

# The University of Burdwan

**Corrected Draft Revised Syllabus for B.A./ B.Sc. (General) Course (3-years)  
in Mathematics as finalized by the UG Syllabus Committee after the  
Workshop held on 22.04.2015**

**[One hour lecture (1L) per one mark]**

## **Part-I**

Paper – I : Group A: Differential Calculus	40 Marks (40 L)
Group B: Integral Calculus	30 Marks (30 L)
Group C: Ordinary Differential Equations	30 Marks (30 L)

## **Part-II**

Paper –II : Group A: Abstract Algebra	15 Marks (15 L)
Group B: Classical Algebra	15 Marks (15 L)
Group C: Linear Algebra	15 Marks (15 L)
Group D: Geometry (2D)	10 Marks (10 L)
Group E: Geometry (3D)	30 Marks (30 L)
Group F: Vector Analysis	15 Marks (15 L)

Paper – III : Group A: Dynamics of a Particle	40 Marks (40 L)
Group B: Statics	20 Marks (20 L)
Group C: Probability and Statistics	40 Marks (40 L)

## **Part-III**

Paper –IV : Group A: Linear Programming	40 Marks (40 L)
Group B: Numerical Analysis	30 Marks (30 L)
Group C: Computer programming	30 Marks (30 L)

## **Part-I**

### **Paper –I**

#### **Group –A**

#### **Differential Calculus (Marks - 40)**

Rational and Irrational numbers, Linear continuum, Functions, limit of functions, Algebra of limits, Continuous functions, Properties of continuous functions, Monotone functions, Inverse function.

Derivative and its applications, Successive differentiation, Leibnitz's theorem, Rolle's theorem, Mean value theorem of Lagrange and of Cauchy with geometrical interpretations. Taylor's theorem and Maclaurin's theorem with remainder in Lagrange's and Cauchy's form, and application of mean value theorem, Darboux's theorem. Series expansion of  $\sin x$ ,  $\cos x$ ,  $\log(1+x)$ ,  $(1+x)^n$ ,  $a^x$  with domain of convergence. Determination of maxima and minima, Indeterminate forms.

Sequence and its convergence, Cauchy's Criteria of convergence. Tests of convergence, Infinite series of constant terms, comparison test, D'Alembert's ratio test, Cauchy's root test, Raabe's, test, Logarithmic test, Gauss' test. Alternating series, Leibnitz's test for alternating series (proofs are not required).

Functions of several variables, repeated and simultaneous limits, continuity, partial derivatives, total differentials, directional derivatives. Euler's theorem on homogeneous functions of two and three variables.

Rectilinear asymptotes, Envelopes, Curvature, Radius of curvature, tangent and normal, pedal equation of a curve.

#### **Group –B**

#### **Integral Calculus ( Marks-30)**

Definite integral as limit of a sum, its geometrical interpretation, Fundamental theorem of integral calculus, Reduction formula, Evaluation of definite integral ,viz:

$$\int_0^{\pi/2} \sin^n x dx, \int_0^{\pi/2} \cos^n x dx, \int_0^{\pi/2} \sin^m x \cos^n x dx \quad (m, n \text{ being positive integers}).$$

Idea of improper integrals and test of convergence of the following improper integrals (proofs are not required).

$$\int_0^1 \frac{dx}{x^\mu}, \int_a^\infty f(x) dx, \int_a^\infty \frac{f(x) dx}{(x-a)^\mu}$$

Beta and Gamma functions (only simple properties and examples).

Quadratures, Rectification of curves, Volume and surface of solids of revolutions, Pappus theorem (statement only), Centre of gravity of simple bodies.

### Group – C

#### Ordinary Differential Equations (Marks – 30)

First order and first degree ordinary differential equation : Existence and uniqueness theorem of solution, Exact differential equation, Integrating factor, First order linear differential equation , Equation reducible to linear form.

Trajectories, orthogonal trajectories.

Equation of first order but not of first degree: Equations solvable for  $p = \frac{dy}{dx}$ , Equations solvable for x, Equations solvable for y, Clairaut's form of equation, singular solution, Equations reducible to Clairaut's form .

