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UNIVERSITY OF DELHI 36

SCHEME OF EXAMINATION

AND

COURSES OF READING

OF

B.A./B.Sc. (HONOURS) EXAMINATION IN MATHEMATICS

Part I Examination 2003

Part II Examination 2004

Part III Examination 2005

AUTHENTICATED ON
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Officer-on-Special Duty
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Syllabi applicable for Students seeking admission to the B.A./B.Sc. (Hons.) Mathematics Course in the academic Year **2002 - 2003**

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B.A./B.Sc. (HONOURS) MATHEMATICS

COMPULSORY—16 UNITS OPTIONAL—2 UNITS

Distribution of Units

Ist Year

Unit 1	:	Vector Calculus and Geometry
Unit 2	:	Algebra-I
Unit 3	:	Analysis-I
Unit 4	:	Analysis-II

IInd Year

Unit 5	:	Algebra-II
Unit 6	:	Differential Equations-I
Unit 7	:	Mechanics-I
Unit 8	:	Numerical Analysis & Computer Programming ✓
Unit 9	:	Analysis-III
Unit 10	:	Probability & Mathematical Statistics ✓

3rd Year

Unit 11	:	Differential Equations-II
Unit 12	:	Algebra-III
Unit 13	:	Algebra-IV
✓Unit 14	:	Mechanics-II
Unit 15	:	Analysis-IV
Unit 16	:	Analysis-V

Units 17 & 18 (optionals)

(i)	:	Number Theory
(ii)	:	Boolean Algebras
(iii)	:	Discrete Mathematics
(iv)	:	Integral Transforms, Fourier Series & Boundary Value Problems

(v) : Computer Mathematics

(vi) : Linear Programming & Game Theory

Scheme of Examinations

(i) Each unit will be of 50 marks and will have two hours examination.

(ii) Each unit will be divided into 4 sections and the candidates will have to answer only one Question from each section with a provision for internal choice in each section.

(iiI) There will be examination at the end of Ist Year, 2nd Year and 3rd Year.

Teaching Schedule :

(i) 3 periods per week will be the teaching norm to cover each unit.

(ii) Adequate number of tutorials will be provided as per the University norms. Two periods per week will be provided for practicals.

(iii) Subsidiary subjects and other requirements of the languages will be the same as approved by the University for the Honours subjects.

(The other conditions will remain the same).

Unit 1. Vector Calculus and Geometry

Section 1

Differentiation and partial differentiation of a vector function. Derivative of Sum, Dot Product and Cross Product of two vectors. Gradient, Divergence and Curl.

Section 2

System of circles, Standard equations and properties of Parabola, Ellipse and Hyperbola.

Section 3

General equation of second degree in two variables. Tracing of a conic.

Section 4

Sphere, Cone, Cylinder, tangent lines and tangent planes.

Unit 2. Algebra-1

Section I

De'Moivre's Theorem (both integral and rational index). Summation of Series, Expression for Cos $n\theta$, *Sin* $n\theta$, in terms of powers of *Sin* θ, Cosθ, and Cos $n\theta$, *Sin* $n\theta$, in terms of Cosine and Sine of multiples of θ, solution of equations using trigonometry.

Section II

Symmetric, skew symmetric, Hermitian, Skew Hermitian matrices, Elementary operations on matrices. Inverse of a matrix, Linear independence of row and column matrices, Row rank, Column rank and Rank of matrix, equivalence of Column and Row Rank. Characteristic equation of a matrix, Cayley Hamilton Theorem.

Section III

Applications of Matrices to a system of linear (both homogeneous and non-homogeneous) equations, Theorems on consistency of a system of linear equations.

Relations between the roots and the coefficients of polynomials. Symmetric functions of the roots of an equation, transformation of equations.

Section IV

Permutations, Cycles, permutation as a product of disjoint cycles, transposition, even and odd permutation.

