Dr. Ram Manohar Lal Avadh University Faizabad  
Syllabus of M.A. /M.Sc. Mathematics (for affiliated colleges)

**MATHEMATICS**

*M.A./M.Sc. (Previous)*  
*(From 2018-2019 onwards)*

There shall be four compulsory, one optional and one viva-voce as follows:

<table>
<thead>
<tr>
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**MATHEMATICS**

*M.A./M.Sc. (Final)*  
*(From 2018 onwards)*

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\[\text{Signatures:}\]

\[\text{Date:}\]
Dr. Ram Manohar Lal Avadh University Faizabad
Syllabus of M.A. /M.Sc. Mathematics (for affiliated colleges)

M.A./MSc.(Previous): Mathematics
(From 2018-19 onwards)

Paper I: ADVANCED ABSTRACT ALGEBRA
Marks: 100

Groups: Conjugacy relation, Normalizer of an element, class equation of a finite group. Center of a group, Fundamental theorem on isomorphism of groups. Automorphism. Inner automorphism, Maximal subgroups.

Normal and subnormal series, Composition series. Jordan Holder theorem for soluble groups. Nilpotent groups, Commutator subgroups. Exterernal and Internal direct product of groups. Cauchy theorem for finite groups, Sylow's theorem.


Modules: Cyclic modules, Simple modules, Semi-simple modules, Schur's Lemma, free modules.

M.A./MSc.(Previous): Mathematics
Marks: 100

Paper II: ADVANCED REAL ANALYSIS AND MEASURE THEORY


Rearrangements of terms of a series, Riemann's theorem, Functions of bounded variation.

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

Integration of the general integral, Integration of series, Riemann and Lebesgue integrals, The four derivatives, Lebesgue differentiation theorem. Differentiation and integration.

The L^p-space, Convex function, Jensen's inequality, Holder and Minkowski inequalities, completeness of L^p-space convergence in Measure. Almost everywhere convergence.
M.A./M.Sc. (previous) Mathematics
Paper-III
TOPOLOGY


Alternative methods of defining topology in terms of Kuratowski closure operator and Neighborhood system.

Continuous system and Homeomorphism.

First and second countable spaces, Lindelof’s theorems, separable spaces, second countability and separability.

Separation axioms $T_0, T_1, T_2, T_3, T_4$; their characterization and basic properties, Urysohn’s lemma, Tietze extension theorem.


Connected spaces.


M.A./M.Sc. (previous)
Mathematics
Paper IV
FLUID MECHANICS

Lagrangian and Eulerian methods. Stream lines, Stream tubes, equation of continuity, irrotational and rotational motion, circulation, Euler’s dynamical equations, surface conditions. Velocity potential, Bernoulli’s theorem.


Viscoscity. Most general motion of a fluid element, stain quadric, stress quadric, relation between stress and rate of strain components.
Any one of the following papers-

**M.A./M.Sc. (Previous)**
Mathematics
*PAPER-V (Optional Paper)*

**OBJECT ORIENTED PROGRAMMING USING C++**

*Basics of C++*: Structure of main(), Data Types, Variables, Constants and keywords, Operators, Header files, printf(), scanf(), Control flow (if-else, switch, break, while, do-while, for, continue, goto), Arrays, Strings, Structures and unions, Pointers.

*Preliminary of C++*: cin, cout objects, Insertion and Extraction operators, Reference variables.


*Classes and Objects*: Access specifiers, Defining data members & member functions, Creating objects, Accessing members of a class, Array of objects, Objects as function arguments, Returning objects, Constant & Static member functions, friend function.

*Constructors & Destructors*: Basics, 'this' pointer, Types of constructor (parameterized, copy, default), Memory allocation, Destructors.

*Operator overloading*: Operator function definition, Overloading all operators, Overloading using friend functions.


*Files*: Introduction, Classes for file stream operations, Opening & closing a file.
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M.A./M.Sc. (Previous)
Mathematics
PAPER-V(B)
GRAPH THEORY


Networks: Max-Min Theorem, Separating sets, Menger’s Theorem.

Ramsey Theory: Party Problem, relations among Ramsey numbers.

M.A./M.Sc. (Previous)
Mathematics
PAPER-V(C)
Differential Geometry of Manifolds

Definition and examples of differentiable manifold. Differentiable functions, Differentiable curves, Tengent space, Vector fields, Lie bracket.


Riemannian Manifold, Riemannian connection, Riemannian curvature tensor and Ricci tensor, Identities of Bianchi, Sectional curvature.

Exterior product of two vectors, Exterior algebra of order r, Exterior derivative, Cartan’s structural equations.

Submanifolds, Normals, Induced connection, Gauss formulae, Weingarten formulae, Lines of curvature, Mean curvature, Equations of Gauss and Codazzi.
M.A./M.Sc. (Previous)
Mathematics
PAPER-V(D)

MATHEMATICAL MODELING


M.A./M.Sc. (Previous)
Mathematics
PAPER-VI

Project Work and Viva-Voce
Dr. Ram Manohar Lal Avadh University Faizabad
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**MATHEMATICS**
M.A./M.Sc. (Previous)
(From 2018-2019 onwards)

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**MATHEMATICS**
M.A./M.Sc. (Final)
(From 2019 onwards)

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Dr. Ram Manohar Lal Avehad University Faizabad
Syllabus of M.A./M.Sc. Mathematics (for affiliated colleges)

M.A./M.Sc. (Final)
Mathematics
(From 2010 onwards)

PAPER-I
FUNCTIONAL ANALYSIS


M.A./M.Sc. (Final)
Mathematics
PAPER II

DYNAMICS OF RIGID BODIES AND ANALYTICAL DYNAMICS

Moment of inertia and product of inertia, D’ Alembert’s principle, Motion of a rigid body in two dimensions under finite and impulsive forces. Kinetic energy and moment of momentum in two dimensions. Conservation of energy and momentum.


