# Syllabus of Mathematics (General course)

## 1st Year

**Paper –MTMG101**

Group A (Marks 20) Classical Algebra
Group B (Marks 20) Modem Algebra
Group C(Marks 10) Vector Algebra
Internal Assessment (Marks05)

**Paper – MTMG201**
Group A (Marks 30) Analytical Geometry of Two and Three Dimensions
Group B(Marks 20) Ordinary .Differential Equations
Internal Assessment (Marks 05)

## 2nd Year

**Paper – MTMG301**
(Marks 50)Differential Calculus
Internal Assessment (Marks 05)

**Paper – MTMG302**
Group A (Marks 25) Integral Calculus
Group B (Marks 25) Numerical Analysis
Internal Assessment (Marks 05)

**Paper – MTMG401**
Group A (Marks 25) Linear Programming
Group B (Marks 25) Analytical Dynamics
Internal Assessment (Marks 05)

**Paper – MTMG402**
Group A (Marks25) Element of computer science
Group B (Marks25) Probability
Internal Assessment (Marks 05)

## 3rd Year

**Paper – MTMG501**

Group A (Marks25) Statistics
Group B (Marks25) Discrete Mathematics
Internal Assessment (Marks 05)

**Paper – MTMG601**
Group A (Marks25) Partial differential equation
Group B (Marks25) Mathematical Modeling
Internal Assessment (Marks 05)

## Paper –MTMG101

### *Group A (Marks 20) Classical Algebra.*

1. De-Moivre's theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number, definition of $a^z (a\ 0)$ and Hyperbolic function.

2. Polynomials with real coefficients: Division Algorithm, fundamental theorem of classical algebra (no proof required), n-th degree polynomial equation has exactly *n* roots. Nature of roots of an equation (Surd of complex roots occur in pairs). Statements of Descartes'. Rule of sine and its applications. Relations between roots and coefficients, symmetric functions of roots, transformation of polynomial equation. Cardan's method of solution of a cubic equation, solution of biquadratic equation by Ferrari's method.

3. Orthogonal matrix, rank of a matrix, detenninatiol1 of rank, solution of a system of linear equations with not more than three variables by matrix method. Solution of a system of linear equation with consistence.

### *Group B (Marks 20) Modem Algebra.*

1. Group-definition and examples taken from various branches (examples from number system roots of unity, 2 x 2 real matrices, non-singular real matrices of a fixed order). Elementary properties using the definition of group, Definition and examples of sub groups, order of an elements and order of group related problems, cyclic groups, permutation-even and odd permutation, group of permutation cosets, related problems, Normal subgroups.

2. Definition and examples of ring, sub-ring. Integral Domain. Division of zero. Every field is an integral domain. Field, sub-field.

3. Characteristic equation of a square matrix of order not more than three, determination of eigen values and eigen vectors-problems only. Statement and illustration ofCayley-Hamilton theorem.

### *Group C (Marks 10) Vector Algebra.*

scalar triple product of three vectors and its geometrical interpretation, simple application to geometry. Vector equations of straight lines and planes. Shortest distance, Work done.

### *Reference Books*

1. Ghosh and Chakraborty: Higher Algebra.
2. S.K.Mapa: Higher Algebra (Abstract and Linear).
3. M.K.Sen, P.Mukhopadhyay and S. Ghosh: Topics in Abstract Algebra.
4. K.B. Datta: Matrix and Linear Algebra.
5. Shanti Narayan: A Text Book Of Matrices.
6. A. K.Das: Higher Algebra.
7. Maity and Ghosh: Vector· Analysis.

## Paper –MTMG201

### *Group A (Marks 30) Analytical Geometry of Two and Three Dimensions.*

1. Two dimensions: Polar equations of straight lines and circles, Polar equation of a conic referred to a focus as pole, equations of chord; tangent and normal. General equation of second degree in two variables and its reduction to canonical (normal) forms. Classification of conics and their equations in canonical form. Pairs of

straight:-lines: Condition that the general equation of second degree may represent two straight lines. Point of intersection of two intersecting straight lines:. Angle and angle bisectors between two lines given by $ax^2 + 2hxy + by^2 = 0$ Equations of two straight lines joining the origin to the points in "which line meets a conic.

2. Three dimensions: Rectangular Cartesian co-ordinates in space, the concept a geometric vector (free vector).Equation of a plane. General form, intercept and normal form, angle between two planes, signed distance of a point from a plane. The straight line in space: Its equation in symmetric (canonical) and parametric forms. Conditions for the parallelism and the perpendicularity of two planes, of two straight lines and of a straight line and a plane, Distance between two skew straight lines, co-planarity of two straight lines. The sphere, tangent and normal. The cone. The cylinder: equations.

