Syllabi & Course Scheme of M.Sc. Math (2015)

M.Sc. (Mathematics)
Total Credit required for the course: 96
Max Marks: 2400
Core Courses: 20
Lab: 03
Project:01

Semester I

Subject code Subject	Credit(L-T-P)	Marks Theory	Weightage Sessional
MTH 501 Real Analysis	4 (4-0-0)	60	40
MTH 503 Algebra	4 (4-0-0)	60	40
MT 505 Ordinary Differential Equations	4 (4-0-0)	60	40
MTH 507Complex Analysis	4 (4-0-0)	60	40
MTH 509 Programming in C(theory)	4 (4-0-0)	60	40
MTH 551 Programming in C Lab	4 (0-0-8)	60	40
Total	24 (20-0-8)	360	240

Semester II

Subject code Subject	Credit(L-T-P)	Marks Theory	Weightage Sessional
MTH 502 Mathematical Statistics	4 (4-0-0)	60	40
MTH 504 Linear Algebra	4 (4-0-0)	60	40
MTH 506 Methods of Applied Mathematics	4 (4-0-0)	60	40
MTH 508Numerical Analysis	4 (4-0-0)	60	40
MT H 510 Programming in C++ (Theory)	4 (4-0-0)	60	40
MTH 552 Programming in C++ Lab	4 (0-0-8)	60	40
Total	24 (20-0-8)	360	240

Semester III

Subject code Subject	Credit(L-T-P)	Marks Theory	Weightage Sessional
MTH 511 Topology	4 (4-0-0)	60	40
MTH 513 Mechanics	4 (4-0-0)	60	40
MTH 515 Partial Differential Equation	4 (4-0-0)	60	40
MTH 517 Operations Research	4 (4-0-0)	60	40
MTH 519 Elective -I	4 (4-0-0)	60	40
MTH 553MATLAB	4 (0-0-8)	60	40
Total	24 (20-0-8)	360	240

Semester IV

Subject code Subject	Credit(L-T-P)	Marks Theory	Weightage Sessional
MTH 512 Functional Analysis	4 (4-0-0)	60	40
MTH 514Differential Geometry	4 (4-0-0)	60	40
MTH 516 Fluid Dynamics	4 (4-0-0)	60	40
MTH 518Advanced Discrete Mathematics	4 (4-0-0)	60	40
MTH 520Elective –II	4 (4-0-0)	60	40
MT H 554 Project	4 (0-0-8)	60	40
Total	24 (20-0-8)	360	240

Elective-I
1.Fuzzy sets and its applications
2.Number theory & cryptography
3.Mechanics of solids
4.Mathematics for finance &insurance
5.MathematicalModelling
Elective-II
1.Integral equation & calculus of variation
2.Algebraic coding theory
3.Wavelets and its applications
4.Advanced Operation Research
5. Information theory

Semester-I

MTH 501 Real Analysis

Unit - I

Sequence and Series of a function, point-wise convergence, uniform convergence, Cauchy criterion for uniform convergence, test for uniform convergence (Weierstrass M-test, Abel's test, Dirichelts test), uniform convergence and integration, uniform convergence and differentiation, Weierstrass approximation theorem.

Unit - II

R-S integral, definition and existence of integral, condition of integrability, properties of integral, fundamental theorem of calculus, mean value theorem of integral calculus.

Unit - III

Power series, generic term, definition, uniqueness theorem for power series, properties of function expressed as power series, abel's theorem.

Unit - IV

Function of several variables, explicit and implicit functions, derivation of higher orders, change of variables, Taylor's theorem, Inverse function theorem, Implicit function theorem, Jacobian, Extreme problems with constraints, Lagrange's multiplier method.

Unit - V

Lebesgue integral, measurable sets, non-measurable sets, sets of measure zero, borel sets, measurable functions, lebesgue integral, formulation of measurable sets in terms of open sets, closed sets, f sigma sets, g delta sets, integrability and measurability, classical lebesgue dominated convergence theorem, fatou's lemma, Tauber's theorem.

Text Books:

1. W. Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha,1976, International student edition.
2. T.M.Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985.
3. P.K.Jain and V.P.Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 (Reprint 2000).
4. H.L.Royden, Real Analysis, Macmillan Pub. Co. Inc. 4th Edition, New York, 1993.
5.S.C. Malik &SavitaArora, Mathematical Analysis, New Age International (P) Limited Published,2008.

MTH 503 Algebra

Unit-I

Normal subgroups, Quotient groups, Simple groups, Homomorphisms, Isomorphisms and Automorphisms, Cayley's theorem, Factor's theorem, Cauchy's theorem, Second Fundamental theorem.

Unit-II

Normal& Composition chains, Jordon Holder's Theorem, Solvable groups, Permutation groups, Alternating groups, Simplicity of An (n>=5), Galois theorem, Conjugacy, Class equations, Sylow's theorems, Direct products, Finite abelian groups, Fundamental theorem on finite abelian groups, Decomposable groups.

Unit-III

Rings, Ideals, Prime and maximal ideals, Homomorphism, Quotient- rings, Integral domains,

Imbedding of rings, Field, Prime fields, Wilson's theorem, Zorn's lemma, Zrulls theorem, Field of quotients of an Integral domain, Euclidean domains, The ring of Gussian integers, Principal ideal domains, Unique factorization theorem, Fermat's theorem.

Unit-IV

Polynomial rings over rings and fields, Division algorithm, Gauss lemma, Eisenstein's irreduciblity criterion, Primitive polynomials, Cyclotomic polynomials, Unique factorization in R[x] where R is a Unique factorization Domain.

Unit-V

Field extensions, Algebraic and transcendental extensions, Normal extensions, Construction by Ruler and Compass, Finite fields, Structure of finite fields, Subfields of finite fields.

Text Books:

1. I. N. Herstein, Topics in Algebra, New Age International (P) Limited, New Delhi
2. P. B. Bhattacharya, S.K. Nagpaul, Basic Abstract Algebra (2nd Edition) Cambridge University Press, Indian Edition, 1997.
3. M. Artin, Algebra, Prentice Hall of India, New Delhi.
5. N. Jacobson, Basic Algebra Vols. I &II, W.H. Freeman. 1980
6. S. Lang, Algebra, 3rd Edition, Pearson Education Asia, New Delhi
7. I. S. Luther and IBS Passi, Algebra, Vol. I-Groups, Vol.-II Rings Narosa Publishing House (Vol. I-1996 Vol. II-1996)
8. J. B. Fraleigh, A First Course in Abstract Algebra, Narosa Publishing House, New Delhi.
9. S. K. Jain, A. Gunawardena and P. B. Battacharya, Basic Linear Algebra with MATLAB, KCB (Springer-Verlag) 2001.

MTH 505 Ordinary Differential Equations

Unit - I

Linear Equations

Classification of differential equations, their origin and application, Exact differential equations and integrating factors, special integrating factors andtransformation ,Basic theory of L.D.E., Method of successive approximation, Lipschitz condition, existence and uniqueness theorem for first order equations. Statement of existence and uniqueness theorem for solution of ordinary differential equations of order n.

