

## **SYLLABUS FOR B.Sc MATHEMATICS(I year)**

### **Paper1: Algebra and Trigonometry - 1**

#### **Algebra:**

Theory of Equations : Polynomial equations; Imaginary and irrational roots; Symmetric functions of roots in terms of coefficient; Sum of  $r$ th powers of roots; Reciprocal equations; Transformations of equations.

Discrete rule of signs: Approximate solutions of roots of polynomials by Newton - Raphson method - Horner's method; Cardon's method of solution of a cubic polynomial.

Summation of series : Binomial, Exponential and Logarithmic series (theorems without proof); summation of finite series using method of differences - Simple problems.

#### **Trigonometry :**

Expansions of  $\sin x$ ,  $\cos x$ ,  $\tan x$  in terms of  $x$ ;  $\sin nx$ ,  $\cos nx$ ,  $\tan nx$ ,  $\sin^n x$ ,  $\cos^n x$ ,  $\tan^n x$ , hyperbolic and inverse hyperbolic functions – Simple problems.

#### **Reference Books :-**

1. Algebra : T.K. Manickavachagam Pillai and others (S.V. Vishwanathan publications)
2. Higher Algebra : H.S. Hall and S.R. Knight (HM publications – 1994)
3. Pure Mathematics : Hardy
4. Trigonometry : P.Duraipandian
5. Plane Trigonometry part 2 : S.L.Loney, (Macmillan and Co.London)
6. Algebra , Analytical Geometry (2D) & Trigonometry : Dr. S. Sudha (Emerald publishers).

### **Paper 2: Calculus and Coordinate geometry of 2 dimensions:-**

#### **Differential Calculus :-**

$n$ th derivative; Leibnitz's theorem (without proof) and its applications; Partial differential equations; Total differential equations; Jacobians; Maxima and Minima of functions of 2 and 3 independent variables – necessary and sufficient conditions (without proof); Lagrange's method (without proof) – simple problems on these concepts.

#### **Integral Calculus :-**

Methods of integration; Properties of definite integrals; Reduction formulae – Simple problems.

### Coordinate Geometry :-

Conics – Parabola, ellipse, hyperbola and rectangular hyperbola – pole, polar, co-normal points, con-cyclic points, conjugate diameters, asymptotes and conjugate hyperbola.

### Reference Books:-

1. Analytical Geometry : T.K. Manickavachagam Pillai and others (S.Viswanathan Publications)
2. Analytical Geometry of 2 dimensions : P. Duraipandian
3. Coordinate Geometry : Dr. P. Balasubramanian and others (McGraw Hill publishers)
4. Calculus : S. Narayanan and others (S.Viswanathan Publications)
5. Integral Calculus : Shanti Narayanan (S.Chand and Co.)
6. Integral Calculus and Differential Equations : Dipak Chatterji (TATA McGraw Hill publishing company)
7. Calculus : Dr. S. Sudha (Emerald Publishers).

### Paper 3: Algebra and Trigonometry II :-

#### Matrices :-

Symmetric; Skew Symmetric; Hermitian; Skew Hermitian; Orthogonal and Unitary Matrices; Rank of a matrix; Consistency of Linear Equations and solutions: Cayley Hamilton Theorem; Eigen values; Eigen vectors; Similar matrices; Diagonalization of a matrix.

#### Group Theory and number theory :-

Equivalence relations; Groups; subgroups – cyclic groups and properties of cyclic groups – simple problems; Lagrange's theorem; Prime number: Composite number; decomposition of a composite number as a product of primes uniquely (without proof); divisors of a positive integer  $n$ ; congruence modulo  $n$ ; Euler function (without proof); highest power of a prime number  $p$  contained in  $n!$ ; Fermat's and Wilson's theorems – simple problems.

Logarithms of Complex numbers.

#### Summation of series:-

Sums of sines and cosines of  $n$  angles which are in A.P.; Summation of trigonometric series using telescopic methods,  $c+$  method.

