Chaudhary Ranbir Singh University, Jind

Scheme of Examination of M.Sc. Mathematics, Semester –III
(w.e.f. Session 2017-18)

Compulsory Papers:

Paper Code	Nomenclature	External Theory Exam. Marks	Internal Assessment Marks	Max. Marks	Examination Hours
MM-501	Functional Analysis -I	80	20	100	3 Hours
MM-502	Partial differential equations and mechanics	80	20	100	3 Hours

Optional Papers: A student can opt one optional paper from MM-503 opt (i) to opt (iv). Similarly one paper will be opted each from MM-504 opt (i) to opt (iv) and MM-505 opt (i) to (iv)

Paper Code	Nomenclature	External Theory Exam. Marks	Internal Assessment Marks	Max. Marks	Examination Hours
MM-503 (Opt. (i))	Elasticity	80	20	100	3 Hours
MM-503 **(Opt. (ii)**	Difference Equations-I	80	20	100	3 Hours
MM-503 **(Opt. (iii)**	Complex Analysis	80	20	100	3 Hours
MM-503 **(Opt. (iv)**	Number Theory	80	20	100	3 Hours
MM-504 (Opt. (i)	Fluid Mechanics - I	80	20	100	3 Hours
MM-504 **(Opt. (ii)**	Mathematical Statistics	80	20	100	3 Hours
MM-504 **(Opt. (iii)**	Algebraic Coding Theory	80	20	100	3 Hours
MM-504 **(Opt. (iv)**	Commutative Algebra	80	20	100	3 Hours

Paper Code	Nomenclature	External Theory Exam. Marks	Internal Assessment Marks	Max. Marks	Examination Hours
MM-505 (Opt. (i)	Integral Equations and calculus of variations	80	20	100	3 Hours
MM-505 **(Opt. (ii)**	Mathematical Modeling	80	20	100	3 Hours
MM-505 **(Opt. (iii)**	Linear Programming	80	20	100	3 Hours
MM-505 **(Opt. (iv)**	Fuzzy Sets & Applications -I	80	20	100	3 Hours

SEMESTER-III

MM-501 : Functional Analysis-I

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks : 80
+Internal Assessment Marks : 20)

Note : The question paper will consist of **five** Sections. Each of the first four Sections will contain **two** questions from Section **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each Section. Section five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**. **Books Recommended** 1. H.L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993. 2. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley. 3. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963. 4. A. H. Siddiqi, Khalil Ahmad and P. Manchanda, Introduction to Functional Analysis with Applications.

Section -I (2 Questions) Normed linear spaces, Metric on normed linear spaces, Completion of a normed space, Banach spaces, subspace of a Banach space, Holder"s and Minkowski"s inequality, Completeness of quotient spaces of normed linear spaces. Completeness of lp, Lp, Rn, Cn and C[a,b]. Incomplete normed spaces.

Section -II (2 Questions) Finite dimensional normed linear spaces and Subspaces, Bounded linear transformation, Equivalent formulation of continuity, Spaces of bounded linear transformations, Continuous linear functional, Conjugate spaces, Hahn-Banach extension theorem (Real and Complex form).

Section -III (2 Questions) Riesz Representation theorem for bounded linear functionals on Lp and C[a,b]. Second conjugate spaces, Reflexive space, Uniform boundedness principle and its consequences, Open mapping theorem and its application projections, Closed Graph theorem.

Section -IV (2 Questions) Equivalent norms, Weak and Strong convergence, their equivalence in finite dimensional spaces. Weak sequential compactness, Solvability of linear equations in Banach spaces, Compact operator and its relation with continuous operator. Compactness of linear transformation on a finite dimensional space, properties of compact 5 operators, compactness of the limit of the sequence of compact operators, the closed range theorem.

Books Recommended

1. H.L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993.

2. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley.

3. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.

