

ANNEXURE I
For B.Sc.(MATHEMATICS) GRADUATES
MATHEMATICS

Unit - I:

Differential Equations of First Order and First Degree: Linear Differential Equations; Differential Equations Reducible to Linear Form; Exact Differential Equations; Integrating Factors; Change of Variables; Total Differential Equations; Simultaneous Total Differential Equations; Equations of the Form $dx/P = dy/Q = dz/R$

- (i) Method of Grouping (ii) Method of Multipliers

Differential Equations of the First Order but not of the First Degree: Equations Solvable for p ; Equations Solvable for y , Equations Solvable for x ; Equations that do not Contain x (or y); Equations Homogeneous in x and y ; Equations of the First Degree in x and y ; Clairaut's Equation

Unit - II:

Higher Order Linear Differential Equations: Solution of Homogeneous Linear Differential Equations of Order n with Constant Coefficients

Solution of the Non-homogeneous Linear Differential Equations with Constant Coefficients by means of Polynomial Operators.

- (i) When $Q(x) = bx^k$ and $P(D) = D - a_0, a_0 \neq 0$
(ii) When $Q(x) = bx^k$ and $P(D) = a_0 D^n + a_1 D^{n-1} + \dots + a_n$
(iii) When $Q(x) = e^{ax}$
(iv) When $Q(x) = b \sin ax$ or $b \cos ax$
(v) When $Q(x) = e^{ax} V$ where V is a function of x .
(vi) When $Q(x) = xV$. Where V is any function x .

Unit - III:

Elements of Number Theory: Divisibility, Primes, Congruences, Solutions of Congruences, Congruences of Degree 1; the Function $\phi(n)$

Unit - IV:

Binary Operations: Definition and Properties, Tables

Groups: Definition and Elementary Properties; Finite Groups and Group Tables.

Subgroups: Subsets and Subgroups; Cyclic Subgroups

Permutations: Functions and Permutations; Groups of Permutations, Cycles and Cyclic Notation, Even and Odd Permutations, The Alternating Groups

Cyclic Groups: Elementary Properties, The Classification of Cyclic Groups, Subgroups of Finite Cyclic Groups

Isomorphism: Definition and Elementary Properties, How to show that groups are Isomorphic, How to show that Groups are Not Isomorphic, Cayley's Theorem.

Groups of Cosets: Cosets; Applications

Normal Subgroups and Factor Groups: Criteria for the Existence of a Coset Group; Inner Automorphisms and Normal Subgroups; Factor Groups; Simple Groups

Homomorphisms: Definition and Elementary Properties; The Fundamental Homomorphism Theorem; Applications.

Unit - V:

Vector Differentiation: Differential Operator; Gradient; Divergence; Curl

Vector Integration: Theorems of Gauss, Green and Stokes and Problems related to them.

Unit - VI:

The Plane: Every equation of the first degree in x, y, z represents a plane, Converse of the preceding theorem; Transformation to the normal form, Determination of a plane under given conditions.

- i) Equation of a plane in terms of its intercepts on the axes.
ii) Equations of the plane through three given points.

Systems of planes; Two sides of a plane; Length of the perpendicular from a given point to a given plane; Bisectors of angles between two planes; Joint equation of two planes;

Orthogonal projection on a plane; Volume of a tetrahedron in terms of the co-ordinates of its vertices; Equations of a line; Right Line; Angle between a line and a plane; The condition that a given line may lie in a given plane; The condition that two given lines are coplanar, Number of arbitrary constants in the equations of a straight line. Sets of conditions which determine a line; The shortest distance between two lines. The length and equations of the line of shortest distance between two straight lines; Length of the perpendicular from a given point to a given line; Intersection of three planes; Triangular Prism.

The Sphere: Definition and equation of the sphere; Equation of the Sphere through four given points; Plane sections of a sphere. Intersection of two spheres; Equation of a circle. Sphere through a given circle; Intersection of a sphere and a line. Power of a point; Tangent plane. Plane of contact. Polar plane. Angle of intersection of two spheres. Conditions of two spheres. Conditions for two spheres to be orthogonal; Radical plane, coaxial system of spheres; Simplified form of the equation of two spheres.

Unit - VII:

The Real Numbers: The algebraic and Order Properties of \mathbb{R} ; Absolute Value and Real Line; The Completeness Property of \mathbb{R} ; Applications of the Supremum Property; Intervals (No question should be set from this part).

Sequences and Series: Sequences and their Limits; Limits Theorems; Monotone Sequences; Subsequences and the Bolzano - Weierstrass Theorem; The Cauchy Criterion; Properly Divergent Sequences; Series.

Limits: Limits of Functions, Limits Theorems, Some Extensions of the Limit Concept.

Continuous Functions: Continuous Functions, Combinations of Continuous Functions; Continuous Functions on Intervals, Uniform Continuity, Definition, Non-Uniform Continuity Criteria, Uniform Continuity Theorem.

Unit - VIII:

Differentiation: The derivative, The Mean Value theorem, L'Hospital Rules, Taylor's Theorem.

The Riemann Integral: The Riemann Integral, Riemann Integrable Functions, the Fundamental theorem (Scope as in Introduction to Real Analysis by Robert G. Bartle and Donald R. Sherbert, published by John. Willey and Sons, Inc.)

Unit - IX:

Rings: Definition and Basic Properties, Fields.

Integral Domains: Divisors of 0 and cancellation, Integral domains, The Characteristic of a Ring.

