

# MAGADH UNIVERSITY

BODH-GAYA



**COURSES OF STUDIES**

**FOR**

**B. A./B. Sc. HONOURS SUBSIDIARY &**

**GENERAL Part I, II & III Examination**

**IN**

**MATHEMATICS—1996-98 on Wards**

PRICE Rs. 10/-

# Magadh University

## COURSES OF STUDY

B. A. / B. Sc. PART I EXAMINATION, 1996-98

### MATHEMATICS (HONOURS)

#### PAPER—I

Twelve questions to be set. Six to be answered selecting at least one from each group. One question will be objective and it will be compulsory. This question will carry 20 marks. Rest questions are each of 16 marks.

#### GROUP—A

( Set theory and Trigonometry )

Sets, subsets, power set, Algebra of sets, Demorgan's laws, Cartesian product of sets, relation, equivalence relation, Definition and examples of partial and total order relation, Countable and uncountable sets, Countability of rational, real and algebraic number system, Countability of unions. (2 questions)

Hyperbolic functions, Resolution into factors.

(2 questions)

#### GROUP—B

( Matrices )

Sum of product of matrices, Symmetric and skew symmetric matrices, Transpose, adjoint and inverse of a

matrix. Orthogonal matrices and their properties. Rank of a matrix. Solution of a system of linear equations with three unknowns. (2 questions)

**GROUP—C**

( Linear Programming )

Convex sets and their properties. L. P. problems and their graphical solutions. Theory of Simplex method and their simple applications. (2 questions)

**GROUP—D**

( Theory of Equations )

Fundamental theory of algebra. Relation between roots and coefficients. Polynomial equations. Evaluation of symmetric functions of roots of cubic and biquadratic equations. Solution of cubic equation. Descartes' rule of signs. ( 3 questions )

**PAPER—II**

Twelve questions to be set. Six to be answered selecting at least one from each group. One question will be objective and it will be compulsory. This question will carry 20 marks and rest questions are each of 16 marks.

**GROUP—A**

( Differential Calculus )

Successive differentiation, Leibnitz theorem. Tangent and Normal, Curvature, Asymptotes, Partial differentiation, Euler's theorem, Exact differential, Indeterminate form, L. Hospital, rule.

( 3 )

**GROUP—B**

( Integral Calculus )

Integration of rational, irrational and trigonometric functions, Notion of integral as limit of sum, Evaluation of definite integrals, Reduction formula, Curve tracing, Areas of curves, Length of curves, Volumes and surface areas of Solids of revolution. ( 2 questions )

**GROUP—C**

( Analytical Geometry of 2 dimensions )

Condition for the general equation of second degree to represent parabola, ellipse and hyperbola and reduction into standard forms. Equations of tangents and normals in case of general equation and their forms in their particular conic section. Equation of polar, chord of contact, pair of tangents in case of parabola, ellipse, Hyperbola and their special properties. Polar equation of a conic section—Tangent and normal. ( 3 questions )

**GROUP - D**

( Analytical Geometry of 3 dimensions )

Rectangular, Spherical, Polar and cylindrical coordinates, Angle between straight lines. Equations of planes and straight Lines, Shortest distance between Lines, Sphere, Cone, Cylinder, Standard equations of conicoids. Normal and conjugate diameters of ellipsoid. ( 3 questions )

PAPER—III

Twelve questions will be set. Six to be answered selecting at least one from each group. One question will be objective and it will be compulsory. This question will carry 20 marks and rest questions are each of 16 marks.

GROUP—A

( Real Analysis )

Dedekind's theory of real numbers, Sequence and its convergence, Cauchy sequence, Cauchy general principle for convergence, Monotonic sequence, Cantor's construction of real numbers, Properties of real numbers.

Continuity and Differentiability of a function of one variable, Properties of continuous and discontinuous functions, Rolle's theorem, Mean value theorem, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's and Maclaurin's series of elementary functions.

( Four questions )

GROUP—B

( infinite series )

Infinite series and their convergence, Comparison test, root test, Raabe's test, Cauchy's condensation test, Integral test, Leibnitz test, Gauss test, Kummer's test, De Morgan and Bertrand's test. Absolute convergence

and rearrangement of series, Pringheim's theorem, Cauchy's multiplication of series and its convergence.

( Three questions )

GROUP—C

( Algebra )

Binary operations, Notions of group, Abelian group and non-abelian group with examples, Uniqueness of identity elements and inverse elements in a group, Different ways of defining group, Concept of sub-group and cyclic group with examples, intersection of sub-groups, Sub-group of cyclic groups, concepts of rings, integral domains and fields and their examples and general properties, Cancellation law, Divisions of Zero, A finite integral domain as a field.

Cosets, Order of an element, Lagrange's theorem, Group of residue classes, Permutation groups, Cayley's theorem, Homomorphism and Isomorphism of groups, Normal subgroups, Kernel of a group homomorphism, Isomorphism theorems for cyclic group, factor groups, Fundamental theorem of homomorphism of groups.

