UNIVERSITY OF DELHI

SCHEME OF EXAMINATION
AND
COURSES OF READING
FOR
& B.Sc. (HONS.) EXAMINATION IN MATHEMATICS

Part I Examination 1978
Part II Examination 1979
Part III Examination 1980

...labi applicable for students seeking admission to the ...B.A. & B.Sc. (Hons.) Mathematics Course in the academic year : 1977-78

Price Rs 1 - 00 P

25

B.A. & B.Sc. (Hons.) MATHEMATICS

Scheme of Examination

MAIN SUBJECTS

The courses are divided into three parts. Part I is to b[e] covered in the first year, Part II in the second year an[d] Part III in the third year. The contents of the courses hav[e] been divided into ten papers. The distribution of the part[s] is as follows :

Part	I	—	2 papers
Part	II	—	3 papers
Part	III	—	5 papers

Details of the syllabi for each paper are given in the followin[g] pages. The course in each paper is expected to be covere[d] in 4 lectures per week, plus one tutorial per week per group, during the academice year. A tutorial group should ordinarily consist of not more than eight students.

	Duration Hours	Marks
Part I *Examination* 1978		
Paper I—Algebra (i)	3	100
Paper II—Calculus and Analytic Geometry (i)	3	100
Part II *Examination* 1979		
Paper III—Algebra (ii)	3	100
Paper IV—Analysis (i)	3	100
Paper V—Vectors and Mechanics (i)	3	100
Part III *Examination* 1980		
Paper VI—Algebra (iii)	3	100
Paper VII—Analysis (ii)	3	100
Paper VIII—Calculus and Analytic Geometry (ii)	3	100
Paper IX—Mechanics (ii) and Differential Equations	3	100

	Duration Hours	Marks
Paper X—Any one of the following :	3	100

(i) Probability Theory (ii) Mathematical Statistics

(iii) Linear Programming and Theory of Games (iv) Computer Mathematics

(v) Numerical Mathematics (vi) Number Theory

(vii) Multilinear Algebra (viii) Lattice Theory

For Subsidiary Subjects for B.A. (Hons.) See the schedule attached to the book.

Subsidiary Subjects (for B.Sc. (Hons.)

English (Qualifying) (at the end of I year) —one paper

History of Sc. & Scientific method (at the end of II year) —one paper

PHYSICS

I Examination 1978

Paper I—Properties of Matter	50 Marks
Paper II—Thermal Physics	50 Marks
Practical Examination	50 Marks

Note :— Each of the written papers shall be of three hours' duration and shall carry 50 marks. The Practical Examination shall be of five hours' duration and carry 50 marks out of which 20 p.c. marks shall be reserved for the Laboratory Records of the candidate.

II Examination 1979

Paper III—Waves and Oscillation	50 Marks
Paper IV—Electricity and Magnetism	50 Marks
Practical Examination	50 Marks

Note :— Each of the written papers shall be of three hours' duration and shall carry 50 marks. The Practical Examination shall be of five hours' duration and carry 50 marks out of which 20 p.c. marks shall be reserved for the Laboratory Records of the candidates.

CHEMISTRY

I Examination 1978

Paper I—Inorganic and Physical	50 marks
Paper II—Organic and Physical	50 marks
Practical Examination	40 marks

Note :— Each of the written papers shall be of three hour's duration and shall carry 50 marks. The Practical Examination shall be of five hour's duration and shall carry 40 marks out of which 8 marks shall be reserved for the Laboratory Records of the candidate.

II Examination 1979

Paper III—Inorganic and Physical	50 marks
Paper IV—Organic and Physical	50 marks
Practical Examination	60 marks

Note :— Each of the written papers shall be of three hours' duration and shall carry 50 marks. The Practical Examination shall be of six hours' duration and shall carry 60 marks out of which 12 marks shall be reserved for the Laboratory Records of the candidate.

