

Himalayan Garhwal University Uttarakhand (India)



A STUDY AND EVALUTION SCHEME OF MASTER OF ARTS - MATHEMATICS

M.A. (MATHEMATICS)

Academic Session 2017-18 onwards

SUMMARY

Programme	M.A. (MATHEMATICS)
Duration	Two year (Four Semester)
Medium	English



P.G. Department of mathematics
M.A. Mathematics

Semester-I	Name of the paper	Internal	External	Total
CC101	Partial Differential Equations and its Applications.	30	70	100
CC102	Topology	30	70	100
CC103	Algebra-I	30	70	100
CC104	Elementary Complex Analysis	30	70	100
CC105	Numerical Analysis and its Applications	30	70	100
Semester-II				
CC201	Abstract Measure	30	70	100
CC202	Advanced Calculus	30	70	100
CC203	Algebra-II	30	70	100
CC204	Advanced Complex Analysis	30	70	100
CC 205	Mathematical Statistics-I	30	70	100
Semester-III				
CC301	Functional Analysis-I	30	70	100
CC302	Numbertheoretic Cryptography-I	30	70	100
CE	<i>A student is allowed to opt any two papers.</i>	30	70	100
CE303	Optimization Techniques-I	30	70	100
CE313	Ordinary Differential Equations-I	30	70	100
CE323	Matrix Transformations in Sequence Spaces-I	30	70	100
CE333	Fluid Dynamics-I	30	70	100
CE343	Abstract Measure and Probability-I	30	70	100
AE	<i>Under CBC a student from other departments/Courses can opt for AE. A student is allowed to opt any one paper.</i>	30	70	100
AE305	Mathematical Methods-I	30	70	100
AE306	Mathematical Methods-II	30	70	100
	<i>Under CBC a student from Mathematics department.</i>	30	70	100
AE307	Mathematical Statistics -II	30	70	100
Semester-IV				
CC401	Graph Theory	30	70	100
CC402	Functional Analysis-II	30	70	100
CC403	Numbertheoretic Cryptography-II	30	70	100
CE	<i>A student is allowed to opt any two papers.</i>	30	70	100
CE404	Optimization Techniques-II	30	70	100
CE414	Ordinary Differential Equations-II	30	70	100
CE424	Matrix Transformations in Sequences Spaces-II	30	70	100
CE434	Fluid Dynamics-II	30	70	100
CE444	Abstract Measure and Probability-II	30	70	100
Grand Total		600	1400	2000



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80
Credits

CC – Core Course 1500 (Mandatory with no choice)

CE – Core Elective – 400 (Mandatory with choice departmentally)

AE – Allied Elective-100 (Mandatory with choice inter-departmental)

M.A. Mathematics 2015-16

FIRST SEMESTER

PAPER-CC101

PARTIAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS

Unit-I	: Basic Concepts and Classifications of Second Order equation.
Unit-II	: The Cauchy Problem, The Method of Separation of Variables.
Unit- III	: Eigen value Problems, Boundary value problems
Unit- IV	: Fourier Transforms and Laplace Transforms.

BOOK PRESCRIBED:

Linear Partial Differential Equations for Scientists and Engineers. Tyn Myint, U & Lokenath Debnath (Birkhauser Pub) 4th Edition. Chapters:1(1.2-1.6), 4 , 5(5.1-5.7), 7,8,9,12(12.1-12.6,12.8-12.11).

BOOKS FOR REFERENCE:

Partial Differential Equations of Mathematical Physics. Tyn Myint, U & (Else Her Pub).

PAPER-CC102

TOPOLOGY

Unit-I	: Open sets and limit points, closed sets and closure, Bases and relative topologies.
Unit-II	: Connected Sets and components, compact and .Countable compact spaces, continuous functions, homeomorphisms.
Unit- III	: T_0 -and T_1 -spaces & sequence, Axioms of countability. T_2 Spaces, Axiom of Countability, Regular and Normal Spaces, Completely regular Spaces.
Unit- IV	: Urysohn's metrization theorem, Finite products, product invariant properties, metric products, product topology.