Unit - II

Power Series Solutions : Review of power series, Series solutions of first order equations, Second order linear equations, Ordinary points, Regular singular points, Indicial equations, , The point at infinity,Frobenius method, Legendres polynomial, Bessels function.

Unit - III

Sturm Liouville Theory

Sturm separation theorem. Normal form, Sturm's comparison theorem, Sturm liouville problems, Characteristic values and Characteristic functions in Sturm liouville problems

Unit- IV

System of Linear Differential Equatins: Basic theory of linear systems in normal form: two equations in two unknown functions, homogeneous linear systems with constant coefficients: two equations in two unknown functions

Unit - V

Non-linear equations : Autonomous systems, Critical points, Concepts of Stability, Critical points and paths of linear system, Liapunov's direct method, , Liapunov functions.

MTH 507 Complex Analysis

Unit -I

Function of a complex variable, continuity, differentiability. Analytic functions and their properties, Cauchy-Riemann equations in Cartesian and polar coordinates. Power series, Radius of convergence, Differentiability of sum function of a power series. Branches of many valued functions with special reference to arg z, log z and z^a.

Unit -II

Path in a region, Contour, Simply and multiply connected regions, Complex integration. Cauchy theorem. Cauchy's integral formula. Poisson's integral formula. Higher order derivatives. Complex integral as a function of its upper limit, Morera's theorem. Cauchy's inequality. Liouville's theorem.

Unit -III

Zeros of an analytic function, Cassorati- Weierstrass theorem, Limit point of zeros and poles. Maximum modulus principle, Minimum modulus principle. Schwarz lemma. Meromorphic functions. The argument principle. Rouche's theorem, Inverse function theorem.

Unit - IV

Taylor's and Laurent's Theorem .Calculus of residues. Cauchy's residue theorem. Types of singularities. Application of residue theorem in Evaluation of improper real integrals and Evaluation of sum. Schwarz lemma (Without proof).

Unit - V

B ilinear transformations, their properties and classifications. Definitions and examples of Conformal mappings. Schwarz lemma (Without proof).

Text Books

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
3. S. Lang, Complex Analysis, Addison Wesley, 1977.
4. Mark J. Ablowitz and A.S. Fokas, Complex Variables : Introduction and Applications, Cambridge University Press, South Asian Edition, 1998.
5. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
6. Ruel V. Churchill and James Ward Brown, Complex Variables and Applications, McGraw-Hill Publishing Company.
7. Rudin, Real and Complex Analysis .
8. B. Choudhary, The Elements of Complex Analysis. New Age International.

MTH 509 Programming In C

Unit-I

Computer fundamentals: Computer components, characteristics and classification of computers hardware and software, Peripheral devices. Algorithm development, techniques of problem solving, flow-chart, decision table, structured programming concepts of Moduler

programming, algorithm for searching, sorting (exchange and insertion), merging of ordered Programming methodologies top-down and bottom-up design, development of efficientprogram; program correctness; debugging and testing of programs
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Unit-II

Programming in C:An over view of programming , programming languages, Classifications, Introduction to C, Data type, constants and variable; structure of a C program,operators and expressions, control statements: sequencing, alteration and iteration; functions,recursion, array, string and pointers, file handling, Formatting source files , Continuation character.

Unit-III

The Preprocessor, Scalar data types –Declarations, different types and kinds of integers, Floating point type, Initialization, mixing types, Explicit conversions-Casts.The void data types, Typedefs.

Unit-IV

Operators and Expressions: Precedence and associativity, Unary Plus and Minus Operator. Binary comma Operators . relational Operator. Logical Operators, Bit manipulation Operators, Memory Operators, input and out putfunctions. Control flow- Conditional Branching, The switch statement. Looping, Nested Loops. The break and continue statement. The goto statement , infinite loop

Unit-V

Arrays: Declaring an array ,arrays and memory, initializing arrays ,Strings Functions-Passing argument , declarations and calls. Recursion, the main ( ) function, passing array as function arguments.
Pointers: Pointer arithmetic ,accessing array elements through pointer ,passing pointer as function arguments, array of pointer, pointers to pointers, Complex declarations.
Text Books:
1. Kenneth, A. : C problem solving and programming, Prentice Hall.
2. Gottfried, B. : Theory and problems of Programming in C, Schaum Series.
3. Kerninghan&Ritchie : The Programming Language, PHI.
4. E. Horowitz and S. Sahani, “Fundamentals of Data Structures”, GalgotiaBooksourcePvt. Ltd, 2003
5. R. S. Salaria, “Data Structure & Algorithms”, Khanna Book Publishing Co. (P) Ltd.,2002.
6. P. S. Deshpande and O.G. Kakde, “C & Data Structure”, Wiley Dreamtech, 1stEdition, 2003.
7. Schaum’s outline series, “Data Structure”, TMH, 2002

MT 551: Programming in C Lab

Practicals will be based on the Theory paper MT 509: Programming in C.

Semester-II

MTH 502 Mathematical Statistics

Unit - I

Review of Mean, Median, Mode. Probability: Rules of probability, Conditional probability, Independent events, Baye’s theorem, Probability distribution.

Random variable, Discrete and continuous random variables, Two dimensional random variable, Transformation of one, two and n-dimensional random variables.

Unit - II

Probability density function, Multivariate distribution, Marginal distribution, Conditional distribution.

Mathematical expectation, Conditional expectation, Chebyshev's theorem, Moment generating function, Product moments, Characteristic functions. Convergence in probability and in distribution, Weak law of large numbers and central limit theorem for independent identically distributed random variables with finite variance.

Unit - III

Theoretical distributions: Binomial Distribution, Fitting of Binomial Distribution, Poisson Distribution, Fitting of Poisson Distribution, Normal Distribution, Relation between Binomial distribution, Relation between Poisson and Normal Distribution. Properties of Normal Distribution. Area under Normal Probability Curve. Importance of Normal Distribution.

Unit - IV

Estimation theory: Estimators, Unbiasedness, Efficiency, Consistency, Sufficiency, Method of Point Estimation, Sampling distribution of Statistic and Mean, Centeral limit Theorem, Sampling Distribution of Proportion, Interval Estimation for large samples, Confidence limit for Mean, Proportion, Standard Deviation, Difference of Means, Difference of Proportions, Size of Random Sample for Specified Precision.

Unit - V

Testing of Hypothesis: Simple and composite hypothesis, Test of Significance, Types of errors, Critical region, one tailed and two tailed tests, Critical value or significant value, Procedure of Testing of Hypothesis. Large sample tests, Chi- Square test, Test of significance based on t, F and z Distributions.

Text Books:

1. Baisnab and Jas,M., Element of Probability and statistics, Tata McGraw Hill.
2. Freund,J.E., Mathematical Statistics, Prentice Hall of India.
3. Hogg,R.V. and Craig,A.T., Introduction to Mathematical Statistics, MawellMcmillian.
4. Gupta, S.C., Mathematical Statistics, Himalayan Publications.
5. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi.
6. Speigel, M., Probability and Statistics, Schaum Outline Series.
7.Taneja, H.C. "Statistical Methods for Engineering & Science", IK International, New Delhi.

