Course Structure and Syllabus
For
Two Year M.Sc. Programme in Mathematics

First Semester

Course Code	Title of the Course	Core/Elective	L-T-P	Internal	External Exam	Total Marks
AM- 101	Linear Algebra	C	3-1-0	30	70	100
AM-102	Real Analysis	C	3-1-0	30	70	100
AM-103	Ordinary Differential Equations	C	3-1-0	30	70	100
AM-104	Complex Analysis	C	3-1-0	30	70	100
AM-105	Programming in Python	C	3-0-2	30	70	100

Second Semester

Course Code	Title of the Course	Core/Elective	L-T-P	Internal	External Exam	Total Marks
AM- 201	Abstract Algebra	C	3-1-0	30	70	100
AM-202	Numerical Method	C	3-1-0	30	70	100
AM-203	Partial Differential Equations	C	3-1-0	30	70	100
AM-204	Integral Transforms	C	3-1-0	30	70	100
AM-205	Probability and Statistics	C	3-1-0	30	70	100

Third Semester

Course Code	Title of the Course	Core/Elective	L-T-P	Internal	External Exam	Total Marks
AM- 301	Discrete Mathematics	C	3-1-0	30	70	100
AM-302	Number Theory	C	3-1-0	30	70	100
AM-303	Topology	C	3-1-0	30	70	100
AM-304	Integral Equation and Calculus of Variation	C	3-1-0	30	70	100
AM-305(A)	Elective -I	E	3-1-0	30	70	100

Fourth Semester

Course Code	Title of the Course	Core/Elective	L-T-P	Internal	External Exam	Total Marks
AM- 401	Fluid dynamics	C	3-1-0	30	70	100
AM-402	Cryptography	C	3-1-0	30	70	100
AM-403	Operations Research	C	3-1-0	30	70	100
AM-404	Elective -II	E	3-1-0	30	70	100
AM-405	Project and Seminar	C	4-0-0	30	70	100

AM 101 Linear Algebra

Unit -I: Vector space, Direct sum,linear transformation, Range & null space of linear transformation, Matrix representation of linear transformation, Inverse linear transformation,

Change of basis matrix.
Unit-II: Eigen values and Eigen vectors, Cayley-Hamilton Theorem, Diagonalization, Geometric and algebraic multiplicity, minimal & characteristic polynomial of Block matrices.
Unit III: Inner products, Cauchy-Schwartz Inequality, orthogonality, orthonormal sets, projections, Gram-Schmidt orthogonalization, Bessel's inequality.
Unit-IV:Linear functional, and Dual space , Dual basis, Annihilators, transpose of linear mapping,Bilinear form, matrices of bilinear form, alternating bilinear form, diagonalization algorithm, Symmetric bilinear form, Law of Inertia, positive definite, orthogonal projections,

Text and Reference Books:

1. Linda Gilbert and Jimmie Gilbert, Elements of Modern Algebra, Seventh edition, Cengage Learning.
2. Herstein,I.N, Topics in Algebra, 7^{th} edition, John Wiley & Sons,2004
3. Hoffman,K and Kunze,R, Linear Algebra, Pearson Education (Asia)Pvt.Ltd/Prentice Hall of India 2004
4.Leon, S.J, Linear Algebra with Applications, 8^{th} Edition, Pearson 2009.

AM- 102 Real Analysis

Unit -I
Elementary set theory, Countable and Uncountable sets, Real number system and its order completeness, Dedekind's theory of real numbers, Construction of real field from the field of rational numbers,
Unit -II
Definition and existence of Riemann-Stieltjes integral, Properties of the integral integration and differentiation, Fundamental theorem of integral calculus, Riemann- Stieljes integration, integration of vector valued functions, Rectifiable curves,.
Unit -III
Sequences and series of functions, Point wise and uniform convergence of sequences of functions, Equicontinuity, Weierstrass approximation theorem, Power Series, Uniqueness theorem for power series, Abel's theorems. Arzelà-Ascoli Theorem, Dini's Theorem, Stone-Weierstrass Theorems.
Unit -IV
Functions of several variables, Euclidian spaces, concept of functional of several variables, Linear transformations, continuous functions, Derivatives in an open subset of R^n , Chain rule, Partial derivatives, Interchange of the order differentiation, Inverse function theorem, Implicit Function theorem, Derivatives of higher order.

Text and Reference Books:

1. GF Simmons: Introduction to Topology and Modern Analysis, Mc Graw Hill, 1963.

2. JL Kelly: Topology, Von Nostrand Reinhold Co. New York, 1995
3. Real Analysis by H.L. Royden
4. Measure Theory and Integration, by G.de Barra

AM – 103 Ordinary Differential Equations

Unit I

Existence and uniqueness of solution; Continuity and differentiability of solution w.r.t. initial condition and parameters; General theory of linear deferential equations; Methods of solving non homogeneous linear equations; Cauchy Euler equation; Linear equations with periodic co efficient; System of linear deferential equations; Stability theory for system of linear deferential equations.