BOOK PRESCRIBED:

1. W. J. Pervin, Foundations of General Topology, Academic Press. Chapters : 3(3.1, S.2 and 3.4), 4(4.1 to 4.4), 5(1.1 to 5.3, 3.5 and 5.6), 8(8,1 to 8.4), 10(10.1 only)

BOOKS FOR REFERENCE:

1. J. R. Munkers ,Topology-A First Course, Prentice Hall, 1996.
2. K. D. Joshi, Introduction to General Topology, Willey Eastern Ltd., 1983.

PAPER-CC103
ALGEBRA-
I

Unit-I	: Automorphisms, Cayley's Theorem, Permutation Groups, Another Counting Principle.
Unit-II	: Sylow's Theorems. More Ideals and Quotient Rings, The Field of Quotients of an Integra! Domain. Euclidean Rings. A Particular Euclidean Ring.
Unit- III	: Polynomial Rings, Polynomial Rings over the Rational Field, Elementary Basic Concepts of Vector Space, Linear Independence and Bases.
Unit- IV	: Extension Fields, The Transcendence of e, Roots of Polynomials, Construction with Straightedge and Compass, More about Roots.

BOOKS PRESCRIBED:

- I. N. Hersfein : Topics in Algebra, John Wiley and Sons, (2nd Edn.,) 2002. Chapters : 2(2.8 to 2,12i, 3(3.5 to 3.10), 4(4.1, 4.2), 5(5.1 to 5.5).

BOOKS FOR REFERENCE:

1. S. Singh end Q, Zameeraddin, Modern Algebra, Vikas Publishing House, 1590.
2. P. B .Bhattacharya. S. K. Jain and S. R. Nagpal, Basic Abstract Algebra, Cambridge University Press, 1995.

PAPER-CC104
ELEMENTARY COMPLEX ANALYSIS-
I

Unit-I	: Complex Numbers
Unit-II	: Complex Functions
Unit- III	: Conformality and linear transformations
Unit- IV	: Complex Integration : Fundamental theorems, Cauchy's Integral fomtula, local properties of analytic functions, Complex integration continued : General form of Cauchy's theorem.



BOOK PRESCRIBED :

Lfirs V. Ahifors, Complex Analysis, Third Edition, Mc Graw Hill Kegakusha Ltd., International Student Edition. THE COURSE IS COVERED BY:

Unit-1 : Chapter—1, Unit-2 : Chapter—2, Unit-3 : Chapter—S (2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3 only) Unit-4 (Chapter—4 (Sections 1,2,3&4),

**PAPER-CC105
NUMERICAL ANALYSIS AND ITS
APPLICATIONS**

Unit-I	:	Interpolation & Approximation : Introduction, Lagrange and Newton interpolations, finite difference operators. Interpolating Polynomials using finite differences, Hermite Interpolation, Piecewise and spline interpolation.
Unit-II	:	Interpolation and Approximation (contd) : Bivariate interpolations, Approximation, least square approximation, uniform approximation, Rational approximation,, choice of the method.
Unit-III	:	Differentiation and Integration : Introduction, Numerical differentiation, Optimum choice of step length, extrapolation method, partial differentiation, Numerical Integration, Methods based on interpolation. Methods based on undetermined coefficients, Composite Integration methods, Romberg Integration, Double integration.
Unit-IV	:	Ordinary Differential Equations, Intial Value Problems : Introduction, Difference Equations, Ordinary Differential Equations, Initial Value Problem (contd.) : Numerical methods, single step methods, stability analysis of single step methods, Multi step methods.

BOOK PRESCRIBED :

M. K. Jain, S. R. K. Iyengar and R.K. Jain : Numerical Methods for Science and Engineering Computations (Fourth Edition) New Age International Publishers, 2003., Chapters : 4, 5, 6.



**SECOND
SEMESTER PAPER-
CC201
ABSTRACT MEASURE**

Unit-I	Introduction, Outermeasure, Measurable sets and Lebesgue measure, A nonmeasurable set. Measurable functions, Littlehood's three principle.
Unit-II	The Lebesgue Integral.
Unit- III	Differentiation and Integration.
Unit- IV	The classical Banach Spaces.

BOOK PRESCRIBED:

Real Analysis-H.L.Royden(Macmillan) Chapter: 3,4,5,6.

**PAPER-CC202
ADVANCED CALCULUS**

Unit-I	: Derivatives for Functions on R^n - Differentiation of composite functions, Taylors Theorem
Unit-II	: Transformations, Linear function and transformations, Differentials of transformations, Inverse of transformations.
Unit- III	: Implicit function theorems, functional dependence, set function transformation of multiple Integrals.
Unit- IV	: Curves and Arc length, surfaces and surface area, Integrals over curves and surface, Differential forms, Theorem of Green, Gauss and stokes, exact form and closed form.