4. A. H. Siddiqi, Khalil Ahmad and P. Manchanda, Introduction to Functional Analysis with Applications.

SEMESTER-III

MM:502 : Partial Differential Equations and Mechanics

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks : 80
+Internal Assessment Marks : 20)

Note : The question paper will consist of **five** Sections. Each of the first four Sections will contain **two** questions from Section **I** , **II** , **III** , **IV** respectively and the students shall be asked to attempt **one** question from each Section. Section five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Section – I(2 Questions) Method of separation of variables to solve B.V.P. associated with one dimensional heat equation. Solution of two dimensional heat equation and two dimensional Laplace equation. Steady state temperature in a rectangular plate, in the circular disc, in a semi-infinite plate. The head equation in semi-infinite and infinite regions. Temperature distribution in square plate and infinite cylinder. Solution of three dimensional Laplace equation in Cartesian, cylindrical and spherical coordinates. Dirichlets problem for a solid sphere. (Relevant topics from the books by O"Neil)

Section -II(2 Questions) Method of separation of variables to solve B.V.P. associated with motion of a vibrating string. Solution of wave equation for Semi-infinite and infinite strings. Solution of wave equation in two dimensions. Solution of three dimensional wave equation in Cartesian, cylindrical and spherical coordinates. Laplace transform solution of B.V.P.. Fourier transform solution of B.V.P. (Relevant topics from the books by O"Neil)

Section-III(2 Questions) Kinematics of a rigid body rotating about a fixed point, Euler"s theorem, general rigid body motion as a screw motion, moving coordinate system - rectilinear moving frame, rotating frame of reference, rotating earth. Two- dimensional rigid body dynamics – problems illustrating the laws of motion and impulsive motion. (Relevant topics from the book of Chorlton).

Section -IV(2 Questions) Moments and products of inertia, angular momentum of a rigid body, principal axes and principal moment of inertia of a rigid body, kinetic energy of a rigid body rotating about a fixed point, momental ellipsoid and equimomental systems, coplanar mass distributions, general motion of a rigid body. (Relevant topics from the book of Chorlton).

SEMESTER-III

MM503 (opt. i) Elasticity

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : **The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.**

SECTION-I (Two Questions)

Tensor Algebra: Coordinate-transformation. Cartesian Tensor of different order. Properties of tensors. Isotropic tensors of different orders and relation between them. Symmetric and skew symmetric tensors. Tensor invariants. Deviatoric tensors. Eigen-values and eigen-vectors of a tensor.

Tensor Analysis: Scalar, vector, tensor functions. Comma notation. Gradient. divergence and curl of a vector / tensor field. (Relevant portions of Chapters 2 and 3 of book by D.S. Chandrasekharaiah and L Debnath)

SECTION-II (Two Questions)

Analysis of Strain : Affine transformation. Infinitesimal affine deformation. Geometrical Interpretation of the components of strain. Strain quadric of Cauchy. Principal strains and invariance, General infinitesimal deformation. Saint-Venant's equations of compatibility. Finite deformations

Analysis of Stress : Stress Vecotr, Stress tensor. Equations of equilibrium. Transformation of coordinates.

(Relevant portion of Chapter I & II of book by I.S. Sokolnikoff).

SECTION-III (Two Questions)

Stress quadric of Cauchy. Principal stress and invariants. Maximum normal and shear stresses. Mohr's circles, examples of stress. Equations of Elasticity : Generalised Hooks Law. Anisotropic symmetries, Homogeneous isotropic medium.

(Relevant portion of Chapter II & III of book by I.S. Sokolnikoff).

SECTION-IV (Two Questions)

Elasticity moduli for Isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid. Strain energy function and its connection with Hooke's Law. Uniqueness of solution. Beltrami-Michell compatibility equations. Clapeyrom's theorem. Saint-Venant's principle.
(Relevant portion of Chapter III of book by I.S.Sokolnikoff).

Books:

1. I.S. Sokolnikoff, Mathematical Theory of Elasticity, Tata-McGraw Hill Publishing Company Ltd., New Delhi, 1977.
2. A.E.H. Love, A Treatise on the Mathematical Theory of Elasticity Dover Publications, New York.
3. Y.C. Fung, Foundations of Solid Mechanics, Prentice Hall, New Delhi, 1965.
4. D.S. Chandrasekharaiah and L. Debnath, Continuum Mechanics, Academic Press, 1994.
5. Shanti Narayan, Text Book of Cartesian Tensor, S. Chand & Co., 1950.
6. S. Timeshenki and N. Goodier, Theory of Elasticity, McGraw Hill, New York, 1970.
7. I.H. Shames, Introduction to Solid Mechanics, Prentice Hall, New Delhi, 1975.

SEMESTER-III

MM-503 (opt. ii) Difference Equations-I

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.

SECTION-I (Two Questions)

Introduction,the difference calculus: The difference operator,falling factorial power t^r ,binomial coefficient $\binom{t}{r}$, summation, definition, properties and examples, Abel's summation formula, Generating functions, Euler's summation formula, Bernoulli polynomials and examples, approximate summation.

