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ANNEXURE-I

HIMACHAL PRADESH UNIVERSITY
DETAILS OF SYLLABI
M.A./M.Sc. (Mathematics)
w.e.f. July 2006

Duration: Two Years (Four Semesters)

Semester – I		**Semester - III**	
M101	Real Analysis-I	M301	Complex Analysis-I
M102	Advanced Algebra-I	M302	Topology
M103	Ordinary Differential Equations	M303	Analytic Number Theory
M104	Operations Research-I	M304	Operations Research-II
M105	Fluid Dynamics	M305	Mathematical Statistics
Semester – II		**Semester – IV**	
M201	Real Analysis-II	M401	Complex Analysis-II
M202	Advanced Algebra-II	M402	Functional Analysis
M203	Partial Differential Equations	M403	Advanced Discrete Mathematics
M204	Classical Mechanics	M404	Differential Geometry
M205	Solid Mechanics	M405	Magneto Fluid Dynamics

Note:

1. M.A/M.Sc. (Mathematics) is a Two Years Post-Graduate degree course divided into Four Semesters. Maximum Marks for each paper will be of 60 marks.

2. Each paper will be divided into three sections. Nine questions will be set in all. Each section will contain three questions. The candidates will be required to attempt five questions in all selecting at least one question (but not more than two questions) from each section.

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Mathematics) First Semester Course

M101 Real Analysis-I

Section –I

The Riemann-Stieltjes Integral

Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, Integration and differentiation. The Fundamental theorem of calculus. Integration of vector ï valued functions. Rectifiable curves.

Section – II

Sequences and Series of Functions

Pointwise and uniform convergence, Cauchy Criterion for uniform convergence. Weierstrass M-Test. Abelôs and Dirichletôs tests for uniform convergence. Uniform convergence and continuity. Uniform convergence and Riemann ï Stieltjes integration. Uniform convergence and differentiation. Weierstrass approximation Theorem. Power series, Uniqueness theorem for power series. Abelôs and Taylorôs Theorems.

Section – III

Functions of Several Variables

Linear Transformations. Differentiation. Partial derivatives. Continuity of partial derivatives. The contraction Principle. The Inverse Function Theorem. The Implicit Function Theorem, Derivatives in an open subset of R^n, Chain rule, Derivatives of higher orders, The Rank Theorem. Determinants, Jacobians.

Text Book

1. Walter Rudin, Principles of Mathematical Analysis (3rd Edition), McGrawHill, Kogakusha, 1976, International Student Edition, (Chapter 6: §§ 6.1 to 6.27, Chapter 7: §§ 7.1 to 7.18, 7.26 ï 7.32, Chapter 8: §§ 8.1 to 8.5, Chapter 9: §§ 9.1 to 9.41).

Reference Books

1. T.M. Apostol, Mathematical Analysis, Narosa publishing House, New Delhi, 1985.

2. I.P. Natanson, Theory of Functions of a Real Variable, Vol. I, Frederick Ungar Publishing Co., 1961.

3. S. Lang, Analysis-I, Addison ï Wesley Publishing Company, Inc. 1969.

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Mathematics) First Semester Course

M102 Advanced Algebra-I

Section –I

The Sylow Theorems, Applications of Sylow Theory, Direct products, The classification of finite abelian groups, the Jordan-Hölder Theorem, Composition factors and chief factors, Soluble groups & Examples of soluble groups.

Section – II

Definition and Examples of Rings, Some Special Classes of Rings, Homomorphisms, Ideals and Quotient Rings, More Ideals and Quotient Rings and The Field of Quotients of an Integral Domain.

Euclidean Rings, a Particular Eudclidean Ring, Polynomial Rings, Polynomials over the Rational Field, Polynomial Rings over Commutative Rings.

Section – III

Unitary Operators, Normal Operators, Forms on Inner Product Spaces, Positive Forms, More on Forms, Spectral Theory.

Text Books

1. John F. Humphreys, óA Course in Group Theoryô, Oxford University, Press, 1996 (§§ 11-18).

2. I.N. Herstein, óTopics in Algebraô, Second Edition), John Wiley & Sons, New York (§§ 3.1 to 3.11).

3. Kenneth Hoffman & Ray Kunze, óLinear Algebraô, Second Edition, Prentice-Hall of India Private Limited, New Delhi (§§ 8.4, 8.5, 9.1 to 9.5).

