Semester Courses of M.A/M.Sc. (Mathematics)

The course of M.A/M.Sc. (Mathematics) will be spread in two years – 1st year being called "Previous" & other "Final". There will be two semester examinations and a viva-voce & project work examination every year.

M.A./ M.Sc. Previous (Mathematics)

(Effective from session 2011-2012)

The M.A./ M.Sc. "Previous" (Mathematics) examination will consist of two semesters, called first and second semesters. Their examinations will be held in the months of December and April respectively. In each of these semester examinations there will be five compulsory papers and one optional paper. Each paper will be of three hours' duration and of 50 maximum marks, except where stated otherwise. Besides there will be a viva-voce & project work examination of 50 marks in the second semester.

Format of the Question Paper.

There will be one compulsory question consisting of 5 parts of short answer type question based on the whole course, with all being mandatory to be answered. Besides, there will be 8 more questions, ordinarily consisting of two parts (a) and (b), 4 questions per part, out of which exactly 4 questions (two from each part) will have to be answered. Thus in all 5 questions will have to be attempted and 9 questions will have to be set. All questions will carry equal marks, except where stated otherwise.

First Semester

Compulsory Papers

Paper I	:	Groups and Canonical Forms
Paper II	:	Topology-I
Paper III	:	Differential and Integral Equations
Paper IV	:	Riemannian Geometry
Paper V	:	Hydrodynamics

Optional Papers

Any one of the following papers will have to be opted.

Paper VI (a)	:	Spherical Astronomy-I
Paper VI (b)	:	**Operations Research-I**
Paper VI (c)	:	Fuzzy Sets
Paper VI (d)	:	**Programming in C (with ANSI features)** **(i) Theory : 30 marks** **(ii) Practical : 20 marks (2 hours' duration)**
Paper VI (e)	:	History of Mathematics-I
Paper VI (f)	:	Dynamics of Real Gases-I

M.A./ M.Sc. First Semester
Mathematics
Paper I
Groups and Canonical forms

Groups : Conjugacy relation. Normalizer of an element. Class equation of a finite group. Center of a group. Fundamental theorems on isomorphism of groups. Automorphisms. Inner automorphism. Maximal subgroups. Composition series. Jordan-Holder theorem. Solvable groups. Nilpotent groups. Commutator subgroups. External and iternal direct product of groups. Cauchy's theorem for finite group. Sylow's theorem.

(5 questions)

Canonical forms : Similarity of linear transformations. Invariant subspaces. Reduction to triangular forms .Nilpotent transformations. Index of nilpotency. Invariants of a nilpotent transformation. The primary decomposition theorem. Jordan blocks and Jordan forms.

(3 questions)

Books Recommended:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul : Basic Abstract Algebra (Second Edition), Cambridge University Press, Indian Edition , 1997.
3. Surjeet Singh and Qazi Zameeruddin: Modern Algebra, Vikas Publishing House. Pvt. Ltd., 2005.
4. K.B. Datta : Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
5. S. Kumaresan : Linear Algebra, A Geometric Approach, Prentice Hall of India, 2000.
6. S.K. Jain, A. Gunawardena and P.B. Bhattacharya : Basic Linear Algebra with MATLAB, Key College Publishing (Springer- Verlag), 2001.
7. A.R. Vasishtha & A.K. Vasishtha : Modern Algebra, Krishna Prakashan Media (P) Ltd., Meerut .

M.A./ M. Sc. First Semester
Mathematics
Paper –II

Topology –I

Topological space - Definition through open set axioms. Examples including usual topology, ray, lower limit and upper limit topologies on R, topology of metric spaces, cofinite and cocountable topologies, weak and strong topologies.

Closed sets, interior of a set, closure of a set. Characterization of topologies in terms o1 closed sets, interior operators, closure axioms.

Neighbourhoods, neighbourhood system and neighbourhood base. Topology through neighbourhood axioms.

(2 questions)

Adherent points, limit points and derived set, dense set.
Base and subbase for a topology and characterization of topology in terms of base and subbase axioms. Topology generated by a family of subsets.

First countable and second countable spaces. Relative topology and subspaces, hereditary property. Lindeloff theorem and separable spaces.

(3 questions)

Continuous functions and their properties. Continuity in terms of open sets ,closed sets, neighbourhoods, closures. Convergence of a sequence, sequential continuity, homeomorphisms. Topological invariant properties.

Compact sets and their properties. Finite intersection property, Bolzano Weierstrass property. Continuous functions and compactness, Sequential compactness, countable compactness and their comparison. One point compactification.

(3 questions)

Books recommended :

1. George F. Simmons : Introduction to Topology and Modern Analysis, McGraw-Hill Book Company 1963.
2. J.L. Kelley : General Topology, Van Nostrand, Reinhold Co., New York 1995.
3. K.D. Joshi : Introduction to General Topology, Wiley Eastern Ltd., 1983.
4. James R Munkres : Topology, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
5. S. Willard : General Topology Addison-Wesley, Reading, 1970.