Unit II

System of first order equation: Nonlinear system, Volterra's prey & predator equation, Non Linear equation: Autonomous system. The phase plane & its phenomena, types of critical points & stability. Critical points & stability for linear system, stability by Liapunov's direct method simple critical points of non linear system & non linear mechanics. Conservative system, Periodic solution, Poincare – Bendixson Theorem.

Unit III

Eigen Value Problem, Orthogonality of Eigen Function, Eigen function expansion in series of orthonormal function , Matrix method for linear system of homogenous and non homogenous equation .

Unit IV

Second order differential equation Introduction, Preliminary results, Boundedness of solution, Oscillatory equation, number of zeroes, Pruffer's transformation, Strum Liouville boundary value problems Oscillation theory, Green's function.

Text and Reference Books :

1. E. A. Coddington and N. Levinson: Theory of Ordinary Differential Equations, McGraw Hill, 1955.
2. S. L. Ross: Differential Equations, John Wiley sons, New York.
3. Shair Ahmad and M.R.M Rao: Theory of ordinary differential equations. Affiliated East-West Press Private Ltd. New Delhi, 1999.
4. G.F. Simmons: Differential Equations, McGraw Hill, 1991.
5. E. D. Renville and P. E. Bedient: Elementary Differential Equations, McGraw Hill, 1969.

AM – 104 Complex Analysis

Unit -I

Analytic Function, Cauchy- Riemann Equation, harmonic conjugates, Power series, Radius of Convergence of Power series, Power series representation of an analytic function, Cauchy hadamard's theorem.

Unit -II
Elementary function: Branch Point, Branch cut, branch of multivalued function, Analyticity of branches of Log z, z^a, Mobius transforms, Conformal mapping, Cauchy's theorem, Cauchy integral formula, Morera's theorem, Open mapping theorem, Cauchy's inequality, Liouville's theorem and applications, Taylor's and Laurent's series, Maximum modulus principle and Schwarz's Lemma.
Unit -III
Singularity: zeroes of an analytic function, Singular point, different types of singularities, limiting point of zeroes and poles, Weierstrass theorem.
Unit -IV
Calculus of Residue's: Residue at pole, Residue at infinity, Cauchy's residue theorem, Jordan's lemma, Evaluation of real definite integral, evaluation of improper integral, Meromorphic function, Argument principle and Rouche's theorem.

Text and Reference Books:
1.J.B. Conway : Functional of one complex variable, Narosa, 1987.
2. L. V. Ahlfors : Complex analysis, McGraw Hil, 1986
3.Churchill,J. W. and Brown, R.V., " Complex Analysis", McGraw Hill. 2009

AM -105 PYTHON PROGRAMMING

Unit I: Introduction:TheProgrammingCycle forPython,PythonIDE,InteractingwithPythonPrograms,Elements ofPython,TypeConversion.Expressions,AssignmentStatement,ArithmeticOperators,OperatorPrecedence,BooleanExpression.
Unit II: Conditionals**:**ConditionalstatementinPython(if-elsestatement,itsworkingandexecution),Nested-ifstatement andElifstatement inPython,ExpressionEvaluation&FloatRepresentation.Loops:Purposeandworkingofloops,Whileloopincludingitsworking,ForLoop,NestedLoops,Breakand Continue.
Unit III:
Function:PartsofAFunction,ExecutionofAFunction,KeywordandDefaultArguments,ScopeRules.
Strings:LengthofthestringandperformConcatenationandRepeatoperationsinit.IndexingandSlicing ofStrings.
PythonDataStructure:Tuples,UnpackingSequences,Lists,MutableSequences,ListComprehension, Sets, Dictionaries
HigherOrderFunctions:Treat functionsasfirst classObjects,LambdaExpressions
UnitIV: SieveofEratosthenes:generateprimenumberswiththehelpofanalgorithmgivenbytheGreek MathematiciannamedEratosthenes, whosealgorithmisknownas SieveofEratosthenes.
FileI/O:FileinputandoutputoperationsinPythonProgramming
ExceptionsandAssertions
Modules:Introduction, ImportingModules
AbstractDataTypes:AbstractdatatypesandADT interfaceinPythonProgramming.
Classes:Classdefinitionandotheroperationsintheclasses,SpecialMethods(suchas_init_,_str_,comparisonmethodsandArithmeticmethodsetc.),ClassExample,Inheritance,InheritanceandO**OP.**

Unit V: Iterators& Recursion:Recursive Fibonacci,TowerofHanoi
Search:SimpleSearchandEstimatingSearchTime,BinarySearchandEstimatingBinarySearchTime
Sorting&Merging:Selection Sort,MergeList ,Merge Sort ,HigherOrder Sor
Text and Referencebooks:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3,Shroff/O'ReillyPublishers,2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, NetworkTheoryLtd., 2011.
3. JohnV Guttag—IntroductiontoComputationandProgrammingUsingPython",RevisedandexpandedEdition,MITPress, 2013
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinaryApproach,PearsonIndia Education Services Pvt. Ltd.,2016.Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,,

AM – 201 ABSTRACT ALGEBRA

Unit -I

Groups, Normal and subnormal series, Composition series, Jordan- Holder theorem, Solvable groups, Nilpotent groups, P- Sylow subgroup, Cauchy's theorem , Conjugacy relation, Class equation, Direct product, Sylow's theorems, structure theorem for finite abelian groups.