Number system, well ordering principle, Divisibility and basic properties of congruence.

Unit 3. Analysis-I

Section I

The real number system as a complete ordered field, Neighbourhoods, open and closed sets, Limit points of sets, Bolzano-Weierstrass theorem.

Section II

Sequences, convergent sequences, Cauchy sequences, Monotonic sequences, Subsequences, Limit superior and limit inferior of a sequence.

Section III

Infinite series, convergence of infinite series, Positive term series Comparison test, Cauchy's nth root test, D' Alembert's ratio test, Raabe's test, Cauchy's integral test, alternating series, Leibnitz test. Absolute and conditional convergence.

Section IV

Successive Differentiation, Leibnitz Theorem, Partial differentiation, curvature, asymptotes, singular points concavity, covexity, Points of inflexion tracing of curves in cartesian and polar coordinates.

Note :— The emphasis of Calculus portion should be on curve tracing.

Unit 4. Analysis-II

Section I

Limits, continuity, sequential continuity, algebra of continuous functions, continuity of composite functions, continuity on [a, b] implying boundedness, Intermediate Value Theorem, Inverse Function Theorem, Uniform continuity.

Section II

Differentiation, Algebra of derivatives, Differentiability and continuity, chain rule, Inverse function theorem, Darboux theorem, Rolle's theorem, Mean Value theorems, Taylor's theorem.

Section III

Taylor's series, Maclaurin's series, Expensions of Sin x, Cos x, e^x, log (1+x), $(1 + x)^m$, Applications of Mean Value theorems to Monotone functions and inequalities, Maxima and Minima, Indeterminate forms.

Section IV

Integration of irrational functions, reduction formulae, Rectification, Quadrature, Volumes and Surfaces of revolution.

Unit 5. Algebra II

Section I

Groups, subgroups, Lagrange's Theorem, Normal subgroups, quotient groups.

Section II

Homomorphism, Isomorphism, First and second theorem of Homomorphism, Permutation groups, Cayley's Theorem.

Section III

Automorphisms, Counting principle, class equation, Cauchy's Theorem.

Section IV

Sylow's Theorems, Direct product of groups, Fundamental theorem of finite abelian groups (Only statement with illustrations), Survey of groups upto order 8.

Unit 6. Differential Equations I

Nature and origin of differential equations.

1. *First Order Differential Equations*

   Linear equations. Homogeneous and non-homogenous equations. Separable equations. Exact equations. First Order higher degree equations solvable for x,y,p. Applications to the cooling law, population growth and radioactive decay.

2. *Second Order Differential Equations*

   Statement of existence and uniqueness of solution under given initial conditions. Algebraic properties of solutions. Wronskian, its properties and applications. Linear homogeneous equations with constant coefficients. Linear non-homogeneous equations. The method of variation of parameters. The method of undetermined coefficients. Euler's equation.

3. Power series solutions. Ordinary points, singular points. The method of Frobenius. Bessel's equation. Legendre's equation.

4. The method of elimination for two simultaneous first order equations. Picard's existence theorem. Pffafian differential equations.

Unit 7. Mechanics—I

1. *Coplaner Force Systems*

   Necessary and sufficient condition for equilibrium of a particle. Triangle law of forces, polygon law of forces, Lami's theorem. Moment of a force about a line. Varignon's Theorem for concurrent force systems. Necessary condition for a system of particles to be in equilibrium.

   Equipollent force systems. Couples and their moments, Equipollence of two couples. Reduction of a general plane force system. Parallel force systems.

Work and Potential Energy. Principle of Virtual Work for a system of particles.

Infinitesimal displacement of a plane lamina. Necessary and sufficient conditions for the equilibrium of a rigid body movable parallel to a fixed plane.

II. Centre of Gravity. Formulae, Methods of symmetry and decomposition, Theorem of Pappus.

Friction : Laws of Static and Kinetic Friction, Problems of equilibrium under forces including friction (excluding indeterminate cases).