MT-504 Linear Algebra

Unit 1.

Linear transformation, Rank and nullity of a linear transformation, Sylvester's law of nullity, Subspaces, Quotient spaces, Basis.

Unit -II

Algebra of linear transformations, Orthogonal and supplementary linear transformations,Dual space, Linear functional, Bidual, Cannonical isomorphism.

Unit-III.

Matrix of a linear transformation, Change of basis, Equivalent and similar matrices, Minimal polynomials, Invertible linear transformations.

Unit IV.

Eigen values, Eigen vectors, More on maximal polynomials, Diagonal vectors of a square matrix, Jordan Block, Jordan Cannonical form, Cyclic linear transformation, Cyclic spaces,

Jordan normal form.

Unit -V

Trace and transpose of a linear transformation, Adjoint,Hermitianadjoint, Unitary and Normallinear operators.

Books Recommended

1. I.N. Herstein,
Topics in Algebra
2. P.R. Halmos,
Linear Algebra with Problems.
3. Hoffman &kunze,
Linear Algebra
4. Krishnamurthy,
An introduction to Linear algebra

MTH 506 Methods of Applied Mathematics

Unit-I

Curvilinear Co-ordinates: Co-ordinate transformation, Orthogonal Co-ordinates, Change of Co-ordinates, Cartesian, Cylindrical and spherical coordinates, expressions for velocity and acceleration ds, dv and ds^2 in orthogonal coordinates, Areas ,volumes and Surface area in Cartesian , Cylindrical and spherical coordinates in few simple cases, Grad, div, Curl, Laplacian in orthogonal Co-ordinates, Contravariant and Co-variant components of a vector, Metric coefficients and the volume element.

Unit-II

Laplace Transform: Review and its application to solve ordinary differential equation and integral equation.

Fourier Transform: Definition and properties, fourier transform of some elementary functions, convolution theorem, application of fourier transform to solve ordinary and partial differential equation.

Unit-III

Mellin Tranform: Definition, Elementry properties, Mellin transform of derivatives, Integrals, Inverse Mellin transform, Convolution theorem , Inverse Mellin transform of two functions.

Hankel Tranform: Definition, Elementry properties, Hankel transform of derivatives, Exponential functions, Inversion formula for Hankel transformation, Parsevals theorem , Relation between Hankel and Laplace transform.

Unit-IV

Modified Bessel function, ber and bei function, Kelvin function, spherical Bessel function , modified spherical Bessel function.

Unit-V

Legender's associated functions and differential equation, integral expression for associated legender polynomial, recurrence relation for associated legender polynomial.

Text Books:

1. Sneddon, I. N., The Use of integral Transforms.
2. Schaum's Series, Vector Analysis.
3. Gupta, S.C. and Kapoor, V.K., Fundamentals of Mathematical Statistics.
4. Goyal S.P. and Goyal A.K., Integral Transforms.

MTH 508 Numerical Analysis

Unit-I

Various difference operators and relation between them .Newton‘s forward and backward interpolation formulae . Central difference interpolation formula. Gauss forward and backward interpolation formulae. Langrages interpolation formula and Newton‘s divided difference formulae.

Unit-II

Solution of algebraic and transcendental equations: Bisection method, method of false position,secant method, iteration method, Newton's Raphson method, Generalised Newton-Raphson method

Unit-III

Solution of simultaneous algebraic equations: Jacobi's method, Gauss-Seidal method, Relaxation method.

Numerical differentiation and integration: Formula for derivatives Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Boole's rule and Weddle's rule, Romberg's Integration.

Unit-IV

Numerical solution of O.D.E.: Taylor series,Picard‘s method, Eule , Modified Euler method, Runge-Kutta second and fourth order methods, predictor collector methods(Adams-Bashforth and Milne's method only). Finite element method for finding approximate solution to boundary value problems for differential equation.

Unit- V

Numerical solution of P.D.E.: Finite difference approximations of partial derivatives, solution of Laplace equation (Standard 5-point formula only), one-dimensional heat equation (Schmidt method, Crank-Nicolson method, Dufort and Frankel method) and wave equation.

Text Books :

1. K.Atkinson and W. Han, Elementary Numerical Analysis, John Wiley,2006.
2. Numerical Methods in Engg. &Science : B.S. Grewal;khanna.
3. Numerical Methods for Scientific and Engg. Computations : M.K. Jain, S.R.K. Iyenger and R.K. Jain-Wiley Eastern Ltd
4. Taneja, H.C. "Advanced Engineering Mathematics", IK International, New Delhi.

MTH 510 Programming in C++

Unit-I

Introduction to c++, structure of c++ program, Basic concepts of object oriented programming (OOP), Advantages and Applications of OOP- Object Oriented Languages. Creating a source files, Compiling and Linking. C++ Programming Basics.

Unit-II

Data types, Operators, Expressions, Control Structures, Library functions, Functions in C++, Passing Arguments to and returning values from Function, inline function, default arguments, function overloading .

Unit –III

Classes and objects, Specifying and using class and object, array within a class, Arrays of object as a function argument, friendly functions, pointer to members, constructors and deconstructors. Operator overloading and type conversion.

Unit –IV

Inheritance, derived class and their constructs, overriding member function, class hierarchies, Public and Private inheritance levels, Polymorphism, pointer to objects, this pointer, Pointer to derived classes, Virtual functions, Strums and streams classes, unformatted I/O operations. Formatted console.

Unit-V

I/O operations, managing output with manipulators, classes for file stream operations, opening and closing a file. File pointers and their manipulations, Random Access, Error handling during file operations, Command–line argument, Exceptional handling.

Text Books :

1. I.S. Robert Lafore, Object Oriented Programming using C++, Waite's Group Galgotia Pub.
2. E. Balagrusamy, Object Oriented Programming with C++, 2nd Edition, Tata Mc Graw Hill Pub.Co.
3. Byron, S. Gottfried, Object Oriented Programming using C++, Schaum's Outline Series, Tata McGraw Hill Pub.Co.
4. J.N. Barakaki, Object Oriented Programming using C++, Prentice Hall of India, 1996.
5. Deitel and Deitel, C++: How to program, Prentice Hall of India

MT 552: Programming in C++ Lab

Practicals will be based on MT 510: Programming in C++

Semester-III

MTH 511 Topology

Unit - I

Definition and examples of topological spaces; basis and sub basis; order relations, Limit points , adherent points , Derived sets , Kuratowski's closure axioms, Dense subsets, closure, interior, exterior and boundary pts. of a set, subspace , relative topology.