BOOKS RECOMMENDED :

Advanced Calculus (third edition by R. C. Back, Mo Graw Hill). Chapters: 3(3.3 to 3.3), 7(7.2 to 7.7), 8(8.2 to 8.6), 9(9.2, 9.4.9.5)

**PAPER-CC203
ALGEBRA-II**

Unit-I	: Dual Spaces, Inner Product Spaces, The Elements of Galois Theory, Solvability by Radicals.
Unit-II	: The Algebra of Linear Transformation, Characteristic Roots, Matrices.
Unit- III	: Canonical Forms I Triangular Form, Nilpotent Transformations, Jordan Form.
Unit- IV	: Trace and Transpose, Determinants, Hermitian, Unitary and normal Transformations.

BOOKS PRESCRIBED:

1. I. N. Herstein : Topics in Algebra, John Wiley and Sons, (2nd Edn.,) 2002. Chapters : 2(2.8 to 2,12i), 3(3.5 to 3.10), 4(4.1, 4.2), 5(5.1 to 5.5)



BOOKS FOR REFERENCE:

1. S. Singh and Q. Zameeraddin, Modern Algebra, Vikas Publishing House, 1990.
2. P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, Basic Abstract Algebra, Cambridge University Press, 1995.

**PAPER-CC204
ADVANCED COMPLEX ANALYSIS**

Unit-I	:	Complex Integration Calculus of Residues.
Unit-II	:	Series and Product development: Power series expansion, partial fraction and factorisation.
Unit-III	:	Series and product development continued : Entire function, Riemann Zeta Function.
Unit-IV	:	Elliptic Functions: Simple periodic functions and Double periodic functions, Elliptic Functions, Weirstrass Theory.

BOOKS PRESCRIBED:

Lars V. Ahlfors, Complex Analysis, Third Edition, Mc Gr&w Mill Kogakusha Ltd., International Student Edition.

The Course is covered by

- Unit-1: Chapter—IV (Section 5 only)
 Unit-2: Chapter—V (Sections 1 and 2 only)
 Unit-3: Chapter—V (Sections 3 and 4 only)
 Unit-4: Chapter—VII (Sections 1, 2 and 3 only) .

**PAPER-CC205
MATHEMATICAL STATISTICS-I**

Unit-I	:	Elements of Theory of Probability : Classical definition of probability, Theorems on probability of union of events, Conditional probability : Theorem of compound probability, Independence of events, The Bayes Theorem, Statistical and empirical definition of probability, Geometric probability, Axiomatic definition of probability, Conditional probability (Axiomatic definition of probability). Exercises.
Unit-II	:	Probability distribution on R: Random variables, probability distribution of a r. v., discrete and continuous random variables, independent random variables, lebesgue -stieltjes integrals, Integration of a random variables. Exercises.



Unit-III	:	Some characteristic of probability distribution: Expectation, Moments, some inequalities concerning moments, Different measures of central tendency. Measures of dispersion, Measures of skewness and kurtosis. some probability inequalities . Exercises.
Unit-IV	:	Generating functions: probability generating function, Moment generating function , Factorial generating function , Cumulant generating function , characteristic function, Exercises, Some discrete distribution on \mathbb{R} : The discrete uniform distribution , the Bernoulli distribution, the binomial distribution , The hypergeometric distribution , The Poisson distribution, The geometric distribution, The negative binomial distribution ,The power series distribution, Exercises.

BOOK PRESCRIBED:

Parimal Mukhopadhyay, Mathematical Statistics, Books and Allied (P) Ltd. , No1-E(1). Subham Plaza, First Floor , 83/1 Belgachia Main /road , Kolkata 70010. Chapters: 1,2,3,4 and 5

BOOKS FOR REFERENCE:

1. Robert V. Hogg and Allen T. Craig, Introduction to mathematical statistics, Pearson Education Asia, Indian Branch :482 F.I.E Pratapganj, Delhi 110092
2. John E. Freund and Ronald E. Walpole, Mathematical statistics, Prentice Hall India Pvt. Ltd. New Delhi-110001

**THIRD SEMESTER
PAPER-CC301
FUNCTIONAL ANALYSIS-I**

Unit-I	:	Normed spaces, continuity of linear maps.
Unit-II	:	Hahn-Bachach Theorems, Banach spaces.
Unit-III	:	Uniform Boundedness principle. Closed Graph and Open Mapping Theorems, Bounded Inverse Theorem.
Unit-IV	:	Spectrum of a Bounded operator, Duals and Transposes.