Stable Equilibrium. Energy test of stability (problems involving one variable only).

III. General Force Systems. Total force, total moment relative to a base point, total moment under a change of base point. Necessary and sufficient conditions for a system to be equipollent to zero. Reduction of force systems. To a force and couple and to a wrench Invariants of system.

General displacements of a rigid body, Composition of infinitesimal displacements.

Generalized co-ordinates; Definition; infinitesimal displacements of a system in terms of generalized co-ordinates, Genevolized Forces, Work done and Potential Energy in terms of generalized co-ordinates; Principle of Virtual Work for a rigid body.

IV. Hydrostatics; Pressure at a point; Resultant pressure on a plane surface; Centre of Pressure.

Unit 8. Numerical Analysis and Computer Programming.

I. Fortran 77. Organization of digital computer Algorithm and flowchart. Constants; Variables, Type declaration, Arithmetic expression, Assignment statements. Input/Output statements. Control statements if, block if, go to ands. Arrays; Arithmetic statement function, function and subroutine subprograms.

II. Solution of algebraic and transcedental equations. Bisection method; Iteration methods based on first degree equation, Secant method and Newton-Raphson method, Rate of convergence of iterative methods, Development of FORTRAN programs of these methods.

III. System of linear algebraic equations.

Direct methods, Gauss elimination (without pivoting for programs); Gauss-Jordan elimination and error analysis. Iterative methods, Gauss-Jacobi and Gauss-Seidel iterative methods and their convergence. Development of FORTRAN programs for above methods.

IV. Interpolation and Approximation.

Lagrange and Newton interpolation. Linear and higher order, Finite difference operators; Interpolating polynomials using finite differences, Hermite interpolation. Approximation by least square method: Development of FORTRAN programs for the above theory.

Notes :

I. Theory paper in the university examination will be of 2 hours duration and will carry 40 marks. Apart from this, 10 marks are reserved for internal assessment based on the practical work done during the year.

II. For theory paper 3 periods and for practicals 2 periods per week per student are to be allotted.

III. Use of scientific calculator by the students is allowed in the theory examination.

Unit 9. Analysis III

Section I

Definition and examples of meric spaces. Neighbourhoods, Limit points, open and closed sets, Sequences and continuous functions on metric spaces, uniform continuity.

Section II

Compactness, Connectedness.

Section III

Completeness, Cantor's intersection theorem, contraction Principle, Construction of real numbers as the completion of the incomplete metric space of rationals, real numbers as a complete ordered field.

Section IV

Functions from $R^2 \to R$, Schwarz and Young's theorem, Implicit function theorem, Taylor's theorem. Maxima and Minima, Lagrange's, method of undetermined multipliers.

Unit 10. Probability and Mathematical Statistics

Section I

Probability, Classical, Relative and Axiomatic. Conditional Probability and independence. Random Variables, Distribution Function, Mathematical expectation and generating functions.

Section II

Discrete Distribution, Binomial, Poisson, Geometric, Negative Binomial, Hypergeometric and Multinomial, Continuous Distribution Uniform, Exponential, Gamma, Beta, Cauchy, Laplace and their interrelation.

Section III

Joint and conditional distribution, Conditional expectations, Correlation and linear regression for two variables. Joint moment generating function and moments. Bivariate normal distributions.

Section IV

Normal distributions, Characteristic function. Weak law of large numbers. Central limit Theorem for independent and identically distributed random Variables.

Unit 11. Differential Equations–II

I. *First Order Partial Differential Equations.*

Definition of partial differential equations, its order and degree Classification of Partial differential equations into linear, semilinear quasilinear and nonlinear.

Linear partial differential equations of first order. Charpit's Method, solution of standard forms, compatible system of first order equations Jacobi's methods.

Classification of solutions of first order equations and their geometrical interpretation.

