JAI PRAKASH UNIVERSITY
CHAPRA

REGULATION
AND
COURSES OF STUDIES
FOR
M.A./M.Sc. (MATH)
BASED ON SEMESTER SYSTEM
w.e.f. The Session–2012-13

Blank

JAI PRAKASH UNIVERSITY, CHAPRA
DEPARTMENT OF MATHEMATICS
M.A./M.Sc. MATHEMATICS

COURSE STRUCTURE
Duration: Four Semesters (Each of six months)

First Semester:-

Core subjects : Compulsory Papers :

MM 101:- Advanced Abstract Algebra.
MM 102:- Complex Analysis.
MM 103:- Real Analysis.
MM 104:- Topology.

Second Semester:-

Core subjects : Compulsory Papers :

MM 201:- Discrete Mathematics (Boolean algebra, Lattice theory & Linear Algebra).
MM 202:- Measure Theory.
MM 203:- Fluid Mechanics.
MM 204:- Tensor Calculus & Riemannian Geometry.

Third Semester:-

Core subjects : Compulsory Papers :

MM 301:- Functional Analysis.
MM 302:- Analytical Dynamics.
MM 303:- Differential Equations.
MM 304:- Elective Subject: - Optional Papers:-
Student will choose one optional paper out of the following,

(i) Advanced Functional Analysis
(ii) Fuzzy Sets and their Applications.
(iii) History of Mathematics-I.
(iv) Differential Geometry.
(v) Partial Differential Equations.
(vi) Programming in C (with ANSI Feature).
(vii) Space Dynamics.

Fourth Semester

Core subjects : Compulsory Papers :

MM 401:- Set Theory & Graph Theory.

MM 402:- Numerical Analysis.

MM 403:- Integration Theory.

MM 404:- Elective Subject: - Optional Papers:-

Student will choose one optional paper out of the following,

(i) Operation Research.

(ii) General Relativity & Cosmology.

(iii) History of Mathematics-II.

(iv) Wavelets.

(v) Theory of Linear Operators.

(vi) Mathematical Biology.

(vii) Mathematical Modeling.

DETAILS OF SYLLABI

M.A/M.Sc (Mathematics)

SEMESTER - I

MM 101 : Advanced Abstract Algebra.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Groups- Normal and subnormal series, composition series, Jordan - Holder theorem, solvable groups, Nilpotent groups.

Canonical from : Similarity of linear transformation, Invariant subspaces, Reduction to triangular forms, Nilpotent transformations, Index of nilpotency, Invariants of a nilpotent transformations, the primary decomposition theorem.

Unit - II

Field theory - Extension fields, Algebraic and transcendental extensions. Separable and Inseparable extensions, Normal extensions, Galois extensions, Fundamental theorem of Galois theory, solution of polynomial equations by radicals, Insolvability of the general equation of degree 5 by radicals.

References :-

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd, New Delhi - 1975.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic abstract Algebra (2nd edition) Cambridge University Press, Indian Edition - 1997.
3. Artin, M. Algebra, Prentice Hall of India, New Delhi 1994.
4. Singh, Surjeet & Qazi Zammerudin, Modern Algebra, Vikas Publishing House, New Delhi (8th edition) 2006.
5. S. Lang, Algebra, 3rd edition, Addison- Wesley - 1993.
6. Luthan, I.S and Passi, I.B.S, Algebra val I & II, Narosa Publishing House, New Delhi.
7. K.B. Dutta, Matrix & Linear algebra, Prentice Hall of india Pvt Ltd, New Delhi - 2000.
8. S, Kumaresan, Linear Algebra, A Geometric Approach - Prentice Hall of India - 2000.

M.A/M.Sc (Mathematics)
SEMESTER - I

MM 102 : Complex Analysis.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Analytic function - Cauchy -Riemann differential equation, Necessary and sufficient condition for a function to be analytic, Polar form of Cauchy -Riemann Equation.

Bilinear transformation -Resultant and inverse of bilinear transformation, Preservance of cross-ratio , Preservance of family of St. line and circle, Fixed point and normal form of bilinear transformation.

Conformal mapping, Necessary and sufficient condition for a mapping to be conformal.

Poles and residues, Cauchy's theorem on residues, Evaluation of real integrals with the help of contour integral.

Unit - II

Complex line integral, Cauchy's theorem, Cauchy's integral formula, Higher order derivatives, Cauchy's inequality, Taylor's theorem, Laurents theorem, Liouville's theorem, Morera's theorem.

Fundamental theorem of algebra, Principle of arguments, Rouche's theorem, Meromorphic function, Maximum modulus Principle.

References :-

1. J.B Conway- Function of complex variable, Springer-Verlag , Narosa Pub. House 1980.
2. L.V.Ahlfors- Complex analysis- Tata Mc Graw-Hill 1979.
3. D.Sarason- Complex function Theory- Hindustan Book agency, Delhi -1994.
4. E . T. Copson -An Introduction to the theory of function of complex variable, Oxford Univ. Press.
5. H.A. Priestly -Introduction to complex analysis, Clarendon Press. Oxford 1990.
6. S. Lang- Complex Analysis Addison Wesley 1997.

M.A/M.Sc (Mathematics)
SEMESTER - I

MM 103 : Real Analysis.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Definition and examples of Riemann-stieltje's Integral, Properties of integral, Integration and differentiation, The Fundamental theorem of calculus, Integration of vector valued Functions.

Sequence and series of Functions, Point wise and Uniform convergence, Cauchy criterion for uniform convergence, Weierstrass-M-test, Abel's and Dirichlet's test for uniform convergence, Uniform convergence and differentiation.

Unit - II

Function of several variables , Linear transformation, Derivatives in an open subset of R^n , Chain rule, Partial derivatives, Interchange of order of differentiation, Derivatives of higher order, Taylor's theorem, Inverse function theorem, Implicit function theorem, Jaccobians.