SECTION-II (Two Questions)

Linear Difference Equation: First order linear equations, general results for linear equations, solution of linear difference equation with constant coefficients and with variable coefficients, Non-Linear Equations that can be linearized, applications.

SECTION-III (Two Questions)

Stability Theory : Initial value Problems for Linear systems, eigen values, eigen vectors and spectral radius, Caylay-Hamilton Theorem, Putzer algorithm, Solution of nonhomogeneous system with initial conditions, Stability of linear systems, stable subspace theorem and example, Stability of non-linear system, Chaotic behaviour.

SECTION-IV (Two Questions)

The Z-Transform, definition, Properties, initial and final value Theorem, Convolation Theorem, Solving the initial value problems. Volterra summation equation and Fredholm summation equation by use of Z-Transform.

Asymptotic Methods : Introduction, Asymptotic Analysis of Sums, and examples. Asymptotic behaviour of solutions of homogeneous linear equations, Poincare's Theorem, Perron Theorem (Statement only), non-linear equations.

Recommended Text:

W.G. Kelley and A.C. Peterson: Difference Equations: An introduction with Applications. Academic Press, Harcourt, 1991 (Relevant portions of chapters 1-5.)

Reference Book:

Calvin Ahlbrandt & Allan C. Peterson, Discreet Hamiltonian systems, Difference Equations, Continued Fractions & Ricati Equation. Kluwer Botson, 1996

SEMESTER-III

MM:503(opt. iii) : Complex Analysis

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks : 80
+Internal Assessment Marks : 20)

Note : The question paper of each course will consist of **five** Sections. Each of the sections **I to IV** will contain **two** questions and the students shall be asked to attempt **one** question from each. **Section-V** shall be **compulsory** and will contain **eight** short answer type questions without any internal choice covering the entire syllabus

Section - I

Function of a complex variable, Continuity, Differentiability. Analytic functions and their properties, Cauchy-Riemann equations in cartesian and polar coordinates. Power series, Radius of convergence, Differentiability of sum function of a power series, Branches of many valued functions with special reference to argz, logz and z^n.

Section - II

Path in a region, Contour, Complex integration, Cauchy theorem, Cauchy integral formula, Extension of Cauchy integral formula for multiple connected domain, Poisson integral formula, Higher order derivatives, Complex integral as a function of its upper limit, Morera theorem, Cauchy inequality, Liouville theorem, Taylor theorem.

Section - III

Zeros of an analytic function, Laurent series, Isolated singularities, Cassorati- Weierstrass theorem, Limit point of zeros and poles. Maximum modulus principle, Schwarz lemma, Meromorphic functions, Argument principle, Rouche theorem, Fundamental theorem of algebra, Inverse function theorem.

Section - IV

Calculus of residues, Cauchy residue theorem, Evaluation of integrals of the types $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$, $\int_{-\infty}^{\infty} f(x)dx$, $\int_0^{\infty} f(x)\sin mx\,dx$ and $\int_0^{\infty} f(x)\cos mx\,dx$, Conformal mappings.

Space of analytic functions and their completeness, Hurwitz theorem, Montel theorem, Riemann mapping theorem.

Books Recommended:

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of One Complex Variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 2002.
3. Liang-Shin Hann & Bernand Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
4. E.T. Copson, An Introduction to the Theory of Functions of a Complex Variable, Oxford University Press, London, 1972.
5. E.C. Titchmarsh, The Theory of Functions, Oxford University Press, London.
6. Ruel V. Churchill and James Ward Brown, Complex Variables and Applications, McGraw-Hill Publishing Company, 2009.
7. H.S. Kasana, Complex Variable Theory and Applications, PHI Learning Private Ltd, 2011.
8. Dennis G. Zill and Patrik D. Shanahan, A First Course in Complex Analysis with Applications, John Bartlett Publication, 2nd Edition, 2010.

SEMESTER-III

MM-503 (opt. iv) **Number Theory**

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : **The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.**

SECTION-I (Two Questions)

The equation ax+by = c, simultaneous linear equations, Pythagorean triangles, assorted examples, ternary quadratic forms, rational points on curves.

SECTION-II (Two Questions)

Elliptic curves, Factorization using elliptic curves, curves of genus greater than 1. Farey sequences, rational approximations, Hurwitz theorem, irrational numbers, Geometry of Numbers, Blichfeldt's principle, Minkowski's Convex body theorem Lagrange's four square theorem.