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Mathematics) First Semester Course

M103 Ordinary Differential Equations

Section –I

Existence and Uniqueness Theory

Some Concepts from Real Function Theory. The Fundamental Existence and Uniqueness Theorem. Dependence of Solutions on Initial Conditions and on the Funcition f. Existence and Uniqueness Theorems for Systems and Higher-Order equations.

The Theory of Linear Differential Equations

Introduction. Basic Theory of the Homogeneous Linear System. Further Theory of the Homogeneous Linear System. The Nonhomogeneous Linear System. Basic Theory of the nth-Order Homogeneous Linear Differential Equation. The nth-Order Nonhomogeneous Linear equation.

Section – II

Sturm-Liouville Boundary-Value Problems

Sturm-Liouville Problems. Orthogonality of Characteristic Functions. The Expansion of a Function in a Series of Orthonormal Functions.

Strumian Theory

The separation theorem, Sturmǿs fundamental theorem Modification due to Picone, Conditions for Oscillatory or non-oscillatory solution, First and Second comparison theorems. Sturmǿs Oscillation theorems. Application to Sturm Liouville System.

Section – III

Nonlinear Differential Equations

Phase Plane, Paths, and Critical Points. Critical Points and paths of Linear Systems. Critical Points and Paths of Nonlinear Systems. Limit Cycles and Periodic Solutions. The Method of Kryloff and Bogoliuboff.

Text Books

1. S.L. Ross, Differential Equations, Third Edition, John Wiley & Sons, Inc., (Chapter 10: §§ 10.1 to 10.4; Chapter 11: §§ 11.1 to 11.8; Chapter 12: §§ 12.1 to 12.3; Chapter 13: §§ 13.1 to 13.5).
2. E.L. Ince, Ordinary Differential Equations,, Dover Publication Inc. 1956 (Chapter X: §§ 10.1 to 10.6.1)

Reference

1. W. Boyce and R. Diprima, Elementry Differential Equations and Boundary value Problems, 3rd Ed. New York, (1977).
2. E.A. Coddington, An Introduction to Ordinary Differential Equations, 2nd Ed. Prentice Hall of India Pvt. Ltd., Delhi, (1974).

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Mathematics) First Semester Course

M104 Operations Research-I

Section –I

Hyperplane and hyperspheres, Convex sets and their properties, convex functions. Linear Programming Problem (LPP): Formulation and examples, Feasible, Basic feasible and optimal solutions, Extreme points. Graphical Methods to solve L.P.P., Simplex Method, Charnes Big M Method, Two phase Method, Degeneracy, Unrestricted variables, unbounded solutions, Duality theory, Dual LPP, fundamental properties of Dual problems, Complementary slackness, Dual simplex algorithin, Sensivity analysis.

Section – II

Integer programming: Gomoryôs Method, Branch and Bound Method.
Transportation Problem (TP): Mathematical formulation, Basic feasible solutions of T.Ps by North ï West corner method, Least cost-Method, Vogelôs approximation method. Unbalanced TP, optimality test of Basic Feasible Solution (BFS) by U-V method, Stepping Stone method, degeneracy in TP.
Assignment Problem (AP): Mathematical formulation, assignment methods, Hungarian method, Unbalanced AP.

Section – III

Goal programming Problem (GPP): formulation of G.P. Graphical Goal attainment method, simplex method for GPP.
Game theory: Two-person, zero-sum games, The maximin ï minimax principle, pure strategies, mixed strategies, Graphical solution of 2xn and mx2 games, Dominance property, General solution of m x n rectangular games, Linear programming problem of GP.
Network Techniques

Shortest path model, Dijkastra algorithm, Floydôs algorithm, Minimal Spanning tree, Maximal flow problem.

Text Books

1. S.D. Sharma, Operations Research, Kedar Nath Ram Nath & Co. 14th Edition 2004 (Scope as in relevant sections of Chapters 3 to 13 and 19).
2. Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons 12th Edition, 2004 (Scope as in relevant sections of Chapters 0, 02 to 08 & 10, 11 & 17).
3. R. Panneerselvam, Operations Research, Prentice Hall of India Pvt. Ltd., 2004 (Chapters 5: §§ 5.1 to 5.4).