DETAILED COURSES OF READING

B.A./B.Sc. (Hons.) Part I Examination 1978

Paper I—Algebra (i) 100 Marks

Sets : Ordered pair. Cartesian product of two sets. Binary relations. Reflexive, symmetric, antisymmetric and transitive relations. Equivalence classes. Partitions. Theorem of equivalence classes. Function, 1-1-functions, onto functions. 1-1-correspondence. Equality of two functions. Identity functions, composite of functions and invertible functions. Binary compositions. Associative and commutative compositions. Neutral element. Distributivity of one composition with respect to another composition.

Complex Numbers : System of complex numbers introduced as a system of ordered pairs of real numbers. Geometry of complex numbers : Addition and multiplication of complex numbers Representation of the line segment, straight line, circle and regions

in the complex plane. Demoivies theorem (for rational index only). Applications to the determination of roots of complex numbers, expressions for sin $n\theta$ and cos $n\theta$ in terms of powers of sin θ and cos θ and vice versa. Sums of simple finite series like ecos $n\theta$, esin $n\theta$ etc.

Matrix Theory : Matrices defined as rectangular arrays of complex numbers. Equality of matrices. Addition and multiplication of matrices. Multiplication of a matrix by a complex number. Associativity of matrix addition and multiplication. Commutativity of matrix addition. Distributivity of multiplication over addition. Definition of null matrix, identity matrix, negative of a matrix and their properties. Determinants of order three and four and their properties. Multiplication of determinants. Singular and non-singular matrices. Adjoint of a matrix. Inverse of a matrix. Rank of a matrix and its invariance as a result of elementary row and column transformations. Consistency of homogenous and non-homogeneous systems of linear equations. Solutions of systems of linear equations with not more than four unknowns.

Theory of Equations : Relations between roots and coefficients of a polynomial equation. Evaluation of symmetric functions of roots of cubic and biquadratic equations.

Group Theory : Semigroups, Uniqueness of identity element and inverse of an element. *Theorems* : $(a^{-1})^{-1}=a$; $(ab)^{-1}=b^{-1}a^{-1}$. Groups. Cancellation laws (right and left both). Solvability of ax=b and xa=b.

Following characterisation of groups (finite and infinite) : (i) Finite semi-groups with right and left cancellation laws. (ii) Semi groups in which both ax=b and xa=b are solvable. (iii) Semi groups with right identity and right inverse (left identity and left inverse).

Abelian group (definition). Examples of Abelian and Non-abelian groups which must include those of matrices, permutations and integers modulo n. Subgroups. Criteria for finite and infinite subgroups. Intersection and union of two subgroups. Theorem : If H and K are subgroups then KH is a subgroup iff HK=KH.

Right and left cosets. Coset decomposition of a group. Order of a finite group. Lagrange's Theorem. Index of a subgroup, Theorem : 'If H and K are finite subgroups then o(HK)=o(H)

COMPLIMENTARY CO

$o(K)/o(H \cap K)$. Definition of a Cyclic Group. Order of an element of a group.

Theorem : 'In a finite group, order of every element is a factor of the order of the group'.

Ring Theory : Ring Group properties of Addition. Following properties : In a ring R (i) xo=ox=o for all x in R

(ii) $(-x)y = x(-y) = -xy$ for all x, y in R.

(iii) $(-x)(-y) = xy$ for all x, y in R.

Commutative rings, Rings with unity. Zero divisors. Integral domains. Division rings. Fields. (Illustrations of all these concepts must include examples from Matrices, real-valued continuous functions and integers modulo n). Concellation laws for non-zero elements for multiplication in a division ring. *Theorem* : 'A finite integral domain is a field.' Subrings. Criterion for a subring.

Finite Dimensional Vector Spaces. Vector spaces over a field. Illustrations must include matrices. Group properties of addition. Following properties : For a vector space V over a field F.

(i) ao=0 for all a in F

(ii) ov=0 for all v in V

(iii) $(-a)\,v = -av$ for all a in F and all v in V

(iv) $(-a)(-v) = av$ for all a in F and all v in V

(v) av=0 iff either a=0 or v=0.