SECTION-III (Two Questions)

Euclidean algorithm, infinite continued fractions, irrational numbers, approximations to irrational numbers. Best possible approximations. Periodic continued fractions, Pell's equation.

SECTION-IV (Two Questions)

Partitions, Ferrers Graphs, Formal power series, generating functions and Euler's identity, Euler's formula, bounds on P(n), Jacobi's formula, a divisibility property.

Recommended Text:

An Introduction to the Theory of Numbers	Ivan Niven Herbert S. Zuckerman Hugh L. Montgomery John Wiley & Sons(Asia)Pte.Ltd. (Fifth Edition)

SEMESTER- III

MM-504 (opt. i) Fluid Mechanics-I

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.

SECTION-I (Two Questions)

Kinematics of fluid in motion:Velocity at a point of a fluid. Lagrangian and Eulerian methods. Stream lines, path lines and streak liens, vorticity and circulation. Vortex lines, Acceleration and Material derivative, Equation of continuity (vector or Cartesian form). Reynolds transport Theorem. General analysis of fluid motion. Properties of fluids- static and dynamic pressure. Boundary surfaces and boundary surface conditions. Inotational and rotational motions. Velocity potential.

SECTION-II (Two Questions)

Equation of Motion : Lagrange's and Euler's equations of Motion (vector or in Cartesian form). Bernoulli's theorem. Applications of the Bernoulli Equation in one -dimensional flow problems. Kelvins circulation theorem, vorticity equation. Energy equation for incompressible flow. Kinetic energy of irrotational flow. Kelvins minimum energy theorem .mean potential over a spherical surface. Kinetic energy of infinite liquid. Uniqueness theorems.

SECTION -III (Two Questions)

Stress components in a real fluid. Relations between rectangular components of stress. Connection between stresses and gradients of velocity.Navier- Stoke's equations of motion. Steady flows between two parallel plates. Plane Poiseuille and Couette flows.

SECTION -IV (Two Questions)

Reduction of Navier-Stock equations in flows having axis of symmetry, steady flow in circular pipe: the Hagen-Poiseuille flow, steady flow between two coaxial cylinders, flow between two concentric rotating cylinders. Steady flows through tubes of uniform cross-section in the form (i) Ellipse, (ii) equilateral triangle, (iii) rectangle, under constant pressure gradient, uniqueness theorem.

SEMESTER- III

MM-504 (opt. i) Fluid Mechanics-I

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.

SECTION-I (Two Questions)

Kinematics of fluid in motion:Velocity at a point of a fluid. Lagrangian and Eulerian methods. Stream lines, path lines and streak liens. vorticity and circulation. Vortex lines. Acceleration and Material derivative. Equation of continuity (vector or Cartesian form). Reynolds transport Theorem. General analysis of fluid motion. Properties of fluids- static and dynamic pressure. Boundary surfaces and boundary surface conditions. Inotational and rotational motions. Velocity potential.

SECTION-II (Two Questions)

Equation of Motion : Lagrange's and Euler's equations of Motion (vector or in Cartesian form). Berneulli's theorem. Applications of the Bernoulli Equation in one dimensional flow problems. Kelvins circulation theorem. vorticity equation. Energy equation for incompressible flow. Kinetic energy of irrotational flow. Kelvins minimum energy theorem .mean potential over a spherical surface. Kinetic energy of infinite liquid. Uniqueness theorems.

SECTION -III (Two Questions)

Stress components in a real fluid. Relations between rectangular components of stress. Connection between stresses and gradients of velocity.Navier- Stoke's equations of motion. Steady flows between two parallel plates. Plane Poiseuille and Couette flows.

SECTION -IV (Two Questions)

Reduction of Navier-Stock equations in flows having axis of symmetry. steady flow in circular pipe: the Hagen-Poiseuille flow. steady flow between two coaxial cylinders. flow between two concentric rotating cylinders. Steady flows through tubes of uniform cross-section in the form (i) Ellipse. (ii) equilateral triangle. (iii) rectangle. under constant pressure gradient. uniqueness theorem.