References :-

1. Walter Rudin - Principles of Mathematical analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International student edition.1983.
2. T.M. A postol - Mathematical Analysis, Narosa Publishing company Inc, 1969
3. Serge Lange- Analysis I & II , Addison Wesley Publishing company Inc, 1969.
4. Walter Rudin- Real & complex Analysis, Tata McGraw-Hill Publishing Co. Ltd, New Delhi-1966.
5. K.K Jha, Advance real analysis,
6. Malik, S.C. Mathematical analysis, Wiley Eastern, New Delhi- 1984
7. Shanti Narayan, A course of mathematical analysis, S. Chand and co. Ltd, New Delhi, Twelfth Revised edition. 1986.

M.A/M.Sc (Mathematics)
SEMESTER - I

MM 104 : Topology.

Total Marks - 100
Theory -70 Marks
Viva-voce: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Definition and examples of topological spaces, closed sets, closure, dense subset, Neighbourhoods, Interior, Exterior and Boundary, Accumulation points, Derived sets, Bases and sub bases, Subspaces and relative topology.

Alternate method of defining a topology in terms of Kuratowski closure operator and neighbourhood system.

Continuous functions and homeomorphism. Separation axioms T_0, T_1, T_2, T_3, T_4 and their characterizations and basic properties, Uryshon's Lemma and Tietze extension theorem.

Unit - II

Compactness, continuous functions and compact sets, Basic Properties of compactness and finite intersection property, sequentially and countable compact sets, compactness in metric spaces, Local compactness and one point compactification.

Connected spaces, connectedness on real line, components, locally connected spaces, Tychonoff's theorem.

References :-

1. James R. Munkres, Topology, A First course, Prentice Hall of India Pvt Ltd, New Delhi -2000.
2. George F. Simmons, Introduction to topology and modern Analysis, McGraw -Hill Company 1963.
3. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd, New Delhi- 1983.
4. B. Menlelson, Introduction to topology, Allyn & Bacon Inc. Boston, 1962.
5. M.J. Mansfield, Introduction to topology D.Van Nostrand Co. Inc. Princeton N.J. 1963.

M.A/M.Sc (Mathematics)
SEMESTER - II

MM 201 : Discrete Mathematics.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Linear Algebra- Bilinear form, Algebra of bilinear forms, Matrix of bilinear forms, Degenerate and Non- degenerate bilinear from, Alternating bilinear form, Symmetric bilinear form, Skew-symmetric bilinear form and quadratic form,

Lattice theory - Lattice as a partially ordered set and their properties, Lattices as algebraic systems, sub lattices, Direct products and Homomorphism.

Unit - II

Boolean algebra- Boolean algebra as a complemented distributive lattices, Boolean rings, identification of Boolean algebra and Boolean rings, sub algebra and generators, Boolean Homomorphism and Ring Homomorphism, Ideals in a Boolean algebra and Dual ideals, Fundamental Theorem of homomorphism, Simple application to electrical network.

References :-

I. I. N. Herstein, Topics in algebra-Wiley Eastern Ltd, New Delhi 1975.
2. P.M. Cohn, Algebra, Vol. I,II&III- John Wiley &Sons 1982 , 1989, 1991.
3. N. Jacobson, Basic algebras - Vol. I & II -W.H.F. Free Man 1980.
4. K.B. Dutta- Matrix and Linear algebra- Prentice Hall of India N. Delhi 2000.
5. S. Kumaresan - Linear algebra- A Geometrical approach, Prentice Hall of India - 2000.
6. S.K. Jain, P.B. Bhattacharya; Basic linear algebras with - MATLAB- Springer Verlag, 2001.

M.A/M.Sc (Mathematics)
SEMESTER - II

MM 202 : Measure Theory.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Lebesgue outer measure, Measurable sets, Regularity of Measurable functions, Borel and Lebesgue measurability, Non - measurable sets.

Integration of non-negative functions, the general integral, integration of series, Riemann and Lebesgue integrals.

The four derivatives, Functions of bounded variations, Lebesgue differentiation theorem, Differentiation and integration.

Unit - II

Measures and outer measures, Extension of measures, uniqueness of extension completion of a measure, measure spaces, Integration with respect of a measure.

The p spaces, convex functions, Jensen's inequality, Holder and Minkowski inequalities , completeness of p spaces, convergence in measure, almost uniform convergence .

References :-

1. G.de Barra- Measure theory & integration, Wiley Eastern Ltd. 1981.
2. P.R. Halmos - Measure theory- Van Nostrand, Co. Inc., 1950.
3. T.G. Hawkins - Lebesgue's theory of integration- Its origin & development, Chelsea New York 1979.
4. Inder K. Rana - An Introduction to Measure and integration- Narosa Publishing House- Delhi 1977.
5. R.G. Bartle, The Elements of integration, John wiley & Sons, New York 1966.
6. P. K. Jain and V.P. Gupta - Lebesgue Measure and Integration- New Age International Ltd. Pub. New Delhi- 2000.

M.A/M.Sc (Mathematics)
SEMESTER - II

MM 203 : Fluid Mechanics.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Kinematics - Velocity and acceleration at a point, stream lines and path lines, velocity potential , Equation of continuity in vector, Cartesian, Polar and Spherical coordinates.

Rotational and irrotational motion, Boundary surfaces. Irrotational motion in two dimensions, complex velocity potential ,sources, sinks, doublets and their images.

Unit - II

Theorem of Blasius, circle theorem Kelvin's circulation theorem

Equation of motion- Euler's and Lagrange's equation of motion, Bernoulli's equation, impulsive action General motion of a cylinder in two dimension, Liquid streaming past a fixed circular cylinder and a fixed elliptic cylinder, kinetic energy of rotating elliptic cylinder.

