocols and Standards, Network Software, Protocol Hierarchies, layers, protocols, peers, interfaces, network architecture, protocol stack, design issues of the layers – addressing, error control, flow control, multiplexing and de-multiplexing, routing, Connection-oriented and connectionless service. Network Models: Reference Models, The OSI Reference Model, TCP/IP Reference Model, Comparison of the OSI and TCP/IP reference models.

UNIT II

Physical Layer: Tasks Performed, Signals, Analog and Digital, Analog signals, Digital signals, Digital Transmission, Line coding, Some characteristics of Line coding, Line coding scheme, Sampling, PAM, PCM, Transmission Mode, Parallel Transmission, Serial Transmission, Transmission Media, Guided Media, Unguided Media (Wireless),The Public Switched Telephone Network, Structure of the telephone Network, Switching Circuit, Message and Packet: Data Link Layer, Data Link Layer Design Issues, Services provided to the network layer, Framing, Error control, Flow control, Error Detection and Correction, Types of Errors Single bit and burst errors, Detection, Error Correction, Elementary Data Link Protocols, Unrestricted Simplex protocol, A simplex stop-and wait protocol, A simplex protocol for a noisy channel

UNIT III

Sliding Window protocols, One-bit sliding window protocol, A protocol using Go Back N,
A protocol using Selective Repeat, The Medium Access Sublayer, The Channel Allocation Problem, Static Channel Allocation in LANs and MANs, Dynamic channel allocation in LANs and MANs, Multiple Access, Random Access, Controlled Access, Channelization FDMA, TDMA, CDMA concepts, Local Area Networks : Ethernet, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, Data Link Layer Switching, Bridges from 802.x to 802.y, Local Internetworking, Spanning tree Bridges, Remote Bridges, Repeaters, Hubs, Bridges, Switches, Routers and Gateways, Virtual LANs, IEEE 802.11 Architecture: BSS and ESS, Station types, Bluetooth Architecture : Piconets and scatternet,

UNIT IV

Network Layer, Network Layer Design Issues, Store and Forward Packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Services, Implementation of Connection oriented services, Comparison of Virtual Circuit and Datagram, Subnets, Addressing, Internet Address, Classful Address, Subnetting, Classless Addressing, Dynamic Address Configuration, Routing Algorithms, Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Routing Techniques Routing Table, Next hop Routing, Network specific Routing, Host specific routing, Default Routing, Static versus Dynamic Routing Table, Routing Table for Classful Addressing, Congestion Control, Concept, General Principles of Congestion Control, Congestion Control Prevention Policies, Internetworking, How networks Differ, Network Layer Protocols, ARP, IP, ICMP,

REFERENCE BOOKS:

1. Computer Networks , A. S. Tanenbaum, 4th Edition
2. Data Communication and Networking, Behrouz Forouzan, 3rd Edition
3. An Introduction to Computer Networks, S. A. M. Rizvi and V. K. Sharma

SPT-4.4(C): COMPUTER NETWORKING

UNIT I

Introduction to Computer Networks: Data Communication, characteristics of data communication, components, data representation, data flow, Computer Networks :· goals and applications, Network Hardware: broadcast and point-to-point, Network Topologies: mesh, star, bus, ring, hybrid, Network Types: LAN, MAN, WAN, Wireless Networks, Home Networks, Protocols and Standards, Network Software, Protocol Hierarchies, layers, protocols, peers, interfaces, network architecture, protocol stack, design issues of the layers – addressing, error control, flow control, multiplexing and de-multiplexing, routing, Connection-oriented and connectionless service. Network Models: Reference Models, The OSI Reference Model, TCP/IP Reference Model, Comparison of the OSI and TCP/IP reference models.