Books :

1. W.H. Besant and A.S. Ramsey, A Treatise on Hydromechanics, Part-II, CBS Publishers, Delhi, 1988.
2. F. Chorlton, Text-book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985.
3. Michael E.O. Neill and F. Chorlton, Ideal and Incompressible Fluid Dynamics, John Wiley & Sons, 1986.
4. G.K. Batchelor, An Introduciton to Fluid Mechanics, Foundation Books, New Delhi, 1994.
5. A.J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics Springer-Verlag, New York, 1993.
6. L.D. Landau and E.M. Lipschitz, Fluid Mechanics Pergamon Press, London, 1985.
7. H. Schlichting, Boundary Layer Theory, McGraw Hill Book Company, New York, 1979.
8. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.9
9. A.D. Young, Boundary Layers, AIAA Education Series, Washington DC, 1989.
10. S. W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Ltd., New Delhi, 1976.

SEMESTER - III

MM-504 (opt.ii) : Mathematical Statistics

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks : 80
+Internal Assessment Marks : 20)

Note : The question paper will consist of **five** Sections. Each of the first four Sections will contain **two** questions from Section **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each Section. Section five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**

Section - I (2 Questions) Probability: Definition of probability-classical, relative frequency, statistical and axiomatic approach, Addition theorem, Boole's inequality, Conditional probability and multiplication theorem, Independent events, Mutual and pairwise independence of events, Bayes' theorem and its applications.

Section - II (2 Questions) Random Variable and Probability Functions: Definition and properties of random variables, discrete and continuous random variables, probability mass and density functions, distribution function. Concepts of bivariate random variable: joint, marginal and conditional distributions. Mathematical Expectation: Definition and its properties. Variance, Covariance, Moment generating function- Definitions and their properties. Chebychev's inequality.

Section - III (2 Questions) Discrete distributions: Uniform, Bernoulli, binomial, Poisson and geometric distributions with their properties. Continuous distributions: Uniform, Exponential and Normal distributions with their properties. Central Limit Theorem (Statement only).

Section - IV (2 Questions) Statistical estimation: Parameter and statistic, sampling distribution and standard error of estimate. Point and interval estimation, Unbiasedness, Efficiency. Testing of Hypothesis: Null and alternative hypotheses, Simple and composite hypotheses, Critical region, Level of significance, One tailed and two tailed tests, Two types of errors. Tests of significance: Large sample tests for single mean, single proportion, difference between two means and two proportions;

Books Recommended :

1. Mood, A.M., Graybill, F.A. and Boes, D.C., Mc Graw Hill Book Company.
2. Freund, J.E., Mathematical Statistics, Prentice Hall of India.
3. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi.
4. Speigel, M., Probability and Statistics, Schaum Outline Series.

Semester - III

MM- 504 (opt. iii) Algebraic Coding Theory

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : **The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.**

SECTION - I (Two Questions)

Block Codes. Minimum distance of a code. Decoding principle of maximum likelihood. Binary error detecting and error correcting codes. Group codes. Minimum distance of a group code (m, m+1) parity check code. Double and triple repition codes. Matrix codes. Generator and parity check matrices. Dual codes. Polynomial codes. Exponent of a polynomial over the binary field. Binary representation of a number. Hamming codes. Minimum distance of a Hamming code. (Chapter 1, 2, 3 of the book given at Sr. No. 1).

SECTION - II (Two Questions)

Finite fields. Construction of finite fields. Primitive element of a finite field. Irreducibility of polynomials over finite fields. Irreducible polynomials over finite fields. Primitive polynomials over finite fields. Automorphism group of $GF(q^n)$. Normal basis of $GF(q^n)$. The number of irreducible polynomials over a finite field. The order of an irreducible polynomial. Generator polynomial of a Bose-Chaudhuri-Hocqhenghem codes (BCH codes) construction of BCH codes over finite fields. (Chapter 4 of the book given at Sr. No. 1 and Section 7.1 to 7.3 of the book given at Sr. No. 2)

SECTION - III (Two Questions)

Linear codes. Generator matrices of linear codes. Equivalent codes and permutation matrices. Relation between generator and parity-check matrix of a linear codes over a finite field. Dual code of a linear code. Self dual codes. Weight distribution of a linear code. Weight enumerator of a linear code. Hadamard transform. Macwilliams identity for binary linear codes.

Maximum distance separable codes. (MDS codes). Examples of MDS codes. Characterization of MDS codes in terms of generator and parity check matrices. Dual code of a MDS code. Trivial MDS codes. Weight distribution of a MDS code. Number of code words of minimum distance d in a MDS code. Reed solomon codes. (Chapter 5 & 9 of the book at Sr. No. 1).