**Reference books:-**

1. Topics in Algebra : I. N. Herstein (Vikas Publishing Co.)
2. Algebra : S. Arumugam (New Gama publishing house, Palayamkottai)
3. Algebra : T.K. Manickavachagam Pillai and others (S. Viswanathan publishers)
4. Trigonometry :P.Duraipandian (Emerald Publishers)
5. Plane Trigonometry Part 2: S. L. Loney.

**Paper 4: Calculus and Differential Geometry :-****Curvature:-**

Curvature; radius of curvature in Cartesian coordinates; polar coordinates; equations of straight line, circle and conic; radius of curvature in polar coordinates; p-r equations; evolutes; envelopes;

**Asympotes:-**

Methods (without proof) of finding asympotes of rational algebraic curves with special cases.

Beta and Gamma functions, properties and simple problems.

Double Integrals; change of order of integration; triple integrals; application to area, surface area and volumes.

**Reference Books:-**

1. Calculus: S. Narayanan and others (S.Viswanathan publishers)
2. Integral Calculus and differential equations: Dipak Chatterjee (TATA McGraw Hill Publishing company ltd.)

**III SEMESTER****Paper V: Differential Equations and Laplace Transforms****Differential Equations**

Ordinary differential equations: First order and first degree – first order and higher degree equations – solvable for p, solvable for x, solvable for y, Clairaut's form. Simple problems

Second order equations with constant coefficients: P. I. for  $e^{ax}V$ , where V is  $x^m, \cos mx, \sin mx$  (m is a positive integer). Second order differential equation with variable coefficients of the form  $Ax^2 (d^2y/dx^2) + Bx(dy/dx) + Cy = Q$ .

Method of variation of parameters. Total differential equation  $Pdx + Qdy + Rdz = 0$ . Simple problems.

**Partial differential equation :**

Formation of P. D. E. by eliminating arbitrary constants and arbitrary functions – complete, singular and general integral solution of standard types:

$f(p, q) = 0$ ;  $f(x, p, q) = 0$ ;  $f(y, p, q) = 0$ ;  $f(z, p, q) = 0$ ;  $f(x, p) = f(y, q)$ ;

Clairaut's form – Lagrange's equation  $Pp + Qq = R$ . Simple problems.

Laplace transform – inverse Laplace transform – application of Laplace transform to solution of first and second order linear differential equations and simultaneous linear differential equations. Simple problems

### **Books for study and reference:**

1. Engineering Mathematics Volume 3: M.K. Venkataraman (National Publishing Co.)
2. Engineering Mathematics Volume 3: P.Kandasamy and others (S.Chand and Co.)
3. Integral Calculus and Differential equations : Dipak Chatterjee (TATA McGraw Hill Publishing company Ltd.)
4. Advanced Engineering Mathematics : Erwin Kreyszig (John Wiley and sons New york 1999)
5. Calculus: Narayanan and others (S.Viswanathan Publishers)
6. Differential Equations : Dr. S.Sudha (Emerald Publishers)

### **Paper VI: Coordinate Geometry of 3 dimensions and Probability**

**Planes and lines:** Reduction of a line to symmetric form – a line given as an intersection of two planes – condition for two lines to be coplanar and equation of the plane containing them – length and equation of S. D. between two skew lines image of a point and of a line with respect to a plane – bisector planes Simple problems.

#### **Spheres:**

Equations of sphere in centre-radius form, diametric form and general form – equation of circle as a section of a sphere by a plane – its centre and radius – tangent plane – coaxial system of spheres – orthogonal systems. Simple problems.

#### **Probability :**

Probability space; total probability ;multiplication law on probability; conditional probability independent events ; Baye's theorem,

Random variables; discrete and continuous; distribution function expected values; moments; moment generating function; probability generating function.