References :-

1. A.S. Ramsey- A Treatise on Hydro-Mechanics; CBS Pub. Delhi.
2. F Chorlton - Text Book of fluid dynamics CBS Publishing New Delhi, 1985
3. Shanti Swaroop - Hydrodynamics, Krishna Prakashan Mandir, Meerut.
4. R.K. Rathy An Introduction to Fluid dynamics -Oxford and IBH Pub. Comp. New Delhi, 1976
5. S.W. Yuan - Foundations of Fluid Mechanics -Prantice Hall of India Pvt Ltd. New Delhi, 1976
6. Milne Thomson, Hydrodynamics -.

M.A/M.Sc (Mathematics)
SEMESTER - II

MM 204 : Tensor Calculus & Riemannian Geometry.

Total Marks - 100
Theory -70 Marks
Viva-voce: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Tensor Algebra:Tensor of first order- Contravariant and covariant vectors, Tensors of second order and higher orders. Algebraic operations with tensors Contraction , Symmetric and skew-symmetric tensors. Riemannian metric,Riemannian space, Fundamental contravarient tensor,Associated tensors, Raising and Lowering of Indices, Hypersurface, Congruence of curves, Orthogonal ennuple, The Christoffel three index symbols,Transformation of Christoffel symbols,Covariant differentiation of tensor, Intrinsic derivatives of tensor.

Unit - II

Curvature of a curve. First curvature, Principal normal. Geodesics,Euler's condition , Differentiable equation of Geodesic in a V_N , Riemannian co-ordinates. Geodesic form of the linear element. Parallelism of a vector of constant/variable magnitude.

Riemannian Christoffel tensor or curvature tensor, Its contraction Riemannian's symbols of the second kind Ricci Tensor, Covariant Curvature tensor, Riemannian's symbols of first kind , Bianchi 's identity. Riemannian curvature of a at a point. Theorem of Schur. Mean curvature of a space for a given direction.

Books recommended:References :-

1. C.E. Weatherburn: An Introduction to Riemannian Geometry and the Tensor Calculus, Cam bridge University Press, 1996.
2. R.S. Mishra: A Course in Tensors with Applications to Riemannian geometry, Pothishala (Pvt.) Ltd., 1965.
3. L.P. Eisenhart: Riemannian Geometry.
4. T.J. Willmore: An Introduction to Differential Geometry.

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 301 : Functional Analysis.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Normed linear spaces, Banach spaces and examples, Quotient space of normed linear space and its completeness, equivalent norms, Riesz lemma, basic properties of finite dimensional normed linear spaces and compactness, weak convergence and bounded linear transformations, normed linear spaces of bounded linear transformations, dual space with examples.

Unit - II

Open mapping and closed graph theorems , Hahn- Banach theorem for real linear spaces, complex linear spaces and normed linear spaces, Reflexive spaces, Inner Product spaces, orthonormal sets and preserve's relation, structure of Hilbert spaces, Projection theorem, Riesz representation theorem, Adjoints of an operator on a Hilbert space.

References :-

1. K.K.Jha , Functional Analysis, Student Friends.
2. A. H. Siddiqui - Functional Analysis with applications, Tata Mcgraw-Hill publishing company Ltd; New Delhi.
3. P.K. Jain, O.P. Ahuja & Khalil Ahmad, Functional Analysis, New Age International (P) Ltd & Wiley Eastern Ltd, New Delhi - 1997.
4. C. Coffman & G. Pedrick, First course in Functional analysis - Prentice Hall of India, New Delhi - 1987
5. B. chaudhary & Sudarsan Nand; Functional Analysis with applications, Wiley Eastern Ltd, New Delhi- 1989.
6. A.E. Taylor, Introduction to Functional Analysis, John Wiley & Sons, New York.
7. Topology & Functional Analysis - Ram Kumar Verma & Balgangadhar Prasad - Ganga Pustakalaya Patna-4.
8. Walter Rudin; Functional Analysis, Tata McGraw-Hill Publishing Com. Ltd, New Delhi.
9. K. Yosidda - Functional Analysis, 3rd edition, Springer - Verlag. New York - 1971.
10. J.B. Coneway, A Course in Functional Analysis, Springer-Verlag-1990.

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 302 : Analytical Dynamics.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Generalised co-ordinates, holonomic and non-holonomic systems Scleronomic and Rheonomic systems, Generalised forces and momentum, Lagrange's equation of first kind, Lagrange's equation of second kind , Energy equation for conservative fields.

Hamilton's canonical equations, Cyclic co-ordinates Routh's, equations, Poisson's Bracket, Jacobi-Poisson theorem.

Unit - II

Hamilton's principle, principle of least action, Hamilton -Jacobi equations, Jacobi theorem, Method of separation of variables, and canonical transformations, condition of canonical transformation in terms of Lagrange's and Poisson's Brackets, Invariance of Lagrange's and Poisson's Brackets under canonical transformation.

References :-

1. A.S. Ramsey, Dynamics Part II Cambridge University Press.
2. F. Gantmacher, Lectures in analytical mechanics - Mir Publishers.
3. N.C., Rana and Promod S.C.Joag - Classical Mechanics - Tata McGraw-Hill 1991.
4. S.L. Loney, An elementary treatise on statics- Kalyani Pub. N Delhi.
5. H. Gold Setein, Classical Mechanics -Narosa Pub. N. Delhi.
6. Louis N Hand and Jonet D Finch; Analytical Mechanics- Cambridge Univ. Press,1998.

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 303 : Differential Equations.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Preliminaries - Initial value problem and the equivalent integral equation mth order equation in d-dimensions as a first order system, concepts of local existence, existence in the large and uniqueness of solutions with examples. A theorem on the convergence of a family of initial value problems. Picard's method of Successive approximations and Lipschitz condition with examples

Unit - II

The Picard - Lindelof Theorem, Peano's Existence Theorem and corollary , Kamke's convergence theorem (statement only) and Kneser's theorem (statement only)

Differential inequalities and uniqueness - Gronwall's inequalities, Maximal and minimal solutions, Differential inequalities. A theorem of Wintner uniqueness theorems. Nagumo's and Osgood's criteria. Egres points and Lyapunov functions.