***Group B (Marks 20) Differential Equations.***

1. First order linear and non-linear differential equations, application in simple geometrical problems.
2. Second order linear differential equations with constant coefficient, linear homogeneous second order differential equations.
3. Simultaneous linear differential equation with constant coefficients up to second order.
4. Simple eigen value problems.
5. Orthogonal trajectories

***Reference Books***

1. Chakraborty and Ghosh: Differential Equations.
2. Maity and Ghosh: Differential Equations.
3. M.C. Chaki: A text book ofAnalytic Geometry.
4. N.Datta and R.N.Jana: Analytical Geometry.
5. Ghosh and Chakraborty: Analytical Geometry.
6. R.M. Khan: Analytical Geometry.

**Paper – MTMG301**

***(Marks 50 )Differential Calculus.***

1. Concept of rational number, Irrational number, real number.
2. Sequence of numbers, concept of limit of a sequence, Null sequence, Bounded sequence, Monotonic sequence, supremum and infimum of a sequence. A convergent sequence is bounded and has a unique limit, Bounded and monotonic sequence is convergent, $e = \lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n$. Statement of the theorems on limits of sequence, Cauchy sequence, Statement of Cauchy's general principle of convergence, simple.
3. Infinite series of constant term: Definition of convergence and divergence, Cauchy's convergence Principle (application only), Geometric series and p-series and their convergence (Only statement). Series of nonnegative terms: Statement of comparison test. D' Alembert ratio test, Cauchy's nth root test and Raabe's test. Simple applications.

4. Function of a single real variable defined on an interval, their graphs, . Algebra of limits and continuity (no proof). Definition, and acquaintance (no proof required) with the properties of continuous function on closed intervals, statement and "existence of inverse function of a strictly monotonic function and its continuity.

5. Successive derivatives, Leibnitz theorem: increasing and decreasing functions,. Sign of the derivatives, statement of Rolle's Theorem and its geometrical interpretation. Mean value theorem of Lagrange, its geometrical interpretation, Cauchy's mean value theorem. Taylor's and Maclaurin's theorems with Cauchy's and Lagrange's form of remainder (statement only). Expansion in power of x with infinite series .for such functions as exp(x), sin(x), cos(x), (1+x)n, log(l+x) (with restrictions wherever necessary). Indeterminate form, L'Hospital's rule, maxima and minima (Definition and acquaintance with rules of finding extreme, emphasis on solving problems only).

6. Function· of two variables, their geometrical interpretation, .limit, repeated limit and continuity (definitions and examples only). Partial differentiation, knowledge of chain rules, Exact differential, Differentiation of implicit functions, successive partial derivatives, statew.ent of Schwarz's theorem on the commutative property of mixed partial derivative, Ewer's theorem on a homogeneous function of two variables.

7. Applications: Problem on
   (i) Tangent and normals.
   (ii) Rectilinear asymptotes of algebraic curves,
   (iii) Curvature and radius of curvature of plane curves,
   (iv) Envelope of family of straight lines.

### *Reference Books*


1. Differential Calculus: Das and Mukherjee.
2. Shanti Narayan: Differential Calculus.
3. Das and Mukherjee: Integral Calculus.
4. Shanti Narayan: Integral Calculus.
5. Maity and Ghosh: Integral Calculus.


## Paper –MTMG302

### *Group A (Marks 25) Integral Calculus.*

Indefinite Integration: Standard form, Methods by substitution and Integration by parts (Revision of previous knowledge). Integration of rational function and trigonometric function.

Definite Integral as the limit of sum, Geometrical interpretation of definite Integrals of bounded continuous functions, Fundamental theorem of integral calculus, Properties of definite integral and their applications.

Reduction formula of $\int_0^{\frac{\pi}{2}} sin^m x dx$ $\int_0^{\frac{\pi}{2}} cos^n x dx$ $\int_0^{\frac{\pi}{2}} sin^m x cos^n dx$ $\int_0^{\frac{\pi}{2}} tan^m x dx$ and associated problems *(m* and *n* are non-negatives).

Definition of improper integrals, working knowledge of Beta and Gamma functions (convergence and important relations being assumed).

Working knowledge of double and triple integrals, Jacobian.