**Books for study and reference:**

1. Differential Equations, Fourier Series and Analytical Solid Geometry: P.R.vital (Margham Publishers)
2. Engineering Mathematics Volume 3: M.K. Venkataraman (National Publishing Co.)
3. Engineering Mathematics Volume 3: P.Kandasamy and others (S.Chand and Co.)
4. Advanced Engineering Mathematics: Stanley Grossman and William R. Devit (Harper and Row publisher)
5. Fundamentals of Mathematical statistics; S.C. Gupta and V.K. Kapoor (Sultan chand and sons)
6. Mathematical statistics and Probability by Dr. P.R. Vittal (Margham Publishers)

**Paper VII: Vector-Calculus, Fourier Series and Fourier Transforms**

Vector Differentiation, gradient- divergence – curl – directional derivative – unit normal to surfaces .

Vector Integration: Line, surface and volume integrals , theorems of Gauss, Stokes and Green (without proof) – simple problems.

Fourier Series: Expansions of periodic functions of period  $2\pi$  – expansion of even and odd functions – half range series.

Fourier Transforms: Infinite Fourier transform (complex form , no derivation); sine and cosine transforms ; simple properties of Fourier transforms – Convolution theorem ; Parseval's identity.

**Books for study and reference:**

1. Engineering Mathematics Volume 3: M.K. Venkataraman (National Publishing Co.)
2. Engineering Mathematics Volume 3: P.Kandasamy and others (S.Chand and Co.)
3. Vector Analysis: Murray Spiegel (Schaum Publishing company , New York)
4. Vector Analysis: P. Duraipandian and Lakshmi Duraipandian

(Emerald Publishers)

### **Paper 8 – Statics**

**Forces:** Types of forces, magnitude and direction of the resultant of the forces acting on a particle, Lami's theorem, Equilibrium of a particle under several coplanar forces -, parallel forces, moments, Couples – simple problems.

**Friction :** Laws of Friction, angle of friction, Equilibrium of a body on a rough inclined plane acted on by several forces, Centre of gravity of simple uniform bodies - triangular lamina, rods forming a triangle, trapezium, Centre of gravity of a circular arc, elliptic quadrant, solid and hollow hemisphere and solid and hollow cone, catenary - simple problems.

#### **Books for Reference:**

1. Mechanics by P. Duraipandian and others, S. Chand and Co.
2. Statics: K. Viswanatha Naik and M. S. Kasi, Emerald Publishers.
3. Statics S.Narayanan and others, S. Chand and Co.
5. Statics: A. V. Dharmapadam, S. Viswanathan and Co.

### **V Semester**

#### **Paper IX - Algebraic Structures – I**

##### **Groups:**

Normal subgroups homomorphism -automorphism - Cayley's theorem - permutation groups; Conjugacy and class equation.

##### **Rings:**

Definition and examples; integral domain - homomorphism of rings; Ideals and quotient rings - prime and maximal ideals; the field of quotients of an integral domain - Euclidean rings

Content and treatment as in 'Topics in Algebra' by I. N. Herstein.(Wiley Eastern Ltd)

Chapter 2 –sections 2.6, 2.7(Omit applications 1 and 2), 2.8, 2.9, 2.10 and 2.11.

Chapter 3 - From 3.1 - 3.7.

#### **Books for reference:**

1. University Algebra : N.S. Gopalakrishnan (Wiley Eastern Ltd)
2. A first course in Algebra : John B. Fraleigh (2<sup>nd</sup> Edition Addison Wesley)

3. Textbook of Algebra: R. Balakrishnan and N. Ramabadran (Vikas Publishing Co.).
4. Algebra: S. Arumugam (New Gama Publishing house, Palayankottai).

### **Paper X - Real Analysis - I**

#### **Sets and functions:**

sets and elements - operations on sets - function – realvalued functions - equivalence - countability - real numbers - least upper bounds

#### **Sequences of real numbers:**

Definition of a sequence and subsequence - limit of a sequence - convergent sequences - divergent sequences – bounded sequences - monotone sequences operations on Convergent sequences operations on divergent sequences - limit superior and limit inferior – Cauchy sequences.