Recommended Text: P. Hartman, Ordinary Differential Equations, John Wiley (1964)

References :-

1. W.T. Reid- Ordinary diff. equations - John Wiley & Sons , NY(1971)
2. E.A.Coddington & N. Levinson - Theory of Ordinary Differential Equations McGraw-Hill. N.Y. (1955)
3. J.C. Burkil - Ordinary Diff. Equations, Oliver and Boys.
4. L.Elsgolts - Differential and Calculus of Variation - Mir Publication

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 304 (i) : Advanced Functional Analysis.

Total Marks - 100
Theory -70 Marks
Viva Voce t: 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions:

Definition and examples of topological vector Speces. Convex, balanced and absorbing sets and their properties, Minkowski's functional, Subspace, product space and quotient space of a topological vector space.

Locally convex topological Vector spaces. Normable and metrizable topological vector spaces. Complete topological vector spaces and Frechet space.

Linear transformations and linear functional and their continuity. Finite-dimensional topological vector spaces. Linear varieties and Hyperplanes. Geometric form of Hahn- Banach theorem. Uniform-boundedness principle. Open mapping theorem and closed graph theorem for Frechet space. Banach-Alaoglu theorem.

Extreme points and Extremal sets. Krein-Milman's theorem.

Duality. Polar. Bipolar theorem. Baralled and Bornological spaces. Macekey Spaces. Semi-reflexive and Reflexive topological vector spaces. Montel Spaces . Distributions.

References :-

1. John Horvath . Topological vector Spaces and Distributions . Addison Wesley Publishing Company, 1966.
2. J.L. Kelley and Isaac Namioka, Linear Topological Spaces, D. Van Nostrand Company Inc. 1963.
3. You-Chuen Wong. Introductory Theory of Topological Vector Spaces, Marcel Dekker, Inc. 1992.
4. Laurent Schwarz, Functional Analysis, Courant Institute of Mathematical Sciences, New York University, 1964.
5. F. Treves, Topological Vector Spaces, Distribution, and Kernel, Academic Press, Inc, New York, 1967.
6. G. Kothe, Topological Vector Spaces, Vol. I, Springer, New York, 1969.
7. R. Larsen, Functional Analysis, Marcel Dekker, Inc., New York, 1973.
8. Walter Rudin, Functional Analysis, TMH Edition, 1974.
9. L.V. Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press, 1982.
10. Edward W. Packel. Functional Analysis, Intext, Inc.,1974.
11. H.H. Schaefer, Topological Vector Space, Macmillan, N.Y. 1966 , Reprinted, Springer, N.Y. 1971.

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 304 (ii) : Fuzzy Sets and Their Applications.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions:

Fuzzy Sets-Basic definition $\propto-\alpha$ **a** level sets, Convex fuzzy sets. Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian products. Algebraic products. Bounded sum and difference. t-norms and t-conorms.

The Extension Principle-The Zadeh's extension principle , Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.

Fuzzy Relations and Fuzzy Graphs-Fuzzy relations on Fuzzy sets. Composition of Fuzzy relations,Min-Max Composition and its properties, Fuzzy equivalence relations. Fuzzy compatibility relations. Fuzzy relation equations. Fuzzy graphs. Similarity relation.

Possibility Theory - Fuzzy measures, Evidence theory. Necessity measure. Possibility measure. Possibility distribution. Possibility Theory and fuzzy sets. Possibility theory versus probability theory.

Fuzzy logic-An overview of classical logic , Multivalued logics. Fuzzy Propositions. Fussy quantifiers. Linguistic variables and hedges. Inference from conditional Fuzzy propositions, the compositional rule of inference.

References :-

1. H.J. Zimmermann. Fuzzy set theory and its Applications. Allied Pubishers Ltd., New Delhi. 1991.
2. G.J. Klir and B. Yuan-Fuzzy sets and Fuzzy logic, Prentice-Hall of India, New Delhi, 1995.

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 304 (iii) : History of Mathematics-I.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions:

Glimpse of ancient India , Scope and development of Hindu Mathematics, Numeral terminology in Yajurveda Samhita and other literature, Lalitvistara, Kaccayana's Pali grammer, (Jain's Script) Numeral Symbols in Kharosthi and Brahmi Script (Table I & Table II) The decimal Place Value System, Word Numerals with place Value and without place value. The place Value notation in Hindu literature and its date of envertion Hindu numerals in Arabia and Europe and miscellaneous references Zero in arithmetic, Zero in Algebra, Infinity, Origin of Hindu Algebra, Fundamental Operation (Addition, Subtraction, multiplication, division, squaring and extraction of square roots) , Quadratic equation-early treatment, Bakhashali, Aryabhata- I, Brahmagupta, Sri Dhara, Mahavira, Aryabhata-II,Sripati, Bhaskara-II, rule Indeterminate equation of first degrees, Bhaskara-I, Brahmagusta, Mahavira, Sripati rules.

Book Recommended :

B.B. Dutta & A.N. Singh - History of Hindu mathematics, Part I and II - Asia Publishing House - New Delhi, New York .

References :-

1. C.B. Boyer, UTA C Merzbach - A History of Mathematics - Second edition - Johnweley & Sons, New York.
2. A.K. Bag- Mathematics in Ancient India and Medieval india - Chaukhambha Orientalia - New Delhi.
3. S.N. Sen & Bag - The Sulba - Sutras - Indian National science Academy - New Delhi.
4. G. Thibaut - edited - Sulba sutras.
5. G.R. Kaye - Bakhashali Manuskript - A Study of Medieval Mathematic - Calcutta 1927, 1933.
6. A.M.Sinha, A Study of Mathematical Development in India from about 5th Century BC to 5th Century AD. - Nirmal Publications, Shahdara, Delhi-94.