Unit -II

Integral domain, Imbedding theorem, prime and maximal ideals, Quotient rings, Euclidean rings, Polynomial rings, Gaussian ring, Unique factorization theorem.

Unit -III

Field extension, algebraic and transcendental extensions, separable and inseparable extensions, Normal extensions, perfect field, Finite field, Primitive elements, Algebraically closed fields, Automorphisms of extensions, Galois extensions, fundamental theorem of Galois theory; solvability by radicals.

Unit –IV

Canonical Forms: Similarity of linear transformations, Invariant subspaces, Reduction to triangular forms, Nilpotent transformations, The primary decomposition theorem, Jordan blocks and Jordan forms

Text and reference Books :

1. Serge Lang: Algebra, Addison Wesley
2. V.Sahai & V.Bist: Algebra, Second edition, Narosa.
3. I.N. Herstain, Topic in Algebra, Wiley Eastern limited, New delhi 1975

AM – 202 Numerical Methods

Unit I: Roots of transcendental equations and polynomial equations, Bisection method, Iteration based on first degree equations, Regula-Falsimethods, Rate of convergence, Generalized Newton- Raphson method.

Unit II: System of linear equation: Direct method-: Gauss Elimination method, Triangularization

method, Iterative methods-: Jacobi's method, Gauss-Seidel method, SOR method, Givens power method for eigen value and eigen vectors.

Unit III: Interpolation and Approximation: Lagrange's and Newtons divided difference, Finite difference operators, Hermite interpolation, piecewise & cubic spline interpolation, Least square approximation, Min-Max polynomial approximation method, Chebyshev polynomial, Lanczos economization.

Unit IV: Newton cotes methods, Method based on Undetermined coefficients, Gauss Legendre integration method.

UnitV: Numerical Methods for ODE: Single step method- Euler's method, Taylor series method, Runge- Kutta method of 2^{nd} and 4^{th} order, Numerical methods for BVP, Multistep method- :predictor -corrector method, Adams Bashforth method, Adams Moulton method, Milne method, convergence and stability.

Text and Reference Books:

1.Gerald, C.F and Wheatly, P.O," Applied Numerical Analysis", 6^{th} edition,Wesley,2002
2. Jain,M.K, Iyengar, S.R.K and Jain,R.K, "Numerical methods for Scientific and Engineering computation", New Age Pvt.Pub,New-Delhi,2000
3. Introduction to Numerical Analysis by S.S Sastry, Prentice Hall,Flied
4.Krishnamurthy, E.V & Sen, S.K ,"Applied Numerical analysis, East West Publication

AM – 203 Partial Differential Equation

Unit I

Introduction, basic concept and definition, classification of second order linear equation and method of characteristics, canonical form, Equations with constant coefficients, Supper position principle. Method of separation of variables.

Unit II

Boundary Value Problems, Maximum and Minimum Principles, Uniqueness and Stability theorem, Dirichlet problem for a Circle, Dirichlet Problem for a Circular annulus, Neumann problem for a Circle, Dirichlet problem for a Rectangular, Dirichlet problem involving Poisson equation.

Unit III

The Cauchy problem: The Cauchy problem, Cauchy-Kowalewsky Theorem, Hadmard example, Cauchy problem for homogeneous wave equations, Initial value problem, The Cauchy problem for Non-homogenous wave equation., The vibration string problem, Existence and uniqueness solution of the vibrating problem.

Unit IV

Fourier transform and Initial boundary value problems. Properties of Fourier Transform, Convolution (Fourier Transform), Step and impulse Function Fourier Transform, Semi infinite region, Green's functions and boundary value problem

Text and Reference Books:

1 L. C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Vol. 19, AMS, 1999.
2. Jurgen Jost, Partial Differential Equations: Graduate Text in Mathematics, Springer Verlag Heidelberg, 1998.

3. Robert C Mcowen, Partial Differential Equations: Methods and Applications, Pearson Education Inc. 2003.
4. Fritz John, Partial Differential Equations, Springer-Verlag, 1986.
5. I.N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, 1988.

AM – 204 Integral Transforms

Unit I

Laplace Transform: Existence of Laplace Transform, Function of exponential order, a function of Class A, Laplace Transform of some elementary function, First and Second translation, change of scale property, Laplace transform of the derivative, Laplace transform of Integral, Multiplication, Division , Periodic function.

