SYLLABUS
For
Three Year B. A./B.Sc. (General) Courses
of studies in MATHEMATICS

(Effective from the academic session 2005 – 2006 and onwards)

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THE UNIVERSITY OF BURDWAN
RAJBATI, BURDWAN
WEST BENGAL

3 – YEAR GENERAL COURSES

PART – I

Paper				Marks	No. of Lectures
I	**Group – A**	**:**	Differential Calculus	**50**	**60**
	Group – B	**:**	Integral Calculus	**30**	**30**
	Group – C	**:**	Ordinary Differential Equations	**20**	**30**

PART – II

II	**First Half**	**:**	**Algebra**		
	Group – A	**:**	Abstract Algebras	**15**	**20**
	Group – B	**:**	Classical Algebra	**15**	**20**
	Group – C	**:**	Linear Algebra	**20**	**25**
	Second Half		**Geometry & Vector Algebra**		
	Group – D	**:**	Geometry (2-dimension)	**10**	**15**
	Group – E	**:**	Geometry (3-dimension)	**30**	**30**
	Group – F	**:**	Vector Algebra	**10**	**15**
III	**First Half**	**:**	Dynamics of a Particle	**50**	**60**
	Second Half	**:**	Probability & Statistics	**50**	**60**

PART – III

IV	**Group - A**	**:**	Linear Programming	**40**	**50**
	Group – B	**:**	Numerical Analysis	**30**	**40**
	Group - C	**:**	Computer Programming	**30**	**40**

Part - I

Paper – I

Group – A ***Differential Calculus*** ***(Marks – 50)***

Rational and Irrational numbers, Linear continuum, Functions. Sequences, Convergence of sequences, infinite series of constant terms, Tests of convergence, Comparison test, D'Alembert's ratio test, Cauchy's root test.

Limit of functions, Algebra of limits, Continuous functions, Properties of continuous functions (proof not required), Monotone functions, Inverse of function. Derivatives. Fundamental rules of differentiation, Successive differentiation, Leibnitz theorem, Rolle's theorem. Mean-value theorem of Lagrange and of Cauchy; Geometrical interpretations. Taylor's theorem and Maclaurian's theorem with remainder in Cauchy's and Lagrange's form; Taylor's series for a^x, log (1+x), $(1+x)^n$, sin x , cos x and for those functions dependent on them with discussion of convergence. Application of Mean value theorem and Taylor's theorem; Theory of maxima and minima, Indeterminate forms.

Functions of several variables, limits, repeated limits, continuity of functions of two variables; partial derivatives, Total differentials. Euler's theorem on homogeneous function of two variables, Differentiation of implicit function and of functions in parametric forms.

Rectilinear asymptotes, Envelopes, Curvature, Radius of curvature, Ideas of the Curve, Catenary, Folium of Descartes, Lemniscate of Bernoulli, Cardiode and Cycloid.

Group –B ***Integral Calculus*** ***(Marks – 30)***

Indefinite integrals, Method of substitution, Standard forms, Rules of integration, Integration by parts, Partial fraction method, Reduction formulae.

Definite integral as limit of a sum and its geometrical interpretation, Fundamental theorem of integral calculus. Elementary properties of definite integrals. Evaluation of definite integrals, viz, :

$$\int_0^{\pi/2} \sin^n x \, dx, \quad \int_0^{\pi/2} \cos^n x \, dx \text{ ,} \quad \int_0^{\pi/2} \sin^m x \cos^n x \, dx$$

(m, n being positive integers). Idea of improper integrals & test of convergence of the following improper integrals :

$$\text{(i)} \int_0^1 \frac{dx}{x^\mu} \qquad \text{(ii)} \int_a^\alpha f(x)\, dx \qquad \text{(iii)} \int_a^\infty \frac{f(x)\, dx}{(x - a)^\mu}$$

Rectification of plane curves, quadratures, volume and surfaces of solids of revolution, center of gravity of simple bodies.

Group – C ***Ordinary Differential Equation*** ***(Marks – 20)***

Genesis of differential equation, Family of curves represented by dy/dx = f(x,y), Solution of first order differential equation. Linear differential equation of second order with constant co-efficient, both homogeneous and non-homogeneous, Evaluation of solution satisfying initial conditions, simultaneous differential equation of first order.

References:

1. Das and Mukherjee – *Differential Calculus*
2. Das and Mukherjee – *Integral Calculus*
3. Goldberg – *Methods of Real Analysis*
4. Shantinarayan – *Differential Calculus and Integral Calculus*
5. Murray – *Ordinary Differential Equations*
6. Ghosh & Chakravorty – *Differential Equations*
7. Maity & Ghosh – *Differential & Integral Calculus*

Part - II

Paper – II

First Half : Algebra

Group – A ***Classical Algebra*** ***(Marks - 15)***

Polynomials, Division algorithm, Fundamental theorem of classical algebra (proof not required) and its consequences; Descartes rule of signs – its verification and applications, Relation between roots and co-efficients, symmetric function of roots, Transformation of polynomial equation, Cardon's solution of cubic equation, Complex numbers, De-Moivre's theorem, Exponential, sine, cosine and logarithm of a complex number.