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 304 (iv) :Differential Geometry.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions:

Space curve; arc length; tangent vectors and vector fields on a curve; curvature and torsion; Serret-frenet formula; osculating plane; osculation cirele; osculation sphere; fundamental theorem of local theory of space curves (existence and uniqueness theorems).
Surfaces and their (local) parametrization on co-ordinate systems; change of parameters; parametrized surfaces; curves on surface; tangent and normal vectors; tangent and normal vector fields on a surface; first, second and third fundmental forms of a surface at a point.

Normal sections and normal curvature of a surface at a point; Meusnier's theorem; elliptic, hyperbolic, parabolic and plannar points; Dupin indicatrix; principal direction; principal curvartures of a surface at a point; Mean curvature of a surface at a point.

Line of curvature; asymptotic lines ; conjugate directions; fundamental equations of the local theory of surfaces; statement of Bonnet's fundamental theorem of local theory of surfaces.

Text Book :

1. A first course in Differential Geometry - Chun-Chin Hsiung, Wiley-Interscience Publications, John Wiley & Sons, 1981.

References :-

1. P. Eisenthart, A treatise on the differential geometry of curves and surfaces Dover Publications, Inc., New York , 1960.
2. C. E. Weatherburn Differential Geometry of three dimensions, The English Language Book Society and Cambridge University Press, 1964.
3. T.S. Willmore, An Introduction to differential geometry Oxford, Clarendon Press, 1979.
4. W. Klingenberg, A course in differential geometry - Graduate Texts in Mathematics 51, Springer- Verlag, 1978.
5. A. Pressley, Elementary differential Geometry, Springer International Edition. 2005.
6. Bansi Lal , Three dimensional Differential Geometry with numerous examples, Atma Ram & Sons, Delhi-7.

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 304 (v) :Partial Differential Equations.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions:

Examples in partial differential equations , Classification

Laplace's transformation, Canonical forms, The solution of linear hyperbolic equations, Riemann method of solution of general Linear hyperbolic equaltions of second order.

Transport Equation - Initial value problem, Non-homogeneous Equation.

Laplace's Equation- Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions.

Heat equation- Fundamental Solution, Mean Value Formula, Properties of Solution, Energy methods .

Wave Equation- Solution by spherical means non-homogeneous equations

Non - linear First Order P.D.E-Complete Integrals, Envelopes, Characteristic, Hamilton-Jacobi Equation.

References :-

1. I.N. Sneddon - Elements of partial diff. equations. - Tata McGraw-Hill.
2. I.G. Petrovsky- Partial Differential Equations.
3. L.C. Evans- Partial diff. equation- Graduate studies in mathematics, Vol. 19 AMS 1998.

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 304 (vi) :Programming in C (with ANSI feature)

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions:

An overview of Programming. Programming language, Classification.

C Essentials-Program Development. Functions. Anatomy of a C Function. Variables and Constants. Expresssions. Assignment Statements. Formatting Source Files. Continuation Character The Preprocessor.

Scalar Date Types-Declarations. Different Types of Integers. Different kinds of Integer constant. Floating-Point Types. Initialization. Mixing Types. Explicit Conversions- Cast. Enumeration Types. The Void Data Type. Typedefs. Finding the Address of and object. Pointers.

Control Flow-Conditional Branching. The Switch Statement. Looping. Nested Loops. The Break and continue Statements. The goto statement. Infinite Loops.

Operators and Expressions-Precedence and Associativity. Unary Plus and Minus operators. Binary Arithmetic Operators. Arithmetic Assignment Operators. Increment and Decrement Operators, comma Operator. Relational Operators. Logical Operators, Bit- Manipulation . Operators. Bitwise Assignment Operators. Cast Operator. Size of Operators . Conditional Operator. Memory Operators.

The C Preprocessor-Macro Substitution.Conditioanal Compilation. Include Facility. Line control.

Input and Output-Streams, Buffering. The <Stdio.h> Header File. Error Handling. Opening and Closing a File. Reading and Writing Data. Selecting an I/O Method. Unbuffered I/O Random Access. The standard library for Input/Output.

Recommended Test :

1. Peter A. Darnell and Philip E. Margolis, C: A Software Engineering Approch, Narosa Publishing House (Springer International Student Edition) 1993.

References :-

1. Samueal P. Haarkison and Gly L. Steele Jr. C: Reference Manual 2nd Edition. Prentice Hall. 1994.
2. Brian W. Kernighan & Dennis M. Ritchie. The C Programme Language, 2nd Edition (ANSI teatures), Prentice Hall 1989.
3. S.B. Lipman. J. Lajoi: C++ Primer. Addison Wesley.
4. B.Strustrup: The C++ Programming Language Addison Wesley.
5. C.J. Date: Inroduction to Datebase Systems, Addison Wesley.
6. C. Ritchie; Operating Systems-Incorporation UNIX and Windows, BPB Pubications.
7. M.A Weiss. Data Structures and Algorithm Analysis in C++ , Addison Wesley.

M.A/M.Sc (Mathematics)
SEMESTER - III

MM 304 (vii) :Space Dynamics.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions:

Basic Formulae of a spherical triangle-The Two-body Problem : The Motion of the Center of Mass. The relative motion. Kepler's equation. Solution by Hamilton Jacobi theory.

The Determination of Orbits-Laplace's Gauss Methods.

The Three-Body Problem-General three Body Problem. Restricted Three Body Problem. Jacobi Integral. Curves of Zero velocity. Stationary Solutions and their stability.

The n-Body Problem- The motion of the centre of Mass . Calssical integrals.

Perturbation-Osculating orbit, Perturbing forces, Secular & Periodic perturbations. Lagrange's Planetory Equations In terms of Pertaining forces and in term of a perturbed Hamiltonian.

Motion of the moon-The perturbing force. Perturbations of Keplerian elements of the Moon by the sun.

Flight Mechanics-Rocket Performance in a Vacuum. Vertically ascending paths. Gravity Twin Trajectories. Multi stage rocket in a Vacuum. Definitions pertinent to single rocket. Performance limitations of single stage rokets, Definitions pertinent to multi stage rockets. Analysis of multi stage rockets neglecting gravity. Analaysis of multi stage rockets including gravity.