II. *Second Order Partial Differential Equations–I*

Classification of second order equations into elliptic, parabolic and hyperbolic, Reduction to canonical forms.

Cauchy Problem and Notion of Characteristics. Solution of Linear Hyperbolic Equation.

III *Second Order Partial Differential Equations-II*

Separation of Variables. Product Solutions for Laplace's Equation, Heat Equation and Wave Equation in cartesian, cylinderical and spherical polar co-ordinates.

IV. *Second and Higher Order Partial Differential Equations.*

Linear partial differential equations with constant co-efficients; Homogeneous linear partial differential equations with variable co-efficients.

Non-linear partial differential equations of second order, Monge's method of solving equations of the form $Rr + Ss + Tt = V$.

Unit 12. Algebra-III

Section I

Rings, Subrings, Integral Domain, Field, characteristic, Ideals and Quotient Rings.

Section II

Embedding of Rings, Prime and Maximal Ideals, The field of Quotients of Integral Domain, Principal Ideal Domain.

Section III

Euclidean Ring, Gaussian Ring of Integers, Polynomial Rings over a rational field, Polynomial Rings over Commutative Rings, Unique Factorization Domains.

Section IV

Extension Field, Finite an Algebraic Extensions, Roots of polynomials, Definition and examples of spliting field, construction by straight edge and compass.

Unit 13. Algebra IV

Section I

Vector space, Subspace, linearly independence, basis dimension, direct sums.

Section II

Linear Transformation, Hom (V, W) Matrix of a linear transformation, change of basis, Rank and Nullity of linear transformation.

Section III

Inner product space, Cauchy-Schwartz Inequality, Bessel's Inequality, Gram Schimdt orthogonalization process, Dual spaces, Applications to system of linear equations.

Section IV

Eigen value, Eigen vector, characteristic and minimal polynomial, Cayley Hamilton Theorem, Diagonalisation of a linear transformation. Invariant subspaces, direct sum decomposition, Invariant direct sum, Primary Decomposition Theorem.

Unit 14. Mechanics-II

I. Kinematics

Basic concepts of mechanics, Position Vector, Velocity, Acceleration, Velocity and Acceleration of a particle along a curve. Radial and Transverse Components (Plane curves); Tangential and Normal components (space curves) Angular Velocity and Angular Acceleration. Principles of linear momentum, angular momentum and energy for a particle and system of particles, use of cenroids, De'Alembert's principle. Conservation field and potential energy. Principle of Conservation of Energy.

II. Particle Dynamics I

Rectilinear motion. Uniformly accelerated motion, resisted motion; Harmonic Oscillator, Damped and forced vibrations. Elastic springs and strings. Hooke's law, Projectile Motion. Under gravity and in resisted medium.

III. Particle Dynamics II

Constrained particle motion. In a horizontal circle and on a smooth vertical circle.

Orbital Motion; Motion of a particle under a central force, use of reciprocal co-ordinates and pedal co-ordinates, Newton's law of gravitation and planetary orbits. Kepler's laws of motion deduced from Newton's law of gravitation and vice-versa.

IV. Rigid Body Dynamics

Moments of Inertia, Definition and standard results; Momental ellipsoid, Theorems of parallel axes and perpendicular axes, Principal axes and their determination, Equi-momental systems. Rigid body motion in 2-D. Flywheels, Compound Pendulum; Cylinder Rolling down and Inclined Plane.

Angular momentum and Kinetic Energy of a rigid body. Rotating about a Fixed Point and in a General Motion. Principles of linear momentum, angular momentum and energy for a rigid body.

Unit 15. Analysis IV

Section I

Riemann Integral, Integrability of continuous and monotonic functions. The Fundamental theorem of Integral Calculus, Riemann—Stieltjes Integral Definition and examples only.

Section II

Improper integrals and their convergénces, comparison tests, Abel's and Dirichlet's tests, Beta and Gamma functions and their properties.