Reference Books

1. G. Hadley, Linear Programming, Narosa Publishing House (2002).
2. H.A. Taha, Operations Research: An Introduction, Prentice Hall of India Pvt. Ltd., 7th Edition, 2004.
3. J.K. Sharma, Operations Research, Macmillan India Pvt. Ltd. 2003.

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Mathematics) First Semester Course

M105 Fluid Dynamics

Section –I

Continuum hypothesis, Newton's Law of Viscosity, Some Cartesian Tensor Notations, General Analysis of Fluid Motion, Thermal Conductivity, Generalised Heat conduction.

Fundamental Equations of Motion of Viscous Fluid

Equation of State, Equation of Continuity, Navier – Stokes (NS) Equations (equation of Motion, Equation of Energy, Streamlines & Pathlines, Vorticity and Circulation (Kelvin's Circulation Theorem).

Section – II

Dynamical Similarity (Reynold's Law), Inspection Analysis- Dimensional Analysis, Buckingham – π - Theorem, and its Applications π – products and coefficients, Non-dimensional parameters and their physical importance.

Exact Solutions of the N S Equations

Steady Motion between parallel plates (a) Velocity distribution, (b) Temperature Distribution, Plane Couette flow, plane Poiseuille flow, generalized plane Couette flow.

Flow in a circular pipe (Hagen-Poiseuille flow (a) velocity distribution (b) Temperature distribution.

Section – III

Flow between two concentric Rotating Cylinders (Couette flow): (a) Velocity distribution (b) Temperature distribution.

Flow due to a plane wall suddenly set in motion, flow due to an oscillating plane wall.

Plane Couette flow with transpiration cooling.

Steady Flow past a fixed sphere: Stokes equation and Oseen's equation of flow.

Theory of Lubrication. Prandtl's boundary layer equations, the boundary layer on a flat plate (Blassius equation), Characteristic boundary layer parameters.

Text Books

1. J.L. Bansal, Viscous Fluid Dynamics, Oxford and IBH Publishing Co. Pvt. Ltd., (1977), (Scope as in relevant sections of Chapters 1 to 6).
2. F. Chorlton, Textbook of Fluid Dynamics, CBS Publishers & Distributors (2000) (Scope as in relevant sections of Chapters 1, 2, 3, 6 & 8).

Reference Books

1. G.K. Batchelor, An Introduction to Fluid Dynamics, Cambridge University Press (1970).
2. C.S. Yih, Fluid Mechanics, McGraw-Hill Book, Company.

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athematics) Second Semester Course

M201 Real Analysis-II

Section –I

Lebesgue Measure

Introduction. Outer measure. Measurable sets and Lebesgue measure. A nonmeasurable set. Measurable functions. Littlewood's three principles.

Section – II

The Lebesgue Integral

The Riemann integral. The Lebesgue integral of a bounded function over a set of finite measure. The integral of a nonnegative function. The general Lebesgue integral. Convergence in measure.

Section – III

Differentiation and Integration

Differentiation of monotone functions. Functions of bounded variation. Differentiation of an integral. Absolute continuity. Convex functions.

The Classical Banach Spaces

The L^pspaces. The Minkowski and Hölder inequalities. Convergence and completeness. Approximation in L^p. Bounded linear functionals on the L^pspaces.

Text Book

1. H.L. Royden, Real Analysis, Third Edition, Prentice-Hall of India, Private Limited, New Delhi – 110 001 (1995), (Chapter 3 to 6).

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athematics) Second Semester Course

M202 Advanced Algebra-II

Section –I

Modules

Definition and examples, Submodules and direct sums, homomorphisms and quotient modules, Completely reducible modules, Free modules.

Section – II

Field Theory

Irreducible polynomials and Eisenstein criterion, Adjunction of roots, Algebraic extensions, Algebraically closed fields, Splitting fields, Normal extensions, Multiple roots, Finite fields, Separable extensions.

Section – III

Galois Theory and its Applications

Automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of algebra, Roots of unity and cyclotomic polynomials, Cyclic extensions, Polynomials solvable by radicals, Symmetric functions, Ruler and compass constructions.

Text Book

1. P.B. Bhattacharya, S.K. Jain & S.R. Nagpaul, ôBasic Abstract Algebraö, Second Edition, Cambridge University Press (Chapter 14 (§§ 1 to 5), Chapter 15 to Chapter 18).