References :-

1. J.M.A. Danby. Fundamentals of Celestial Mechanics, the Macmillan Company, 1962.
2. E. Finlay, Freundlich, Celestial Mechanics, The Macmillan company, 1958.
3. Theodore E. Sterne, An Introduction of Celestial Machanics, Intersciences Publishers. INC.,1990.

M.A/M.Sc (Mathematics)
SEMESTER - IV

MM 401 : Set theory and Graph theory.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Set theory - countable and uncountable sets, infinite sets and the axioms of choice, cardinal numbers and its arithmetic, Schroeder- Bernstein theorem, Cantor's theorem and the continuum hypothesis , Zorn's Lemma, Well- ordering theorem.

Unit - II

Graph Theory - Definition of graphs, paths, circuits, cycles, and sub-graphs, induced sub-graphs, Degree of a vertex , connectivity, planar graphs and their properties and trees Spanning trees and enumeration. Matching: Matching and Maximum Matching, Hall's Matching condition, Minimax Theorems. Inependent sets snd Convers, Dominationg Sets.

Connectivity: Connectivities of graphs, Cut-sets, Edge Connectivity and Vertex Connectivity. Menger's Theorem.

References :-

1. C. L. liu- Elements of Discrete mathematic - McGraw-Hill Book Co.
2. N.Deo- Graph theory with - application to Engineering & Computers Science - P.H.I.
3. D.B. West, Graph Theory, Pearson Publ. 2002.
4. F. Harary. Graph Theory, Narosa Publ. ND.
5. R. Diestel, Graph Theory, Springer, 2000.

M.A/M.Sc (Mathematics)
SEMESTER - IV

MM 402 : Numerical Analysis.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Method of finite difference:

Difference formula, fundamental theorem of difference calculus, Operators E and their Properties, Relation Between difference and differential operators Effect of an error in tabular value one or more missing terms, factorial notation and methods of representing any given polynomial in factorial notation, differences of zero and recurrence relation between them, Leibnitz rule.

Unit - II

Solution of algebraic and transcendental equations, Errors and their analysis, bisection method, False position method, Newton Raphson Method, Newton's iterative formula for finding the inverse square root.

Interpolation :

Newton's formula for interpolation, Gauss's central difference formula, Lagrange's Interpolation formula, Divided, differences and their properties, Newton's general Interpolation formula.

References :-

1. S. Shastri, Introductory method of numerical analysis, Prentice Hall of India Pvt. Ltd. Delhi.
2. A. Raiston; A first course of numerical analysis, McGraw-Hill.
3. C.E. Forlung; Introduction of Numerical Analysis, Addison Wesley.
4. Kalyan Mukherjee, Numerical Analysis; New central Book Agency (P) Ltd. Calcutta.
5. S.A. Mollah; Numerical Analysis, Books & Allied Pvt. Ltd. Calcutta & computation Procedures.
6. H.C. Saxena, Finite Differences and Numerical Analysis: S. Chand & Company Ltd. New Delhi.

M.A/M.Sc (Mathematics)
SEMESTER - IV

MM 403 : Integration Theory.

Total Marks - 100
Theory -70 Marks
Internal Assessment: 30 Marks
Time - 3 hrs.

Note. 1. The question paper will consist of nine questions. Candidates will attempt a total of five questions:
2. Question No. 1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each unit and the candidates will be required to attempt two questions from each unit.
4. All questions carry equal marks.

Unit - I

Signed measure, Hahn decomposition theorem, Mutually singular measures, Radon- Nikodym theorem, Lebesgue decomposition, Riesz representation Theorem, Lebesgue- Stieltjes integral, Product measure, Fubini's theorem. Differentiation and Integration. Decomposition into absolutely continuous parts.

Unit - II

Bair sets, Bair measure, Continuous function with compact support, Regularity of measure on locally compact spaces, Integration of continuous functions with compact support, Riesz-Markoff theorem.

References :-

1. H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc. 1995.
2. P.K. Jain & V.P. Gupta, Lebesgue measure and integration, New Age International (P) Ltd, New Delhi- 2000.
3. Inder K. Rana, An Introduction to Measure and integration; Narosa Publishing House, Delhi-1997.
4. Walter Rudin - Real and complex Analysis; Tata McGraw-Hill Publishing Comp.
5. G.D. Barra, Measure Theory & Integration; Wiley Eastern Ltd 1981.
6. S.K. Berberian, Measure & Integration Chelsea Publishing Company New York -1965.
7. P.R. Halmos- Measure theory, Springer International Student Edition.
8. K.P. Gupta, Measure theory, Krishna Prakashan Mandir, Merrut.

M.A/M.Sc (Mathematics)
SEMESTER - IV

MM 404 (i) : Operations Research.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions:

Operations Research and its Scope. Necessity of Operations Research in industry.

Linear Programming-simplex Method. Theory of the Simplex Method. Duality and Sensitivity Analysis.

Other Algorithms for Linear Programming-Dual Simplex Method. Parametric Linear Programming. Upper Bound Technique. Interior Point Algorithm. Linear Goal Programming.

Transportation and Assignment Problems.

Network Analysis-Shortest Path Problem. Minimum Spanning Tree Problem. Maximum Flow Problem. Minimum Cost Flow Problem . Network Simplex Method. Project Planning and Control with PERT-CPM

Dynamic Programming-Deterministic and Probabilistic Dynamic Programming.

Game Theory-Two-Person. Games with Mixed Strategies. Graphical Solution. Solution by Linear Programming.