Sub-spaces. Criteria for subspaces. Sum, intersection, union and direct sum of two subspaces. Liner Independence and dependence. Dimension of a vector space as the maximum of the numbers of elements in all linearly independent subsets of the vector space. Linear span. Basis. *Theorem* : 'A vector space is of dimension n iff it has a basis of n elements.' *Theorem* : Two bases of a vector space consist of same number of elements. *Theorem* : 'Every linearly independent subset can be extended to a basis of the vector space.'

Inequalities : A. M. $\geq$ G. M., Cauchy–Schwarz, Holder's, Minkowski's inequalities (for finite sums).

Paper II—Calculus and Analytic Geometry (i) 100 Marks

Properties of the real number system as a complete ordered field explicitly stated. Representation of real numbers as points on a line. Absolute value of a real number, and distance on the line. Co-ordinate systems (Cartesian and polar) in the plane.

Sequence, limit of a sequence, convergent sequences. Statement without proof of the result that a bounded monotone sequence of real numbers is convergent. Illustrations to include the sequences

$x^n, \left(1+\frac{1}{n}\right)^n$ and $n^{1/n}$. Some examples of non-convergent sequences.

Infinite series and their convergence. The geometric series. Comparison test and Ratio test for the convergence of series of positive terms.

Real functions. Graph of a function in simple cases e.g.

$y=x,\ y=|x|\quad y=1-|x|,\ y=ax+b,\quad y=x^2$

$y=x^3,\ y=\sqrt{1-x^2},\ y=\frac{1}{x},$

Polynomial functions and Rational functions. Exponential functions and Trigonometric functions, (to be defined by means of power series). Logarithmic functions and inverse trigonometric functions.

Limits of functions defined on intervals. Algebra of limits (Statement of results only). Continuity of a function. Examples of continuous and discontinuous functions.

Derivative of a function at a point. Derivative as a slope and as a rate measurer. Derivatives of sums, products and quotients of derivable functions. Derivative of a composite function of differentiable functions.

Derivatives of higher orders. Leibnitz rule. Taylor's and Maclaurin's series—expansions of some suitable functions.

Functions on R^2 to R. Partial differentiation. Euler's theorem on homogeneous functions.

Derivative of an implicit function. Tangents and normal to plane curves in cartesain co-ordinates.

Primitives. Methods of obtaining Primitives ; (i) Standard forms, (ii) Substitution, (iii) Integration by parts and (iv) Partial fractions. Definite integral as the limit of a sum Representation of a definite integral as a area associated with the graph of the functions. Geometrical demonstration of the fundamental theorem of Integral Calculus. Properties of the definite integral. Integration of Trigonometric function. Reduction formulae for

$$\int \sin^n x\,dx,\ \int \cos^n x\,dx,\ \int \operatorname{cosec}^n x\,dx,\ \int$$

$$\sin^p x \cos^q x\,dx \int \cos^m x \cos nx\,dx \text{ etc.}$$

Determination of area in simple cases (as under graphs of real functions and other similar cases). Formation of Differential Equations and solution of differential equation of the first order. Orthogonal Trajectories.

Analytical study of straight lines in a plane. Second or higher degree equations representing straight lines.

Equations of circle, parabola, ellipse and hyperbola in standard forms. Elementary properties of these curves. Change of coordinate axes. Classification of curves represented by an equation of the second degree in two variables.

B.A./B.Sc. (Hons.) Part II Examination 1979

Paper III—Algebra (ii) **100 Marks**

Normal subgroups. Homomorphism. isomorphism. Kernel of a homomorphism. Quotient groups. Theorems of homomorphisms and isomorphism. Permutation group. Cycles. Transpositions. Even and odd permutations, Alternating group. *Theorem* : "There is 1—1 correspondence between the conjugate classes of Sn and partitions of n". Cayley's Theorem.

Ring Theory :—One sided and two sided ideals, intersection. union, sum and product of two ideals *Theorem* : A commutative ring with identity is a field iff it has no proper too sided ideals. Ring homomorphism. Isomorphism. Kernel of a homomorphism. Quotient rings. Theorems of Homomorphism and Isomorphism. Embedding of a ring without unity in a ring with unity. Ring of Endomorphisms of an Abelian group.