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Section – I

Fundamental Concepts

Classification of Second Order Partial Differential Equations. Canonical Forms: Canonical Form for Hyperbolic Equation, Canonical Form for Parabolic Equation, Canonical form for elliptic equation. Adjoint Operators.

Elliptic Differential Equations

Occurrence of the Laplace and Poisson Equations: Derivation of Laplace Equation, Derivation of Poisson Equation. Boundary Value Problems (BVPs). Some Important Mathematical Tools. Properties of Harmonic Functions. Separation of Variables.

Section – II

Parabolic Differential Equations

Occurrence of the Diffusion Equation. Boundary Conditions. Elementary Solutions of the Diffusion Equation. Dirac Delta Function. Separation of Variables Method. Solution of Diffusion Equation in Cylindrical Coordinates. Solution of Diffusion Equation in Spherical Coordinates. Maximum-Minimum Principle and its Consequences.

Section – III

Hyperbolic Differential Equations

Occurrence of the Wave Equation. Derivation of One-dimensional Wave Equation. Solution of One-dimensional Wave Equation by Canonical Reduction. The Initial Value Problem; DôAlemberts Solution. Vibrating String ï Variables Separable Solution. Forced Vibrations ï Solution of Nonhomogeneous Equation. Boundary and Initial Value Problem for Two-dimensional Wave Equation ï Method of Eigenfunction. Periodic Solution of One-dimensional Wave Equation in Cylindrical Coordinates. Periodic Solution of One-dimensional Wave Equation in Spherical Polar Coordinates.

Text Book

1. K. Sankara Rao, Introduction to Partial Differential Equations, Prentice Hall of India Private Limited, New Delhi, 1997 (Scope as in relevant sections of Chapters 1 to 4).

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Section-I

Generalized Coordinates. Constraints. Work and potential energy. Generalized forces. The Principle of virtual work. Introduction to Lagrangeøs equations. Lagrangeøs Equations for a particle in a plane. The Classification of Dynamical Systems. Lagrangeøs equations for any simple Dynamical system. Lagrangeøs equations for Non-holonomic systems with moving constraints. Lagrangeøs equations for impulsive motion.

Section-II

Hamiltonøs Principle. Stationary Values of a function. Constrained stationary values. Stationary Value of a definite integral. The Brachistochrone problem. Hamiltonøs equations. Derivation of Hamiltonøs equations. Ignorable coordinates. The Routhian function.

Section-III

The form of Hamiltonian function. Modified Hamiltonøs principle. Principle of least action. The Hamiton-Jacobi equation. Lagrange and Poission Brackets. Calculus of Variation. Invariance of Lagrange and Poission Brackets under canonical transformation.

Text Books

1. Principle of Mechanics, John L. Synge and Byron A. Griffith, McGraw Hill, International Edition (§§ 10.6, 10.7, 15.1 & 15.2), Third Edition.

2. Classical Dynamics, Donald. T. Green ï Wood, Prentice ï Hall of India, 1979, (§§ 4.2, 4.3, 5.2 & 6.3).

3. Classical Mechanics, K. Sankara Rao, Prentice-Hall of India, 2005 (§§ 6.7, 6.8, 7.5 & 7.6).

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Section-I

Analysis of Strain ï Affine transformation, Infinitesimal Affine deformations, Geometrical interpretation of the components of Strain. Strain Quadric of Cauchy, Principal Strains. Invariants. General Infinitesimal Deformation. Equation of compatibility. Finite deformation.

Analysis of Stress ï Stress Tensor. Equations of Equilibrium. Transformation of coordinates. Stress Quadric of Cauchy. Principal stress and Invariants. Maximum normal and shear stresses, Mohrôs circle Diagram.

Section – II

Equations of Elasticity ï Generalized Hookeôs law. Stress ï Strain relations for a medium having one plane elastic symmetry, three orthogonal planes symmetry and for homogeneous isotropic media. Elastic-moduli for isotropic media. Equilibrium and Dynamic equations for an isotropic solids. Strain energy function and its connection with Hookeôs law. Unique solution of Boundary value problem. Derivation of Navierôs equations and Beltrami-Michal compatibility equations.

Section – III

Statement of problem. Extension of beams by longitudinal forces. Beam stretched by its own weight. Bending of beams by terminal couples. Torsion of a circular shaft. Plane stress. Plane strain.

Text Book

1. I.S. Sokolnikoff, Mathematical Theory of Elasticity, Tata McGraw-Hill Publishing Company Ltd, 1977, (Chapter I, II, III, IV: §§29 ï 33 and Chapter V: §§ 65-67).