#### **Series of real numbers:**

Convergence and divergence - series with non-negative numbers - alternating series - conditional convergence and absolute convergence; tests for absolute convergence - series whose terms form a non-increasing sequence - the class  $l^2$ .

#### **Limits and metric spaces:**

Limit of a function on a real line - metric spaces - limits in metric spaces.

#### **Reference Book:**

Treatment as in ‘Methods of Real Analysis’ by Richard R. Goldberg (Oxford and IBH publishing co.)

Chapter 1,

Ch - 2.1-2.10,

Ch - 3.1-3.4, 3.6, 3.7, 3.10 and

Chapter 4.

### **Paper 11 – Dynamics**

**Kinematics:** velocity - resultant velocity - relative velocity, angular velocity, Newton laws of motion, equation of motion, rectilinear motion under constant acceleration - ,simple harmonic motion.

**Projectiles:** Time of flight, horizontal range, range in an inclined plane. Impulse and impulsive motion collision of two smooth spheres, direct and oblique impact- simple problems.

central forces and central orbit as plane curve p-r equation of a central orbit ,finding law of force and speed for a given orbit ,finding the Central orbit for a given law of force, Moment of inertia of simple bodies, theorems of parallel and perpendicular axes, moment

of inertia of triangular lamina, circular lamina, circular ring, right circular cone, sphere (hollow and solid)

**Books for Reference:**

1. Mechanics by P. Duraipandian and others, S. Chand and Co.
2. Statics: K. Viswanatha Naik and M. S. Kasi, Emerald Publishers.
3. Statics: A. V. Dharmapadam, S. Viswanathan and Co.

**VI Semester**

**Paper XIII - Algebraic Structures II**

Vector Spaces: Definition and examples - linear dependence and independence - dual spaces, Inner product spaces.

Linear transformations:

Algebra of linear transformations, Characteristic roots, Matrices, canonical forms, triangular forms.

**Content and treatment** as in 'Topics in Algebra', by I. N. Herstein- Wiley Eastern Ltd.

Chapter 4- sections : (4.1, 4.2, 4.3, 4.4),

Chapter 6 – sections (6.1, 6.2, 6.3, 6.4).

Books for reference:

1. University Algebra - N.S. Gopalakrishnan – Newage International Publications, Wiley Eastern Ltd.
2. First Course in Algebra – John B. Fraleigh, Addison Wesley
3. Textbook of Algebra: R. Balakrishnan and N. Ramabadrana (Vikas Publishing Co.).
4. Algebra: S. Arumugam (New Gama Publishing house, Palayankottai).

**Paper XIV - Real Analysis – II**

Functions continuous at a point on the real line - reformulation - functions continuous on a metric space - open sets, closed sets - discontinuous functions on the real line.

Connectedness, Completeness and compactness

More about open sets, connected sets, bounded sets and totally bounded sets Complete metric spaces – compact metric spaces, continuous functions on a compact metric space - continuity of inverse functions - uniform continuity.



Calculus: Sets of measure zero - definition of Riemann integral - existence of Riemann integral (statement only) - properties of Riemann integral - derivatives - Roll's theorem - law of mean - fundamental theorem of calculus. Taylor's theorem.

Sequences and Series of functions:

pointwise convergence of sequences of functions - uniform convergence of sequence of functions.

Content and treatment as in 'Methods of Real Analysis' by Richard R. Goldberg.-Oxford and IBH Publishing co.

Chapter 5, and 6(full), chapter 7 (7.1 - 7.8),chapter 8 (section 8.5 only), chapter 9 (9.1 and 9.2 only). R.Bartle and Sherbert . Real Analysis 5<sup>th</sup> edition, Wiley and sons Newyork.

### **Paper XV - Complex Analysis**

Complex numbers - point at infinity- stereographic projection.