Group – B ***Abstract Algebra*** ***(Matks - 15)***

Sets, union, intersection, complement, De-Morgan's law, Venn-diagram, Cartesian product of a finite number of sets; Mapping, 1-1 and onto property; composition of mapping. Groups, properties like uniqueness of inverse element, law of cancellation and solution of equation ax = b. Commutative property ; Sub-groups, Permutation, even and odd permutation, Group of permutations, Rings, Integral domain, divisor of zeros, fields.

Group – C ***Linear Algebra*** ***(Marks - 20)***

Definition of determinant of order n, determinants of order 3, their properties, minors, co-factors, adjoint of determinants, reduction of determinants.

Matrices, matrix algebra, square matrix, diagonal matrix, identity matrix, symmetric and skew symmetric matrices, transpose of a matrix, adjugate of a matrix, inverse of square matrix, non-singular matrix, orthogonal matrix, solutions of non-homogeneons system of three linear equations by matrix inversion method, Cramer's rule for solution of linear equations in three variables.

Vector-spaces over reals; Euclidean 3-space, polynomial space as examples of vector spaces. Linear dependence and independence of a finite set of vector; Sub-spaces. Definitions and examples.

Second Half : Geometry & Vector Algebra

Group – D ***Geometry(2- Dimension)*** ***(Marks - 10)***

Transformation of rectangular axes, Invariants, General equation of second degree –reduction to standard forms and classification. Polar co-ordinates, polar equation of a straight line, circle and conic.

Group – E ***Geometry(3- Dimension)*** ***(Marks - 30)***

Rectangular Cartesian co-ordinates. Transformation of axes. Direction cosines. Equations of a plane and a straight line. Shortest distance between two skew lines. Spheres, Cone, Cylinder, Ellipsoid, Hyperboloid and Paraboloid referred to principal axes. Tangent planes and normals.

Group – F ***Vector Algebra*** ***(Marks - 10)***

Definition of vector, Geometrical representation of vectors, Addition of vectors, Resolution of vectors into components along three directions. Scalar and vector products of two and three vectors. Applications to geometry and mechanics**.**

References:

1. S. K. Mapa – *Higher Algebra*
2. S. K. Mapa – *Linear Algebra*
3. B. K. Lahiri & K. C. Roy – *A Text Book of Algebra*
4. Das & Roy – *Linear Algebra*
5. Burnside and Panton – *Theory of Equations*
6. Loney – *Co-ordinate Geometry*
7. M. C. Chaki. – *A Text Book of Analytic Geometry*
8. Bell – *Co-ordinate Geometry of Three Dimensions*
9. Smith – *Solid Geometry*
10. Ghosh & Chakravorty – *Algebra*
11. Ghosh & Khan – *Algebra*
12. Dutta & Jana - *Geometry*

Paper – III

First Half ***Dynamics of Particles*** ***(Marks - 50)***

(Use of vector methods and calculus should be made as far as possible.)

Velocity and acceleration of a particle. Kinematical relations for displacement and velocity of a particle in rectilinear motion, uniform acceleration. Simple problems.

Linear momentum, angular momentum, kinetic energy, work done by a force. Potential energy for conservative system of forces.

Components of velocity and acceleration of a particle in (i) rectangular co-ordinates and (ii) polar co-ordinates for two dimensional motion.

Energy, Newton's law of motion. Principles of linear momentum and energy for two-dimensional motion. Some illustrative examples.

Problem of (i) motion of a particle on a smooth inclined plane (ii) motion of a connected system (iii) simple harmonic motion (iv) forced oscillation with linear damping (v) motion of a projectile (vi) uniform motion in a circle (vii) Central orbit with reference to motion under inverse square law.

Friction, laws of friction: motion of a particle on a rough inclined plane.

Impulsive force and impulse. One dimensional collision of two elastic bodies. Co-efficient of restitution, direct impact of two spheres, loss of kinetic energy.

Second Half ***Probability and Statistics*** ***(Marks – 50)***

Probability : ***(Marks - 25)***

Definition of probability. Classical and axiomatic definitions. Events. Sample space. Addition and multiplication theorem of probability. Conditional probability. Baye's theorem. Independence of events. Random variable, Cumulative distribution function and its properties. Bernoullian trials. Probability in continuum. Mathematical expectation. Tehebyshev's inequality and Bernoullli's theorem (statement only). Binomial, Poisson and normal distributions, limiting forms of Binomial and Poisson distributions.

Statistics : ***(Marks - 25)***

Frequency distribution, their graphical representation by histogram, frequency polygon and frequency curve. Measures of central tendency : arithmetic mean, median, mode, Measures of dispersion :. Standard deviation, range, semi-inter quartile range and mean deviation. Measures of Skewness and Kurtosis, Bivariate frequency distribution, scatter diagram, lines of regression, regression co-efficients, co-efficient of correlation, Samples, types of population, methods of sampling, random sampling, problem of statistical inference (qualitative discussion only).