Reference Books

1. S. Timoshenko and N.Goodier, Theory of Elasticity, McGraw-Hill, New York 1970.
2. A.E. Love, A Treatise on the Mathematical Theory of Elasticity, Cambridge University Press, London, 1963.
3. Y.C. Fung, Foundations of Solid Mechanics, Prentice-Hall, New Delhi , 1965.
4. I.H. Shames, Introduction to Solid Mechanics, Prentice-Hall, New Delhi , 1975.
5. S.Valliappan, Continuum Mechanics, Oxford and IBH Publishing Company, New Delhi, 1981.

M.A./M.Sc. (Mathematics) Third Semester Course

M301 Complex Analysis-I

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Section – I

The algebra and the geometric representation of complex numbers. Limits and continuity. Analytic functions. Polynomials and rational functions. The exponential and the trignometric functions. The periodicity. The logarithm. Sets and elements. Arcs and closed curves, Analytic functions in region.

Conformal mapping, length and area. The linear group, the cross ratio, symmetry, oriented circles, family of circles. The use of level curves, a survey of elementary mappings, elementary Riemann surfaces.

Section- II

Line integrals, rectifiable arcs, line integral as function of arcs, Cauchyôs theorem for a rectangle, Cauchyôs theorem in a disk. The index of a point with respect to a closed curve. The integral formula. Higher derivatives.

Sequences, Series, Uniform convergence, Power series and Abelôs limit theorem. Weierstrassôs theorem, the Taylorôs series and the Laurent series.

Removable singularities. Taylorôs theorem, zeros and poles. The local mapping and the maximum principle.

Section – III

Chains and cycles, simple connectivity, Homology, the general statement of Cauchyôs theorem. Proof of Cauchyôs theorem. Locally exact differentials and multiply connected regions. The residue theorem, the argument principle and evaluation of definite integral.

Text Books

1. Lars V. Ahlfors, Complex Analysis, McGraw Hill Int. Ed. (1979).
   Section-I: Chapter-1 §§ 1.1 - 1.5 and §§ 2.1 ï 2.4. Chapter-2 §§ 1.1 ï 1.4, 3.1 ï 3.4. Chapter-3 §§ 1.1, 2.1 ï 2.4, 3.1 ï 3.5 and 4.1 ï 4.3.
   Section-II: Chapter-4 §§ 1.1 ï 1.5, 2.1 ï 2.3, 3.1 ï 3.4. Chapter ï 2 §§ 2.1 ï 2.5. Chapter ï 5 §§ 1.1 ï 1.3 and
   Section-III: Chapter- 4 §§ 4.1 ï 4.7 , 5.1 ï 5.3.

Reference

1. John B. Conway, Function of One Complex Variable, (Second Edition), Narosa Publishers.

M.A./M.Sc. (Mathematics) Third Semester Course

M302 Topology

Section - I

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Partial ordered sets and lattices.

Metric Spaces
Open sets, closed sets, convergence, completeness, Baireôs category theorem, continuity.

Topological Spaces
The definition and some examples, elementary concepts, Open bases and open subbases, weak topologies, the function algebras C (X, R) and C (X, C).

Section - II

Compactness
Compact spaces, products of spaces, Tychonoffôs theorem and locally compact spaces, compactness for metric spaces, Ascoliôs theorem.

Separation
T_1-spaces and Hausdorff spaces, completely regular spaces and normal spaces, Urysohnôs lemma and Tietzeôs extension theorem, the Urysohn imbedding theorem, the Stone-Cech compactification.

Section - III

Connectedness

Connected spaces, the components of a space, totally disconnected spaces, locally connected spaces.

Aproximation
The Weierstrass approximation theorem.

Text Book

1. G.F. Simmons, Introduction to Topology and Modern Analysis, International Student Edition, McGraw Hill Book Company, Inc. 1963, Chapter1: §§ 8; Chapter 2: §§ 9-15; Chapter3: §§ 16-20; Chapter 4: §§ 21-25; Chapter 5: §§ 26-30); Chapter 6: §§ 31-34 and Chapter 7: 35.

M.A./M.Sc. (Mathematics) Third Semester Course

M303 Analytic Number Theory

Section – I

Divisibility Theory in the Integers

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e Greatest Common Divisor, The Euclidean Algorithm, and
= c.