Linear Algebra : Linear Transformations. *Theorem* : Two finite dimensional vector spaces are isomorphic iff they have the same dimensions. Quotient spaces. Dimension of a Quotient space. *Theorem* : If U and V are two finite dimensional subspaces then dim (U+V)=dim U+dim V—dim U∩V. Theorems of homomorphism (i.e. Linear transformations). Matrix of a linear transformation. Algebra of linear transformations. Rank and Nullity of linear transformations. Singular and non-singular linear transformations. Linear functionals. Triaspose of a matrix. *Theorem* : 'Rank of a matrix equals the rank of its transpox'. *Theorem* ; Rank of a matrix equals the rank of the linear transformation associated with it ; Scalar, diagonal, tringular, symmetric, skew-symmetric hermitian, skew-hermitian, orthogonal, and unitary matrices. Row rank, column rank of a matrix. Equivalence of row rank and column rank. Similarity of matrices. Characteristic roots and vectors. Cayley-Hamilton Theorem and its use to compute the inverse of a matrix. Inner product spaces and real quardratic forms.

Paper IV—Analysis (i)

Bounded sets of real numbers, Suprema and Infima. Existence of suprema and infima of bounded sets. Neighbourhood of a point. Interior and accumulation points of a set. Limit superior and inferior of a sequence, Cauchy's general principle and algebra of convergent sequences. Ratio test, comparison test, root test, integral test, Leibnitz test, Dirichilet's test for convergence of series. Absolute convergence. Re-arrangement of series.

Continuous functions and their properties. Uniform continuity. Derivatives. Mean value theorems. Taylor's theorem with Lagrange's and Cauchy's forms of remainder. Applications to maxima-minina. Inequalities and evaluation of limits of indeterminate forms.

Riemann Integration : Definition, Darboux condition of integrability. R-intergral of a (i) continuous function (ii) monotone function. Fundamental Theorem of integral calculus (continuous case only).

Asymptotes. Curvature, radius and circle of curvature. Singular points. Curve tracing. Rectification and quadrature. Volumes and surface areas of solids of revolution. Linear differential equations with constant coefficients. Homogenous linear differential equations.

Paper V—Vectors and Mechanics (i) 100 Marks

Vectors : Addition of vectors, scalar multiple of a vector. A vector represented as a triplet of real numbers. Scalar and vector products. Projection of a vector on a directed line. Differentation and integration of a vector function on an interval.

Basic concepts of Mechanics : particle, rigid body, frame of reference, time, matter, mass, inertia, force, Body force, tension or thrust. Friction. Units of mass, length and time (C.G.S.&M.K.S. systems). Basic laws of Mechanics. Inertial frames of reference. Work and energy. Principles of linear momentum. Angular momentum and energy for a particle. Conservative field and potential energy. Principle of conservation of energy for a particle.

Rectilinear motion : Uniformly accelerated motion (Including connected systems), resisted motion. Harmonic oscillator. Damped and forced vibrations. Elastic springs and strings Hooke's law Vertical and horizontal vibrations of a particle attached to an elastic string.

Motion in plane : Compoxents of velocity and acceleration : Cartesian, radial and transverse, tangential and normal. Projectile motion in a non-resisting medium. Constrained motion in a horizontal circle, conical pendulum. Constrained motion on a smooth vertical circle. Simple pendulum. Motion of a particle under a central force. Differential equation of a central orbit in both reciprocal polar and pedal coordinates. Newton's law of gravitation and planetary orbits. Kapler's laws of motion deduced from Newton's law of gravitation and vice-versa.

Coplanar force systems. Necessary and sufficient condition for equilibrium of a particle. Triangle law of forces, polygon law of forces and Lami's theorem.

Moment of a forces about a line. Varignon's theorem for concurrent force systems. Necessary condition for a system of particles to be in equilibrium.

Equipollent force system—definition. Couples, moment of a couple, equipollence of two couples. Reduction of a geenral plane force system. Parallel force systems. Centre of gravity Formulae, use of symmetry and standard results (stated only). Principle of virtual work for a system of particles.