BOOK PRESCRIBED :

Functional Analysis—B. V. Limayee (New Age— International Limited, Publishers, Second Edition)

ARTICLES :

5, 6, 7(Except Banach Limits) 8, 9(Except Divergence of Fourier Series of continuous Functions and Matrix Transformations and Summability Methods) 10, 11, 12 (upto theorem 12.6) and 13 (upto Theorem 13.5)



PAPER-CC302
NUMBER THEORETIC CRYPTOGRAPHY-I

Unit-I	Time estimates for doing arithmetic, Divisibility and Euclidean algorithm, congruences. Some applications to factoring.
Unit-II	finite fields, Quadratic residues and reciprocity.
Unit- III	Some simple cryptosystems, Enciphering matrices.
Unit- IV	The idea of public key cryptography, RSA.

BOOKS PRESCRIBED:

Neal Koblitz: A Course In number theoretic Cryptography, Springer Verlag, GTM No. 114; 1987). Chapters : 1, 2, 3, 4(4.1, and 4.2,) only.

BOOKS FOR REFERENCE :

A. J. Menezes. P. C. Van Oorschot and Scoff A. Vanstone, Hand Book of Applied Cryptography, CRC Press (1997).

PAPER-CE303
OPTIMIZATION TECHNIQUES-I

Unit-I	:	Integer Programming : Gomory's Algorithm for pure integer linear programs, Gomory's mixed integer- continuous variable algorithm, Branch and Bound methods.
Unit-II	:	Kuhn-Tucker optimality conditions : Some theorem, Kuhn-Tucker first order Necessary optimality conditions, Second order optimality condition. Lagranges method.
Unit-III	:	Convex programming problem, Sufficiency of Kuhn-Tucker conditions, Lagrangian saddlepoint and duality, duality for convex programs.
Unit-IV	:	Game Theory : Game theory problem, Two person zero sum Game, Finite matrix Game, Graphical method for $2 \times n$ and $m \times 2$ matrix games, Some theorems, Dominance principal.

BOOKS RECOMMENDED :

Mathematical Programming by N. S. Kambo. Chapters 6(6.4 to 6.6), 7(7.1 and 7.4) 8, IS

PAPER-CE313
ORDINARY DIFFERENTIAL EQUATIONS-I

Unit-I	:	Basic Concepts and Linear Equations of the First Order.
Unit-II	:	Linear Differential Equations of Higher Order.


 Head of Department


 Deputy Head of Department

Unit-III	:	Systems of Linear Differential Equations; Systems of First Order Equations, Existence and Uniqueness Theorems. Fundamental Matrix Non Homogeneous Linear Systems, Systems of Linear Differential Equations Continued Linear Systems with Constant Coefficients, Linear System with Periodic Coefficients.
Unit-IV	:	Equations with Deviating Arguments, Existence and Uniqueness of Solutions.

BOOK PRESCRIBED:

Text Book of Ordinary Differential Equations (Second Edition) S, G. Deo. V. Lakhimkantbam, V. Raghavendra, Tata-Mc Graw-Hill Publishing Company Limited. New Delhi., Chapters : 1.2, (except 2.10), 4, 5, 11.

PAPER-CE323

MATRIX TRANSFORMATIONS IN SEQUENCE SPACES-I

Unit-I	:	Limitation Methods : Limitation methods, Examples of Limitation Methods, Matrix Limitation Methods. Norlund and Riesz Musos.
Unit-II	:	Limitation Methods : Schur Matrices: Consistency of Matrix Methods.
Unit-III	:	Some particular Limitation Matrices : Norlund Mean, Cesaro and Holder Matrices.
Unit-IV	:	Hausdorff Methods, Abels method, Tauberin Theorem, Banach Limits, Strongly Regular Matrices, Counting function.

BOOK RECOMMENDED:

Regular Matrix Transformation by G.N.Peterson Mc. Graw-Hill Publishing Company. (Chapters: 1,2,3(3.1 to 3.3)).