Unit II

Inverse Laplace Transform: Null Function, Lerch's Theorem, first and second Translation, Change of scale, Derivatives, Integrals, Multiplication, Division, Convolution Theorem, Heviside's expansion, The complex inversion formula.

Applications: Solution of Ordinary Differential equations. Solution of Simultaneous Ordinary differential equations, Solution of Partial differential equation, Application to Electric circuits, Mechanics. Integral equations, Initial and Boundary value problem

Unit III

Fourier Integral theorem, Fourier Transform, Convolution, Relation between Fourier and Laplace Transform, Parseval's Indentity for Fourier Transform, Relationship between Fourier and Laplace Transforms, Fourier Transform of derivative of function, Finite Fourier Transform, Application of Fourier transform in Initial and Boundary value problems.

Unit IV

Hankel Transfrom, Inversion formula for the Hankel Transform, Some important results for Bessel function, Hankel Transform of derivative of Function, Parsevals Theorem, Finite Hankel Transform, Application of Hankel Transform in initial and Boundary value Problems.

Unit V

Mellin Transform, The Mellin inversion Theorem, Linear property, some elementary properties,, Mellin transform of derivative, Mellin transform of Integral, convolution Theorem.

Text and Reference Books:

1. Ian N Senddon: The Use of Integral Transform, McGraw Hill, 1972.
2. L. Dobanth and D. Bhatta: Integral Transforms and Their Applications, 2nd edition, Taylor and Francis Group.
3. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons 2011

AM – 205 PROBABILITY AND STATISTICS

UNIT I

Probability: Axiomatic definition, Properties. Conditional probability, Bayes rule and independence of events, Random variables, Distribution function, Probability mass and density functions, Expectation, Moments, Moment generating function.

UNIT II

Probability distributions: Binomial, Geometric, Negative -Binomial, Poisson, Uniform, Exponential, Gamma, Normal distributions, Moments Independence of random variables, Covariance, Correlation, Functions of random variables.

UNIT III

Statistics: Population, Sample, Parameters. Method of moment, Unbiasedness, Confidence interval, estimation for mean, difference of means, variance, proportions, Sample size problem,

UNIT IV

Test of Hypotheses: Tests for means, variance, two sample problems, Test for proportions, Relation between confidence intervals and tests of hypotheses, Chi-square goodness of fit tests, Contingency tables.

Text and Reference Books:

1. S.C. Gupta and V.K. Kapoor: "Fundamentals of Mathematical Statistics" Sultan Chand & Sons New Delhi.
2. V. K. Rohatgi and A. K. Md. Ehsanes Saleh: An Introduction to Probability and Statistics", John Wiley and Sons, 2nd edition.2000.
3. R. V. Hogg and A. Craig: Introduction to Mathematical Statistics, Pearson Education, 6th Edition, 2005.

AM – 301 Discrete Mathematics

Unit I: Logic: Introduction to logic, Rules of Inference, Validity of arguments, Normal forms, Direct and Indirect proofs, Proof by contradiction.

Unit II: Recurrence relations with examples of Fibonacci numbers, the tower of Hanoi problem, Difference equation, Generating function, solution of recurrence relation using generating functions.

Unit III: Definition and types of relations, representing relations using digraphs and matrices, closure of relations, paths in diagraph,Transitive closure using Warshall's algorithm, Posets, Hasse diagram, Lattices.

Unit IV: Boolean algebra and Boolean functions, different representations of Boolean function, application to synthesis of circuits, circuit minimization and simplification, Karnaugh map.

UnitV: Automata theory, Finite state automaton, Types of automaton, Deterministic finite state automaton, Non-deterministic finite state automaton, Non-deterministic finite state automaton with □, Equivalence of NFA and DFA, Equivalence of NFA and NFA-□, Equivalence of NFA-□ and DFA, Finite state machines :Moore and Mealy machine and their conversion, Turning machine.

Text and Reference Books:

1.C.L Liu: Elements of Discrete Mathematics, Tata McGraw- Hill,2000
2. Kenneth Rosen, WCB McGraw-Hill, 6th edition,2004
3.J.P Tremblay and R.P Manohar: Discrete Mathematical structureswith Application to Computer science, McGraw-Hill(1975)

AM – 302 Number Theory

Unit I

Introduction to Modular forms : Congruences Residue classes and complete residue system. Linear congruences. Reduced residue system and the Euler-Fermat theorem. Polynomials congruences modulo p, Lagrange's theorem. Simultaneous linear congruences, The Chinese remainder theorem, Application of Chinese remainder theorem, introduction to cryptography.

Unit II

Prime numbers, estimate of prime numbers, primality test, Polynomial congruences with prime power modulli, Fermat's little theorem and pseudoprime, Carmichael numbers, Wilson's theorem, Fermat-Kraitchik factorization method, Euler phi function and use of it in RSA cryptanalysis, Euler's generalization of Fermat's little theorem, modular exponentiation by repeated squaring method.