Unit - II

Continuity and related concepts; product topology; quotient topology; countability axioms; Lindelof spaces and separable spaces, First and second countable spaces,Lindelof theorem Second countability and seperability

Unit - III

Separated sets, connected sets; component, path component; localconnectedness, Disconnected sets, Totally Disconnected sets.,locally connected spaces,connectedness on real line

Unit - IV

Compact spaces; limit point compact and sequentially compact spaces,local compactness and one point compactification; Finite intersection property; finite product of compact spaces, statement of Stone cech theorem and Tychonoff's theorem. Heine Borel theorem

Unit -V

Separation axioms (T_0,T_1,T_2,T_3spaces, Regular space, Completely regular spaces,Normal spaces);their characterizations and basic properties.Urysohn's lemma; Tietze's extension theorem; statement of Urysohn'smetrization theorem.

Textbooks:

1. Topology, a first course – J. R. Munkres, Prentice-Hall of India Ltd., New Delhi, 2000.
2. General Topology – J. L. Kelley, Springer Verlag, New York, 1990.
3. An introduction to general topology (2nd edition) – K. D. Joshi, Wiley Eastern Ltd., New Delhi, 2002.

MTH 513 Mechanics

Unit- I

Moments and products of Inertia, Theorems of parallel and perpendicular axes, principal axes, The momental ellipsoid, Equimomental systems, Coplanar distributions.

Unit- II

Generalized coordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic systems. Lagrange's equations for a holonomic system., Lagrange's equations for a conservative and impulsive forces. Kinetic energy as quadratic function of velocities. Generalized potential, Energy equation for conservative fields. Hamilton's variables.

Unit- III

Hamilton canonical equations. Cyclic coordinates. Routh's equations. Poisson's Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Hamilton's Principle. Principle of least action.

Unit- IV

Poincare Cartan Integral invariant. Whittaker's equations. Jacobi's equations. Statement of Lee Hwa Chung's theorem. Hamilton-Jacobi equation. Jacobi theorem. Method of separation of variables. Lagrange Brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets. Invariance of Lagrange brackets and Poisson brackets under canonical transformations.

Unit -V

Gravitation: Attraction and potential of rod, disc, spherical shells and sphere. Laplace and Poisson equations. Work done by self-attracting systems. Distributions for a given potential. Equipotential surfaces. Surface and solid harmonics. Surface density in terms of surface harmonics.

TEXT BOOKS:

1. F.Chorlton, A Text Book of Dynamics, CBS Publishers & Dist., New Delhi.
2. F.Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow.
3. A.S. Ramsey, Newtonian Gravitation, The English Language Book Society and the Cambridge University Press.
4. Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press.

MTH 515Partial Differential Equation

Unit-I

PDE OF Kthorder : Definition, examples and classifications, Initial value problems. Transport equations homogeneous and non-homogeneous,Radial solution of Laplace's Equation, Fundamental solutions, harmonic functions and their properties, Mean value Formulas, Poission's equation and its solution, strong maximum principle, uniqueness.

Unit-II

Green's function and its derivation, representation formula using Green's function, symmetry of Green's function, Green's function for a half space and for a ball. Energy methods : uniqueness, Dirichlet's principle.

Unit-III

Heat Euqations : Physical interpretation, fundamental solution. Integral of fundamental solution, solution of initial value problem, Duhamel's principle, non-homogeneous heat equation, Mean value formula for heat equation, strong maximum principle and uniqueness.Energy methods.

Unit-IV

Wave equation – Physical interpretation, Solution for one dimentional wave equation, d'Alemberts formula and its applications, reflection method, Solution by spherical means Euler-Poisson_Darboux equation, Kirchhoff's and Poisson's formulas (for n=2,3 only), Solution of non-homogeneous wave equation for n=1, 3. Energy method.Uniqueness of solution.

Unit-V

Non-linear first order PDE-complete integrals, envelopes. Characteristics of (i) linear (ii) quasilinera (iii) fully non-linear first order partial differential equations. Hamilton Jacobi equations (calculus of variations Hamilton's ODE, Legendre Transform, Hopf-Lax formula, weak solutions, Uniqueness).

BOOKS :-

1) L.C. Evans, Partial Differential Euqations, Graduate Studies in 2 books with the above title by I.N. Snedden, F.John, P Prasad and R Ravindran, Amarnath etc.

MTH 517 Operations Research

Unit-I

The origin of OR, Definition and scope of Operation Research, Types, methodology and typical applications of OR, Classification of OR models, Phases of an O.R. study, Impact of OR, Formulation of Linear-programming model, Graphical solution. Converting the linear programming problem to standard form, Simplex method.

Unit-II

Big-M method, Two-phase method, Degeneracy, Alternate optima, unbounded and infeasible solution.

Definition of the dual problem, prima-dual relationship, Dual Simplex method.

Unit-III

Assignment problem and its mathematical formulation, solution of assignment problem (Hyngarian method), Transportation problem and its mathematical formulation. Initial basic feasible solution of transportation problem by North-West corner rule. Lowest-Cost Entry method and Vogel's Approximation method, Optimal solution of transportation problem.

Unit-IV

Game theory: Two person zero games, Minimax and maximum principle, Game with saddle point, Rule of dominance, Algebraic and graphical method. Decision theory: Types of decisions, Components of decision making,

Unit-V

Inventory models: Simple deterministic models, Economic lot size models with quantity discounts, with multiple items under constraints, Inventory control system, Re-order level and optimum buffer stock, Purchase inventory model with one, two and any number of price-breaks.

Queuing theory: Basic characteristic of queuing system, Birth-death equations, Steady state solution of Markovian queuing model with single and multiple servers (M/M/1 and M/M/c) with limited capacity (M/M/1/K and M/M/c/K), Finite source Markovian models.

Books Recommended:

1. Taha, H.A., Operation Research-An introduction, Tata McGraw Hill, New Delhi.
2. Dipak Chatterjee, Linear programming and Game Theory, Prentice-Hall India.
3. Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co.
4. Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications.
5. Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill.
6. Kapoor, V.K.,

MT 553: Matlab-I

Programming assignments using MATLAB based on basic mathematical computations will be given to the students.

ELECTIVE-I

MTH 519A Fuzzy Sets and their Applications

Unit-I

Definition of Fuzzy Set, Expanding Concepts of Fuzzy Set, Standard Operations of Fuzzy Set, Fuzzy Complement, Fuzzy Union, Fuzzy Intersection, Other Operations in Fuzzy Set, T-norms and T- conorms.

Unit-II

Product Set, Definition of Relation, Characteristics of Relation, Representation Methods of Relations, Operations on Relations, Path and Connectivity in Graph, Fundamental Properties, Equivalence Relation, Compatibility Relation, Pre-order Relation, Order Relation, Definition andExamples of Fuzzy Relation, Fuzzy Matrix, Operations on Fuzzy Relation, Composition of Fuzzy Relation, D- cut of Fuzzy Relation, Projection and Cylindrical Extension, Extension by Relation, Extension Principle, Extension by Fuzzy Relation, Fuzzy distance between Fuzzy Sets.