PAPER-CE333

FLUID DYNAMICS-I

Unit-I	:	Kinematics of Fluids, Methods describing Fluid motion. Lagrangian and Eulerian Methods. Translation Rotation and Rate of Deformation.
		Streamlines, Pathlines and Streaklines. The Material derivative and Acceleration Vorticity in Polar and Orthogonal Curvilinear Coordinates.
Unit-II	:	Fundamental equations of the flow of viscous compressible fluids, Equations of continuity, motion and energy in Cartesian coordinate systems.
Unit-III	:	The equation of state. Fundamental equations of continuity, motion and energy in Cylindrical and Spherical coordinates.



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Unit- IV	: 2-D and 3-D inviscid incompressible flow. Basic equations and concepts of flow. Circulation theorems, Velocity potential, Rotational and Irrotational flows. Integration of the equations of motion. Bernoulli's Equation, The momentum theorem and the moment of momentum theorem. Laplace's equations in different coordinate systems. Stream function in 2-D motion.
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Chapters : 3,5 (5.1 to 9.6), 7 (7.1 to 7.9)

BOOK RECOMMENDED

Foundations of Fluid Mechanics by S.W.Yuan, Publisher Prentice-Hall of India.

**PAPER-CE343
ABSTRACT MEASURE AND PROBABILITY-I**

Unit-I	: Sets and Events, Probability on σ -Algebra, Probability Distributions and Elementary Random Variables, Repeated Trials and Statistical Independence, Poisson Approximation to the Binomial Distribution, Normal Approximation to Binomial Distribution.
Unit-II	: Multivariate Normal Approximation to Multinomial Distribution, some applications of the normal approximation. Independent simple Random variables and central limit theorem, Conditional probability, Law of large numbers An application of the law of large numbers to a problem is Analysis.
Unit-III	: σ -algebra and Borel spaces, Monotone classes, Measures on Boolean semi-Algebra and Algebra Extension of Measure to σ -Algebra, Uniqueness of extensions of measures.
Unit-IV	: Extension and completion of measures, measures on matrix spaces, probability contents, the Lebesgue measure on the Real line, Elementary properties of Borel Maps, Borel Maps into Matrix Spaces, Borel Maps on measure Spaces.

BOOKS PRESCRIBED:

Introduction to probability and measure by K. R. Parthsarathy (Macmillan Company), Chapters :1, 2, 3, (22. 23. 24).

**PAPER-AE305
MATHEMATICAL METHODS-I**

Unit-I	Interpolation
Unit-II	Numerical Integration
Unit- III	Mathematical Formulation, Graphical Solution and Simplex Method.
Unit- IV	Random Variables



BOOK PRESCRIBED:

M. K. Jain, S. R. K. Iyengar and R.K. Jain : Numerical Methods for Science and Engineering Computations (Fourth Edition) New Age International Publishers, 2003., Chapter: 4.1 to 4.7, 5.6 to 5.11

Operations Research : Kantiswarup, P. K. Gupta and Manmohan, Sultan Chand and Sons.

G. Shanker Rao, Probability and Statistics for Science and Engineering, Universities Press, Chapter: 2.1 to 2.15.

**PAPER-AE306
MATHEMATICAL METHODS-II**

Unit-I	Laplace Transforms
Unit-II	Fourier Series & Fourier Transforms
Unit- III	Some basic concepts on graph theory.
Unit- IV	Mathematical Logic, Boolean Algebra & Logic circuits.

BOOK PRESCRIBED:

S. Sreenadh, S. Ranganatham, M.V.S.S.N. Prasad, V. Ramesh Babu, Fourier Series and Integral Transforms, S. Chand & Company Ltd., Chapter: Chapter: 1 ,2 & 3.

S. Pirzada, Graph Theory, Universities Press, Chapter: 1 & 2.

S. K. Sarkar, A Text Book of Discrete Mathematics, S. Chand & Company Ltd., Chapter: 2 & 3.

REFERENCE BOOKS :

T.K.V Iyengar, B. Krishnagandhi, S. Ranganatham, M.V.S.S.N. Prasad, Mathematical Methods, S. Chand & Company Ltd.