Primes and their Distribution

The Fundamental Theorem of Arithmetic. The Sieve of Eratosthenes and The Goldbach Conjecture.

The Theory of Congruences

Basic Properties of Congruence, Special Divisibility Tests and Linear Congruences.

Section – II

Fermat's Theorem

Fermatôs Factorization Method, The Little Theorem and Wilsonôs Theorem.

Number – Theoretic Functions

The Functions Ũand ů, The Möbius Inversion Formula, The Greatest Integer Function and An Application to the Calendar.

Euler's Generalization of Fermat's Theorem

Eulerôs Phi-Function, Eulerôs Theorem and Some properties of the Phi-Function, An Application to Cryptography.

Section – III

Primitive Roots and Indices

The Order of an Integer Modulo *n*, Primitive Roots for Primes, Composite Numbers Having Primitive Roots and The Theory of Indices.

The Quadratic Reciprocity Law

Eulerôs Criterion, The Legendre Symbol and Its Properties, Quadratic Reciprocity and Quadratic Congruences with Composite Moduli.

Text Book

1. David M. Burton, ñElementary Number Theoryò, (Fifth Edition) International Edition, McGraw Hill, (Chapter 2^{nd} to 9^{th}).

M.A./M.Sc. (Mathematics) Third Semester Course

M304 Operations Research-II

Section – I

Queueing Theory

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…eing problem, Transient and steady states, Probability … Poisson process (pure birth process), Properties of possions arrivals, Exponential process, Markovian property, Pure death process, Service time distribution, Erlang service time distribution, Solution of Queueing Models.

Dynamic Programming

Decision Tree and Bellmanøs principle of optimality, Concept of dynamic programming, minimum path problem, Mathematical formulation of Multistage Model, Backward & Forward Recursive approach, Application in linear programming.

Section – II

Non-Linear Programming Problems (NLPP): Formulation of a NLPP, General non-linear NLPP, Constrained optimization with equality constraint, Necessary and sufficient condition for a general NLPP (with one constraint), with m(<n) constraints, constrained optimization with inequality constraints (Kuhn ï Tucker conditions), Saddle point problem, saddle point and NLPP, Graphical solution of NLPP, Verification of Kuhn ï Tucker conditions, Kuhn ï Tucker conditions with Non-negative constraints.

Section – III

Quadratic programming

Quadratic programming; Wolfeøs Modified Simplex method, Bealeøs Method.

Separable Programming

Separable Programming, Piecewise linear approximation, Separable programming algorithm.

Simulation

Definition, Types of simulation, Event type simulation, Generation of random numbers, Monte ï Carlo Simulation.

Text Books

1. S.D. Sharma, Operations Research, Kedar Nath Ram Nath & Co. 14^{th} Edition 2004 (Scope as in relevant sections of Chapters 17,23, 27 to 30 and 33).
2. Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons 12^{th} Edition, 2004 (Scope as in relevant sections of Chapters 13,20,23,24 and 25).

Reference Books

1. J.K. Sharma, Operations Research, Macmillan India Pvt. Ltd. 2003.
2. M.S. Bazara, H.D. Sherali and C.M. Shetty, Non-Linear Programming, Theory and Algorethms, 2^{nd} Ed., John Wiley & Sons, Inc.

M.A./M.Sc. (Mathematics) Third Semester Course

M305 Mathematical Statistics

Section – I

Distributions of Random Variables

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...n, random variables, The probability density Function, the distribution function, Certain probability Models, Mathematical Expectation, Some special Mathematical expectations, Chebyshevôs Inequality, conditional probability, Marginal and conditional distributions, the correlation coefficient, Stochastic Independence.

Section – II

Some Special Distributions

The Binomial, trinomial, and Multinomial Distributions, the Poisson Distribution, The Gamma and Chi-square Distributions, the normal distribution, and the bivariate normal distribution.

Sampling theory, Transformations of variables of the Discrete type, Transformations of the variables of the continuous type. The t and F distributions.

Section- III

Extensions of the change-of-variable Technique, Distributions of order statistics, the moment generating function Technique, The distribution of $\overline{\chi}$ and nS^2/ů^2, Expectations of Functions of Random variables, Limiting Distributions, Stochastic Convergence, Limiting Moment Generating Functions, The Central limit Theorem, some theorems on limiting Distributions.