Section III

Differentiation under integral sign, Integration in R^2, Green's theorem.

Section IV

Integration in R^3·Gauss and Stroke's theorems.

Units 16. Analysis V

Section I

Series of arbitrary terms, Abel's and Dirichlet's test, convergence, divergence and oscillation, Rearrangement of series, Multiplication of series, Double series.

Section II

Sequences and series of functions, Pointwise and uniform convergence. Weiestrass M test. Uniform convergence and continuity, differentiation and integration. Weierstrass Approximation Theorem.

Section III

Fourier series, Fourier expansion of piecewise monotonic functions.

Section IV

Power series and their convergences, Absolute and uniform convergence of a power series. Use of power series for defining logrithmic, exponential and trignonometric functions.

Units 17 and 18

Number Theory

Section I

The Diophantine Equation ax + by = C, The Gold bach conjecture. Special Divisibility Tests, Linear congruences, Reduced Residue systems and complete Residue Systems. Fermat's Factorization Method, Fermat's Little Theorem, Wilson's Theorem.

Section II

The functions τ and σ, the Mobius Inversion Formula, The Greatest Integer Function, Euler's Phi-Function, Euler's Theorem, Properties of the Phi-Function, An application to cryptography.

Section III

The order of an integer modulo n, primitive roots of primes, composite Numbers having Primitive roots, The theory of indices, Euler's Criterion, The Legendre's Symbol and its Properties, Quadratic Reciprocity, Quadratic Congruences with composite Moduli.

Section IV

The search for Perfect Numbers, Mersenne Primes, Fermat Numbers, Pythagorean Triples, Fermat's "Last Theorem". Sums of two squares, Sums of more than two squares. The Prime Number Theorem.

The scope of the Course is indicated by the relevant portions of Chapters 2 to 12 and appendix of 'Elementary Number Theory' by 'David M. Burton's Indian Edition, Universal Book Stall, 1990.

Other References :

1. George E. Andrews : 'Number Theory' : W.B. Saunderson & Co., Philadelphia; Hindustan Book Agency Delhi (India).
2. J. Hunter : 'Number Theory' : Oliver & Boyd. Interscience Publishers Inc. 1964.
3. W.J. Leveque : 'Topics in Number Theory' : Vol. I Addison Wesley, Reading Messachussets, 1956.
4. I. Niven & H.J. Zuckerman : 'An Introduction to the Theory of Numbers' : Wiley Eastern Ltd., New Delhi, 1976.

(ii) **Boolean Algebras**

Section I Definition of a Partially Orderd Set, Chains and Lattices, Examples of Lattices, Duality, Meets and Joins, Length and Covering Conditions, Complements, Sublattices, and Homomorphisms in Lattices.

Section II Modular Lattices and Examples, Length and Covering Conditions, Distributive Lattices, Complement in Distributive Lattices, Complemented Distributive Lattices and examples.

Section III Definition of a Boolean Algebra, Ideals of a Boolean Algebra, Boolean function. Disjunctive Normal Form Conjunctive Normal Form, Representation of a Finite Boolean Algebra.

Section IV Switching Circuits, Simplification of Circuits, Non-series parallel circuits, Design examples using Boolean Algebras, Design of n-terminal circuits.

The scope of the Course is indicated by the relevant portions of :

(1) Chapters 2, 3, 4 and 6 of 'Lattice Theory' by Thomas Donnellan, Pergamon Press (1968)

(2) Chapters 2 and 4 of 'Boolean Algebra and its Applications' by J. Eldon Whitesitt, Addison-Wesley Publishing Company, 1961.

(3) § 9.9 of 'modern Applied Algebra' by Garret Birkhoff and Thomas C. Bartee, McGraw Hill Book Company, 1970.

(4) § 12.10 of 'Elements of Discrete Mathematics' by C.L. Liu, McGraw-Hill International editions, 1986.