Ring of residue classes, Ring of matrices, Subrings, ideals, Ring homomorphism and ring isomorphism, Kernel of a ring homomorphism, Quotient rings, Fundamental theorem of homomorphism of rings.

( Four questions )

PAPER—IV

Twelve questions to be set. Six to be answered

( 6 )

selecting at least one from each group. One question will be objective and it will be compulsory. This question will carry 20 marks and rest questions are each of 16 marks.

**GROUP—A**

( Vector Calculus )

Product of three and four vectors. Differentiation of vector functions. Differentiation of product of two vectors; gradient, divergence and curl of a vector function and their deductions. Moments of a localised vector about a point, work done by a force. Scalar moment of a vector about a directed line.

( Two questions )

**GROUP—B**

( Differential Equations )

Formation and solution of differential equations. Differential equation of the first order. Separation of variables, Homogeneous forms, Linear equation of first order, Clairaut's form, geometrical applications of first order differential equations, Linear differential equation of second order with constant coefficients, C. F. and P. I. Orthogonal Trajectories.

( Three questions )

**GROUP - C**

( Statics )

Reduction of a force system to a force and a couple.

Equation of the resultant, principle of virtual work in two dimensions, stable equilibrium. Energy test for stability. Catenary, Poinso't's central axis, wrench, pitch, null lines.

( Three questions )

GROUP—D

( Dynamics )

S. H. M., simple pendulum, Elastic strings and springs, Hook's law.

( One question )

Components of velocities and acceleration, Cartesian, radial and transverse, tangential and normal. Projective motion in non-resisted medium.

( One question )

Motion of a particle under central force, Differential equation of central orbit in polar and pedal forms. Newton's law of gravitation and planetary orbit. Kepler's laws.

( One question )

PAPER—V

( Real Analysis II )

Twelve questions to be set. Six to be answered selecting at least one from each group. One question will be objective and it will be compulsory. This will carry 20 marks and the questions are each of 16 marks.



## GROUP—A

Functions of two variables, Limit, Repeated limits, Moore, Osgood theorem, Continuity and differentiability of functions of two variables, Young's and Schwarz condition of equality of  $f_{xy}$  and  $f_{yx}$ . Implicit function theorem, Taylor's theorem; maxima. minima of functions of two variables, Lagrange's method of undetermined multipliers.

( Three questions )

## GROUP—B

Definition and existence of Riemann integral of bounded function, Darboux condition of integrability, Riemann integrability of continuous functions and monotonic functions, Riemann integral of functions with finite number of discontinuities and of functions with discontinuity points having a finite number of limit points, Riemann integral as the limit of a sum. The fundamental theorem of integral calculus, Mean value theorems.

( Two questions )

Improper integrals, convergence of an improper integral, comparison tests, Dirichlet's test, Beta and Gamma functions, Their properties and relationships. Differentiation under integral sign.

( One question )

Double and triple integrals, iterated integrals.

Change of order of integration, Line, surface and volume integrals. Green's Causs's and stokes theorem.

( One question )

### GROUP—C

Sequences and series of functions and their pointwise convergence, Uniform convergence of sequences and series of functions. Weirstrass M-test, Uniform convergence and continuity, Dini's test, Abel's test, Dirichler's test, Uniform convergence and integration. Uniform convergence and differentiation.

( Two questions )

Infinite product and its convergence and their mutual relations, Double series. Sum by rows, Sum by columns, Pringsheim's theorem. Elementary notions of metric spaces and topological spaces.

( Two questions )

### PAPER—VI

Twelve questions to be set. Six to be answered selecting at least one from each group. One question will be objective and it will be compulsory. This question will carry 20 marks and rest question are each of 16 marks.

### GROUP—A

( Group Theory )

Centre, Normalizer, Conjugacy, class equation.

automorphisms, inner automorphisms, Commutator and commutator subgroups, Direct product of two groups, Solvable groups, Finite groups.

( Three questions )

### GROUP—B

( Ring )

Division ring, Polynomial ring, Imbedding of a ring without unity in a ring with unity, Imbedding of a ring and integral domain in a field, Characteristics of a field, Field of quotients, Polynomials over commutative rings, Prime and maximal ideals in commutative rings, Euclidean domains, Principal ideal domains. Unique factorization domains.

( Four questions )

### GROUP—C

( Linear Algebra )

Vector spaces, subspaces, Bases and dimension, Linear transformation, Algebra of linear transformations, Matrices and linear transformations, Rank and nullity of a linear transformation.

Dual spaces, transpose of a linear transformation, Direct sum of subspaces, Characteristic values, Characteristic vectors, Cayley=Hamilton theorem.

( Four questions )

### PAPER—VII

Twelve questions to be set. Six to be answered.

selecting at least one from each group. One question will be objective and it will be compulsory. This question will carry 20 marks and rest questions are each of 16 marks.

GROUP—A

( Mechanics )

Motion in a resisting medium. Motion of a body about a fixed point. Angular velocity. Relation between angular velocity and linear velocity of a point of the body. General motion of a body. ( One question )

Moment of inertia, Definitions and standard results, Momental ellipsoid and perpendicular axes theorems. Principal axes of inertia (existence of principal axes of inertia at a point), Determination of principal axes of inertia, Equimomental systems. ( One question )

Angular momentum and kinetic energy of a rigid body rotating about a fixed point, kinetic energy of a rigid body in a general motion.