Books :

1. W.H. Besant and A.S. Ramsey, A Treatise on Hydromechanics, Part-II, CBS Publishers, Delhi, 1988.
2. F. Chorlton, Text-book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985.
3. Michael E.O. Neill and F. Chorlton, Ideal and Incompressible Fluid Dynamics, John Wiley & Sons, 1986.
4. G.K. Batchelor, An Introduciton to Fluid Mechanics, Foundation Books, New Delhi, 1994.
5. A.J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics Springer-Verlag, New York, 1993.
6. L.D. Landau and E.M. Lipschitz, Fluid Mechanics Pergamon Press, London, 1985.
7. H. Schlichting, Boundary Layer Theory, McGraw Hill Book Company, New York, 1979.
8. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.9
9. A.D. Young, Boundary Layers, AIAA Education Series, Washington DC, 1989.
10. S. w. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Ltd., New Delhi, 1976.

SEMESTER-III

MM-504 (opt. iv) Commutative Algebra

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : **The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.**

SECTION-I (Two Questions)

Zero divisors, nilpotent elements and units. Prime ideals and maximal ideals. Nil radical and Jacobson radical. Comaximal ideals. Chineese remainder theorem. Ideal quotients and annihilator ideals. Extension and contraction of ideals. Exact sequences. Tensor product of module Restriction and extension of scalars. Exactness property of the tensor product. Tensor products of algebras.

SECTION-II (Two Questions)

Rings and modules of sections. Localization at the prime ideal P. Properties of the localization. Extended and contracted ideals in rings of fractions.

Primary ideals. Primary decomposition of an ideal. Isolated prime ideals. Multiplicatively closed subsets.

SECTION-III (Two Questions)

integral elements. Integral closure and integrally closed domains. Going-up theorem and the Going-down theorem. valuation rings and local rings. Noether's normalization lemma and weak form of nullstellensatz Chain condition. Noetherian and Artinian modules. composition series and chain conditions.

SECTION-IV (Two Questions)

Noetherian rings and primary decomposition in Noetherian rings. radical of an ideal. Nil radical of an Artinian ring. Structure Theorem for Artinian rings. Discrete valuation rings. Dedekind domains. Fractional ideals.

(Scope of the course is as given in Chapter 1 to 9 of the recommended text).

SECTION - IV (Two Questions)

Hadamard matrices. Existence of a Hadamard matrix of order n. Hadamard codes from Hadamard matrices Cyclic codes. Generator polynomial of a cyclic code. Check polynomial of a cyclic code. Equivalent code and dual code of a cyclic code. Idempotent generator of a cyclic code. Hamming and BCH codes as cyclic codes. Perfect codes. The Gilbert-varsha-move and Plotkin bounds. Self dual binary cyclic codes. (Chapter 6 & 11 of the book given at Sr. No. 1).

Recommended Text :

1. L.R. Vermani : Elements of Algebraic Coding Theory (Chapman and Hall Mathematics)
2. Steven Roman : Coding and Information Theory (Springer Verlag)

SEMESTER - III

MM-505 (opt.i): Integral Equations and Calculus of Variations

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks : 80
+Internal Assessment Marks : 20)

Note : The question paper will consist of **five** Sections. Each of the first four Sections will contain **two** questions from Section **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each Section. Section five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Section - I (2 Questions) Linear integral equations, Some basic identities, Initial value problems reduced to Volterra integral equations, Methods of successive substitution and successive approximation to solve Volterra integral equations of second kind, Iterated kernels and Neumann series for Volterra equations. Resolvent kernel as a series in , Laplace transform method for a difference kernel, Solution of a Volterra integral equation of the first kind.

Section - II (2 Questions) Boundary value problems reduced to Fredholm integral equations. Methods of successive approximation and successive substitution to solve Fredholm equations of second kind, Iterated kernels and Neumann series for Fredholm equations. Resolvent kernel as a sum of series. Fredholm resolvent kernel as a ratio of two series. Fredholm equations with separable kernels, Approximation of a kernel by a separable kernel, Fredholm Alternative, Non homogenous Fredholm equations with degenerate kernels.

Section - III (2 Questions) Green's function, Use of method of variation of parameters to construct the Green's function for a nonhomogeneous linear second order boundary value problem, Basic four properties of the Green's function, Orthogonal series representation of Green's function, Alternate procedure for construction of the Green's function by using its basic four properties. Reduction of a boundary value problem to a Fredholm integral equation with kernel as Green's function. Hilbert-Schmidt theory for symmetric kernels.