Unit-III

Graph and Fuzzy Graph, Fuzzy Graph and Fuzzy Relation, D- cut of Fuzzy Graph, Fuzzy Network, Reflexive Relation, Symmetric Relation, Transitive Relation, Transitive Closure, Fuzzy Equivalence Relation, Fuzzy Compatibility Relation, Fuzzy Pre-order Relation, Fuzzy Order Relation, Fuzzy Ordinal Relation, Dissimilitude Relation, Fuzzy Morphism, Examples of Fuzzy Morphism.

Unit-IV

Interval, Fuzzy Number, Operation of Interval, Operation of D- cut Interval, Examples of Fuzzy Number Operation,, Definition of Triangular Fuzzy Number, Operation of Triangular Fuzzy Number, Operation of General Fuzzy Numbers, Approximation of Triangular Fuzzy Number, Operations of Trapezoidal Fuzzy Number, Bell Shape Fuzzy Number.

Unit-V

Function with Fuzzy Constraint, Propagation of Fuzziness by Crisp Function, Fuzzifying Function of Crisp Variable, Maximizing and Minimizing Set, Maximum Value of Crisp Function, Integration and Differentiation of Fuzzy Function.

Text Books:

1. Kwang H. Lee, First Course on Fuzzy Theory and Applications, Springer International Edition, 2005.
2. H.J. Zimmerman, Fuzzy Set Theory and its Applications, Allied Publishers Ltd., New Delhi, 1991.
3. John Yen, Reza Langari, Fuzzy Logic - Intelligence, Control and Information, Pearson Education.

MTH 519B Number Theory and Cryptography

Unit- 1

Division algorithm, lame's theorem linear Diophantine equation fundamental theorem of arithmetic, prime counting function, statement of prime number theorem , since of erastosthenes , Goldbach conjecture, binary and decimal representation of integers linear congruences , complete set of residues, chienese reminder theorem, polynomial congruencesfermat's little theorem , pseudo prime, Wilson 's theorem fermat – Kraitohik factorization method.

Unit II

Number theoretic functions sum and number of divisors, totally multiplicative function, definition and properties of the dirichet product the mobius inversion formula , the greatest integer function ,Euler's phi-function Euler's theorem, reduced set of residues some properties of Euler's phi-function ,Euler's Ø -function.

Unit III

Order of integer modulo n, primitive roots for primes, composite no. having primitive roots , theory of modiecs ,Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli Jacobi symbol and its properties perfect numbers, $x^2 + y^2 = z^2$, fermats last theorem sum of two squares , sum of more than two squares, the Fibonacci sequence , certain identies involving Fibonacci numbers.

Unit IV

Riemann zeta function z(s) and its convergences application to prim number .z(s) as Euler's product evaluation of z(s) and z(2k), dirichlet series with simplic properties, Euler's products dirichlet products.

Unit V

Cryptography plaintext ,ciphertext , enciphering , Deciphering cryptosystem principle of security . types of attack, cryptanalysis. Enciphering matrices hill cipher. Transposition Techniques, public key (Asymmetric key)cryptography, discrete logarithm problem ,diffie-hellman problem, RSA cryptosystem, Rabin cryptosystem, ElGamal Cryptosystem, knapsack cryptosystem. Complexity, semantic security Identity-based cryptosystem, Elliptic curves cryptography,diffiehellman key exchange.

Text Books:

(1) Cryptography and Network security, Tata McGraw – Hill
(2) Hardy G.H and wright E.M an Introduction to the Theory of number.
(3) Burton D.M elementary number theory
(4) Gareth a jones and j. merry jones, elementary number theory springesed 1998.

MTH 519C Mechanics of Solids

Unit-I

Cartesian tensors of different order.Properties of tensors. Symmetric and skew-symmetric tensors. Isotropic tensors of different orders and relation between them. Tensor invariants. Eigen-values and eigen vectors of a second order tensor. Scalar, vector, tensor functions.Comma notation.Gradiant, divergence and curl of a tensor field.

Unit-II

Analysis of Stress : Stress vector, stress components. Cauchy equations of equilibrium. Stress tensor. Symmetry of stress tensor. Stress quadric of Cauchy. Principal stress and invariants. Maximum normal and shear stresses. Mohr's diagram.Examples of stress.

Unit-III

Analysis of Strain : Affine transformations. Infinitesimal affine deformation. Geometrical interpretation of the components of strain.Strain quadric of Cauchy. Principal strains and invariants. General infinitesimal deformation. Saint-Venant's equations of Compatibility. Finite deformations. Examples of uniform dilatation, simple extension and shearing strain.

Unit-IV

Equations of Elasticity : Generalized Hooke's law. Hooke's law in media with one plane of symmetry, orthotroic and transversely isotropic media, Homogeneous isotropic media. Elastic moduli for isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid.

Unit-V

Beltrami-Michellcompatibility equations. Strain energy function. Clapeyron's theorem.Saint-Venant's Principle.

1. I.S. Sokolnikoff, Mathematical Theory of Elasticity, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1977.

2. Teodar M. Atanackovic and ArdeshivGuran, Theory of Elasticity for Scientists and Engineers Birkhausev, Boston, 2000.
3. Y.C. Fung, Foundations of Solid Mechanics, Prentice Hall, New, Delhi, 1965.
4. Jeffreys, H. , Cartesian tensor.
5. Shanti Narayan, Text Book of Tensors, S. chand& co.
6. Saada, A.S., Elasticity- Theory and applications, Pergamon Press, New York.
7. A.E.H. Love, A Treatise on a Mathematical Theory of Elasticity, Dover Pub., New York.
8. D.S. Chandersekhariah and L. Debnath, Continum Mechanics, Academic Press, 1994.

MTH 519D Mathematics for Finance and Insurance

Unit-I

Financial Management – AN overview.Nature and Scope of Financial Management.Goals of Financial Management and main decisions of financial management.Difference between risk, speculation and gambling.Time value of Money - Interest rate and discount rate. Present value and future value- discrete case as well as continuous compounding case. Annuities and its kinds.

Unit-II

Meaning of return. Return as Internal Rate of Return (IRR). Numerical Methods like Newton Raphson Method to calculate IRR. Measurement of returns under uncertainty situations.Meaning of risk.Difference between risk and uncertainty.Types of risks.Measurements of risk.Calculation of security and Portfolio Risk and Return-Markowitz Model.Sharpe's Single Index Model- Systematic Risk and Unsystematic Risk.

Unit-III

Taylor series and Bond Valuation.Calculation of Duration and Convexity of bonds. Insurance Fundamentals – Insurance defined. Meaning of loss.Chances of loss, peril, hazard, and proximate cause in insurance.Costs and benefits of insurance to the society and branches of insurance-life insurance and various types of general insurance. Insurable loss exposures-feature of a loss that is ideal for insurance.

Unit-IV

Life Insurance Mathematics – Construction of Morality Tables.Computation of Premium of Life Insurance for a fixed duration and for the whole life. Determination of claims for General Insurance – Using Poisson Distribution and Negative Binomial Distribution –the Polya Case.