Generalized coordinates, Holonomic and Nonholonomic systems, Scleronomic and Rheonomic systems, Generalized Potential, Lagrange’s equations of first kind, Lagrange’s equations of second kind, Energy equations for conservative fields.

Hamilton’s variables, Hamilton’s canonical equations, Cyclic coordinates, Routh’s equations.

M.A./M.Sc. (Final)
Mathematics
PAPER-III
OPERATIONS RESEARCH


Other Algorithms for Linear Programming- Dual simplex method, Parametric Linear Programming, Upper Bound Technique, Interior Point Algorithm, Linear Goal Programming.

Transport and Assignment Problems. Problems of sequencing n jobs on 2 machines, 2 jobs on m machines.


Integer Programming- Branch and Bound Technique.

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Syllabus of M.A. / M.Sc. Mathematics (for affiliated colleges)

M.A./M.Sc. (Final)
Mathematics
PAPER-IV (Optional)

Any one of the following papers:

M.A./M.Sc. (Final)
Mathematics
PAPER-IV (A)

Integral Equations and Calculus of Variations


Solution of integral equations by transform methods: Singular integral equations, Hilbert transform, Cauchy type integral equations.

Calculus of Variations: Basic concepts of the calculus of variations such as functionals, extremum, variations, function spaces, the brachistochrone problem. Necessary condition for an extremum, Euler’s equation with the cases of one variable and several variables, Variational derivative. Invariance of Euler’s equations. Variational problem in parametric form.

General Variation: Functionals dependent on one or two functions, Derivation of basic formula, Variational problems with moving boundaries, Broken extremals: Weierstrass-Erdmann conditions.

M.A./M.Sc. (Final)
Mathematics
PAPER-IV (B)

ADVANCED FUNCTIONAL ANALYSIS

Definition and example of topological vector spaces. Convex 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 spaces.


\[ \frac{\text{Value}}{20.08.2018} \]

\[ \frac{\text{Time}}{20.08.18} \]
MAGNETO FLUID DYNAMICS


MFD Applications- Astrophysical and geophysical applications. MFD ejectors. MFD accelerators. MFD lubrication. MFD power generation.

FUZZY SETS AND THEIR APPLICATIONS


An introduction to fuzzy control—Fuzzy controllers. Fuzzy rule base. Fuzzy inference engine. Fuzzification, Defuzzification and the various defuzzification methods (the centre of area, the centre of maxima and the mean of maxima methods).

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M.A./M.Sc. (Final)
Mathematics
PAPER-V (Optional)

Any one of the following papers-

M.A./M.Sc. (Final)
Mathematics
PAPER-V(A)
Finite Element Methods

Introduction to finite element methods, comparison with finite difference methods.
Methods of weighted residuals, collocations, least squares and Galerkin's method.
Variational formulation of boundary value problems, equivalence of Galerkin and Ritz
methods.
Applications to solving simple problems of ordinary differential equations.
Linear, quadratic and higher order elements in one dimensional and assembly, solution
of assembled system.
Simplex elements in two and three dimensions, quadratic triangular elements, rectangular
elements, serendipity elements and isoperimetric elements and their assembly,
discretization with curved boundaries, interpolation functions, numerical integration, and
modeling considerations.
Solution of two dimensional partial differential equations under different Geometric
conditions.

M.A./M.Sc. (Final)
Mathematics
PAPER-V(B)
ADVANCED RIEMANNIAN GEOMETRY
Hypersurfaces: Unit normal. Generalised covariant differentiation. Gauss's
formulae. Curvature of a curve in a hypersurface. Normal curvature, Mean curvature.
Principal normal curvature. Lines of curvature, Conjugate and asymptotic directions,
Tensor derivative of the unit normal. Gauss characteristic equation and Mainardi-Codazzi
equations. Totally geodesic hypersurfaces.

Subspaces: Unit normals. Gauss's formulae. Change from one set of normals to
another. Curvature of a curve in subspace. Conjugate and asymptotic
directions. Generalisation of Dupin's theorem. Derived vector of a unit normal. Lines of
curvature for a given normal.

Lie derivative: Infinitesimal transformation. The notion of Lie derivative. Lie
derivative of metric tensor and connection. Motion and affine motion in Riemannian spaces.

Hypersurfaces in Euclidean space: Hyperplanes. Hyperspheres. Central quadric
hypersurfaces. Reciprocal quadric hypersurfaces. Conjugate radii. Any hypersurface in
Euclidean spaces. Riemannian curvature of a hypersphere. Geodesics in a space of positive
constant curvature.
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M.A./M.Sc. (Final)
Mathematics
PAPER-V(C)
GENERAL RELATIVITY AND COSMOLOGY


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.

Hubble’s law, cosmological principles, Weyl’s postulate, derivation of Robertson-Walker metric, Hubble and deceleration Parameters. Redshift, Redshift versus distance relation, Angular size versus redshift relation and source counts in Robertson-Walker space-time.

Advanced Numerical Methods

Numerical Solution of Systems of Linear Equations


Numerical Solution of Partial Differential Equations

Project Work and Viva-Voce