

B.A. /B.Sc. MATHEMATICS

Course structure

(Duration: Three Years)

B.A. /B.Sc. Mathematics Part-I

(w.e.f. 2007)

(Duration: One Year)

BMH 101	Abstract Algebra
BMH 102	Calculus
BMH 103	3-D Coordinate Geometry and Trigonometry

B.A. /B.Sc. Mathematics Part-II

(w.e.f. 2008)

(Duration: One Year)

BMH 201	Elementary Analysis, Differential Equations and Vector Calculus
BMH 202	Linear Algebra
BMH 203	Mechanics

B.A. /B.Sc. Mathematics Part-III

(w.e.f. 2009)

(Duration: One Year)

BMH 301	Real Analysis and Statistics
BMH 302	Differential Geometry
BMH 303	Linear Programming and Probability

ABSTRACT ALGEBRA**Unit-I**

Sets and Logic (No question should be asked on this part). The well-ordering principle. The division algorithm. The fundamental theorem of arithmetic, Congruence modulo. Equivalence relations and Equivalence classes.

Unit-II

Groups: Definition, Examples and Properties, Permutation and Permutation group, Subgroups and their properties.

Unit-III

Cosets and Coset decomposition, Lagrange's theorem and its corollaries, Fermat's theorem, Cyclic group.

Unit-IV

Normal subgroup, Centre of a group, Quotient group, Homomorphism and Isomorphism, Fundamental theorem of homomorphism, Cayley's theorem.

Unit-V

Ring, Examples and simple properties, Different types of rings, Subring and Ideals, Divisibility in an integral domain, Polynomial ring, Field and simple properties.

BOOKS SUGGESTED:

- | | |
|--------------------------------------|--|
| 1. Thomas A. Whitelaw | Introduction to Abstract (Blakie & Son Ltd.) |
| 2. R.S. Mishra and N.N. Bhattacharya | Fundamental structure in Modern Algebra |
| 3. Bhattacharya, Jain & Nagpal | Abstract Algebra (Cambridge Uni. Press) |

Note –The course is divided into five units. The question paper will consist of five questions. One question per unit will be asked. Each question will consist of four parts, out of which the examinee will be asked to attempt only two parts. The examinee will be required to attempt all questions.

BMG: 102

Max Marks: 50

CALCULUS

Unit-I

Successive differentiation: Expansion of functions, Maclaurin's and Taylor's theorems.

Unit-II

Maxima and minima up to two independent variables, Indeterminate form, Jacobian of three functions, Partial differentiation.

Unit-III

Asymptotes, Curvature, Envelop, Double point and curve tracing (Polar and Cartesian).

Unit-IV

Standard reduction formula, Integration, as the limit of sum, Simple definite integrals.

Unit-V

Rectification, Quadrature, Volumes and Surfaces solids of revolution, Beta and Gamma functions with their properties.

Books Recommended:

- | | |
|------------------|-----------------------|
| 1. Gorakh Prasad | Differential Calculus |
| 2. Gorakh Prasad | Integral Calculus |

Note –The course is divided into five units. The question paper will consist of five questions. One question per unit will be asked. Each question will consist of four parts, out of which the examinee will be asked to attempt only two parts. The examinee will be required to attempt all questions.

3-D Coordinate Geometry & Trigonometry

Unit-I

System of coordinates, Direction Cosine, Angle between two lines, Projections, Distance of a point from a line.

The plane: General form, Normal form, Intercept form, Reduction of the general form to normal form, Equation of plane through three points, Angle between two planes, Parallel planes, Perpendicular distance of a point from the planes, Pair of the planes, Area of a triangle and volume of a tetrahedron.

Unit-II

The straight line: Equation of a line in general form, Symmetric form, Two point form, Reduction of the general equation to the symmetrical form, Straight line and the planes, Conditions of parallelism and perpendicularity of a line and a plane, Plane through a given line, Perpendicular distance formula for the line, Projection of a line on a given plane containing them, Equation of a straight line intersecting two given lines, Perpendicular distance formula for the line and coordinates of the foot of the perpendicular, Shortest distance between two lines.

Unit-III

Sphere: General equation of a sphere, Plane section of a sphere, Intersection of two spheres, Sphere through a given circle, Intersection of a straight line and a sphere, Equation of a tangent plane to sphere, Condition of tangency. Plane of contact, Polar plane of a given plane, Angle of intersection of two spheres, Length of tangent, Radical plane, Coaxial system of spheres.

Unit-IV

Cone: Equation of a cone whose vertex is at origin, Equation of a cone with a given vertex and a given conic as base, Condition that general equation of second degree represent a cone, Equation of a tangent plane, Condition of tangency of a plane and a cone, Reciprocal cone, Right circular cone.