(5) § 4.5 of Discrete Mathematical structures with Applications to Computer Science by J.P. Trembley and R. Manohar, McGraw-Hill International Editions 1987.

Other References :

1. Thomas C. Bartee : Digital Computer Fundamentals : McGraw Hill International (6th edition) 1976.
2. H. Graham Flegg : Boolean Algebras and its Applications, Blackie, London (1964)
3. G. Gratzer : Lattice Theory : W.H. Freeman & Co. 1971.
4. L. A. Skornjakov : Elements of Lattice Theory : Hindustan Publishing Company (1977).

(iii) **Discrete Mathematics**

Section I Graphs and Planar Graphs : Basic terminology and introduction. Multigraphs and weighted graphs, Paths and Circuits, Shortest Path in weighted graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits. The travelling salesperson Problem. Planar Graphs.

Section II Finite state Machines : an Introduction, Finite state Machines and Models of Physical systems, Equivalent Machines, Finite State Machines as Language Recognizers, Introduction to Turing Machines and examples.

Section III Block designs, Square Block designs, Hadamard configurations, Error correcting codes, Introduction to Discrete Numeric functions and generating functions. Manipulation of Numeric functions, Asymptotic behaviour of Numeric functions.

Section IV Generating Functions, Recurrence Relations, Linear Recurrence relations with constant co-efficients, Homogeneous Solutions, Particular solutions, Total solutions, Solution by the Method of Generating Functions.

The scope of the syllabus is indicated by the relevant portions of :

(1) Chapters 5, 6, 7, 8, 9 and 10 of the book : Elements of Discrete Mathematics by C.L. Liu, McGraw-Hill. International editions 1985.

(2) § 3.7 p. 83-87 of 'Modern Applied Algebra' by Garrett Birkhoff and Thomas C. Bartee, McGraw-Hill Book Company, 1970.

(3) Chapters 6 of 'A First Course in Combinatorial Mathematics' by Ian Anderson-Oxford Applied Mathematics and Computing-Science Series 1974.

Other References :

1. A.T. Bertztiss : 'Data Structure : Theory and Practice' Academic Press, New York, 1971.
2. Bella Bollagas : 'Graph Theory, an Introduction Course'— Springer Verlag, Graduate Test in Mathematics, No. 83, New York 1979.
3. Narsingh Deo : 'Graphs Theory with Applications to Engineering and Computer Science'—Prentice Hall of India Pvt. Ltd., 1974.
4. Frank Harrary : 'Graph Theory'—Addison Wesley Publishing Co. 1972.
5. John E. Hopcraft & Jeffery D. Ullman : 'Introduction to Automata Theory Langauges and Computation'—Narosa Publishing House, 1989.
6. K.A. Ross & C.R.B. Wright : 'Discrete Mathematic' : Prentice Hall, Englewood Cliffs, London 1985.
7. Oystein Ore : 'Graphs and their uses' : The Mathematical Association of America—1963.

iv) Integral Transforms, Fourier Series and Boundary Value Problems

Section I Laplace Transforms, Definition, Tables of Laplace Transforms. Simple theorems of Laplace Transforms. Solutions of Ordinary Differential Equations with constant coefficients. Solutions of Difference Equations by Laplace transforms.

Section II Linear Boundary Value Problems. The equation for a vibrating string. Fourier Series. Initially displaced vibrating string. Vibrating string, initial velocity prescribed. Transverse vibrating membrane.

Section III Temperature in a bar with different boundary conditions. Heat flow in two-dimensions.

Section IV Fourier Integrals. Fourier transforms. Application of Fourier integrals and transforms in heat flow problems. Mellin transform, Mellin Inversion theorem.