Unit III

Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, theory of indices, application of primitive roots to cryptography.

UNIT IV

Quadratic residues, Euler's criterion, Legendre's Symbol and its properties Gauss Law, the quadratic reciprocity law, Applications of reciprocity law. The Jacobi symbol and reciprocity law for Jacobi symbols. Applications of reciprocity law to Diophantine equations.

Text and Reference Books:

1. A course in number theory and cryptography, Neal Koblitz, Springer-Verlag.
2. An introduction to the theory of number, Ivan Niven, Zuckerman, Montgomery, willy India edition.
3. Elementary number theory, David M. Burton, , Tata McGraw Hill Edition.
4. Introduction to cryptography, Johannes A. Buchmann, Springer.

AM – 303 Topology

Unit -I

Completeness of a metric space, Cantor's intersection theorem, Dense sets, Bair category theorem, Separable spaces, Continuous function, Extension theorem, Uniform Continuity, Isometry and homeomorphism, equivalent matrics, Compactness, Sequential compactness, Totally bounded spaces, Finite intersection property, Continuous function and compact sets.

Unit –II

Axiom of choice, Zermelo's postulate, Zorn's lemma, Well ordering theorem, Cardinal number and its arithmetic, Schroeder- Bernstein theorem, Cantor's theorem and the continuous hypothesis

Unit –III

Topological spaces: Definitions and Examples, Basis and Sub basis for a Topology, limit points, closure, interior; Continuous functions, Homeomorphisms; Subspace Topology, Metric Topology, Product & Box Topology, Order Topology; Quotient spaces

Unit –IV

Characteristics of Topology in terms of Kuratowski closures operator and fundamental system in neighborhood, continuous map and homomorphism, first and second countable space, Lindeloff theorem , separable spaces, second countability and separability, Separation axioms, T_0, T_1, T_2,

T_3, and T_4 spaces their characterization and basic property.

Text and Reference Books:

1. James R Munkres: Topology, A first course, Prentice Hall, New Delhi, 2000
2. GF Simmons: Introduction to Topology and Modern Analysis, Mc Graw Hill, 1963.
3. JL Kelly: Topology, Van Nostrand Reinhold Co. New York, 1995.

AM – 304 Integral Equations and Calculus of Variation

Unit -I

Integral equation: Basic concept, solution of integral equation, conversion of differential equation to integral equation, Intial value problem and boundary value problem, solution of Fredlholm's integral equation, symmetric kernel, Hilbert's-Schmidt theory, Risz – Fischer theorem.

Unit -II

Solution of Fredhlom integral equation of second kind by successive substitution and successive approximation, Solution of Voltera integral equation of second kind by successive substitution and successive approximation, Reduction of Voltera integral equation into differential equation, reduction of Voltera integral equation of first kind to a Voltera integral equation of second kind, classical Fredhlom theory.

Unit -III

Variational problems with fixed boundary: Eulear's equation, the Brachistochorn problem, functional, Euler's poission eqution, Isoperimetric problem, variational problem with moving boundary: transversality condition, variational problem with moving boundary with implicit from, one sided variation.

Unit -IV

Sufficient condition for an extremum: Jacobi condition, legendre condition, Lagrenges equation from hamilton's principle, direct method in variational problem: Ritz method, Galerkin's method, Collocation method and least square method.

Text and Reference Books:

1.Gupta A.S., "Calculas of Variations with Applications " Prentice hall of India.
2. Elsgolts L., Differential equations and calculus of variations", MIR publisher, 1980

ELECTIVE(I) Course Options
AM – 305 (A) MATHEMATICAL STATISTICS

Unit I

SAMPLING DISTRIBUTIONS AND ESTIMATION THEORY: Sampling distributions Characteristics of good estimators Method of Moments, Maximum Likelihood Estimation Interval estimates for mean variance and proportions.

Unit II

TESTING OF HYPOTHESIS: Type I and Type II errors Tests based on Normal, t, Chi-square and F distributions for testing of mean, varianceand proportions-Tests for Independence of attributes and Goodness of fit.

Unit III

CORRELATION AND REGRESSION: Method of Least Squares - Linear Regression - Normal Regression Analysis Normal Correlation AnalysisPartial and Multiple Correlation - Multiple Linear Regression.

Unit IV

DESIGN OF EXPERIMENTS: Analysis of Variance - One-way and two-way Classifications - Completely Randomized Design - Randomized Block Design-Latin Square Design.

Unit V

MULTIVARIATE ANALYSIS: Covariance matrix – Correlation Matrix - Normal density function -Principal components - Sample variation by principal components-Principal components by graphing.