*Analytic functions:* function of a complex variable, mappings, limits, continuity, derivatives and differentiation formula. Cauchy - Riemann equations, sufficient conditions Cauchy Riemann equation in polar form , analytic functions - harmonic functions.

Mappings by elementary functions:

Linear functions, the function  $1/z$  linear fractional transformations, the function

$w = z^n$ ,  $w = e^z$ , Special linear fractional transformations

*Integrals:* Definite integrals Contours, line integrals, Cauchy - Goursat's theorem,(without proof) Cauchy's integral formula, derivatives of analytic functions - maximum modulus function

*series:* Convergence of sequences and series (Theorems without proof) , Taylor's series , Laurent's series, Zeros of Analytic function.

*Residues and poles:* Residues - residue theorem ,the principal part of a function, pole Evaluation of improper real integrals, improper integrals Integrals involving trigonometric function , definite integrals of trigonometric functions..

**Content and treatment** as in 'Complex Variables and applications' by R. V. Churchill and J. W. Brown, McGraw Hill International Book Co.

Sections 8, 9 to 20, 29 to 39, 43 to 48, 56 to 59, 63 to 68, 70 to 75.

#### **Books for Reference:**

1. Complex analysis: P. Duraipandian *et al*.
2. Theory and Problems of Complex Variable - Murray R. Spiegel, Schaum's Outline Series.







## **Syllabus of Allied Mathematics for B.Sc Physics, Chemistry, Computer Science**

### Paper I:

#### Algebra:

Partial fractions, Binomial, Exponential and Logarithmic functions (without proof), Summation and approximation –simple problems.

#### Theory of Equations:

Polynomial equations with real coefficients, irrational roots, complex roots, symmetric functions of roots, transformation of equation by increasing or decreasing roots by a constant, reciprocal equation. Newton's method to find a root approximately-simple problems.

#### Matrices:

Symmetric, Skew symmetric, Orthogonal and Unitary matrices, Rank of a matrix, Consistency of equations, Eigen roots & Eigen vectors, Cayley-Hamilton theorem (without proof), verification and computation of inverse matrix.

#### Finite Differences:

Operators Equations, Different status, Newton's forward and backward interpolation formulae, Lagrange's interpolation formulae.

Trigonometry:

Expansions of  $\sin n\theta$ ,  $\cos n\theta$ ,  $\tan n\theta$  in terms of  $\theta$ , Expansions of  $\sin\theta$ ,  $\cos\theta$ ,  $\tan\theta$ . Hyperbolic and inverse hyperbolic functions, Logarithms of Complex numbers.

Differential Calculus:

$n$ th derivative; Leibnitz's theorem (without proof) and its applications, Jacobians concept of polar coordinates, Equation of straight line, circle and conic, curvature and radius of curvature in coordinates, Maxima and Minima of functions of variables, Lagrange's multipliers-simple problems.

Paper 2:

Integral Calculus:

Integration of irrational, trigonometric functions, Bernoulli's formula for integration by parts, reduction formulae, properties of definite integral and simple problems, Evaluation of double, triple integrals, simple applications to area, volume and centroid, Fourier series for function in  $(0, 2\pi, -\pi, \pi)$ .

Ordinary Differential Equations:

First order and higher degree equations solvable for  $p, y, x$ .  
Second order linear differential equations with constant coefficient;

$$a \frac{d^2y}{dx^2} + b \frac{dy}{dx} + cy = \theta \quad \text{where } \theta = x^m, e^{ax}, x^m e^{ax}, \sin mx, e^{ax} \cos mx$$

Partial Differential Equations:

Formation, complete integrals and general integrals, four standard types of Lagrange's equations.

Laplace Transforms:

Laplace transformations of standard functions and simple properties, inverse Laplace transforms application to solutions of linear differential equations of order 1 and 2-simple problems.

Vector Analysis:

Scalar point function, vector point function, gradient, divergence, curl, directional derivative, normal to a surface. Line and surface integrals; Gauss, Stoke's and Green's theorem(without proof). Simple problems on these.