M.A./ M. Sc. First Semester

Mathematics

Paper III

Differential and Integral Equations

Series Solution of Differential Equations: Solution in power series by Frobenius method. Legendre, Bessel and hypergeometric equations. A set of 24 particular solutions of hypergeometric differential equation. Legendre, Bessel and hypergeometric functions and their properties.

(4 questions)

Integral Equations: Volterra integral equations of first and second kind. L_2- kernels and functions. Solution by successive approximation and successive substitution to a Volterra integral equation. Fredholm integral equations. Solution by successive approximation. Neumann series. Pincherle- Goursat kernels (degenerate kernels). Hilbert- Schmidt theory for symmetric kernels.

(4 questions)

Books recommended:

1. Piaggo : An Elementary Treatise on Differential Equations.
2. A.R. Forsyth : A Treatise on Differential Equations.
3. F.G. Tricomi : Integral Equations.

M.A./ M. Sc. First Semester
Mathematics
Paper – IV
Riemannian Geometry

Tensor Algebra : Dual space. Tensor product of vector spaces. Tensors of type (r,s) .Tensor product of tensors. Algebraic operations .Contraction . Symmetric and skew-symmetric tensors.

(1.5 questions)

Curvature of a curve . Principal normal .Geodesics .Geodesic and Riemannian coordinates .Geodesic form of the linear element . Parallelism of a vector of constant / variable magnitude.

(1.5 questions)

Congruences and orthogonal ennuples . Ricci's coeficients of rotation. Curvature of a congruence . Geodesic congruence. Reason for the name " coefficient of rotation ". Narmal congruence. Irrotational congruence. Congruences canonical with respect to a given congruence.

(2 questions)

Riemannian curvature tensor.Its contration . Covariant curvature tensor . Bianchi 's identity. Riemannian curvature of a V_n . Theorem of Schur . Mean curvature of a space for a given direction .

(1 question)

Projevtive and conformal transformations . Weyl's projective and conformal curvature tensors and their properties .

(2 questions)

Books recommended :

1. C.E. Weatherburn : An Introduction to Riemannian Geometry and the Tensor Calculus ,Cambridge University Press, 1966.
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. First Semester

Mathematics

Paper – V

Hydrodynamics

Lagrangian and Eulerian methods. Equation of continuity. Boundary surfaces. Stream Lines. Path lines and streak lines. Velocity potential. Irrotational and rotational motions. Lagrange's and Euler's equations of motion. Pressure equation. Bernoulli's theorem. Impulsive actions. Flow and circulation. Permanence of irrotational motion. Stream function. Irrotational motion in two-dimensions. Complex velocity potential. Sources, sinks, doublets and their images.

(4 questions)

Two-dimensional irrotational motion produced by motion of circular and elliptic cylinders in a liquid. Kinetic energy of liquid. Milne-Thomson circle theorem. Theorem of Blasius. Stoke's stream function. Motion of a sphere through a liquid. Vortex motion. Vortex lines. Kelvin's proof of permanence. Motion due to circular and rectilinear vortices.

(4 questions)

Books recommended :

1. B.G. Verma: Hydrodynamics, Pragati Prakashan, Meerut, 1995.

2. W.H. Besaint and A.S. Ramsey: A Treatise on Hydrodynamics, Part II, C.B.S.

Publishers, Delhi, 1988.

3. F. Chorlton: Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985.

M.A./ M. Sc. First Semester

Mathematics

Paper – VI (a)

Spherical Astronomy-I

Refraction, parallel plate formula, homogeneous shell, concentric layers of varying density, differential equation for refraction, refraction in right ascension and declination, effect of refraction on sun-rise and disc of the sun.

(1.5 question)

Precession and nutation, physical cause of precession and nutation. Precession and nutation in right declension and declination, independent day numbers.

(1.5 question)

Aberration in longitude and latitude; right ascension and declination, aberrational ellipse, diurnal aberration and its effect in hour angle and declination, planetary aberration.

(3 questions)

Geocentric and heliocentric parallax, geocentric parallax in zenith distance, distance of the moon, lunar parallax in right ascension and declination, stellar parallax in longitude and latitude; right ascension and declination. parallactic ellipse.

(3 questions)

Books recommended :

1. Gorakh Prasad : Spherical Astronomy.

2. Ball : A Text book of Spherical Astronomy.

M.A./ M. Sc. First Semester

Mathematics

Paper – VI (b)

Operations Research-I

Origin and development of OR. Objective, nature, definition and scope of OR. Phases of OR Methods.

Network analysis: Basic concepts and definition. Network drawing and analysis Critical path method. Labelling method. Methods based on time estimates to find critical path. Concept of slack and float. Resource levelling and time-cost trade-off analysis. Time-cost optimization procedure. Project crashing. PERT. Requirements for application of PERT technique. Practical limitations in using PERT. Differences in PERT and CPM. Shortest path problem. Minimum spanning tree problem. Maximum flow problem. Minimum cost flow problem.

(4 questions)

Sequencing Problems : Assumptions for sequencing problem. Processing n jobs on two machines, n jobs on three machines, 2 jobs on m machines.

(1 question)

Non-Linear Programming: Introduction and definitions. Formulation of non-Linear programming problems, General non-linear programming problems. Constrained optimization with equality constraints. Constrained optimization with inequality constraints. Saddle point problems Saddle points and NLPP.