Motion of a system of particles in a plane. Motion of the mass centre and motion relative to the mass centre. Principles of linear momentum, angular momentum and energy for a system. Two body problem. Impulse and impulsive forces. Impulsive motion in a plane. Elastic impact (direct and oblique).

Infinitesimal displacement of a plane lamina. Necessary and sufficient conditions for equilibrium of a rigid body, movable parallel to a fixed plane. Problems on equilibrium under forces including friction (excluding indeterminate cases) Stable Equilibrium. Energy test of stability (problems involving one variable only).

Flexible cables—common catenary, suspension bridge. Cables in contact with smooth curves and cables in contact with rough curves.

(Only simple problems directly related to the theory may be attempted from the books below).

Books for Reference

1. Principles of Mechanics by Synge and Griffiths. (For structure of Mechanics).
2. A text book of Dynamics by F. Chorlton—Chapters 3—6. For Problems.
3. Statics by A.S. Ramsey—Chapters, 3—6, 9, 11—12. For Problems.

B.A./B.Sc. (Hons.) Part III Examination 1980

Paper VI—Algebra (iii) 100 Marks

Group Theory : Cyclic Groups and their structures. Conjugacy relation. Centre, Normalizer. Class Equation of a group.

Theorems : (1) 'Every Group of order p^n where $n > 1$ has a non trivial centre.'

(2) 'Every group of order p^2 is Abelian.'

Cauchy's theorem and sylow's three theorems.

Automorphism of Groups. Inner Automorphism. *Theorem* : 'If Z is the centre of a group G then G/Z is isomorphic to the group of inner automorphisms of G.' Direct product of groups. Complete study of grouos of order 4, 6 and 8. Basis theorem of finitely generated. Abelian groups. Simple groups. Simplicity of A_n for $n \geqslant 5$. Composition series. Schreier Theorem. Jordan-Holder theorem Subgroup generated by a subset. Commutators. Derived Groups. Solrable groups. Unsolvability of S_n for $n \geqslant 5$.

Ring Theory : Embedding of an integral domain in a field. Field of Quotients and its uniqueness within isomorphism. Maximal Ideal. Prime Ideals in commutative rings.

Following Theorems :

(1) 'In a commutative ring R with unity, M is a maximal idea[l] iff R/M is a field.'

(2) 'In a commutative ring R, P is a prime ideal, iff R/P is an integral domain.'

Polnomials over commutative rings and over fields. Euclidean Domains. Principal Ideal. Principal Ideal. Domains. Unique Factorization Domains. Inter-relation between these domains. *Theorem* : 'If R is a unique factorization domain then R [X] is also a unique factorization domain.' Ring of Gaussian Integers. Irreducible poleynomials, Elsentim Criterion of Irreducibility over Q. Characteristic of a field Prime fields, Subfields and Criterion of Subfields.

Books Suggested :

1. Topics in Algebra by I.N. Herstein, Blaisdell Publishing Company, New York.
2. A First Course in Abstract Algebra by J. Fraleigh, Addison-Wesley Publishing Company.
3. Introduction to Abstract Algebra by W.E. Barnes, B.C. Health and Company, Boston.
4. Elements of Abstract Algebra by Dean R.A. John Wiley.

Paper VII—Analysis (ii) 100 Marks

Cantor's theory of real numbers, starting from rational numbers. Riemann-Stieltjes Integral. Definition and existence of the integral. The integral as the limit of a sum. The fundamental theorem of integral calculus. Mean Value theorems. Functions of bounded variation and their integrability. Theorems on integrability. Riemann integral as a particular case of Riemann Stieltjes integral.

Sequences and series of complex numbers. Absolute convergence. Convergence and absolute convergence of double series $\Sigma_{m,n}\, a_{nm}$ Sufficient condition for the validity of $\Sigma_{m,n}\, a_{mn} = \Sigma_m \Sigma_n\, a_{mn} = \Sigma_n \Sigma_m\, a_{mn}$ Product of two absolutely convergent series. Cauchy product of two series, one of which is absolutely convergnnt. Infinite Product. Convergence of $\Pi(1+a_n)a_n \geqslant 0$, $\Pi(1-b_n)$, $b_n \geqslant 0$. Absolute convergence of $\Pi\ (1+a_n)$.