References :-

1. F.S. Hillear and G.J. Lieberman. Introduction to Operations Research (Sixth Edition), McGraw-Hill Internationsl.
2. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
3. G. Hadly, Nonlinear and Dynamic Programming, Addison- Wesley, Reading Mass.
4. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flow, John Willy & Song. New York 1990.
5. H.A. Taha. Operations Research-An Introduction, Macmillan Publishing Co., Inc., New York.
6. Kanti Swarup. P.K.Gupta and Man Mohan, Operation Research, Sultan Chand & Song, New Delhi.
7. S.S. Rao Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
8. Prem Kumar Gupta and D.S. Hira. Operations Research-An Introduction. S. Chand & Com pany Ltd. New Delhi.
9. N.S. Kambo. Mathematical Programming Techniques, Affiliated East-west Press Pvt. Ltd. New Delhi, Madras.

M.A/M.Sc (Mathematics)
SEMESTER - IV

MM 404 (ii) : General Relativity and Cosmology.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions:

Riemannian metric Christoffel symbols. Covariant derivatives. Intrinsic derivatives and geodesics, Riemann Christoffel curvature tensor and its symmetry properties, Bianchi identities and Einstein tensor. (Two Questions).

Review of the special theory of relativity and the Newtonian Theory of gravitation. Principle of equivalence and general covariance,Relativistic field equations: Energy momentum tensor for a perfect fluid , Newtonian approximation of relativistic equations of motion , Einstein's field equations and its Newtonian approximation. (Two Questions)

Schwarzschild external solution and its isotropic form. Planetary orbits and analogues of Kepler's Laws in general relativity. Advance of perihelion of a planet. Bending of light rays in a gravitational field. Gravitational redshitt of spectral lines. (Two Questions)

Cosmology-Mach's principle, Einstein modified field equations with cosmological term. Static Cosmological models of Einstein and de-Sitter, Their derivation, properties and comparison with the actual universe. Non-statical cosmological model , Comoving co-ordinate system, Derivation of the Robertson- Walker line element . (Two Questions)

References :-

1. C.E. Weatherburn. An Introduction to Riemannian Geometry and the Tensor Calculus, Cam bridge University Press. 1950.
2. H.Stepheni, General Relativity: An Introduction to the theory of the gravitational field, Cam bridge University Press. 1982.
3. A.S. Eddington. The Mathematical Theory of Relativity, Cambridge University Press, 1965.
4. J.V. Narlikar, General Relativity and Cosmology: The Macmillan Company of India Limited. 1978.
5. R. Adlev. M. Bazin, M. Schiffer. Introduction to general relativity, McGraw-Hill Inc., 1975.
6. B. F. Shutz. A first course in general relativity. Cambridge University Press. 1990.
7. J.K.Goyal & K.P.Gupta: Theory of Relativity (Special & General).
8. M.Ray: Theory of Relativity (Special & Genral), S.Chand & Co.

M.A/M.Sc (Mathematics)

SEMESTER - IV

MM 404 (iii) : History of Mathematics-II.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions :

A general survey of the history of geometry and mathematics in India.

Sulba- sutra geometry - Number of sulba-sutras, meaning of sulba , Determination of East-West line, To draw perpendicular bisector of a given line.

Construction of squares by Baudhayana and Apastamba, Construction of trapezium with face, base and altitude given

Conversion of a square into rectangle and conversion of rectangle into square , To combine two unequal squares, geometrical truths implied in the construction , properties of similar figures.

Early Jain Geometry- Origin of the value $\sqrt{10}$ for π and explanation given by Hunrath / Cantor.

Aryabhata and Brahmagupta rule for area of triangle. The theorem of the square on the hypotenuse and its proof. Mahavira treatment of triangle, Aryabhata II and Sripati expression for exact area of triangle, Nilakantha Somayajin comment on Aryabhata I area of triangle

Early geometrical terminology .

Geometrical demonstration of the algebraic results namely.

(i) $a^2 - b^2 = (a+b)(a-b)$

(ii) $(a+b)^2 = a^2 + b^2 + 2ab$.

(iii) The sum of geometric Progression $Sn = \frac{ar^n - a}{r-1}$.

Book Recommended :

T.A. Sarasvati Amma- Geometry in Ancient and Medieval India - Moti Lal Banarsidas Publishers Pvt. Ltd. Delhi.

References :-

1. C.B. Boyar, UTA C Merzboch - A History of Mathematics - Second edition - John wiley & sons, New York.
2. A.K. Bag - Mathematics in Ancient and Medieval India - Chaukhambha Orientalia, Delhi
3. S.N. Sen & A.K. Bag The sulbasutras - Indian National Science Academy - New delhi.
4. B.B. Dutta - The Science of sulba - University of Calcutta - 1932.
5. F. Cajori - A History of Mathematics, Newyork 1919.
6. Ganesh Kumar and R.Raj- Ancient India's contribution to the origin of Geometrical knowledge -Samiksha Prakashan Delhi-92.
7. A.M. Sinha- A study of Mathematical Development in India from about 5th Century B.C. to 5th Century A.D.-Nirmal Publications, Shahdara, Delhi-94

M.A/M.Sc (Mathematics)
SEMESTER - IV

MM 404 (iv) : Wavelets.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions :

Preliminaries,

Different ways of constructing wavelets-Orthonormal bases generated by a single function the Balian-Low theorem. Smooth projections on $L^2(R)$. Local sine and cosine bases and construction of some wavelets.The unitary folding operators and the smooth projections. Multiresolution analysis and construction of wavelets. Construction of compactly support wavelets and estimates for its smoothness.Band limited wavelets. Orthonormality. Completeness Characterization of Lemarie-Meyer wavelets and some other characterizations. Franklin wavelets and Spline wavelets on the real line. Orthonormal bases of piecewise linear continuous function for $L^2(T)$. Orthonormal bases of periodic splines, Periodization of wavelets defined on the line.

Characterizations in the theory of wavelets-The basic equations and some of its application. Characaterizations of MRA Wavelets, low-pass filters and scaling functions. Non-existence smooth wavelets in $H^2(R)$

Frames- The reconstruction formula and the Balian-Low theorem for frames, Frames from translations and dilations, Smooth frames for $H^2(R)$.