Unit-V

Determination of the amount of Claims of General Insurance – Compound Aggregate claim model and its properties, and claims of reinsurance. Calculation of a compound claim density function F, recursive and approximate formulae for F.

Text Books

1. AswathDamodaran, Corporate Finance - Theory and Practice, John Wiley & Sons, Inc.
2. John C. Hull, Options, Futures, and Other Derivatives, Prentice-Hall of Indian Private Limited.
3. Sheldon M. Ross, An Introduction to Mathematical Finance, Cambridge University Press.
4. Mark S. Dorfman, Introduction to Risk Management and Insurance, Prentice Hall, Englwood Cliffs, New Jersey.
5. C.D. Daykin, T. Pentikainen and M. Pesonen, Practical Risk Theory for Actuaries, Chapman & Hall.

6. Salih N. Neftci, An Introduction to the Mathematics of Financial Derivatives, Academic Press, Inc.
7. Robert J. Elliott and P. Ekkehard Kopp, Mathematics of Financial Markets, Sprigner-Verlag, New York Inc.
8. Robert C. Merton, Continuous – Time Finance, Basil Blackwell Inc.
9. Tomasz Rolski, HanspterSchmidli, Volker Schmidt and JozefTeugels, Stochastic Processes for Insurance and Finance, John Wiley & Sons Limited.

MTH 519E Mathematical Modeling

Unit- I

Introduction to modeling, Examples and definitions, classification of mathematical Modeling , Dimensional Analysis, Traffic flow modeling, techniques of mathematical modeling, Characteristics of mathematical modeling, steps in mathematical modeling, limitations of mathematical modeling.

Unit-II

Modeling and Simulation, Methods of developing a simulation model, Designing a simulation experiment, How to perform simulation analysis, Advantages of simulation modeling, Some pitfalls to guard against simulation

Unit-III

Modeling with difference equations, overview of basic concepts concerning matrices, eigenvalues and eigenvectors, The Harrod Model, the cobweb model, Samuelson's interaction model, application to Actuarial Science, Application to population dynamics and genetics.

Unit-IV

Queuing models, Poisson Process, Pure birth death process – M/M/1, M/M/c, M/Ek/1 queuing models, steady state probabilities, waiting time distribution. Cost consideration in network models.

Unit-V

Mathematical modeling through calculus of variations and dynamic programming, optimization principles and techniques, Problems related to maximum entropy distribution, geometrical problems, bio-economical problems, maximization and minimization problems, cargo loading problem, transportation problems, inventory problems.

Recommended Textbooks:

1. J N Kapur, Mathematical Modeling, New Age International (P) Ltd.,Publishers, New Delhi

Reference Books:

1.Hamdy A Taha, Operations Research, Pearson Educational Asia Edition
2. F R Giordano, M D Weir, and W P Fox, A First Course in Mathematical Modeling
3. A. Maria, Introduction to Modeling and simulation, Proceedings, Winter Simulation Conference, 1997
4.M M Gibbons, A Concrete Approach to Mathematical Modeling, John Wiley and Sons.
5.P.E. Wellstead, Introduction to Physical System Modeling, Academic Press, 1977.

Semester IV

MTH 512 Functional Analysis

Unit-I

Normed linear spaces, Banach Spaces and examples, subspace of a Banach space, completion of a normed space. Quotient space of a normed linear space and its completeness, product of normed spaces, finite dimensional normed spaces and subspaces, equivalent norms, compactness and finite dimension F. Riesz'z lemma.

Unit-II

Bounded and continuous linear operators, differentiation operator, integral operator, bounded linear extension, linear functionals, bounded linear functionals, continuity and boundedness, definite integral, canonical mapping, linear operators and functionals on finite dimensional spaces, normed spaces of operators, dual spaces with examples.

Unit-III

Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces, application to bounded linear functional on C[a,b], Riesz-representatiion theorem for bounded linear functionals on C[a,b], adjoint operator, norm of the adjoint operator. Reflexive spaces, uniform boundedness theorem and some of its applications to the space of polynomials and fourier series.

Unit-IV

Strong and weak convergence, weak convergence in lp, convergence of sequences of operators, uniform operator convergence, strong operator convergence, weak operator convergence, strong and weak* convergence of a sequence of functionals. Open mapping theorem, bounded inverse theorem, closed linear operators, closed graph theorem, differential operator, relation between closedness and boundedness of a liear operator. Inner product spaces, Hilbert spaces and their examples, Pythagorean theorem, Apolloniu's identity, Schwarz inequality, continuity of innerproduct, completion of an inner product space, subspace of a Hilbert space, orthogonal complements and direct sums, projection theorem.

Unit-V

Orthonormal sets and sequences, Bessel's inequality, series related to orthonormal sequences and sets, total (complete) orthonormal sets and sequences, Parseval's identity, seperable Hilbert spaces. Representation of functionals on Hilbert spaces, Riesz representation theorem for bounded linear functionals on a Hilbert space, sesquilinear form, Riesz representation theorem for bounded sesquilinear forms on a Hilbert space Hilbert adjoint operator, its existence and uniqueness, properties of Hilbert adjoint operators, self adjoint, unitary, normal, positive and projection operators.

Recommended books:

1. G.F. Simmons : Introduction to Topology and Modern Analysis, Mcgraw Hill Book Co., New York, 1963.
2. C. Goffman and G.Pedrick : First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
3. G. Bachman and L.Narici, Functional Analysis, Academic Press, 1966.
4. L.A. Lustenik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.
5. J.B. Conway : A Course in Functional Analysis, Springer-Verlag, 1990.
6. P.K. Jain, O.P. Ahuja and Khalil Ahmad : Functional Analysis, New Age International (P) Ltd. And Wiley Eastern Ltd., New Delhi, 1987.
7. E.Kreyszig : Introductory Functional Analysis with Applications, John Wiley and Sons, New York, 1978.

MTH 514Differential Geometry

Unit-I

Curves with Torsion :Tangent, Principal normal, Curvature, Binormal. Torsion. Serret-Frenet formulae, Locus of centre of curvature, Spherical curvature, Locus of centre of spherical curvature., Involutes, Evolutes.

Unit-II

ENVELOPES. DEVELOPABLE SURFACES: One-parameter family of surfaces, Envelope. Characteristics, Edge of regression, Developable surfaces. Developables associated with a curve, Osculating developable, Polar developable, Rectifying developable, two-parameter family of surfaces: Envelope. Characteristic points ,Envelopes, Edge of regression, Ruled surface, Developable surface, Monge's theorem, conjugate directions.

Unit -III

CURVILINEAR COORDINATES ON A SURFACE. FUNDAMENTAL MAGNITUDES Curvilinear coordinates,First order magnitudes,Directions on a surface,The normalSecond order magnitudes,Derivatives of n ,Curvature of normal section. Meunier's theorem.

Unit -IV

Principal directions and curvatures, First and second curvatures, Euler's theorem, Dupin'sindicatrix, The surface $z = f(x,y)$,Surface of revolution.