Principles of Linear momentum, Angular momentum and energy for a rigid body, D'Alembert's principle and general equations of motion of rigid body. Motion about a fixed axis, Compound pendulum.

( Two questions )

GROUP—B

( Attraction and Potential )

Attraction and potential, Attraction and potential of rod, rectangular and circular discs, spherical shells, sphere

( Laplace's and Poissons equations ), Theorems on equipotential surfaces. ( Two questions )

### Hydrostatics

Pressure at a point, Thrust on plane surfaces, centre of pressure, equilibrium of floating bodies. ( 2 questions )

### GROUP—C

#### ( Differential Equations )

Second order equations with variable co-efficients, Solution of second order differential equations with variable co-efficients, Method of variation of parameters,

Total differential equation in three independent variables, Simultaneous differential equations, Lagrange's Linear partial differential equations, standard forms, Charpits method.

Partial differential equations of higher order with constant co-efficients, Monge's method.

( Three questions )

Ten questions to be set in each optional paper and five questions to be answered.

### PAPER—VIII

100 marks

#### ( Numerical Analysis )

Finite, Central and Divided difference, interpolation, Inverse Interpolation, Numerical differentiation, Numerical integration, Trapezoidal Simpson's 1/3rd and 3/8th

rules, Weddle's Rule, Gauss quadrature formula of Integration, Gregory's formula and the Euler Maclaurin's formula. ( 3 questions )

Solution of difference equation of the first order, General equations, Linear difference equations with constant co-efficients, Solution of ordinary differential equations—one step method : Euler's modified method, Picard's and Runge—Kutta's methods of solution and Milne—Simpson's method. ( 3 questions )

Simultaneous Linear equations : Gauss elimination, Gauss—Seidel's, Jordan's and Relaxation methods (simple problems). ( 2 questions )

Finding roots of polynomial equations : Regula falso, Bisection, Newton—Raphson method for several variables, iterative method and its generalisation.

Significant figures and errors of computation.

( 2 questions )

### PAPER—VIII

( Spherical trigonometry and Astronomy )

( 2 questions )

Spherical triangle, Definitions, fundamental formula (Cosine, Sine, Sine—Cosine, cotangent), Napier's and D' Alembert's Angles, Right angle triangle and Napier's rule. ( 8 questions )

### Astronomy

Celestial sphere : Definition : Different System of

Co-ordinates, Phenomenon of rising and setting of stars,  
Twilight. ( 2 questions )

Solar systems, Two body problem, Equation of  
relative motion. ( 1 question )

Area integral, Kepler's law, Anomalies, Kepler's  
Equation. ( 1 question )

Stationary points phase of planet, Refraction,  
Simpson's—Bradley's and Cassini's formulas, Effect of  
refraction in the position of a body. ( 2 questions )

Annual Aberration, Effect of the aberration on  
celestial latitude and longitude, Effect of aberration on  
right ascension and declination, Parallax, effect of Parallax  
on latitude, longitude, right ascension and declination.

( 2 questions )

## PAPER—VIII

### Number Theory

The Basic Representation theorem. Linear Diophantine equation, Fundamental theorem of Arithmetic, Fermat's little theorem and Wilson's theorem.

( 2 questions )

Basic properties of Congruences, Residue System, Euler's theorem; Chinese Remainder theorem; Multiplicative arithmetic functions, the Euler's function  $\phi(n)$ ,  $\mu(n)$  Mobius function and the function  $d(n)$  and their

simple properties; Mobius Inversion formula, Perfect numbers and the function  $\tau(n)$ . ( 3 questions )

The quadratic Reciprocity law : Euler's criterion, The Legendre symbol and its properties and applications, Gauss, Lemma Gauss' quadratic reciprocity law, Quadratic congruences with composite moduli. ( 3 questions )

Representation of integers as sums of squares : Sums of two squares, Thue's lemma, Fermat's theorem, sums of four squares and Euler's lemma, Lagrange's theorem. ( 2 questions )

### PAPER—VIII

#### Probability Theory

Event, Probability of an event, sample space, probabilities in a finite sample space, Mutually exclusively events and complementary events, independent events, conditional probability. ( 1 question )

Axoms for probability in finite sample spaces, product rule of probabilities in a sample space, Baye's theorem, Random variables and their probability functions. Mathematical expectation and moment of a random variable, Mean of a function of a random variable, Mean absolute deviation, variance, standard variation, Chebyshev's theorems for a probability distribution and frequency distribution of measurements. ( 3 questions )



Convergence of a sequence of random variables, convergence in distributions, convergence in probability, almost sure convergence, convergence in a quadratic mean, Halley/Bary theorem. ( 3 questions )

Complex valued random variables, characteristic function, Inversion theorem, continuity theorem, Distribution and Kolomogarov's inequality, weak and strong laws of large numbers. ( 3 questions )