Test Book

1. Robert V. Hogg and Allen T. Craig, Introduction to Mathematical Statistics, Forth Edition, Macmillan Publishing Co., Inc., New York, 1989, (Chapter 1 to 5).

Reference

1. Feller, W.: Introduction to Probability and its Applications, Wiley Eastem Pvt. Ltd. Vol. 1, (1972).

M.A./M.Sc. (Mathematics) Fourth Semester Course

M401 Complex Analysis-II

Section –I

Harmonic functions

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...perties of harmonic function, The mean value property, ..., Poissonôs formula, Schwarzôs theorem, The reflection principle. A closer look at Harmonic functions, Functions with the mean value property, Harnackôs principle. The Dirichletôs problem; Subharmonic functions, Solution of Dirichletôs problem.

Section – II

Partial fractions and factorization

Partial fractions, infinite products, canonical products, the Gamma functions, Stirlingôs formula. Entire functions; Jensenôs formula, Hadmardôs theorem. The Riemann zeta functions; The product development. Extension of $\zeta(s)$ to the whole plane. The functional equation. The zeros of the zeta function.

Section – III

Simply periodic functions, Representation by exponentials, The Fourier development, Functions of finite order. Doubly periodic functions, The period module, unimodular transformations, The canonical basis, General properties of elliptical functions. Analytic continuations, The Weierstrass theory, germs and sheaves, Sections and Riemann surfaces, Analytic continuations along arcs, Homotopic curves, The Monodromy theorem, Branch points. Algebraic functions, The resultant of two polynomials, Definition and properties of algebraic functions, Behaviour at the critical points. Picardôs theorem.

Text Books

1. Lars V. Ahlfors, Complex Analysis, Int. Ed. McGraw-Hill Book Co. (Third Edition), (1979).
   Section I: Chapter 4: §§ 6.1 - 6.5; Chapter 5: §§ 2.2 to 2.4, 3.1, 3.2, 4.1 & 4.2. **Section II:** Chapter: 6 §§ 3.1, 3.2, 4.1, 4.2, 5.1-5.3.
   Section III: Chapter- 7: §§ 1.1 ï 1.3, 2.1-2.4, & Chapter 8: §§ 1.1-1.7, 2.1-2.3,3.1.

Reference

1. John B. Conway, Function of One Complex Variable, (Second Edition), Narosa Publishers.

M.A./M.Sc. (Mathematics) Fourth Semester Course

M402 Functional Analysis

Section - I

Banach Spaces

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amples, continuous linear transformations. The Hahn- ping Theorem, the Closed Graph Theorem, the Uniform Boundedness Theorem, the natural embedding of N in N**, reflexivity.

Section - II

Hilbert Spaces

The definition and some simple properties, orthogonal complements, orthonormal sets, the conjugate space H*, the adjoint of an operator, self-adjoint normal and unitary operators, projections.

Section - III

Spectral Theory of Linear Operators in Normed Spaces

Spectral Theory in Finite Dimensional Normed Spaces. Basic Concepts. Spectral Properties of Bounded Linear Operators. Further Properties of Resolvent and Spectrum. Use of Complex Analysis in Spectral Theory. Banach Algebras. Further Properties of Banach Algebras.

Text Books

1. G.F. Simmons, Introduction to Topology and Modern Analysis, International Student Edition, McGraw Hill Book Company, Inc. 1963, (Chapter 9: §§ 46-51 and Chapter10: §§ 52-59).

2. E. Kreyszig, Introductory Functional Analysis with Applications, John, Wiley and Sons, Wiley Classics Library Edition Published, 1989 (Chapter 7).

M.A./M.Sc. (Mathematics) Fourth Semester Course

M403 Advanced Discrete Mathematics

Section –I

Boolean Algebras

Logic, Propositional Equivalences, Predicates and Quantifiers. Partial Ordered Sets, Lattices and Algebraic Systems, Principle of Duality, Basic Properties of Algebraic Systems defined by Lattices, Distributive and Complemented Lattices, Boolean Lattices and Boolean

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…olean Algebras, Boolean Functions and Boolean Expressions, …ircuits.

The Pigeonhole Principle

Pigeonhole principle: Simple form, Pigeonhole principle: Strong form, A theorem of Ramsey.

Permutations and Combinations

Two basic counting principles, Permutations of sets, Combinations of Sets, Permutations of multisets, Combinations of multisets.