**PAPER-AE307
MATHEMATICAL STATISTICS-II**

Unit-I	:	Some continuous distributions on R : Continuous uniform distribution, Exponential distribution, The Gamma distribution and Chi-squared distribution, Beta distribution, Cauchy distribution, Normal
Unit-II	:	Probability distribution on R^n : Probability distribution on random vector, Expectation and moments of random variables, Generating functions, Conditional expectation, Variance, Regression,
Unit-III	:	Probability distribution of functions of random variables : Functions of one random variables, Probability integral transformation, Functions of two random variables, Functions on n random variables,
Unit-IV	:	Convergence of sequence of random variables : Convergence of



	<p>distribution functions, Convergence in probability, Almost sure convergence, Convergence in the r th mean, Weak law of large numbers, Strong law of large numbers, Central limit Theorem, Exercises, Some further properties of a multivariate distribution : Expectation and covariance of random vectors, Rank of a distribution, Concentration ellipsoid of a multivariate probability distribution, conditional distribution, Multiple correlation, partial correlation, a few further results, Large sample formulae for standard errors of sample moments, Functions of moments, Exercises.</p>
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BOOK PRESCRIBED:

Parimal Mukhopadhyay, Mathematical Statistics, Books and Allied (P) Ltd. , No1-E(1). Subham Plaza, First Floor , 83/1 Belgachia Main /road , Kolkata 700010. Chapters: 6,7,8,9 and 10.

BOOKS FOR REFERENCE:

1. Robert V. Hogg and Allen T. Craig, Introduction to mathematical statistics, Pearson Education Asia, Indian Branch :482 F.I.E Pratapganj, Delhi 110092
2. John E. Freund and Ronald E. Walpole, Mathematical statistics , Prentice Hall India Pvt. Ltd. New Delhi-110001

**FOURTH SEMESTER
PAPER-CC401
GRAPH THEORY**

Unit-I	:	Introduction to Graphs
Unit-II	:	Trees and Connectivity.
Unit-III	:	Applications of trees and connectivity
Unit-IV	:	Euler Tours and Hamilltonian Cycles, Planar Graphs.

BOOK PRESCRIBED:

John Clark and D.A. Holton A First Look at Graph Theory, World Scientific and Allied Publishers., Chapter: 1.2(2.1, 2.2, 2.3, 2.4, 2.5 and 2.6), (3(3.1 to 3.3, 3.4), 5(5.1 to 5.3).

BOOKS FOR REFERENCE

N. Deo, Graph Theory and Applications to Engineering Anil Computer Sciences, Prentice Hall of India.



PAPER-CC402
FUNCTIONAL ANALYSIS-II

Unit-I	: Weak and Weak *convergence Reflexivity.
Unit-II	: Inner product spaces, Orthonormal sets.
Unit- III	: Approximation and Optimization Projection and Riesz Representation Theorems.
Unit- IV	: Bounded Operators and Adjoints, Normal, Unitary and Self-Adjoint Operators.

BOOK PRESCRIBED:

Functional Analysis — B. V. Limaye (New Age—International! Limited, Publishers, Second Edition) Articles 15, 16 (upto 16.3) 21, 22, 23,24, 25 and 26 (Upto 26.5).

PAPER-CC403
NUMBER THEORETIC CRYPTOGRAPHY-II

Unit-I	: Discrete log, Knapsack.
Unit-II	: Zero knowledge protocol and oblivious transfer, pseudo primes.
Unit- III	: The rho method, Fermat factorization and factor bases.
Unit- IV	: The continued fraction method, The quadratic sieve method.

BOOKS PRESCRIBED:

Neal Koblitz, A Course on number theoretic Cryptography. Springer Verlag, GTM No. 114 (1987). Chapters:4 (4.3,4.4,4.5only), 8.

BOOKS FOR REFERENCE

J. Menezes. P. C. Van Oorschot and Scott A. Vanstone, Hand Book of Applied Cryptography, CRC Press (1997).

PAPER-CE404
OPTIMIZATION TECHNIQUES-II

Unit-I	: Quadratic program, Weife's algorithm, Scales Algorithm, Fletchers method.
Unit-II	: Dual quadratic program, complementarity problem.
Unit- III	: Non linear programming methods ; Frank-Wolfe method, Reduced Gvadieot method, Kelley's cutting plane method.
Unit- IV	: Geometric programming: Proto type primal and dual Geometric Programs, Reduction to proto type Geometric program, Dynamic Programming: Principle of optamility, Reliability of system in series, Height of projectile, Cargo-Loading problem. Inventory problem.