References

1. Operational Methods in Applied Mathematics by H.S. Gaurslaw and J.C. Jaeger, Dover Publications, New York (1963). (Chapter I and Art, 138).
2. Fourier series and Boundary Value Problems by R.V. Churchill and J.W. Broven (McGraw Hill, Kogakusha, Tokyo, 1978 (Chapter I (Arts 1-8). Chap. II (Art 11-13 and 15-17). Chap. VI (Arts 50-53, and 56-68), Chap. VII. (Arts 61-66 and 68-69).
3. Methods of Theoretical Physics by P.M. Morse and Herman Feshbach, 1952, Mc Graw-Hill Book Co.) (p. 469-471, for Mellin Transform).

v) Computer Mathematics

1. *Mathematical Logic*

Statement Connectives, Arguments, Quantifiers; Deductive and inductive methods; Predicates, Basic switching functions, composite functions; Analysis of logical circuits; Postulates of Boolean algebra; De Morgan's theorem, Duality Principle, Algebaric simplifications.

Canonical forms and functions; Minimization of functions by Karnagh's maps and Quine-Moloskey technique.

2. *Data Representation and Binary Arithmatic*

Conversion from decimal to binary, octal and hexadecimal systems and vice-versa; Fixed point representation; Addition Subtraction by 1's and 2's, complement' Multiplication and division; Floating point representation, BCD, ASCII and EBCDIC codes.

3. *Programming Language*

PASCAL, Constants; Variables; Expressions; Assignment; Statements; Input/output constructions, Control statements; Iterative statements; Arrays; Functions and Subroutines Subprograms. Development of simple programs and their implementation.

4. *Optimization*

Principles of Optimality and its applications to multistage decision problems. Algorithms and development of Pascal Programs.

Notes : (1) Theory paper in the examination will consist of 40 marks and shall be of 2 hour durations and 10 marks are allotted to internal assessment based upon the computer practical work during the year.

(2) For theory 3 periods and for practical 2 periods per week per student are allotted.

(vi) **Linear Programming and Game Theory**

Section I Linear Programming Problem. Graphical approach for solving some Linear programs. Convex sets. Supporting and Separating Hyperplanes. Basic Solution, Theory of Simplex Algorithm and Simplex Method.

Linear Programming by G. Hadley.

Chapter 1 Art 1.1–1.7 and Questions on page 22.

Chapter 2 Art. 2.9–2.11, 2.16, 2.19–2.21 and Questions on page 70.

Chapter 3 Art. 3.1–3.10 Questions on page 105.

Section II Charnes' M-Technique, Two Phase Method for artificial variables. Inconsistency and Redundancy.

G. Hadley.

Chapter 4. Art. 4.1, 4.2, 4.5, 4.6, 4.10, 4.11 Questions on page 144-146.

Chapter 5 Art. 5.1, 5.2, 5.3, 5.8 Questions on page 170-171.

Section III Dual Linear Program, Duality Theorems, Formulation of dual problems, Unbounded solution in the Primal Transportation and Assignment Problems. Algorithm for solving them.

G. Hadley.

Chapter 8 Art. 8.1, 8.6 Questions on page 266-267.

Chapter 9 Art. 9.1, 9.10, 9.11, 9.12, Questions on page 324-325.

Operations Research by Maurice Saneni

Chapter 8 page 183-192.

Chapter 9 page 194-218.

Section IV Game Theory Problem. Two Person Zero-Sum Game Graphical Method for solving 2 xn and mx2 matrix game Dominance Principle. The solution of a Rectangular Game.

Theory of Games by McKinglsey.

Chap. 1 Art. 1, 2, 3, 4 Questions on page 18.

Chapter 2 Art. 1, Theorem 2.6 on page 36, 37, 38, 39, 40, 41, 42, 43 Art . 5 page 50-58.

Questions on page 56-58.

Other books for consultation

1. Linear Programming and Net work Problems by Mokhtar S. Bazara, John Wiley and Sons, Second Ed. 1990.
2. Linear Programming Methods and Applications by S.I.Gass International Student Edition, McGraw-Hill Kogakinsha Ltd., 1975.

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