Higher order linear differential equations with constant coefficients : Both homogeneous and non-homogeneous forms.

Simultaneous differential equation of first order.

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2. B.C. Das and B.N.Mukherjee, *Integral Calculus*, U. N. Dhur and Sons Pvt.Ltd. 56<sup>th</sup> Edition.
3. *Calculus: Differentiation and Integration* , ICFAI University Press, Pearson Education, 2012.

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13. S. N. Mukhopadhyay and A. Layek – *Mathematical Analysis – Vol-I* , U. N. Dhar & Sons. Pvt. Ltd.
14. S. N. Mukhopadhyay and S. Mitra – *Mathematical Analysis – Vol-II*, (U. N. Dhar & Sons. Pvt. Ltd.

## **Part-II**

### **Paper –II**

#### **Group –A**

#### **Abstract Algebra (Marks-15)**

Mapping – injective, surjective and bijective.

Composition of two mappings, Inverse mapping.

Binary composition, groupoids, semigroups, monoids, groups – simple examples, properties like uniqueness of identity and inverse element, law of cancellation and solution of the equation  $ax = b$  and  $ya = b$ . Commutative property, subgroups, permutation, even and odd permutation, group of permutation, divisor of zeros, Rings, Integral domain, fields.

## **Group –B**

### **Classical Algebra (Marks 15)**

Polynomials, Division Algorithm, Fundamental Theorem of Classical algebra (proof not required) and its consequences, Descartes, rule of signs – its applications, Relation between roots and co-efficients, symmetric functions of roots, transformation of polynomial equations, Cardan's solution of cubic equation.

Complex numbers, De-Moivre's theorem, exponential, logarithm, sine and cosine of complex numbers.

## **Group-C**

### **Linear Algebra (Marks-15)**

Solution of non-homogeneous system of three linear equations by matrix inversion method.

Elementary row and column operations, rank of a matrix, row reduced echelon form and fully reduced normal form.

Vector spaces over reals, simple examples, Euclidean 3-space  $E^3$ , linear dependence and independence of a finite set of vectors, sub-spaces, definition and examples.

Cayley – Hamilton Theorem (statement only), verification of Cayley-Hamilton Theorem, inverse of a square matrix by Cayley-Hamilton Theorem.

## **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. Equations of a plane and a straight line, Shorter distance between two skew lines. Sphere, Cone, Cylinder, Ellipsoid, Hyperboloid and Paraboloid referred to principal axes. Tangent planes and normals.

### **Group – F**

#### **Vector Analysis (Marks - 15)**

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

Continuity and differentiability of vector-valued function of one variable. Velocity and acceleration. Vector-valued functions of two and three variables, Gradient of scalar function, Divergence curl and their properties.

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1. S. K. Mapa, *Higher Algebra (Abstract and Linear)*, Sarat Book House, 11<sup>th</sup> Edition, 2011.
2. Promode Kumar Saikia, *Linear Algebra With Applications*, Pearson, Second Edition, 2014.
3. Burnside and Panton, *The Theory of Equations*, Hodges Figgis And Company, 1924.
4. U. M. Swamy & A. V. S. N. Murthy, *Algebra: Abstract and Modern*, Pearson, 2011.
5. Ghosh & Chakravorty, *Higher Algebra (Classical & Modern)*, U. N. Dhur & Sons Pvt. Ltd., Revised 22<sup>nd</sup> Edition.
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7. R. J. T. Bell, *An Elementary Treatise on Co-ordinate Geometry*, Macmillan & Co. Ltd., 1963.
8. N. Dutta & R. N. Jana, *Analytical Geometry and Vector Algebra*, Shreedhar Prakashani, Kolkata.
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10. B. Spain, *Vector Analysis*, D. Van Nostrand Company Ltd. 1965.
11. L. Brand, *Vector Analysis*, Dover Publications Inc., 2006.
12. Shanti Narayan, *A Text Book of Vector Analysis*, 19<sup>th</sup> Edn, S.Chand publishing, 2013
13. M. Spiegel, S.Lipschutz , D. Spellman, *Vector Analysis*, McGraw-Hill, 2<sup>nd</sup> edn, 2009.
14. C.E. Weatherburn, *Elementary Vector Analysis: With Application to Geometry and Physics*, Bell, 1921

## **Paper –III**

### **Group –A**

#### **Dynamics of a Particle ( Marks - 40 )**

*(Vector methods and calculus may be used.)*

Motion of a particle in one dimension : Rectilinear motion under constant and variable forces ; Motion under gravity in a resisting medium where resistance varies as the velocity or square of the velocity; Terminal velocity; Simple Harmonic Motion (S.H.M); Elastic string; Damped and forced oscillations.