Some Non-Commutative Examples: Matrices over a field, The Quaternions

Homomorphisms of Rings: Definition and Elementary properties; Maximal and Prime Ideals, Prime Fields

Rings of Polynomials: Polynomials in an Indeterminate, The Evaluation Homomorphisms.

Factorization of Polynomials over a field: The Division Algorithm in $F[x]$; Irreducible polynomials, ideal structure in $F[x]$, Uniqueness of Factorization in $F[x]$.

Unit - X:

Vector Spaces: Vector Spaces, Subspaces, Linear Combinations and Systems of Linear Equations, Linear Dependence and Linear Independence, Bases and Dimension

Linear Transformation and Matrices: Linear Transformations, Null spaces, and Ranges, The Matrix Representation of a Linear Transformation, Composition of Linear Transformations and Matrix Multiplication, Invertibility and Isomorphism's.

Systems of linear Equations: Elementary Matrix operations and Elementary Matrices, The Rank of a Matrix and Matrix Inverses, Systems of Linear Equations:- Theoretical Aspects, Systems of Linear Equations - Computational Aspects.

Determinants: Determinants of Order 2; Determinants of Order n , Properties of Determinants.

Diagonalization: Eigen values and Eigen Vectors

Inner Product Spaces: Inner Products and Norms, the Gram - Schmidt Orthogonalisation Process and Orthogonal Compliments, The Adjoint of a Linear Operator, Normal and Self - Adjoint Operators, Unitary and Orthogonal Operators and their Matrices.

ANNEXURE II

For B.Sc.(MATHEMATICS) GRADUATES

Number of questions to be set unit wise (Total 100)

UNIT No:	TOPICS	Marks
I	Differential Equations of First Order and First Degree	5
	Differential Equations of the First Order but not of the First Degree	5
II	Higher Order Linear Differential Equations	10
III	Elements of Number Theory	1
IV	Binary Operations	1
	Groups	1
	Subgroups	1
	Permutations	1
	Cyclic Groups	1
	Isomorphism	1
	Groups of Cosets	1
	Normal Subgroup and Factor Group	1
	Homomorphisms	1
V	Vector Differentiation	10
	Vector Integration	10
VI	Solid geometry	
	The Plane	5
	The Sphere	5
VII	The Real Numbers	1
	Sequences and Series	2
	Limits	1
	Continuous Functions	2
VIII	Differentiations	4
	The Riemann Integral	4
IX	Rings	1
	Integral Domains	1
	Some Non-Commutative Examples	1
	Homomorphisms of Rings	1
	Rings of Polynomials	1
	Factorization of Polynomials over a field	1
X	Vector Spaces	4
	Linear Transformation and Matrices	4
	Systems of linear Equations	2
	Determinants	3
	Diagonalization	3
	Inner Product Spaces	4

ANNEXURE III
MODEL QUESTIONS FOR B.Sc. (Mathematics)

1. Mathematics (100 Questions of this type)

1. Solution of $x dy - y dx = xy^2 dx$ is
 1. $\frac{x^2}{2} + \frac{x}{y} = c$
 2. $\frac{x^2}{2} + \frac{y^2}{2} = c$
 3. $x + y = c$
 4. $x^2 - y^2 = c$
2. The complimentary function of $(D^2 - 5D + 6)y = xe^{4x}$
 1. $y_c = c_1 e^{-2x} + c_2 e^{-3x}$
 2. $y_c = c_1 e^{2x} + c_2 e^{3x}$
 3. $y_c = c_1 \cos 2x + c_2 \sin 2x$
 4. $y_c = c_1 \cosh 2x + c_2 \sinh 2x$
3. The radius of the sphere $x^2 + y^2 + z^2 + 6x - 8y - t = 0$ is 6 then the value of the t is
 1. 8
 2. 10
 3. 11
 4. 9
4. The No. of generators of a cyclic group of order 5
 1. 1
 2. 4
 3. 2
 4. 3
5. The left hand limit of $\lim_{x \rightarrow 0} \frac{3x + |x|}{7x - 5|x|}$ is
 1. 4/5
 2. 3/2
 3. 2/7
 4. 1/6
6. If $f(x) = x$ on $[0, 1]$ and $P = \{0, 1/3, 2/3, 1\}$ then $U[P, f]$ is
 1. 2/3
 2. 1/3
 3. 4/3
 4. 5/3
7. If $\vec{r} = xi + yj + zk$ then $\text{div } \vec{r}$ is
 1. 2
 2. 3
 3. 0
 4. 4
8. If S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ then $\int_S (axi + byj + czk) \cdot NdS$ is

1. $\frac{4\pi}{3}(a+b+c)$
2. $\frac{2\pi}{3}(a+b+c)$
3. $\frac{\pi}{3}(a+b+c)$
4. $\frac{1}{3}(a+b+c)$

9. Let $T:V_2 \rightarrow V_3$ be defined by $T(x,y) = (x+y, 2x-y, 7y)$ then the matrix of T with respect to the standard bases of V_2 and V_3 is

1. $\begin{bmatrix} 1 & 1 \\ 2 & -1 \\ 0 & 7 \end{bmatrix}$
2. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix}$
3. $\begin{bmatrix} 1 & 3 \\ 2 & 2 \\ 3 & 1 \end{bmatrix}$
4. $\begin{bmatrix} 1 & 2 \\ 2 & 3 \\ 4 & 6 \end{bmatrix}$

10. If $\alpha = (2,1,3)$, $\beta = (1,2,3)$ are two vectors in an inner product space $R^3(R)$ then the inner product between α and β is

1. 13
2. 12
3. 11
4. 10