Text and Reference Books:

1. J.E. Freund: Mathematical Statistica: Prentice Hall of India, 5th Edition, 2001.
2. R.A. Johnson and D.W. Wichern: Applied Multivariate Statistical Analysis, Pearson Education Asia, 5th Edition, 2002.
3. S. C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, SultanChand & Sons, 11th Edition, 2003.

AM – 305 (B) Graph Theory

Unit I

Graph and its terminology, Directed and undirected graph, Multi graph, Simple graph, Complete graph, Weighted graph, Planar and non-planar graph, Regular graph, Graph isomorphism and homeomorphism, Euler's formula, Statement and applications of Kuratowski's theorem, Path factorization of a graph, representing graphs in computer system, Coloring of graph.

Unit II

Graph connectivity, Konigsberg bridge problem, Euleria path and Elerian circuit, Hamiltonian path and Hamiltonian circuit, Shortest path, Dijkstra's algorithm, Paths between the vertices, Path matrix, Warshall's algorithm, Cut point, bridge, cut sets and connectivity, Menger's theorem

Unit III Tree and related terminology, spanning tree, Finding minimum spanning tree by Kruskal's algorithm and Prim's algorithm, inorder, preorder, and postorder tree traversals, Binary tree, Expression trees and reverse polish notation (RPN), RPN evaluation by stack.

Unit IV Flow network, Feasible flows, Multiple sources and multiple sinks, Cutsets in flow network, Relation between flows and cuts, Max flow problem, Max flow min-cut therem, Matching, Covering, Application of networks in Operations Research – CPM/PERT.

Text and Reference Books :

1. Graph Theory, Harary, Addison- Wesley 1969
2. Introduction to Graph Theory, D. B. West, Prentice Hall 1996.
3. Graph Theory and Its Applications, Jonathan Gross and Jay Yellan, CRC 1998

AM – 305 (C) MECHANICS

UNIT I

Lagrangian Formulation: Mechanics of a particle, mechanics of a system of particles, constraints, generalized coordinates, generalized velocity, generalized force and potential. D'Alembert's principle and Lagranges equations, some applications of Lagrangian formulation.

UNIT II

Hamilton's principle, derivation of Lagrange's equations from Hamilton's principle, extension of Hamilton's principle to non-holonomicsystems.

UNIT III

Hamiltonian formulation: Legendre transformations and the Hamilton equations of motion, cyclic coordinates and conservation theorems, derivation of Hamilton's equations from a variational principle, the principle of least action, the equation of canonical transformation.

UNIT IV

Poisson and Lagrange brackets and their invariance under canonical transformation. Jacobi's identity; Poisson's Theorem. Equations of motion infinitesimal canonical transformation in the Poisson bracket. Hamilton Jacobi Equations for Hamilton's principal function, the harmonic oscillator problem as an example of the Hamilton-Jacobi method.

Books Recommended:

1. H.Goldstein , Classical mechanics , 2nd edition, Narosa Publishing House.
2. W.Rindler , Relevant topics from Special relativity , Oliver & Boyd, 1960.

AM – 305(D) SPECIAL FUNCTION

Unit I

Infinite products: Definition of infinite product, necessary condition for convergence, the associated series of logarithms, absolute convergence, uniform convergence. The gamma function, The beta function, Legendre's duplication formula, Gauss multiplication formula, summation formula due to Euler, behavior of log gamma z for log mod z. Asymptotic series, Watson's lemma.

Unit II

Hypergeometric function, integral representation, contiguous function relation, hypergeometirc

differential equation, logarithmic solution of the hypergeometric function, elementary series manipulation, simple transformation, generalized hypergeometric function, confluent hypergeometric function.

Unit III

Bessel function: Definition of Bessel function, Bessel differential equation, recurrence relation, generating function, Bessel integral, modified Bessel functions, Neumann polynomial, Neumann series. Legendre Polynomial, Hermite polynomial Jacobi Polynomial : Generating function, differential equation, recurrence relation, Rodrigues formula, Hypergeometric form of Legendre polynomial, special properties, orthogonality, an expansion theorem, expansion of x^{n}.

Unit IV

Elliptic function: Doubly periodic function, Elliptic function, elementary properties, order of an Elliptic function, The Weierstrass function P(z), other Elliptic function, A differential equation for P(z), connection with Elliptic integral. Theta function: Definition, Elementary properties, the basic properties table. Jacobain Elliptic Function: A differential equation, involving Theta function, The function sn(u), The function cn(u) and dn(u), relation involving square and derivatives.

Text and Reference Books:

1. E. D. Rainville: Special function, MacMillan Co., 1971.
2. .L. C. Andrews, Special function of Mathematics for Engineering, SPIE Publications, 1997.

AM – 401 Fluid Dynamics

Unit -I

Introduction to fluid dynamics, Normal and Shearing stress, Different types of flows, Lagrangian and Eulerian method, local and individual time rate of change, vortricity vector, Beltrami flow, stream line and path line, vortricity equation, equation of continuity by Euler's method, equation of continuity in orthogonal curvilinear coordinates, cartisian coordinates and cylindrical coordinates, Euler's equation of motion in general vector form, Bernoulli's equation .