Unit-V

Expansions of sine and cosine of multiple angles in series, Expansion of sine, cosine and tan in power of angles, Expansion of power of sines and cosines in multiples angles, Exponential series for complex numbers, Circular and inverse circular functions for complex numbers, Hyperbolic functions, Inverse hyperbolic functions, Logarithm of complex numbers, Summation of trigonometric series.

BOOKS SUGGESTED:

- | | |
|--------------------|-------------------------------------|
| 1. Shanti Narayan | Coordinate Geometry of 3-Dimension. |
| 2. S.L.L. Loney | Trigonometry part III |
| 3. Schaum's series | Coordinate Geometry |

Note –The course is divided into five units. The question paper will consist of five questions. One question per unit will be asked. Each question will consist of four parts, out of which the examinee will be asked to attempt only two parts. The examinee will be required to attempt all questions.

Elementary Analysis, Differential Equations and Vector Calculus

Unit-I

Real –Valued functions, Equivalence, Countability, Real numbers, Least upper bound, Sequence of real numbers, Series of real numbers.

Infinite series: Introduction, Alternating series with Leibnitz test, P-series test for positive terms, Comparison test for positive terms, D'Alembert's ratio test, Cauchy's root test, Raabe's test, Logarithmic test,

Open sets, closed sets on \mathbb{R} , Derivatives, Rolle's Theorem, The law of the mean.

Unit-II

Ordinary differential equation of the first order and first degree, Clairaut's form of differential equations, Orthogonal trajectories, Linear differential equations with constant coefficient, Homogeneous linear differential equations.

Unit-III

Linear differential equation of second order with constant coefficients.

Unit-IV

Scalar and Vector product of three vectors, Product of four vectors, Reciprocal vectors, Vector differentiation, Directional derivatives, Gradient, Divergence and Curl.

Unit-V

Vector integration, Theorems of Gauss, Green, Stokes and problems based on these.

BOOKS SUGGESTED

- | | |
|----------------------|---|
| 1. R.R.Goldberg | Methods of Real Analysis |
| 2. Gorakh Prasad | Integral Calculus |
| 3. Shanti Narayan | A text –Book of Vector Calculus
(S. Chand & Co. New Delhi) |
| 4. G.F. Simmons | Differential Equations |
| 5. Murray R. Spiegel | Vector Analysis, Schaum Pub. Company New York |
| 6. S.L. Ross | Ordinary Differential Equations |
| 7. H.L. Royden | Real Analysis |

Note –The course is divided into five units. The question paper will consist of five questions. One question per unit will be asked. Each question will consist of four parts, out of which the examinee will be asked to attempt only two parts. The examinee will be required to attempt all questions.

BMG: 202

Max Marks: 50

Linear Algebra

Unit-I

Vector Space: Field, Vector space, Subspaces, Base and dimension, Coordinates, Summary of rows equivalence, Computations concerning subspaces.

Unit-II

Linear Transformations: Linear transformations and their algebra. Isomorphism, Representation of transformations by matrices.

Linear functionals, Double dual, Transpose of linear transformations.

Unit-III

Polynomials: Algebra of polynomials, Polynomial ideals, Determinant functions and simple properties.

Unit-IV

Canonical Form: Characteristic values and Characteristic vectors, Annihilating polynomials, Examples of invariant subspaces.

Diagonalization, Orthogonal diagonalization, Applications to differential equations.

Unit-V

Quadratic forms: Quadratic forms in two and n variables, Cross-product terms of the quadratic form. Positive definite Quadratic form, Diagonalization of quadratic forms, Application to conic sections.

BOOKS SUGGESTED:

1. H.Anton Elementary Linear Algebra , John Wiley & Sons.
2. Chatles W.Curtis(C.W.Curtis) Elementary Linear Algebra

Note –The course is divided into five units .The question paper will consist of five questions. One question per unit will be asked. Each question will consist of four parts, out of which the examinee will be asked to attempt only two parts. The examinee will be required to attempt all questions.

BMG: 203

Max Marks: 50

Mechanics

Unit-I

Virtual Works: Equilibrium of strings and chains (common catenary and catenary of uniform strength), Stable and Unstable equilibrium, Moments and couples, Varignon's theorem of moments

Unit-II

Equilibrium of forces in three dimensions, central axis, Wrench and Screw, Pitch of the wrench.

Unit-III

Kinematics, Motion in a straight line and a plane, Radial and transverse velocities and accelerations.

Unit-IV

Angular velocity and acceleration, Tangential and normal velocities and acceleration, Rectilinear motion with constant acceleration.