Discrete transforms and algorithms-The discrete and the fast Fourier transforms. The discrete and the fast cosine transforms. The discrete version of the local sine and cosine bases.Decomposition and reconstructions algorithms for wavelets.

Book Recommended :

Eugenio Hernandez and Guido Weiss, A First Course on Wavelets, CRC press , New York. 1996.

References :-

1. C. K. Chut . An Introduction to Wavelets. Academic Press . 1992.
2. I. Daubechies. Ten Lectures on Wavelets. CBS-NSF Regional conferences in Applied Mathematics. 61, SIAM, 1992.
3. Y. Meyer, Wavelets. Algorithms and applications (translated by R.D. Rayan. SIAM, 1993.
4. M.V. Wickerhauser. Adapted wavelet analysis from theory to software , Wellesley, MA, A.K. Peters, 1994.

M.A/M.Sc (Mathematics)
SEMESTER - IV

MM 404 (v) : Theory of Linear Operators.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions :

Spectral Theory in normed linear spaces, resolvent set and spectrum, spectral properties of bounded linear operators, Properties of resolvent and spectrum. Spectral mapping theorem for polynomials. Spectral radius of a bounded linear operator on a complex Banach space, Elementaray theory of Banach algebras.

General properties of compact linear operators Spectral properties of compact linear operators on normed spaces. Behaviours of Compact linear operators with respect to solvability of operator equations. Fredholm type theorems. Fredholm alternative for integral equations.

Spectral properties of bounded self-adjoint linear operators on a complex Hibert space. Positive operators. Monotone sequence theorem for bounded self - adjoint operators on complex Hilbert space. Square roots of positive operator. Projection operators. Spectral family of a bounded self-adjoint linear operator and its properties. Spectral representation of bounded self-adjoint linear operators, Spectral theorem.

References :-

1. E. Kreyszig, Introductory Functional Analysis with applications, John-Wiley & Sons, New York, 1978.
2. P.R. Halmos. Introduction to Hilbert Space and the Theory of Spectral Multiplicity, Secon Edition, Chelsea Publishing Co. N.Y. 1957.
3. N. Dunford and J.T. Schwartz. Linear Operators-3 parts, Interscience Wiley, New York, 1958-71.
4. G. Bachman and L. Narici, Functional Analysis, Academic Press, New York , 1966.
5. Akhiezer. N.I. and I.M. Glazman, Theory of Linear operator in Hilbert space, Frderick Ungar Pub. Co., New York Vol. I (1961). Vol. II(1963).
6. P.R. Halmos. A Hilbert Space Problem Book, D. Van Nostrand Company Inc., 1967.

M.A/M.Sc (Mathematics)
SEMESTER - IV

MM 404 (vi) : Mathematical Biology.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions :

Mathematical Biology is one of the fastest growing areas of applied mathematics. A number of topics are listed below. One can choose some of them depending on his/her interest.

1. Mathematical aspects of Vision
2. Application of Population Isolates in Gene
3. Calcium Excitability: The Dynamics of Calcium Homeostasis
4. Modeling Viral Infection
5. Pattern Tissue Interaction Models
6. Immune Networks and Immune Response
7. Population Genetics Theory
8. Social Animal Aggregation
9. Stochastic Demography and Life Historia
10. Spatial Chaos and Its role in Ecology and Evolution
11. Uncertainty and Fisheries Biology
12. Model building as an Inverse Problem in Biomathematics.

References :-

1. S.A. Levin (Ed), Frontiers in Mathematical Biology, Springer-Verlag, 1994.
2. Mathematical Biology (AMA Short Course) Notes of the AMS No. 9, 1214-1217.
3. J.N.Kaput, Mathematical Models in Biology and Medicine, East & West Affiliated Press.
4. J.D.Murray, Mathematical Biology, Springer-Verlag .

M.A/M.Sc (Mathematics)
SEMESTER - IV

MM 404 (vii) : Mathematical Modeling.

Total Marks - 100
Theory -70 Marks
Viva Voce : 30 Marks
Time - 3 hrs.

The question paper will consist of **eight** questions. Candidates will attempt any **four** questions :

Mathematical Modeling : Need - Techniques - Classification- Some Characteristics of Mathematical Models.

Mathematical Modeling Through Ordinary Differential Equations of First order: Linear Growth and Decay Models - Non Linear Growht and Linear Models- Compartment Models-Mathematical Modeling in Dynamics and Geometrical Problems.

Mathematical Modeling through Systems Of Ordinary differential Equations Of First Order: Mathematical Modeling In Population Dynamics- Epidemics. Compartment Models-Medicine And Arms Race

Mathematical Modeling through Second Order Ordinary Differential Equation: Mathematical Modeling Of Planetary Motion-Circular Motions and Motion of Satellites-Miscellaneous Models.

Mathematical Modeling Through Partial Differential Equations: Mass- Balance Equations-Momentum - Balance Equations - Variation Principles-Probability generating functions-Models of Traffic Flow n a High Way.

Mathematical Modeling Through Graphs: Situations that can be Modeled Through Graphs-Mathematical Models In Term of directe Graphs-Singned Graphs - Weighted Digraphs & Unoriented Graphs.

Text Book :

1. J.N. Kapur, Mathematical Modeling . Wiley Eastern Limite. 1988. [Chapter: 1 . 1 to 1.3; 2;3 (Except3.4); 4; 6 (Except 6,7,6.8); 7].

References :-

1. Fredric Y.M. Wan, Mathematical Models and Their Analysis, Harper and Row Publishers, New York.
2. Michael Mesterton Gibbons, A. Concrete Approach to Mathematical Modeling, Addison - Wesley Publishing company 1989.
3. Walter J Meyer, Concepts of Mathematical Modeling, Mcgraw-Hill Co. 1984.
4. W.W. Boyce, Case studies In Mathematical Modeling, Pitamn Advanced Publishing Program, 1981.