Unit II

Viscous flow: Definition of viscosity, general theory of stress and rate of strain in fluid flow, stress analysis in fluid motion, nature of strain, relation between stress and rate of strain, Navier Stokes equation, dissipation of energy, Reynold's .number, study flow between parallel plates , Laminar flow between parallel plates.

Unit III

Gas dynamics: speed of sound, equation of motion, subsonic, sonic and supersonic flow, isentropic gas flow, Reservoir discharge through a channel of varying cross-section, Shock waves, formation of shock waves, elementary analysis of normal shock waves

Unit IV

Magneto Hydrodynamics: nature of magneto hydro dynamics, Maxwell electromagnetic field equation, equation of motion of conducting fluid, rate of flow of charge, magnetic Reynold's number, Alfven's theorem, Ferraro's law of isorotation.

Text and Reference Books:

1. Bachelor G.K: An introduction to fluid dynamics, Publisher, Cambridge University Press, 2000
2. Hermann Schilichting, Klaus Gersten, Krause E., Jr. Oertel H., Mayes C: "Boundary – Layer

theory" , 8th edition springer 2004
3. Kundu, Pijush K., and Cohen Ira M., fluid mechanics. 3rd ed. Burlington, MA: Elsevier, 2004
.

AM – 402 CRYPTOGRAPHY

Unit -I
Secure communication, cryptographic applications, Symmetric cipher model, Substitution technique: Ceasar cipher, Monoalphabatic cipher, Playfair cipher, Hillcipher, polyalphabatic cipher, one time pad, Transposition techniques, pseudorandom bit generator, linear feedback shift register sequences.
Unit II
Stream cipher and block cipher, simplified DES, Feistel cipher, DES, AES, S-box design, Boolean functions, bent functions, construction of finite fields, modular polynomial arithmetic.
Unit III
Public key cryptosystem, RSA cryptosystem, RAS and factoring, Rabin encryption , Key management, Diffie Hellman key exchange, discrete logarithm, ElGamal encryption, cryptographick hash function, message authentication codes, digital signature.
Unit IV
Factoring: p-1 method, quadratic sieve, discrete logarithm: DL problem, Shanks Babystep Giant step algorithm, Pollard pho algorithm, Pohlig-Hellman algorithm, Elliptic curve cryptography

Text and Reference Books:
1. Introduction to crypogrphy, Johannes A. Buchmann, Springer.
2. Cryptography and network security Principles and practices, William stallings, Pearson education.
3. Handbook of applied cryptography, Alferd J. Menezes, Paul C. Van Oorschot, Scott A. Vanstone, CRC press.
4. Introduction to cryptography and coding theory, Wade Trappe, Lawrance C. Washington

AM – 403 Operations Research

Unit I: Origin of OR and its definition, Phases of OR problem approach, Formulation of Linear Programming problems, Graphical solution of LPP.
Unit II : Solution of LPP by Simplex method, Two phase method, Big-M method, Methods to solve degeneracy in LPP, Revised Simplex Methods and applications.
Unit III: Concept of duality in LPP, Comparison of solutions of Dual and Primal, Dual Simplex method, Sensitivity Analysis, Integer Programming.
Unit IV: Mathematical formulation Of Transportation problem, Tabular representation, Methods to find initial basic feasible solution, Optimality test, Method of finding Optimal solution, Degeneracy in Transportation problem, Unbalanced Transportation problem, Mathematical formulation of Assignment problem, Hungarian Assignment method.

Text and Reference Books:

1. Rao,S.S , Optimization theory and applications, 2nd edition,Willey Eastern Ltd., New-Delhi
2. Hiller,F.S and Liberman, Introduction to Operations Research, 6th Ed. McGraw-Hill, International Edition, Industrial Engg. Series, 1995
3. Taha, H.A, Operations Research:An Introduction, 8th Ed, Prentice Hall Publishers
4.Gupta, P.K,Hira,D.S, Operations Research, S.Chand& Company Pvt. Ltd
5. Sharma, S.D, Operations Research, Kedar Nath Ram Nath and Co. Meerut, 2002

ELECTIVE(II) Course Options

AM – 404(A) Functional Analysis

Unit I

Banach Spaces- the definition and some examples, continuous linear transformations,The Hahn Banach theorem,

Unit II

The natural imbedding of N in N**, the open mapping theorem, the conjugate of an operator.

Unit III

Hilbert spaces- the definition and some simple properties, Orthogonal complements, orthogonal sets, the Conjugate space H*,

Unit IV

The adjoint of an operator, Self adjoint operators, normal and unitary operators,Projections. Finite dimensional spectral theory – Spectrum of an operator, the spectral theorem.