Uniform convergence of sequences and series of complex functions. Weiestrass M-test. Continuity of complex functions. Uniform conver ence and continuity.

Uniform convergence and integration, uniform convergence and differentiation. Weierstrass approximation theorem (reals only).

Complex power series. Circle of convergence. Uniform and absolute convergence of power series within the circle of convergence.

Definitions of e^z, sin z, cos z, sin h z, cosh z by means of power series and deduction of their properties.

Fourier series and its convergence (reals only). Simple cases : (Functions of bounded variation and differentiable functions)

Paper VIII—Calculus and Analytic Geometry (ii) 100 Marks

CALCULUS ($\frac{3}{4}$)

Functions of two and three variables, their continuity and Differentiablility. Partial Derivatives. Applications. Euler's theorm on homogeneous functions. Young's and Schwarz's conditions for equality of f_{xy} and f_{yx}.

Implicit function theorem. Taylor's theorem and maxima and minima for functions of two variables. Lagranges' method of undetermined multipliers.

Double and triple integrals, Iterated integrals. Change of order of intergration. Line, surface integrals and volume integrals.

Vector Calculus. Curl, Divergence and Gradient. Green's theorm. Stoke's theorem, Gauss' Theorem.

Improper integrals. Convergence of an improper integral. Comparison tests. Diricheletss Test. Convergence of $\int_{0}^{\infty} \frac{\sin x}{x} dx$ and $\int_{a}^{\infty} \frac{\cos x}{x} dx, a > o$.

Differentiation under integral sign. Beta and Gama functions ; their properties and relationships.

Analytic Geometry ($\frac{1}{4}$)

Analytical study of plane, st. line, sphere, cone, and cylinder. Standard equations of ellipsoid, paraboloid and hyperbloid.

Paper IX—Mechanics (ii) and Differential Equations 100 Marks

MECHANICS ($\frac{3}{8}$)

Scalar and vector products of two vectors. Differentiation of a product of two vectors. Triple products. Moments of a (localised) vector about a point. Scalar moment of a vector about a directed line.

General force system—total force and total moment relative to a base point. Total moment, under a changes of base point. Necessary and sufficient conditions for a system to be equipollent to zero. Moment of a couple, composition of couples. Reduction of a force system to a force and a couple. Reduction to a wrench. Invariants of a system.

Euler's theorem (without proof) on displacement of a rigid body with one point fixed. General displacement of a rigid body, Infinitesimal displacement of a rigid body, about a point. Composition of infinitesimal displacements. Reduction to a screw displacement.

Work done on (i) a particle (ii) a rigid body, in a given infinitesimal displacement. Necessary and sufficient conditions for equilibrium of a rigid body (or a system with workless constraints) by an application of the principle of virtual work.

Motion of a body about a fixed point. Angular velocity. Relation between angular velocity and linear velocity of a point of the body. General motion of a body.

Accelerating frames, Rotating frames. Time flux of a vector, referred to a rotating frame Coriolis force and centrifugal force. Frames with constant angular velocity.

Moments of inertia. Definitions. Standard results. Momental ellipsoid. Parallel exes theorem for moments and products of inertia. Perpendicular axis theorem for a planar distribution. Principal axes of inertia, defined as the axes about which M. I. has a stationary value. Existence of principal axes of inertia at a point. Determination of other two principal axes of inertia at a point of a body, when a line through that point is given to be a principal axis. Equimomental systems.

Angular momentum and Kinetic energy of a rigid body rotating about a fixed point. K.E. of a rigid body in a general motion expressed as the sum of two terms, one due to translation of the body and the other due to rotation about its centre of mass.

Principles of linear momentum, Angular momentum and energy for a rigid body. D 'Alemberts' Principle & general equations of motion of a rigid body. Motions about a fixed axis. Compound Pendulum. Two dimensional problems in rigid body dynamics, under finite and impulsive forces.