Section – II

Generating Permutations and Combinations

Generating permutations, Inversions in permutations, Generating combinations, Partial orders and equivalence relations.

The Binomial Coefficients

Pascal's formula, The binomial theorem, Identities, Unimodality of binomial coefficients, The multinomial theorem, Newton's binomial theorem.

The Inclusion-Exclusion Principle and Applications

The inclusion-exclusion principle, Combinations with repetition, Derangements, Permutations with forbidden positions.

Recurrence Relations and Generating Functions

Some number sequences, Linear homogeneous recurrence relations, Non-homogeneous recurrence relations, Generating functions, Recurrences and generating functions, Exponential generating functions.

Section – III

Introduction to Graph Theory

Basic properties, Eulerian trails, Hamilton chains and cycles, Bipartite multigraphs, Trees, The Shannon switching game.

Digraphs and Networks

Digraphs and Networks.

More on Graph Theory

Chromatic number, Plane and planar graphs, A 5-color theorem, Independence number and clique number, Connectivity.

Text Books

1. C.L. Liu, 'Elements of Discrete Mathematics', Tata McGraw-Hill, Second Edition, (§§ 12.1 to 12.8 & 12.10)
2. Richard A. Brualdi, Introductory Combinatorics, third Edition, (Chapter 2 to 7 and Chapter 11 to 13).

Reference

1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", Tata McGraw-Hill, Fourth Edition.

M.A./M.Sc. (Mathematics) Fourth Semester Course

M404 Differential Geometry

Section –I

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Curvature, Binormal, Torsion, Serret Frenet formulae, Locus curvature, Locus of center of spherical curvature. Theorem: Curve determined by its intrinsic equations, Helices, Involutes & Evolutes.

Section – II

Surfaces, Tangent plane, Normal, Curvilinear co-ordinates First order magnitudes, Directions on a surface, The normal, second order magnitudes, Derivatives of n, Curvature of normal section. Meunierôs theorem, Principal directions and curvatures, first and second curvatures, Eulerôs theorem. Surface of revolution.

Section – III

Gaussôs formulae for $\vec{r}_{11}$, $\vec{r}_{12}$, $\vec{r}_{22}$, Gauss characteristic equation, Mainardi ï Codazzi relations, Derivalives of angle ω, Geodesic property, Equations of geodesics, Surface of revolution, Torsion of Geodesic, Bonnetôs theorem, vector curvature, Geodesic curvature, κ_g.

Text Book

1. Differential Geometry of Three Dimension, C.E. Weatherburn, Khosla Publishing House, 2003 (§§ 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, 14, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 34, 41, 42, 43, 46, 47, 48, 49, 50, 52, 53).

Reference

1. Introduction to Differential Geometry, T.J. Willmore, Oxford University.

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M405 Magneto Fluid Dynamics

Section – I

Fundamental Equations

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field equations, Magnetic induction equation and magnetic Reynold's number. Alfven's Theorem and its consequences. Magnetic energy equation. Mechanical equations and effects.

Magnetohydrostatics

Magnetohydrostatic, Force Free magnetic fluids (Basic equations, boundary conditions & magnetic energy, general solution when Ŭ is constant).

Section – II

Steady States

Pressure balanced magnetohydrostatic configurations. Toroidal magnetic field. Steady laminar motion. General solution of a vector wave equation.

Magnetohydrodynamic Waves

Aflven waves, Magnetohydrodynamic waves in compressible fluid. Reflection and refraction of Alfven waves. Dissipative effects.

Section – III

Stability

Indroduction. Linear Pinch. Method of small Oscillations. Energy principle. Virial Theorem. Marginal stability – Bénard problem with a magnetic field.

Turbulence

Introduction, spectral analysis. Homogeneity and Isotropy. Kolmogorff's principle. Hydromagnetic turbulence. Inhibition of trubulence by a magnetic field.

Text Book

1. An Introduction to Magneto Fluid Dynamics by V.C.A. Ferraro & C. Plumpton. Clarendon Press, Oxford 2nd Edition, 1966, (Chapter 1: §§ 1.1 to 1.7, Chapter 2: §§ 2.1, 2.1 (1,2,3), 2.3, 2.4; Chapter 4: §§ 5.1 to 5.6, Chapter 6: §§ 6.1, 6.3 to 6.7).

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