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BOOKS PRESCRIBED:

Mathematical Programming by N. S. Kambo. Chapters : 10(10.1 to 10.5, 10.8), II (II to II 3), 12 (12.1 to 12,2), 15(15 1 to 15 5)

PAPER-CE414
ORDINARY DIFFERENTIAL EQUATIONS-II

Unit-I	: Analysis and Methods of Nonlinear Differential Equations.
Unit-II	: Boundary Value Problems.
Unit- III	: Oscillations of Second Order Equations.
Unit- IV	: Stability of Linear and Nonlinear, Systems: Elementary Critical Points, System of Equations with constant coefficients, linear Equations with constant coefficients, Stability of Linear and Nonlinear Systems (continued) Lyapunov stability, stability of Quasi-linear systems, Second Order Linear Differential Equations.

BOOKS PRESCRIBED:

Text Book of Ordinary Differential Equations (Second Edition) S. G. Deo. V. Lakshmikantham, V. Raghavendra, Tata Mc Graw Hill, Tata-Mc Gran-Hill Publishing Company Limited. New Delhi. Chapters: 6, 7, 8, 9.

PAPER-CE424
MATRIX TRANSFORMATIONS IN SEQUENCE SPACES-II

Unit-I	: Strongly Regular Matrices: Some Matrices of a special Type, A universal Tauberian Theorem.
Unit-II	: Bounded sequence, Uniformly limitable sequence, Intersection of Bounded Convergence Filters.
Unit- III	: Set of Matrices, Bounds on Limits of sequences, Matrix Norms, Pairs of consistent matrices.
Unit- IV	: Matrix and linear transformations Algebras of matrices, Summability, Tauberian theorems.

BOOKS RECOMMENDED :

1. Regular Matrix Transformations by O. M. Peterson, Chapter-3 (8.4 and 3.5), 4.
2. Elements of Functional Analysis by I. J. Maddox, Cambridge University Press, Chapter; 7



PAPER-CE434
FLUID DYNAMICS-II

Unit-I	: Laminar flow of viscous incompressible fluids. Similarity of flows. The Reynolds number. Flow between parallel flat plates. Couette flow, plane Poiseuille flow. Steady flow in pipes, The Hagen-Poiseuille flow. Flow between two coaxial cylinders*
Unit-II	: Flow between two Coaxial rotating cylinders. Steady flow around a sphere Theory of very slow motion. Unsteady motion of a flat
Unit- III	: The laminary boundary layer. Properties of Navier-Stokes equations. The boundary layer, equations in 2-D flow. The boundary layer along a flat plate. Boundary layer on a surface with pressure gradient, Momentum integral theorems for the boundary layer.
Unit- IV	: Von Karman-Pohlhausen method. Boundary layer for axially symmetrical flow. Separation of boundary layer flow. Boundary layer control. Separation prevention by boundary layer suction, The origin of turbulence. Reynolds modification of the Navier-Stokes equations for turbulent flow. Reynolds equations and Reynolds stresses, Prandtl's mixing length theory. The universal velocity profile near a wall. Turbulent flow in pipes, Turbulent boundary layer over a smooth flat plate.

BOOKS RECOMMENDED:

Foundations of Fluid Mechanics-S. W. Yuan, Publisher: Prentice-Hall of India. Chapters'. 8 (8.1 to 8.3, 8.7 to 8.8). 9, 10.

PAPER-CE444
ABSTRACT MEASURE AND PROBABILITY-II

Unit-I	: Integration of non-negative Functions, Integration of Borel Functions, Riemann and Lebesgue Integrals.
Unit-II	: Riesz's Representation theorem, some Integral Inequality.
Unit- III	: Transition Measures and Fubini's theorem, convolution of probability measure on \mathbb{R}^n Lebesgue measure on \mathbb{R}^n
Unit- IV	: Convolution Algebra $L^1(\mathbb{R}^n)$ approximation on L^p spaces with respect to Lebesgue Measure on \mathbb{R}^n , Elementary properties of Banach spaces, projections in Hilbert space, orthogonal sequences.

BOOKS RECOMMENDED:

Introduction to probability and measure by K. R. Parthasarathy (Macmillan Company) Chapters: 4 (except 30.-31), 3, 6 (40, 41, 42).