References:

1. J. L. Synge & S. A. Griffith – *Principles of Mechanics*
2. S. L. Loney – *Dynamics of a Particle*
3. F. Chorlton – *A Text Book of Dynamics*
4. Das & Mukherjee – *Dynamics of a Particle*
5. Ghosh & Chakraborty – *Dynamics of a Particle*
6. A. Gupta – *Mathematical Probability and Statistics* (Academic Publishers)

7. Goon, Gupta & Dasgupta – *Fundamentals of Statistics*, Vol. I, 2
8. Groxton and Cowdon – *Applied General statistics*
9. Kenney and Keeping – *Mathematics of Statistics*, Part – I
10. Baisnab and Jas – *Elements of Probability and Statistics* (Tata-McGraw Hill Ltd.)
11. Ganguly & Saha – *Dynamics of a particle*
12. Dutta & Jana - *Dynamics*

Part - III

Paper –IV

Group – A ***Linear Programming*** ***(Marks –40)***

General introduction to optimization problem, Definition of L.P.P., Mathematical formulation of the problem, Canonical & Standard form of L.P.P., Basic solutions, feasible, basic feasible & optimal solutions, Reduction of a feasible solution to basic feasible solution.

Hyperplanes, Convex sets and their properties, Extreme points, Convex feasible region, Convex polyhedron, Graphical solution of L. P.P.

Fundamental theorems of L.P.P., Replacement of a basis vector, Improved basic feasible solutions, Unbounded solution, Condition of optimality, Simplex method, Simplex algorithm, Artificial variable technique (Big M method, Two phase method),

Duality in L.P.P. : Concept of duality, Fundamental properties of duality, Fundamental theorem of duality, Duality & Simplex method.

Transportation Problem (T.P.) : Matrix form of T.P., the transportation table, Initial basic feasible solutions (different methods like North West corner, Row minima, Column minima, Matrix minima & Vogel's Approximation method), Loops in T.P. table and their properties, Optimal solutions, Unbalanced T.P.

Theory of Games : Introduction, Two person zero-sum games, Minimax and Maximin priciples, Minimax and Saddle point theorems, Mixed Strategies games without saddle points.

Group –B ***Numerical Analysis*** ***(Marks –30)***

Exact and approximate numbers, significant figures, rounding off of numbers, errors-absolute, relative and percentage, general formula for errors, errors in arithmetic operations.

Ordinary and divided difference; propagation of error in difference table, problem of interpolation – Newton's forward, backward and divided difference formulae, Lagranges formula ; errors in interpolation formulae.

Numerical integration – Newton-cotes's formula, trapezoidal rule, and Simpson's one – third rule; geometrical significance; inherent errors.

Solution for simple real roots of algebraic and transcendental equations: Location of roots by (i) tabulation and graphical method. Finding the roots by the method of (i) Regula-falsi (ii) Fixed point iteration and (iii) Newton – Raphson ; geometrical significances and convergence.

Solution of system of linear equations – Gauss' elimination and Gauss-Seidel method, condition of convergence (statement only).

Solution of first-order ordinary differential equations by picard's method and Euler's method.

Group – C ***Computer Programming*** ***(Marks – 30)***

Preliminary Concept of Algorithm and Flow Chart; Functional Units and Block diagram of a Computer. Common hardware components, software, concept of machine language and computer high level language; Compiler and operating systems; Source and object programes.

Fortran –77 programming language; Basic data types; variables and constants; Arithmetic expression; Assignment statement; I/O statement (Format free); STOP & END statement; Constructions of simple FORTRAN Program. Arithmetic statement functions; Library function in FORTRAN.

Control statements; Unconditional GOTO; Computed GOTO, Logical IF and Arithmetic IF.

Subscripted variables; Arrays and DO statement; DIMENSION statement; CONTINUE statement.

FORTRAN 77 Programs of

1. Sum of the series
2. Largest and Smallest of Three given numbers
3. Roots of a quadratic equation with real coefficients
4. H.C.F. and L.C.M. of two integers
5. Numerical Integration :

(a) Trapezoidal rule

(b) Simpsons's 1/3 rule.

References:

1. F. B. Hildebrand –*Introduction to Numerical Analysis* (MacGraw Hill)
2. J. B. Scarborough – *Numerical Mathematical Analysis* (The Johns Hopkins Press)
3. S. S. Sastry – *Elementary Numerical Analysis*
4. A. Gupta and S. C. Bose – *Introduction to Numerical Analysis* (Academic Press)
5. Hadley – *Linear Programming*
6. Gauss – *Linear Programming*
7. J. K. Sharma – Operations Research – Theory and Applications (Macmilan)
8. Taha – *Operations Research*
9. Schaum's Outline Series – *Operations Research*

10. Ghosh & Chakraborty – *An Introduction to Linear Programming*
11. Swarup, Gupta & Man Mohan – *Operations Research*
12. V. Rajaraman – Fortran – 77
13. P. S. Grover – Fortran – 77/90
14. Ram Kumar - Fortran – 77
15. C. Xavier – Fortran – 77 and Numerical Methods
16. Arup Kr. Mukherjee – *A Fundamental treatise on Linear Programming, Numerical methods & Computer Programming in Fortran*