Motion of a heavy particle along a smooth and rough inclined plane.

Laws of motion; Impulse and Impulsive forces; Work, power and energy; Principle of conservation of energy and linear momentum; One dimensional collision of two elastic bodies; Coefficient of restitution; Loss of kinetic energy in direct collision.

Motion of a connected system and related problems.

Motion of a particle in two dimension : Expressions of velocity and acceleration components in Cartesian and polar co-ordinates; Angular velocity and angular accelerations; Equations of motion in Cartesian and polar co-ordinates; Motion of a projectile under gravity (neglected air resistance); Circular motion; Tangential and normal accelerations; Central forces and central orbits; Apses; Motion under inverse square law; Planetary motions; Kepler's laws; Escape velocity.

### **Group -B**

#### **Statics (Marks-20)**

Forces (various types ) : Forces acting at a point, Parallelogram of forces, Composition and resolution of forces, Triangle law of forces and polygon of forces, Lami's theorem, Converse of Lami's theorem, Parallel forces (like, unlike), Moments, Couples, General conditions for equilibrium of coplanar forces.

## Group –C

### Probability and Statistics (Marks 40)

#### Probability ( Marks 20)

Probability: Random variable, probability mass function and distribution function of discrete random variable.

Probability density function and distribution function for continuous random variable and its properties.

Mathematical Expectations: Properties, Addition theorem, Multiplication theorem. Variance, properties of variance. Tchebyshev's inequality and Bernoulli's theorem (statement only).

Discrete uniform distribution, Bernoulli's distribution, Binomial, Poisson and Normal distribution, Expectation, Variance of the distributions.

#### Statistics (Marks 20)

Measures of Dispersion: Range, semi-inter quartile range, Mean deviation, standard deviation, effect of change of origin and scale on S.D., variance of the combined series, coefficient of dispersion:- based upon 1.Quartile deviation 2.Mean deviation 3.S.D.,coefficient of variation.

Moments: Relation between moments about mean in terms of moments about any point and vice versa, effect of change of origin and scale on moments, Pearson's beta and gamma coefficients, measures of Skewness and Kurtosis, Bivariate frequency distribution, scatter diagram, lines of regression, regressin coefficients, coefficient of correlation, samples, types of population, method of sampling, random sampling.

#### References:

1. J. L. Synge and B. A. Griffith, *Principles of Mechanics*, McGraw-Hill, 1959.
2. S. L. Loney, *An Elementary Treatise on The Dynamics of a Particle*, Cambridge University Press, 1913.
3. F. Chorlton, *A Text Book of Dynamics*, E. Horwood, 1983.
4. B. C. Das and B. N. Mukherjee, *Dynamics*, U. N. Dhur & Sons (P) Ltd., Kolkata, 23<sup>rd</sup> Edition, 1996.

5. P. R. Ghosh and J.G. Chakraborty, *Advanced Analytical Dynamics*, U. N. Dhur & Sons (P) Ltd., Kolkata.
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7. A. M. Goon, M. K. Gupta and B. Dasgupta, *Fundamentals of Statistics, Vol. 1*, World Press, 1998.
8. A. M. Goon, M. K. Gupta and B. Dasgupta, *Fundamentals of Statistics, Vol. 2*, World Press, 2001.
9. F. E. Croxton, D. J. Cowden and Klein, *Applied General Statistics*, Prentice Hall, 1969.
10. J. F. Kenney and E.S. Keeping, *Mathematics of statistics, Part I*, Van Nostrand, 3<sup>rd</sup> Edition, 1954.
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12. K. N. Hari Bhat, J. Ganguly and K. Anitha Sheela, *Probability Theory and Stochastic Processes for Engineers*, Pearson Education, 2010.
13. S. Ross, *A First Course in Probability*, 9<sup>th</sup> Edition, 2012.
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17. S. Ganguly and S. Saha, *Analytical dynamics of a particle including elements of statics*, New Central Book Agency (P) Ltd., 1996.
18. B. C. Das and B. N. Mukherjee, *Statics*, U. N. Dhur & Sons (P) Ltd., Kolkata, 25<sup>th</sup> Edition, 1996.