Unit-V

Simple harmonic motion, Hook's law, Repulsion from a fixed point varying as the distance from the point, Constrained motion on a smooth plane (Vertical circle and cycloid) , Projection.

BOOKS SUGGESTED:

1.R.S.Verma	Statics
2.S.L.Loney	Statics
3.M.Ray	Dynamics

Note –The course is divided into five units .The question paper will consist of five questions. One question per unit will be asked. Each question will consist of four parts, out of which the examinee will be asked to attempt only two parts. The examinee will be required to attempt all questions.

BMG: 301
Real Analysis and Mathematical Statistics

Max Marks: 50

Unit I

Concepts of metric space: Continuous functions, Open sets and closed sets in metric spaces, connected sets, Bounded and Totally bounded sets, Complete metric spaces, Contraction mapping, Compact metric spaces, Uniform continuity.

Unit II

Existence and properties of the Riemann integral, Fundamental theorem of calculus, Improper integral.

Sequence and series of function: Point-wise and uniform convergence of sequence of functions, Convergence and uniform convergence of series of function, Integration and differentiation of series of functions.

Unit III

The metric space $C[a,b]$.The Weierstrass approximation theorem ,Picard's existence of differential equation, Fourier series ,Formulation of convergence problems, Convergence of Fourier series .

Unit IV

Curve fitting-Method of least square, Introduction of Moments, Applications of t-test , Z-test and F-test.

Unit V

Interpolation :(Newton's and Lagrange's formula), Correlation and regression, Measures of correlation, The least square regression lines, Coefficient of correlation, Rank correlation.

Books suggested:

- | | |
|--------------------|--|
| 1. R.R Goldberg | Method of Real Analysis.(Relevant parts) |
| 2. E.T.Coppson | Metric spaces, Cambridge Univ .Press. |
| 3 Ray & Sharma | Mathematical Statistics. |
| 4 Murray & Spiegel | Statistics |
| 5. C.E.Weatherban | A text Book of Statistics |

Note –The course is divided into five units .The question paper will consist of five questions. One question per unit will be asked. Each question will consist of four parts, out of which the examinee will be asked to attempt only two parts. The examinee will be required to attempt all questions.

Differential Geometry

Unit-I

Curves With Torsion: Tangent, Principal normal-Curvature, Binormal -Torsion ,Serret-Frenet formulae, Locus of centre of curvature and examples. Spherical curvature, Locus of centre of spherical curvature, Theorem: Curve determined by its intrinsic equation, Helices, Spherical indicatrix of tangent, Involutives, Evolutes. Bertrand curves.

Unit-II

Envelopes, Developable Surfaces: Surfaces, Tangent plane –Normal, One –Parameter Family of Surfaces: Envelope, Characteristics, Edge of regression, Developable surfaces, Developables associated with a curve : Osculating development , Polar development, Rectifying development. Two –parameter Family of Surface: Envelope, Characteristics points, and its examples.

Unit-III

Curvilinear Coordinates on a Surface Fundamental Magnitudes: Curvilinear Coordinates, First order magnitude , Directions on a surface , The normal , Second order Magnitude ,Derivatives of n ,Curvature of normal section ,Meunier's theorem and examples.

Unit-IV

Curves on a Surface: Lines of Curvature: Principal direction and curvatures, First and second curvature, Euler's theorem, Dupin's indicatrix, The Surface $z = f(x,y)$, Surface of revolution and examples. Conjugate directions, Conjugate systems.

Asymptotic lines, Curvature and torsion, Isometric Parameters, Null Lines or Minimal curves and examples.

Unit-V

The Equations of Gauss and of Codazzi: Gauss's formula for r_{11} , r_{12} , r_{22} ,Gauss's characteristic equations ,Mainardi–Codazzi relations, Alternative expressions ,Bonnet's theorem, Derivation of an angle ω and examples.

Geodesic: Geodesic property, Equations of geodesics, Surface of revolution, Torsion of a geodesic ,Curves in relation to Geodesics : Bonnet's theorem ,Joachimsthal's theorems ,Vector curvature , Geodesic curvature and its other formulae ,Examples.

BOOKS SUGGESTED:

- | | |
|-------------------|---|
| 1.C.E.Weatherburn | Differential Geometry |
| 2.Bansi Lal | Differential Geometry, Atma Ram & Sons, Delhi |
| 3.Andrew Presely | Elementary Differential Geometry, Springer |

Note –The course is divided into five units .The question paper will consist of five questions. One question per unit will be asked. Each question will consist of four parts, out of which the examinee will be asked to attempt only two parts. The examinee will be required to attempt all questions.