Only simple problems directly related to the theory may be attempted from the books below.

References :

1. Principles of Mechanics by Synge and Griffith.
   For structure of Mechanics and Problems.
2. A text book of Dynamics by F. Chorlton—Chapters 7-8 Problems.
3. Statics by A.S. Ramsey—Chapter XIV. Problems.

Differential Equations ($\frac{1}{8}$)

Second order linear differential equations. Systems of linear differential equations.

Total differential equations in three variables. General singular and complete solutions of partial differential equations of the first order. Lagrange's method, Charpit's method. Monge's method for partial differential equations of the second order. Linear partial differential equations with constant co-efficients. Homogeneous linear partial differential equations with variable co-efficients.

Paper X—Option (i) Probability Theory 100 Marks

Probability spaces. Finite Probability space. Conditional Probability, Bayes' theorem. Random variables. Mathematical Expectation and Moments. Joint Distributions. Independent Random variables. Covergence of a sequence of random variables convergence in distribution, convergence in probability, almost sure convergence, convergence in quadratic mean. Helley-Bray Theorem. Complex-valued Random variables. Characteristic function, Inversion theorem. Continuity theorem. Distribution derived froni the Normal-distribution—Distribution of $\bar{X}$ and S^2. Kolmogorov's inequality. Weak and strong laws of Large Numbers. Central Limit theorems.

Books for reference :

1. Modern Probability Theory and its applications: E. Parzon.
2. An Introduction to Probability Tleory and its applications Vol. I (3rd edition). W. Feller.
3. Probability. Elements of the Mathematics Theory : C.R. Heathcote.

Option (ii) Mathematical Statistics

Concepts of Statistical population and Random sample. Collection and presentation of data. Histogram. Frequency polygon. Frequency curves and Ogives. Measures of location and dispersion. Moments. Sheppard's corrections for moments up to fourth order. Cumulants. Measures of skewness and kurtosis. Elements of the theory of attributes, Association and Contingency.

Random experiment. Discrete sample space. Events, their union, intersection etc. Probability—Classical, Relative frequency and axiomatic approches. Probability spaces. Conditional probability and independence of events. Basic laws of probability. Probability of at least one event. Geometrical probability. Bayes'

theorem. Random variable. Probability function, Probability in continuum. Probability density function and Distribution function. Independent random variables. Mathematical expectations and its laws. Variance and covariance. Bivariate distributions. Marginal and conditional distributions. Conditional expectation. Correlation and Linear regression for two veriables. Rank correlation with Ties. Correlation ratio. Curve fitting by least squares. Multiple and partial correlation for 3 variates only.

Moment generating function, characteristic function and cumulant function. Bernoulli trials. Distributions : Binomial, Poisson, Normal, Geometric, Uniform, Triangular, Exponential, Double exponential, Cauchy, Multinomial, Beta and Gamma. Limiting forms of the Binomial and Poisson distributions. Chebychev's lemma, law of Large Numbers. Central limit theorem for identical variates.

Concepts of sampling distribution and standard error. Derivation of sampling distribution of (i) mean of random sample from normal population, (ii) sum of squares of standard normal deviates, (iii) t and F statistics. Large sample tests for mean and proportion. Tests of significance based on t, F and X^2 (Chi-square) statistics.

Option (iii) Linear Programming and Theory of Games :

Linear Programming : Convex sets and their properties. Theory of simple method. Revised simplex algorithm. Degeneracy. Duality theory. Sensitivity Analysis, Parametric linear programming Transportation and Assignment problems

Theory of Games : Rectangular Games. Saddle points. Mixed strategies. Fundamental Theorem for rectangular games. Properties of optimal strategies. Relations of dominance. Various methods for solving rectangular games. Inter-relation between theory of games and linear programming.

Books suggested :

1. G. Hadley : Linear Programming
2. S.I. Gass : Linear Programming : Methods and applications.
3. Mc Kinsey : Introduction to the Theory of Games.