(1.5 questions)

Goal Programming: Introduction and definition. Concept of goal programming. Difference between linear programming approach and goal programming approach. Goal programming model formulation. Methods of solution of goal programming problem. Graphical method and Simplex method.

(1.5 questions)

Books recommended :

1. H.A. Taha: Operations Research – An Introduction, Macmillan Publishing Co., Inc., New York.
2. Kanti Swarup, P.K. Gupta, Man Mohan: Operations Research, Sultan Chand and Sons, New Delhi.
3. B.S. Goel, S.K. Mittal: Operations Research, Pragati Prakashan, Meerut.
4. P.K. Gupta, D.S. Hira: Operatons Research – An Introduction, S. Chand & Company Ltd., New Delhi.
5. S.S. Rao: Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
6. J.K. Sharma: Operations Research – Theory and Applications, Macmillan India Ltd.

7. S.D. Sharma: Operations Research, Kedar Nath Ram Nath & Company.

M.A./ M. Sc. First Semester

Mathematics

Paper – VI (c)

Fuzzy Sets

Fuzzy Sets: Basic definitions, α-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.

(2 questions)

The Extension Principle: The zadeh's extension principle. Image and inverse image of Fuzzy sets. Fuzzy numbers. Elements of Fuzzy arithmetic.

(2 questions)

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.

(2 questions)

Possibility Theory: Fuzzy measures, Evidence theory. Necessity measure. Possibility measure. Possibility distribution Possibility theory and Fuzzy sets. Possibility theory verses probability theory.

(2 questions)

Books recommended :

1. H.J.Zimmermann: Fuzzy set theory and its applications, Allied Publishers 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. First Semester
Mathematics
Paper – VI (d)
Programming in C (with ANSI features)

Theory : Max Marks : 30

Overview of C : History and importance of C. Sample Programs. Programming Style. Executing a 'C' Program. Constants, Variables and Data Type.

Operators : Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional, Bitwise, Special.

Expressions : Arithmetic expressions, evaluation of expressions. Input and output operators. (3 questions)

Decision Making and Branching: Decision making with if statement, simple if statement, the if ..... else statement. Nesting of if .....else statements. The else if Ladder. The Switch statement. The Goto statement.

Decision Making and Looping: The while statement. The do statement. The for statement. Jump in Loop.

Arrays : One and Two- Dimensional Arrays. Deceleration of One and Two-Dimensional

Arrays. Initializing of One and Two-Dimensional Arrays. Multi-dimensional Arrays. Dynamic Arrays. Character Arrays and Strings, (2 questions)

User defined Functions : Need for user defined functions. A multi function program. Elements of user defined functions. Definition of functions. Functions Call . Functions Deceleration. Category of function. Nesting of functions.

Pointers: Understanding pointers. Declaring pointer variables. Initializing of pointer variables. Accessing a variable through its pointer. Chain of pointers. Pointers and arrays. Pointer as function argument. File management in C. (3 questions)

Book recommended :

1. E. Balagurusamy: Programming in ANSI C, TMH, New Delhi

Practical : Max. Marks : 20

Programming in C (with ANSI features)

1. To print the prime numbers between 1 and 100.
2. To print the odd prime numbers between 1 and 100.
3. To find the sum of first 10 natural numbers.
4. To find the average of n numbers.
5. To find the area of a triangle when coordinates of its vertices are given.
6. To find the area of a triangle when lengths of its sides are given.
7. To find the roots of a quadratic equation.
8. To add any two 3x3 matrices.
9. To multiply any two 3x3 matrices.
10. To sort all the elements of a 4x4 matrix.

11. To find the value of determinant of a 5x5 matrix.
12. To implement bisection method.
13. To implement false- position method.

M.A./ M. Sc. First Semester

Mathematics

Paper – VI (e)

History of Mathematics-I

Ancient Mathematics: The Babylorians. The Egyptians. The Greeks. The Romans. The Maya. The Chinese. The Japanese. The Hindus. The Arabs. Mathematics in Europe during the middle age. Mathematics in the sixteenth, seventeenth and eighteenth centuries. The renaissance, Vieta and Descartes to Newton, Euler, Lagrange. and Laplace.

(8 questions)

Book recommended :

1. F. Cajon: A History of Mathematics.

M.A./ M. Sc. First Semester

Mathematics

Paper – VI (f)

Dynamics of Real Gases-I

Chemical Thermodynamics: Thermodynamics system and kind of equilibrium. Conservation of mass. First and second laws of thermodynamics Gibbs equation. Entropy production.

Equilibrium flow: Steady shock waves, steady nozzle flow, Prandtl-Meyer flow, frozen flow.

(4 questions)

Flow with vibrational or chemical non-equilibrium. Basic equations. Equilibrium and frozen flow. Acoustic equations. Equilibrium and frozen velocities. Propagation of plane acoustic waves. Small departures from a uniform free system. Flow over a wavy wall.

(4 questions)

Book recommended :

1. W. G. and C.H.: Introduction to Physical Gas Dynamics.