### **Part-III**

#### **Paper - IV**

#### **Group – A**

#### **Linear Programming (Marks-40)**

General introduction of LPP (Motivation, Formulation). Convex set, hyper plane, extreme point, convex polyhedron, basic solution, feasible solution, basic feasible solution.

Fundamental theorem of L.P.P. (statement only), replacement of a basis vector, improved basic feasible solutions, unbounded solutions, condition of optimality, simplex method, simplex algorithm, artificial variable technique (big M method).

Duality in L.P.P.: Concept of duality, fundamental properties of duality, fundamental theorem of duality (statement only), duality and simplex method.

Transportation problem (T.P.): Matrix form of T.P., the transportation table, Initial basic feasible solutions by North West corner, matrix minima and Vogel's Approximation method, loops in T.P. table, optimal solutions (simple problems).

Assignment problem: Balanced problem, optimal solution of assignment problem (Hungarian method).

### **Group –B**

#### **Numerical Analysis (Marks – 30)**

Approximate numbers, significant figures, rounding off numbers. Errors - absolute, relative and percentage. General formula for errors. Errors in arithmetic operations.

Ordinary and divided differences. Propagation of error in difference table. Newton's forward and backward interpolation formulae. Newton's divided difference formula. Lagrange interpolation formula. Errors in interpolation formulae. Problems related to interpolations.

Numerical integration - Newton- Cotes' formula. Trapezoidal rule and Simpson's 1/3 rule - their inherent error and geometrical significance.

Solution of system of linear equations - Gauss Elimination Method , Gauss - Seidel Method, condition of convergence (statement only).

Solution of first order o.d.e. - Picard's method and Euler's method.

Solution for real roots of algebraic and transcendental equations - Regula Falsi Method , Fixed point iteration method and Newton - Raphson Method - their convergences (statement only).

### **Group –C**

#### **Computer Programming (Marks 30)**

Functional units of a computer. Common Hardware components. Computer software. Concept of Computer Languages - Machine language and High level languages . Operating system. Compiler and Interpreter.

Concept of Algorithm and Flowchart - their basic features and differences . Flowcharts of some common problems.

Binary decimal, octal and hexadecimal number systems and their conversions.

Programming Language C: C-Character set, Keywords, Basic data types, Numeric constants and variables operators, Expressions, Assignment statements, I/O – Statements.

Control Statements: Decision making and Looping statements in C, Break continue and goto statements, Example of simple programs.

C programs of ---

- 1) Evaluation of finite series
- 2) Factorial of an integer
- 3) Fibonacci sequence
- 4) Largest and smallest of n given numbers
- 5) Roots of a quadratic equation with real coefficients
- 6) HCF and LCM of two positive integers

### References :

1. F. B. Hildebrand, *Introduction to Numerical Analysis*, McGraw-Hill Book Company Inc., 1974.
2. C. F. Gerald and P. O. Wheatley, *Applied Numerical Analysis*, Pearson, 7<sup>th</sup> Edition, 2003.
3. J. B. Scarborough, *Numerical Mathematical Analysis*, Oxford and IBH Publishing, 1966
4. B. Dasgupta, *Applied Mathematical Methods*, Pearso, 1<sup>st</sup> Edition, 2006.
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7. G. Hadley, *Linear Programming*, Addison, 2nd Printing edition, 1963.
8. J. K. Sharma, *Operations Research - Theory and Applications*, Macmillan, 5<sup>th</sup> Edition, 2013.

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