Section - IV (2 Questions) Motivating problems of calculus of variations, Shortest distance, Minimum surface of revolution, Branchistochrone problem, Isoperimetric problem, Geodesic. Fundamental lemma of calculus of variations, Euler's equation for one dependant function and its generalization to 'n' dependant functions and to higher order derivatives, Conditional extremum under geometric constraints and under integral constraints.

Books Recommended

1. Jerri, A.J., Introduction to Integral Equations with Applications, A Wiley-Interscience Pub.
2. Kanwal, R.P., Linear Integral Equations, Theory and Techniques, Academic Press, New York.
3. Gelfand, J.M. and Fomin, S.V., Calculus of Variations, Prentice Hall, New Jersy, 1963
4. Weinstock ; Calculus of Variations, McGraw Hall.
5. Abdul-Majid wazwaz, A first course in Integral Equations, World Scientific Pub.
6. David, P. and David, S.G. Stirling, Integral Equations, Cambridge University Press.

Semester-III

MM 505 : (opt. ii) Mathematical Modeling

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : **The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.**

Section-I (Two Questions)

The process of Applied Mathematics: mathematical modeling: need, techniques, classification and illustrative, mathematical modeling through ordinary differential equation of first order: qualitative solutions through sketching.

Section-II (Two Questions)

Mathematical modeling in population dynamics, epidemic spreading and compartment models: mathematical modeling through systems of ordinary differential equations: mathematical modeling in economics, medicine, arm-race, battle.

Section-III (Two Questions)

Mathematical modeling through ordinary differential equations of second order. Higher order (linear) models. Mathematical modeling through difference equations: Need, basic theory: mathematical modeling in probability theory, economics, finance, population dynamics and genetics.

Section-IV(Two Questions)

Mathematical modeling through partial differential equations: simple models, mass-balance equations, variational principles, probability generating function, traffic flow problems, initial & boundary conditions.

Book recommended :

J.N. Kapur: Mathematical Modeling, Wiley Eastern Limited, 1990 (Relevant portions, mainly from Chapters 1 to 6.)

Recommended Text:

M.F.Atiyah, FRS and I.G.Macdonald — Introduction to Commutative Algebra (Addison-Wesley Publishing Company)

Reference Books:

1. N.S.Gopal Krishnan, Oxonian Press Pvt. Ltd. — Commutative Algebra
2. Zariski, Van Nostrand Princeton(1958) — Commutative Algebra(Vol. I)

Semester - III

MM-505 (opt. iii) LINEAR PROGRAMMING

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.

Section - I (Two Questions)

Simultaneous linear equations, Basic solutions, Linear transformations, Point sets, Lines and hyperplanes, Convex sets, Convex sets and hyperplanes, Convex cones, Restatement of the Linear Programming problem, Slack and surplus variables, Preliminary remarks on the theory of the simplex method, Reduction of any feasible solution to a basic feasible solution, Definitions and notations regarding linear programming problems, Improving a basic feasible solution, Unbounded solutions, Optimality conditions, Alternative optima, Extreme points and basic feasible solutions.

Section-II (Two Questions)

The simplex method, Selection of the vector to enter the basis, Degeneracy and breaking ties, Further development of the transformation formulas, The initial basic feasible solution-----artificial variables, Inconsistency and redundancy, Tableau format for simplex computations, Use of the tableau format, Conversion of a minimization problem to a maximization problem, Review of the simplex method.

The two-phase method for artificial variables, Phase I, Phase II, Numerical examples of the two-phase method, Requirements space, Solutions space, Determination of all optimal solutions, Unrestricted variables, Charnes' perturbation method regarding the resolution of the degeneracy problem.

Section-III (Two Questions)

Selection of the vector to be removed, Definition of b(€), Order of vectors in b(€), Use of perturbation technique with simplex tableau format, Geometrical interpretation of the perturbation method. The generalized linear programming problem, The generalized simplex method, Examples pertaining to degeneracy, An example of cycling.

Revised simplex method: Standard Form I, Computational procedure for Standard Form I, Revised simplex method: Standard Form II, Computational procedure for Standard Form II, Initial identity matrix for Phase I, Comparison of the simplex and revised simplex methods, The product form of the inverse of a non-singular matrix. Alternative formulations of linear programming problems.