Unit- V

Conjugate system: Conjugate directions, Conjugate system Asymptotic lines, asymptotic lines,Curvature and torsion, Isometric lines: Isometric parameters. Null lines, or minimal curves. Geodesic Property, Equations of geodesics, Surface of revolution, Torsion of a geodesic.

Text Books :

1. Introduction to Differential Geometry: Abraham Goetz; Addison Wesley Pub. Company.
2. Differential Geometry: Nirmala Prakash; McGraw-Hill
3. Elementary Differential Geometry: B.O. Neill; Academic Press.
4. A course in tensors with Application to Riemannian Geometry: R.S. Mishra
5. An introduction to Differential Geometry: T.J. Willmore
6. Introduction to Riemannian Geometry and Tensor Calculus: Weatherburn

MTH 516 Fluid Dynamics

Unit- I

Concept of fluid and its physical properties, Continuum hypothesis, Kinematics of fluids-Methods of describing fluid motion, Langrangian and Eulerian description,Translation, Rotation and deformation of fluid elements, Stream Lines, Path lines and Streak lines, concepts of Vorticity.

Unit -II

General theory of stress and rate of strain in a real fluid –Symmetry of stress tensor, Principal axes and Principle values of stress tensor, Constitutive equation for Newtonian fluid. Conservation laws- Conservation of mass, Conservation of momentum, Conservation of energy.

Unit- III

One and two dimensional inviscid incompressible flow-Equation of continuity and motion using stream tube, , Circulation, Velocity potential, Irrotational flow, Some theorems about

rotational and irrotational flows – Stoke's theorem, Kelvin's minimum energy theorem, Gauss theorem, Kelvin's circulation theorem.

Unit- IV

Vortex motion and its elementary properties, Integration of equations of motion - Bernoulli's equation, Stream function in two dimensional motion, Complex potential functions, Velocity potential, flow past a circular cylinder, Blasius theorem, Milne's circle theorem, Sources, Sinks and Doublets. Dynamical similarity, Buckingham's pie theorem, Non-dimensional numbers and their physical significance

Unit- V

Incompressible viscous fluid flows- Plane couette flow, Plane poiseuille flow, Generalized plane couette flow, Steady flow of two immiscible fluids between two rigid parallel plates, Steady flow through tube of uniform circular cross section, Steady flow through concentric circular cylinders under constant pressure gradient.

Text Books:

1. S. W. Yuan, FOUNDATIONS OF FLUID MECHANICS Prentice Hall of India Private Limited, New-Delhi,1976.

2. R. K. Rathy, AN INTRODUCTION OF FLUID DYNAMICS. Oxford and IBH Publishing company, New Delhi, 1976.

3.G. K. Betchelor, AN INTRODUCTION OF FLUID MECHANICS, Oxford University Books, New Delhi, 1994.

4. F. Charlton, TEXT BOOK OF FLUID DYNAMICS, C.B.S. Publishers, Delhi. 1985.

MTH 518 Advanced Discrete Mathematics

Unit-I

Sets, Algebra of sets, Representation of relations on finite sets, mappings, Countability of sets, Partially ordered sets, Hasse diagram, Isomorphism, ordered sets, Principle of Mathematical induction, Formal logic statements, Symbolic representations and Tautologies, Quantifiers, proposition logic.

Unit-II

Lattices- Lattices as partially ordered sets, their properties, Lattices as algebraic systems, some special lattices e.g. complete, complemented and distributive lattices

Unit-III

Boolean Algebra – Boolean Algebra as lattices, various Boolean identities, the switching algebra e.g. Toin-Irreducible elements, Atoms and Minterms, Boolean forms and their equivalence, Mintern Boolean forms, Sum of products canonical forms, minimization of boolean functions. Application of Boolean algebra to switching theory (using AND, OR and NOT gates)

Unit-IV

Graph Theory- Definition of Graphs, Paths, Circuits, cycles and subgraphs, induced subgraphs, degree of a vertex connectivity, Planar graphs and their properties, Trees, Euler‘s formula for connected planar graph, Complete and complete bipartite graphs, Spanning trees, Minimal spanning trees, Matrix representation of graphs, Euler‘s theorem on existence of Eulerian paths andcircuits, Directed graphs, Indegree and Outdegree of a vertex, weighted undirected graphs, Strong connectivity and Warshall‘s algorithm, Directed trees, Search trees, Tree traversals.

Unit-V

Numeric function, Operation on numeric functions, Convolution of two numeric functions, Generating functions, recurrence relations, Explicit formula for a sequence, solution of recurrence relations, homogenous recurrence relations with constant coefficients, particular solution of difference equation, recursive functions solution of a recurrence relations by the method of generating function.

Text Books:

1. Babu Ram, Discrete Mathematics, Vinayak Publishers and Distributors, Delhi, 2004.
2. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
3. J.L. Gersting, Mathematical Structures for Computer

Elective -II

MTH 520A Integral equation and calculus of variation

Unit-1

Definition of integral equation and their classification .Conversion of ordinary differential equation into integral equation.Eigenvalues and Eigenfunction.canvoluation integral Fredholm integral equation of the second time with separable kernels and their reduction to a system of algebraic equation. Fredholm alternative. Fredholmtheorem.Fredholm alternative theorem and approximate method .

Unit- II

Method of succesiveapproximation . Iterative scheme for Fredholm integration of second kind Neumann series iterative kernals ,resolventkernals iterative scheme for voltera integral equation of the second kind . Condition of uniform convergence and uniqueness of series solution

Unit-III

Classical Fredholmtheory .Fredholm’s first second and third theorems. Application integral equation to ordinary differential equation .integral value problem transform to voltera integral equation boundary value problem equivalent to Fredholm integral equation. Schmidt’s solution non homogeneous Fredholm integral equation of the second time solution of the Fredholm integral equation of their first kind with symmetric kernal. Integral transform method, dirac delta function

Unit- IV

Construction of Green’s Function for a B.V.P associated with homogeneous with a non homogeneous ordinary differential equation of second order with homogeneous boundary condition by using the method of variation of parameters. Basic four properties of the green’s function alternative procedure for construction of a Green’s function by using its basic four properties . Green’s function approach for are IVP for second order equation Green’s function for higher order differential equation modified Green’s function .

Unit- V

Variation of a functional , Euler Lagrange equation necessary and sufficient condtion for extrema . variation methods for boundary value problem in ordinary in parcel differential equation, Ritz method .

Text Books:

(1) M.Gelfand and S.V Fomin, calculus of variation prentice Hall Inc-2000.

(2) M.L Krasnov problems and Exercise in integral equations, mr,publicationmoslow 1997.

(3) D Logan Applied mathematics; A contemporary approach, john wiley and sons newyork 1997.

(4) Kanwal R.P linear integral equation theory & technique, Academic press 1997.

(5) Kress.R Linear integral equation springer-verlay newyork,1989.

(6) Smirnov V.I intergral equation and partial differential equation Adellson-Wesley 1964.