Application: Rectification (formation of intrinsic equations from Cartesian and polar equation). Quadrature, Volumes and surface area of solids formed by revolution of curves and areas.

### *Group B (Marks 25) Numerical Analysis.*

1. Polynomial interpolation and applications: Lagrangian interpolation problem. Linear interpolation formula. Lagrange's formula.

2. Differences: forward backward and divided differences tables. Newton's general interpolation formula with the rell1ainder term, Newton's forward and backward formulae, error in these formulae, Numerical differentiation based on Newton's forward and backward formulae.
3. Numerical integration: Newton's-Cotes formula, trapezoidal rule:> Simpson's one-third rule and inherent errors, Weddle's rule, Summation of finite series by Euler-Maclaurin series (statement only).

4. Solution of equations(algebraic and transcendental) : Solution of a single equation by

Graphical method. Bisection method. Regular falsi method. Iteration method. Newton-Raphson method.

Geometrical interpretation of these methods. Convergence of Iteration-and Newton-Raphson method, Gauss-elimination, Gauss Siedal method for the solution of a system of linear equations.

### *Reference Books*

1. F.B.Hilderbrand: Introduction to Numerical Analysis.
2. S.A. Mollah: Numerical Analysis and Computational Procedures.

## Paper – MTMG401

### *Group A (Marks 25) Linear Programming.*

Basic solutions and basic feasible solutions with reference to L.P.P., Degenerate and non~ degenerate B. F. S., hyperplane, convex set, extreme points, convex hyperplane and statement of relevant theorems.Statement of the fundamental theorem of L.P.P.

Reduction of a F. S. to a B. F. S., Transformation of in equations to equations by slack and surplus variables. Simplex method (without proof), Feasibility and optimality conditions. The algorithm, simple application from daily life. Big-*M* method, Duality theory, the dual of the dual is primal. Definition of Transportation problem and assignment problem and their connection with L.P.P., algorithmic solution of T.P. and A.P. (no proof is required), simple applications.

### *Group B (Marks 25) Analytical Dynamics.*

Impulse and impulsive forces, work, power and energy, principles of conservation of energy and momentum, collision of elastic bodies (loss of K.E.to be calculated in the case of direct of impact only).

Motion in a straight line under variable forces, damped, forced and damped forced vibration, motion under inverse square law. Velocity and accelerations of a particle in Cartesian and polar co-ordinates. Tangential and normal accelerations, circular motion.

Motion in a plane, equations of motion in Cartesian and polar coordinates, central orbits, escape velocity. Resisting Medium.

### *Reference Books*

**1.** S.l. Loney: An Elementary Treatise on the Dynamics of a particle and of rigid bodies.
**2.** J.G. Chakraborty and P. R. Ghosh: Advanced Analytical Dynamics.
**3.** Das and MukheIjee: Analytical Dynamics.
**4.** S.R.Maity: Dynamics of a Particle.
**5.** P.M. Karak: Linear Programming.
**6.** J.G. Chakraborty and P.R..Ghosh: Linear Programming and Game Theory.

## Paper – MTMG402

### *Group A (Marks25) Element of computer science.*

Fundamentals of Computer Science and Computer Programming:
Computer fundamentals: Historical evolution, computer generations,
Functional description, operating system, hardware & software.
Positional number system : binary, octal, decimal, hexadecimal system. Binary arithmetic.
Storing of data in a computer : BIT, BYTE, Word. Coding of data –ASCII, EBCDIC, etc.
Algorithm and Glow Chart : Important features, Ideas about the complexities of algorithm. Application in simple problems.
Programming languages : General concepts, Machine language, Assembly Language, High Level Languages, Compiler and Interpreter. Object and Source Program. Ideas about some major HLL.
**Introduction to ANSI C :**
Character set in ANSI C. Key words : if, while, do, for, int, char, float etc. Data type : character, integer, floating point, etc. Variables, Operators : =,= =, !!<,>, etc. (arithmetic, assignment, relational, logical, increment, etc.) . Expressions : e.g. (a = = b ) !! (b = = c), Statements : e.g. if (a>b) small = a; else small = b. Standard input/output. Use of while, if…. Else, for, do…while, switch, continue, etc. Arrays, strings. Function definition.
Running simple C Programs. Header file.
**Boolean Algebra** : Huntington Postulates for Boolean Algebra. Algebra of sets and Switching Algebra as examples of Boolean Algebra. Statement of principle of duality. Disjunctive normal and Conjunctive normal forms of Boolean Expressions. Design of simple switching circuits.