Section-IV (Two Questions)

Dual linear programming problems, Fundamental properties of dual problems, Other formulations of dual problems,Complementary slackness, Unbounded solution in the primal, Dual simplex algorithm, Alternative derivation of the dual simplex algorithm, Initial solution for dual simplex algorithm, The dual simplex algorithm: an example, geometric interpretations of the dual linear programming problem and the dual simplex algorithm. A primal dual algorithm, Examples of the primal-dual algorithm.
Transportation problem, its formulation and simple examples.

Books :

1. G.Hadley : Linear Programming Narosa publishing House (1995)
2. S.I. Gauss : Linear Programming : Methods and Applications (4th Edition) McGraw Hill, New York 1975

SEMESTER-III

MM 505 (opt. iv) Fuzzy Sets and Applications-I

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.

SECTION-I (Two Questions)

Fuzzy Sets: Basic definitions, α-cuts, strong α-cuts, level set of a fuzzy set, support of a fuzzy set, the core and height of a fuzzy set, normal and subnormal fuzzy sets, convex fuzzy sets, cutworthy property, strong cutworthy property, standard fuzzy set operations, standard complement, equilibrium points, standard intersection, standard union, fuzzy set inclusion, scalar cardinality of a fuzzy set, the degree of subsethood (Scope as in relevant parts of sections 1.3-1.4 of Chapter 1 of the book given at Sr.No.1).

Additional properties of α-cuts involving the standard fuzzy set operators and the standard fuzzy set inclusion. Representation of fuzzy sets, three basic decomposition theorems of fuzzy sets Extension principle for fuzzy sets: the Zedah's extension principle, Images and inverse images of fuzzy sets, proof of the fact that the extension principle is strong cutworthy but not cutworthy (Scope as in relevant parts of Chapter 2 of the book mentioned at the end).

SECTION-II (Two Questions)

Operators on fuzzy sets: types of operations, fuzzy complements, equilibrium of a fuzzy complement, equilibrium of a continuous fuzzy complement, first and second characterization theorems of fuzzy complements, fuzzy intersections (t-norms), standard fuzzy intersection as the only idempotent t-norm, standard intersection, algebraic product, bounded difference and drastic intersection as examples of t-norms, decreasing generator, the Pseudo-inverse of a decreasing generator, increasing generators and their Pseudo-inverses, convertion of decreasing generators and increasing generators to each other, characterization theorem of t-norms(statement only). Fuzzy unions(t-conorms), standard union, algebraic sum, bounded sum and drastic union as examples of t-conorms, characterization theorem of t-conorms (Statement only) (Scope as in relevant parts of sections 3.1 to 3.4 of Chapter 3 of the book mentioned at the end).

SECTION-III (Two Questions)

Fuzzy numbers, relation between fuzzy number and a convex fuzzy set, characterization of fuzzy numbers in terms of its membership functions as piecewise defined functions, fuzzy cardinality of a fuzzy set using fuzzy numbers, arithmetic operators on fuzzy numbers, extension of standard arithmetic operations on real numbers to fuzzy numbers, lattice of fuzzy numbers, (R, MIN, MAX) as a distributive lattice, fuzzy equations, equation A+X = B, equation A.X = B (Scope as in relevant parts of sections Chapter 4 of book mentioned at the end).

SECTION-IV (Two Questions)

Fuzzy Relations: Crisp and fuzzy relations, projections and cylindrical extensions, binary fuzzy relations, domain, range and height of a fuzzy relation, membership matrices, sagittal diagram, inverse of a fuzzy relation, composition of fuzzy relations, standard composition, max-min composition, relational join, binary relations on a single set, directed graphs, reflexive, irreflexive, antireflexive, symmetric, asymmetric, antisymmetric, transitive (max-min transitive), non transitive, antitransitive fuzzy relations.

Fuzzy equivalence relations, fuzzy compatibility relations, α-compatibility class, maximal α-compatibles, complete α-cover, reflexive undirected graphs, fuzzy ordering relations, fuzzy upper bound, fuzzy pre ordering, fuzzy weak ordering, fuzzy strict ordering, fuzzy morphisms.

(Scope of this section is as in the relevant parts of sections 5.1 to 5.8 of Chapter 5 of the book mentioned at the end).

Recommended Text:

G.J.Klir and B.Yuan: Fuzzy Sets and Fuzzy Logic: Theory and Applications, Sixth Indian Reprint, Prentice Hall of India, New Delhi, 2002.