Text and Reference Books:

1. G F Simmons: Introduction to Topology & Modern Analysis (Mc Graw Hill).
2. JL Kelly: Topology, Von Nostrand Reinhold Co. New York, 1995
3. Real Analysis by H.L. Royden

AM – 404 (B) Measure Theory

Unit -I
Outer measures, measures and measurable sets, Lebesgue measure on R, Borel measure
Unit -II
Measurable functions, simple functions, Egoroff's theorem, Lebesgue integral and its properties, monotone convergence theorem, Fatou's Lemma, Dominated convergence theorem various modes of convergence and their relations.
Unit-III
Signed measures, Hahn and Jordan decomposition theorems, Lebesgue-Radon-Nikodym theorem, Lebesgue decomposition theorem, the representation of positive linear functionals on $C_c(X)$
Unit -IV
Product measures, iterated integrals, Fubini's and Tonelli's theorems Lp spaces and their completeness, conjugate space of L_p for $1 < p <$ infinity, conjugate space of L_1 for sigma-finite measure space Differentiation of monotone functions, functions of bounded variation, differentiation of an integral, absolute continuity.

Text and Reference Books:
1.Rudin, Walter. Real and Complex Analysis. McGraw-Hill International Editions: Mathematics Series. McGraw-Hill Education - Europe, 1986.
2.Jones, Frank. Lebesgue Integration on Euclidean Space. Boston: Jones & Bartlett Publishers, February 1, 1993.
3.Evans, Lawrence C., and Ronald F. Gariepy. Measure Theory and Fine Properties of Function. Boca Raton, Florida: CRC Press, December 18, 1991

AM – 404(C) Optimization Techniques

Unit I: Theory of Games: Introduction, Saddle point, Minimax-Maximin criteria for Optimal strategy, Minimax theorem, Solution of Games by LPP, Arithmetic methods, Principle of Dominance, Graphical methods, Matrix methods and Iterative methods.
Unit II: Network Analysis: Basic steps, Network diagram representation, Rules for drawing networks, Forward and Backward pass computations, Determination of critical path, Project evaluation and review techniques updating, Application areas of PERT/CPM techniques.
Unit III: Job Sequencing, Principle Assumption, Solution of Sequencing problem, n-jobs through 3- machines, 2-jobs through m-machines, n-jobs through m-machines.
Unit IV: Introduction function of inventory and its disadvantage, ABC analysis, Concept of inventory costs, Basics of Inventory policy(order, lead times, types), Fixed order-quantity models-EOQ, POQ and Quality discount models. EOQ models for discrete units, Special cases of EOQ models for safety stock with known/ unknown stock out situations.

Text and Reference Books:
1. Beale, E.M.L and Mackley,L: Introduction to Optimization, John Wiley,1988
2. Rao,S.S, Optimization theory and applications, 2nd edition,Willey Eastern Ltd., New-Delhi

3. Hiller,F.S and Liberman, Introduction to Operations Research, 6th Ed. McGraw-Hill, International Edition, Industrial Engg. Series, 1995
4. Gupta, P.K,Hira,D.S, Operations Research, S.Chand & Company Pvt. Ltd

AM – 404(D)Theory of Linear Operators

Unit I:
Spectral theory in normed linear spaces, resolvent set and spectrum, spectral properties of bounded linear operators, properties of resolvent and spectrum, Spectral mapping theorem for polynomials, Spectral radius of bounded linear operator on complex Banach space, Elementary theory of Banach algebras.

Unit II:
Spectral properties of bounded self-adjoint operators on a complex Hilbert space, Positive operators, monotone sequence theorem for bounded self-adjoint operators on a complex Hilbert space, square roots of positive operator, Projection operators, Spectral family of a bounded self-adjoint linear operatorand its properties, Spectral representation of bounded linear operators, Spectral theorem.

Unit III:
Spectral measures, Spectral Integrals, Regular spectral measures, Real and complex Spectral measures, Complex, spectral integrals, Description of Spectral subspaces, Characterization of Spectral subspaces, The spectral theorem for bounded normal Operators.

Unit IV:
linear opetorars in Hilbert space, Hellinger-Toeplitz theorem, Hilbert adjoint operators, Symmetric and self-adjoint linear operators, closed linear operators and closures, Spectrum of self-adjoint linear operator, Spectral theorem for unitary and self-adjoint linear operators, Multiplication operator and Differentiation operator.

Text and Reference Books:
1. P.R halmos , Introduction to Hilbert Spaces and the Theory of Spectral Multiplicity, Second edition, Chelsea Publishing Co,N.Y,1957
2. N Dunford & J.T Schwartz, Linear Operators-3 Parts, Interscience/Wiley, New-York,1958-71
3. N.I Ahhiezer& I.M Glazman, Theory of Linear Operators in Hilbert Space, Frederick Ungar Pub. Co. N.Y., Vol I(1961), Vol II(1963)
4. P. R Halmos, A Hilbert Space Problem Book, D. Van Nostrand Company Inc., 1967.