UNIT II

Physical Layer: Tasks Performed, Signals, Analog and Digital, Analog signals, Digital signals, Digital Transmission, Line coding, Some characteristics of Line coding, Line coding scheme, Sampling, PAM, PCM, Transmission Mode, Parallel Transmission, Serial Transmission, Transmission Media, Guided Media, Unguided Media (Wireless),The Public Switched Telephone Network, Structure of the telephone Network, Switching Circuit, Message and Packet: Data Link Layer, Data Link Layer Design Issues, Services provided to the network layer, Framing, Error control, Flow control, Error Detection and Correction, Types of Errors Single bit and burst errors, Detection, Error Correction, Elementary Data Link Protocols, Unrestricted Simplex protocol, A simplex stop-and wait protocol, A simplex protocol for a noisy channel

UNIT III

Sliding Window protocols, One-bit sliding window protocol, A protocol using Go Back N,
A protocol using Selective Repeat, The Medium Access Sublayer, The Channel Allocation Problem, Static Channel Allocation in LANs and MANs, Dynamic channel allocation in LANs and MANs, Multiple Access, Random Access, Controlled Access, Channelization FDMA, TDMA, CDMA concepts, Local Area Networks : Ethernet, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, Data Link Layer Switching, Bridges from 802.x to 802.y, Local Internetworking, Spanning tree Bridges, Remote Bridges, Repeaters, Hubs, Bridges, Switches, Routers and Gateways, Virtual LANs, IEEE 802.11 Architecture: BSS and ESS, Station types, Bluetooth Architecture : Piconets and scatternet,

UNIT IV

Network Layer, Network Layer Design Issues, Store and Forward Packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Services, Implementation of Connection oriented services, Comparison of Virtual Circuit and Datagram, Subnets, Addressing, Internet Address, Classful Address, Subnetting, Classless Addressing, Dynamic Address Configuration, Routing Algorithms, Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Routing Techniques Routing Table, Next hop Routing, Network specific Routing, Host specific routing, Default Routing, Static versus Dynamic Routing Table, Routing Table for Classful Addressing, Congestion Control, Concept, General Principles of Congestion Control, Congestion Control Prevention Policies, Internetworking, How networks Differ, Network Layer Protocols, ARP, IP, ICMP,

REFERENCE BOOKS:

1. Computer Networks, A. S. Tanenbaum, 4th Edition
2. Data Communication and Networking, Behrouz Forouzan, 3rd Edition
3. An Introduction to Computer Networks, S. A. M. Rizvi and V. K. Sharma

THEORY QUESTION PAPER PATTERN

Duration of Examination: 3 hrs **Max. Marks** = 70

Note: Answer any **five** full questions.

1.	Descriptive type question (From Unit-1)	14
2.	Descriptive type question (From Unit-1)	14
3.	Descriptive type question (From Unit-2)	14
4.	Descriptive type question (From Unit-2)	14
5.	Descriptive type question (From Unit-3)	14
6.	Descriptive type question (From Unit-3)	14
7.	Descriptive type question (From Unit-4)	14
8.	Descriptive type question (From Unit-4)	14

Note: Equal weightage to be given to each unit while preparing the question paper. Question No. 1 to 8 must include atleast two subquestions.

PRACTICAL BASED THEORY QUESTION PAPER PATTERN

Duration of Examination: 2 hrs **Max. Marks** = 40

Note: Answer any **five full** questions.

1.	Descriptive type question (From Unit-1)	8
2.	Descriptive type question (From Unit-1)	8
3.	Descriptive type question (From Unit-2)	8
4.	Descriptive type question (From Unit-2)	8
5.	Descriptive type question (From Unit-3)	8
6.	Descriptive type question (From Unit-3)	8
7.	Descriptive type question (From Unit-4)	8
8.	Descriptive type question (From Unit-4)	8

Note: Equal weightage to be given to each unit while preparing the question paper.

PRACTICAL QUESTION PAPER PATTERN

Duration of Examination: 3 hrs **Max. Marks** = 40

1.	Experiments, Spotting, Demonstrations & Executions.	**30 Marks**
2.	Records (which includes Logic, Algorithm, Flowchart, Programs & sample outputs) and submission.	**5 Marks**
3.	Viva-voce	**5 Marks**