Reference Books:

1. Allied maths volumes 1&2 by Prof. P. Duraipandian and Dr. S. Udayabaskaran, Muhil publishers, Chennai.
2. Ancillary Mathematics vol.1&2 by P. Balasubramanian and K.G. Subramanian.
3. Integral Calculus and Differential equations by Dipak Chatterjee, Tata McGraw Hill publishers co Ltd.,
4. Ancillary Mathematics by S. Narayanan and others, S. Viswanathan Publishers.
5. Allied Mathematics by Dr. P. R. Vittal (Margham Publications).

### **Syllabus for Allied Mathematics for B.Sc Statistics**

UNIT I:

Continuity and Derivative:

Sets, Operation on Sets, real value functions, countability, real numbers, bound, supremum, infimum sequence of real numbers, limit inferior and limit superior, limits of real sequence, limit theorems, summability of Convergence and Divergence of series with non-negative terms, alternating series, conditional and absolute convergence, rearrangement of series, test for absolute convergence, summation by parts.

UNIT II:

The derivative of real function, mean value theorem, Taylor's theorem, concept of uniform continuity(Riemann integrals, sufficient conditions for Riemann integrability Darboux theorem, fundamental theorem of integral calculus, first mean value theorem, concept of Riemann Stieltjes integrals, its existence and properties.

UNIT III:

Improper and infinite Riemann integrals, Gamma, Beta integrals, Multiple integrals, their evolutions, using transformation of variables-simple examples of multiple integrals.

#### UNIT IV:

Laplace transforms, definitions, Laplace transform of  $t$ ,  $e^{at}$ ,  $\cos at$ ,  $\sin at$ ,  $e^{at}(\cos bt)$ ,  $e^{at}(\sin bt)$ , transform of  $f't$ ,  $f''t$  etc.... Inverse Laplace transforms related to the above standard functions.

#### Reference Books:

1. Gold Berg, R. R. (1970): Methods of Real Analysis, Oxford and IBH.
2. Apostol, T. M. (1985): Mathematical Analysis, Narosa Publications.
3. Narayanan and Manickavasakam Pillai-Ancillary Mathematics Book-2
4. Bartle, R. G. and Shebert, D. R. (1982): Introduction to Real Analysis, Wiley Eastern & Sons.

#### Paper 2:

Matrix Theory-definition and types of matrices, Scalar, Elementary, Symmetric, Skew Symmetric, Hermitian, Skew-Hermitian, independent and unitary matrices-algebraic operations on matrices and their properties-elementary transformations of matrices-determinant of matrices, definition of a low rank- column rank and rank of a matrix – determination of a rank of a matrix.

Inverse of a square matrix-computation of the inverse of the square matrix-solution of linear equation-homogenous and non-homogenous systems of the equations-solutions space-consistency and general solutions Cramer's rule and matrix methods of solving system equations-numerical examples, characteristics equations-root and vectors of a square matrix –left and right Eigen vectors – Cayley-Hamilton Theorem-Quadratic forms, definite, semi definite and indefinite quadratic forms, Sylvester's Law of inertia.

Vector spaces-definition of a vector space with real scalars – linear combination of vectors – linear dependence and independence – definition of a subspace and its characterization – orthogonal basis and Gram – Schmidt orthogonalization process – examples in  $R^n$ .

#### Reference Books:

1. Searle, S. R. (1982): Matrix Algebra useful for statistics, John Wiley and Sons
2. Vasistha, A. R. :Matricews, Krishna Prakasam Mandir.
3. Shanthinarayanan (1959): A text book of Matrices, S. Chand & Co.
4. Graybill, F. A. (1983): Matrices with applications in statistics second edition Wadsworth.
5. Bellman, R. (1970): Introduction to matrix Analysis.



6. Hobn, F. E. (1971): Elementary Matrix Algebra. Amerind Pub. Coy. Pvt. Ltd.