MTH 520B Algebraic Coding Theory

Unit -I

The communication channel.The Coding Problem.Types of Codes. Block Codes. Error-Detecting and Error-Correcting Codes.Linear Codes.Hamming Metric. Description of Linear Block Codes by Matrices. Dual Codes.

Unit -II

Hamming Codes, Golay Codes, perfect and quasi-perfect codes. Modular Representation.Error-Correction Capabilities of Linear Codes.Tree Codes. Description of Linear Tree

Unit -III

Bounds on Minimum Distance for Block Codes.Plotkin Bound. Hamming Sphere Packing Bound. Varshamov-Gilbert – Sacks Bound. Bounds for Burst- Error Detecting and Correcting Codes.

Unit -IV

Convolutional Codes and Convolutional Codes by Matrices. Standard Array.Bounds on minimum distance for Convolutional Codes. V.G.S. bound.

Unit-V

Bounds for Burst-Error Detecting and Correcting Convolutional Codes. The Lee metric, packing bound for Hamming code w.r.t. Lee metric.

Books Recommended

1. Ryamond Hill, A First Course in Coding Theory, Oxford University Press, 1986.
2. Man Young Rhee, Error Correcting Coding Theory, McGraw Hill Inc., 1989.
3. W.W. Petersonand E.J. Weldon, Jr., Error-Correcting Codes.M.I.T. Press, Cambridge Massachuetts, 1972.
4. E.R. Berlekamp, Algebraic Coding Theory, McGraw Hill Inc., 1968.
5. F.J. Macwilliams and N.J.A. Sloane, Theory of Error Correcting Codes, North-Holand Publishing Company.
6. J.H. Van Lint, Introduction to Coding Theory, Graduate Texts in Mathematics, 86, Springer, 1998.
7. L.R. Vermani, Elements of Algebraic Coding Theory, Chapman and Hall, 1996.

MTH 520C Wavelets and its Applications

Unit- I

Definition and Examples of Linear Spaces, Bases and Frames, Normed Spaces, The Lp - Spaces, Definition and Examples of Inner Product Spaces, Hilbert Spaces, Orthogonal and Orthonormal Systems.

Unit - II

Trigonometric Systems, Trigonometric Fourier Series, Convergence of Fourier Series, Generalized Fourier Series.

Fourier Transforms in L1 (R) and L2 (R), Basic Properties of Fourier Transforms, Convolution, Plancherel Formula, Poission Summation Formula, Sampling Theorem and Gibbs Phenomenon.

Unit - III

Definition and Examples of Gabor Transforms, Basic Properties of Gabor Transforms. Definition and Examples of Zak Transforms, Basic Properties of Zak Transforms, Balian- Low Theorem.

Unit- IV

Wavelet Transform, Continuous Wavelet Transforms, Basic Properties of Wavelet Transforms.

Unit- V

Discrete Wavelet Transforms, Partial Discrete Wavelet Transforms, Maximal Overlap Discrete Wavelet Transforms.

Text Books

1. K. Ahmad and F. A. Shah, Introduction to Wavelet Analysis with Applications, Anamaya Publishers, 2008.
2. Eugenio Hernandez and Guido Weiss, A first Course on Wavelets, CRC Press, New York, 1996.
3. C.K. Chui, An Introduction to Wavelets, Academic Press, 1992.
4. I. Daubechies, Ten Lectures on Wavelets, CBS-NSF Regional Conferences in Applied Mathematics, 61, SIAM, 1992.

MTH 520D s

Unit I

Sensitivity Analysis & Integer Linear Programming:

Introduction of Sensitivity Analysis, Change in Objective function coefficient, Change in availability of resources, Addition of new variable and new constraint.

Introduction to Integer Linear Programming, Gomory's all integer cutting plane method, Gomory's mixed-integer cutting plane method, Branch and bound method, Application of Zero-One integer Programming.

Unit II

Dynamic Programming:

Bellman's Principle of optimality of Dynamic Programming, Multistage decision problem and its solution by Dynamic Programming with finite number of stages, Solution of linear programming problems as a Dynamic Programming problem

Unit III

CPM and PERT:

Common errors in network drawing, Rules for network construction, Fulkerson's Rule, Float and Network diagram, PERT computation, Critical Path Analysis, Estimation of Project Completion Time, Project crashing.

Unit IV

Decision Theory & Decision Trees:
Decision making Environments, Decision making under uncertainty, decision making under conditions of risk, expected value criterion for continuously distributed random variables, Decision Trees: Steps, displaying alternatives, Bayesian approach in decision making, advantages and limitations of decision tree approach.

Unit V

Queuing Models :
Introduction of Basic Concepts in Stochastic Processes. Markov Chain and Markov Processes. Queuing Systems. Probability Distribution of Arrival and Service Times. Markovian Queuing Systems: M/M/1, M/M/C, Finite Source queues. Erlangian Queueing Systems: M/Ek/l and Ek/M/1. Bulk Queuing Systems. Basic Idea of Priority Systems. Imbedded Markov Chain Models: M/G/1, G/M/1, M/D/C.

Text Books

1. Hamdy A. Taha, *Operations Research, An Introduction* (8th edition), Prentice-Hall India, 2006.

2. F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research* (8th Edition), Tata McGraw Hill, Singapore, 2004.
3. A. Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, 2005.
4. P K. Gupta and D.S. Hira, Operations Research. S. Chand & Co, New Delhi.

5. T. L. Satty: Elements of Queueing Theory with Applications, Dover, NY, 1983.

6. R.B. Cooper: Introduction to Queueing Theory, 2nd Edition, North Holland, 1981.
7. G. Hadley: Nonlinear and Dynamic Programming, Addison-Wesley, 1964
8. Antoniou, Wu-Sheng Lu: Practical Optimization-Algorithms and Engineering Applications, Springer, 2007.

MTH 520E Information Theory

Unit-I

Measure of Information – Axioms for a measure of uncertainty. The Shannon entropy and its properties. Joint and conditional entropies. Transformation and its properties. Axiomatic characterization of the Shannon entropy due to Shannon andFadeev.

Unit-II

Noiseless coding - Ingredients of noiseless coding problem. Uniquely decipherable codes. Necessary and sufficient condition for the existence of instantaneous codes. Construction of optimal codes.

Unit-III

Discrete Memoryless Channel - Classification of channels. Information

processed by a channel. Calculation of channel capacity.Decoding schemes.
The ideal observer.

Unit-IV

The fundamental theorem of Information Theory and its
strong and weak converses.Continuous Channels - The time-discrete Gaussian channel.
Uncertainty of anabsolutely continuous random variable.

Unit- V

The converse to the coding theorem fortime-discrete Gaussian channel. The
time-continuous Gaussian channel. Bandlimited channels.

Text Books

1. R. Ash, Information Theory, Interscience Publishers, New York, 1965.
2. F.M. Reza, An Introduction to Information Theory, MacGraw-Hill Book
Company Inc., 1961.
3. J. Aczeladn Z. Daroczy, On Measures of Information and their
Characterizations, Academic Press, New York.