### *Group B (Marks25) Probability.*

Elements of Probability Theory: Random experiments, Statistical regularity and idea of probability as long run mutually exclusive event and exhaustive events, union, Intersection and complement, classical definition of probability, axiomatic approach of probability theory (detailed treatment not required), theorem on the union of a number of events conditional probability, theorem of total probability and Bayes' theorem independent event and independent trials, random variable and its probability distribution, expectation and variance. Joint, marginal and conditional distribution.

### *Reference Books*

1. A. Gupta: Ground Work ofMathematical Probability and Statistics.
2. A.P. Baisnab and M.S. Jas: Mathematical Probability and Statistics.
3. Banerjee, Dey and Sen: Mathematical Probability Probability.
4. Dey and Sen: Mathematical Statistics.
5. Kapoor and Saxena : Statistics.
6. :Sribastab sribastab; Depth in C

**Paper –MTMG501**

***Group A (Marks25) Statistics.***

Random sample,sample and population Concept of sampling and various types of sampling.. Collection, tabulation and graphical representation. Grouping of data. Sample characteristic and their computation. Sampling distribution of a statistic. Estimates of a population characteristic or parameter. Unbiased and consistent estimates. Sample characteristics as estimates of the corresponding population characteristics. Sampling distributions of the sample mean and variance.

Bivariate samples. Scatter diagram. Sample correlation co-efficient. Least square regression lines.

Estimation of parameters. Method of maximum likelihood. Applications to binomial, Poisson and normal population. Confidence intervals. Interval estimation for parameters of normal population.

**Reference Books**

1. H. Cramer: *Mathematical method of Statistics*.
2. Dey & Sen: *Mathematical Statistics*.
3. Kapoor and Saxena: *Statistics*.
4. A. Gupta: *Ground work of Mathematical Probability and Statistics*.
5. Gupta and Kapoor: *Mathematical Statistics*.

***Group B (Marks25) Discrete Mathematics.***

Sets and Propositions: Cardinality, principle of inclusion and exclusion, connectives, Tautology and contradictions, equivalence formula.

Graph Theory: Graphs: undirected graphs, Directed graphs, basic properties, complete graph, complement of a Graph, bipartite Graphs, Necessary and Sufficient condition for a Bipartite Graph, Weighted Graphs, Walk, Path, Cycles, Circuit, Euler Graph, Konisberg Bridge Problem. Trees: Basic properties, spanning tree.

**Reference Books**

1. S. Lipschutz and M. L. Lipson: *Discrete Mathematics*.
2. R. Johnsonbaugh : *Discrete Mathematics*.
3. R. P. Grimaldi: *Discrete and Combinatorial Mathematics*.
4. K. H. Rosen: *Elements of Number Theory and its Applications*.
5. J. K. Sharma: *Discrete Mathematics*.
6. R. J. Wilson: *Introduction to Graph Theory*.
7. Babu Ram: *Discrete Mathematics*.
8. N Deo: Introduction to Graph theory

**Paper –MTMG 601**

***Group A (Marks 25) Partial differential equation (PDE) :***

Introduction. Formation of P.D.E., Solution of PDE by Lagrange's method of solution and by Charpit's method.

***Laplace transforms****:* Introduction to infinite integrals. Linearity of Laplace trans-forms. Existence theorem for Laplace transforms(Statement only). Laplace transforms of derivatives and integrals. Shifting theorems. Differentiation and integration of transforms. Convolution theorem. Solution of ODE and PDE of $1^{st}$ order and $2^{nd}$ order by Laplace transformation method.

**Reference Books**

1. Murray: *Differential Equations*.
2. Piaggio: *Differential Equations*.
3. Chakraborty and Ghosh: *Differential Equations*.
4. Maity and Ghosh: *Differential Equations*.
5. S. L. Ross: *Differential Equations*.
6. Rukmangdachari: *Differential Equations*.

***Group B (Marks25) Mathematical Modeling.***

1. Introduction, Basic steps of Mathematical modeling and its utility, preliminary concept of stability of differential equation.
2. Mathematical models with their formulation, solution, interpretation and limitations (i) Single species models (Exponential and Logistic growth), (ii) Two species population models (Two competing species and Prey-prediator).limitations.

**Reference Books**

1. J. N. Kapur: *Mathematical Modelling*.
2. J. D. Murray: *Mathematical Biology*.
3. R. Illner, C. S. Bohun, S. McCollum and T. V. Roode: *Mathematical Modelling*.