Option (iv) Computer Mathematics :

Finite State Mechanics: Binary devices and states, finite state machines, covering and equivalence, equivalent states, minimization procedure, Turing machine.

Programming Languages : Arithmetic expressions, identifiers, arrays, FORMAT statements, Block structures in ALGOL. The ALGOL grammar.

Boolean Algebras : Boolean polynomials, Block diagram for getting network, connection with logic, logical capabilities of ALGOL. Boolean applications, Boolean subalgebras, disjunctive normal form.

Optimization and Computer Design : Optimization, Computerizing optimization, Logic design, NAND gates and NOR gates, the Minization problems, procedure for deriving prime implicants, Flip flops, sequential machine design.

Binary Group Codes : Encoding and decoding, Block codes, matrix encoding techniques, Group codes, Decoding tables, Hamming codes.

Bose Chaudhury Hoequengnen Codes : Computations in GF (2^n), BCH Codes.

References :

Modern Applied Algebra by Garrot Birkhoff and Thrnas C. Bartee, 1970. (McGraw Hill).

Option (v) Numerical Mathematics :

Finite, Central and Divided differences. Interpolation, Inverse Interpolation, Numerical differentiation. Numerical Integration; Trapezoidal, Simpson's 1/3rd and 3/8th rules, Weddle's Rule. Gauss quadrature formula of integration, Gregory's formula and the Euler Maclaurin's formula.

Solution of difference equation of the first order. General properties of linear difference equations. Linear difference equations with constant coefficients.

Solution of ordinary differential equations—One step methods : Euler's modified, Picard's, Runge Kutta's method. Method of starting

the solution and continuing the solution : Adams, Adams Bashforth, Milne.

Simultaneous linear equation : Gauss elimination, Gauss-Seidel Jordan's and Relaxation methods, (Simple problems).

Finding roots of polynomial equations : Regula Falsi, Bolzano's Bisection, Newton Raphson, Newton Raphson method for several variables, iterative method and its generalisation. Chebyshev's Birge-Vieta Lin-Bairstow's Graeffe's Roct Squaring methods and their convergence.

Significant figures and errors of computation. Nomograms.

Books for Reference:

1.	Froberg	Numerical Analysis
2.	Kunz	Numerical Analysis
3.	Nielson	Numerical Analysis
4.	Levy and Lessman	Finite Difference Equations (Chapters 3 and 4).
5.	Hildebrand	Introduction to Numerical Analysis.

Option (vi) Number Theory :

The Basis Representation theorem, Linear Diophantine equations, Fundamental theorem of Arithmetic, Fermat's little Theorem, Wilson's theorem.

Basic properties of congruences. Residue system, Euler's Theorm, Chinese Remainder Theorem. Multiplicative arithmetic functions, the functions ϕ (n), μ (n), σ (n) and their simple properties ; Mobius Inversion formula. Primitive roots modulo n.

Elementary properties of π (x), Legendre's formula for the highest power of a prime number that divides n!, statement of the prim number theorem of Euler's criterion for quadratic regidues, the legendre symbol the Quadratic Reciprociiy law and its applications.

Sums of two and four squares, Fermat's conjecture. Graphical representation of partitions. Euler's partition theorem.

Books for reference :

G.E. Andrews. 1971, Number Theory.

Option (vii) Multilinear Algebra—Syllabus to be prescribed later.

Option (viii) Lattice Theory:

Partial Order, Chains Lattices, Examples of Lattices. Meets and Joins, Duality, Length and Covering conditions. Atoms, Complements. Complemented and relatively complemented lattices. Sublattices, Modular and semi-modular lattices. Lattices of groups and modules.

Distributive lattices. Irreducible elements. Ideals of a lattice. Homomorphism. Isomorphism. Dual Isomorphism. Boolean Algebras.

Books for Reference :

Thomas Donnellan : Lattice Theory. Pergamon Press, Oxford. 1968.

(Chapters. 2, 3, 4; Chapter 5; sections 21, 22 and 23 only. Chapter 6: sections 25, 26 and 27 only.)