

MATHEMATICS (860)

Aims:

1. To enable candidates to acquire knowledge and to develop an understanding of the terms, concepts, symbols, definitions, principles, processes and formulae of Mathematics at the Senior Secondary stage.
2. To develop the ability to apply the knowledge and understanding of Mathematics to unfamiliar situations or to new problems.
3. To develop skills of -
 - (a) computation.
 - (b) drawing geometrical figures and graphs.
 - (c) reading tables, charts, graphs, etc.
4. To develop an appreciation of the role of Mathematics in day-to-day life.
5. To develop an interest in Mathematics.
6. To develop a scientific attitude through the study of Mathematics.

A knowledge of Arithmetic and Pure Geometry is assumed. The parts of Geometry which are of chief importance in other branches of Mathematics are the fundamentals concerning angles, parallels (including

lines and planes in space), similar triangles (including the theorem of Pythagoras) the 'symmetry' properties of chords and tangents of a circle, and the theorem that a line perpendicular to two non-parallel lines in a plane is perpendicular to every line therein. The examination may include questions with a geometrical content.

As regards the standard of algebraic manipulation, students should be taught:

- (i) To check every step before proceeding to the next particularly where minus signs are involved.
- (ii) To attack simplification piecemeal rather than en block, e.g. never to keep a common factor which can be cancelled.
- (iii) To observe and act on any special features of algebraic form that may be obviously present.

The standard as regards (iii) is difficult to define; initial practice should be on the easiest cases, 'trick' examples should be avoided and it should be kept in mind that (iii) is subsidiary in importance to (i) and (ii). Teachers should be scrupulous in setting a standard of neatness and in avoiding the slovenly habit of omitting brackets or replacing them by dots.

CLASS XI

*There will be one paper of **three** hours duration of 100 marks. The syllabus is divided into **three** sections A, B and C. Section A is compulsory for all candidates. Candidates will have a choice of attempting questions from **either** Section B or Section C.*

***Section A (80 marks)** will consist of 9 questions. Candidates will be required to answer **Question I (compulsory)** and **five** out of the rest of the eight questions.*

***Section B / C (20 marks)** Candidates will be required to answer **two** questions out of **three** from either Section B or Section C.*

SECTION A

1. Algebra

(i) Mathematical induction

Using induction to prove various summations and divisibility, finding factors.

(ii) Binomial Theorem

- (a) Significance of Pascal's triangle.
- (b) Binomial theorem (proof using induction) for positive integral powers,

$$\text{i.e. } (x + y)^n = {}^nC_0 x^n + {}^nC_1 x^{n-1} y + \dots + {}^nC_n y^n.$$

Simple direct questions based on the above.

- (c) Binomial theorem for negative or fractional indices

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \frac{n(n-1)(n-2)}{3!}x^3 + \dots$$

When $|x| < 1$

- Simple questions on the application of the above.
- Finding the r th term for the above (T_r).
- Applying the theorem on approximations e.g. $(0.99)^8 = (1 - 0.01)^8$.

(iii) Properties of Binomial Coefficients.

- $C_0 + C_1 + \dots + C_n = 2^n$
- $C_0 + C_2 + C_4 + \dots = C_1 + C_3 + C_5 + \dots = 2^{n-1}$

Simple problems involving application of the above.

- Questions where the product of $(1+x)^n (x+1)^n$ is under consideration e.g. Find the value of $C_0^2 + C_1^2 + C_2^2 + \dots + C_n^2$.

(iv) Logarithms - Properties of Logarithms

Knowledge of

- $\log_a a^x = x = a^{\log_a x}$
- $a^x = b \Leftrightarrow x = \log_a b$
- Change of base application using $\log_b a = \frac{\log_m a}{\log_m b}$
 $\log_a b = \frac{1}{\log_b a}$

(v) Quadratic Equations

- **Solutions of**

$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- **Reducible to this form**

Equations of the type

$$(\sqrt{x})^2 + 2\sqrt{x} + 1 = 0$$

put $\sqrt{x} = t$

& forms where $t = \sqrt{\frac{ax+b}{cx+d}}$

- **Nature of roots**

Product and sum of roots.

Roots are rational, irrational, equal, reciprocal, one square of the other.

Imaginary numbers.

Complex roots.

- Framing quadratic equations with given root.

- **Quadratic Functions.**

- (i) Given α, β as above then find the equation whose roots are of the form α^3, β^3 , etc.

- (ii) Case I: a is Positive
- Real roots
 - Complex roots
 - Equal roots

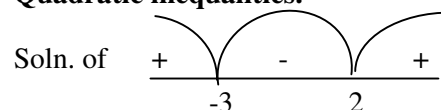
- (iii) Case II: $a < 0$
- Real roots
 - Complex roots
 - Equal roots

Understanding the fact that a quadratic expression (when plotted on a graph) is a parabola.

- **Sign of quadratic**

Sign when the roots are real and when they are complex.

- **Quadratic inequalities.**



(a) $x^2 + x - 6 \geq 0$

(b) A perfect square e.g. $x^2 - 6x + 9 \geq 0$

(c) $\frac{3x^2 - 2x - 5}{x^2 - 2x + 5} < 2$

(d) $\frac{x^2 - 2x + 5}{3x^2 - 2x - 5} > \frac{1}{2}$

(vi) Finite and Infinite Sequences

(a) Arithmetic Progression (A.P.)

- $T_n = a + (n - 1)d$
- $S_n = \frac{n}{2} \{2a + (n - 1)d\}$
- Arithmetic mean: $2b = a + c$
 - Inserting 2 or 3 arithmetic mean between any two numbers.
 - Three numbers in A.P. $\therefore a - d, a, a + d$
 - Four in A.P.: $a - 3d, a - d, a + d, a + 3d$

(b) Geometric Progression (G.P.)

- $T_n = ar^{n-1}, S_n = \frac{a(r^n - 1)}{r - 1}, S_\infty$
 - Geometric Mean, $b = \sqrt{ac}$
 - Inserting 2 or 3 Geometric Mean between any two numbers.
- Three numbers are in G.P. ar, a, ar^{-1}
- Four $ar^3, ar, ar^{-1}, ar^{-3}$

(c) Harmonic Progression

- a, b, c are in H.P then $1/a, 1/b, 1/c$ are A.P.
- Harmonic mean $b = \frac{2ac}{a + c}$
- Inserting two or three harmonic mean between any two numbers.

(d) Arithmetico Geometric Series

- Identifying series as A.P. x G.P. (when we substitute $d = 0$ in the series, we get a G.P. and when we substitute $r = 1$ the A.P.)

(e) Special sums $\sum n, \sum n^2, \sum n^3$

- Using these summations to sum up other related expression.

(f) Logarithmic and exponential series

- Expansion of $\log_e(1+x)$; properties; simple questions based on it.

(vii) Permutations Combinations

- Factorial notation $n!, n! = n(n-1)!$
 - Fundamental principle of counting.

(a) Permutations

- ${}^n P_r$.
- Restricted permutation.
- Certain things always occur together.
- Certain things never occur.
- Formation of numbers with digits.
- Word building - repeated letters – No letters repeated.
- Permutation of alike things.
- Permutation of Repeated things.
- Circular permutation – clockwise counterclockwise – Distinguishable / not distinguishable.

(b) Combinations

- ${}^n C_r, {}^n C_n = 1, {}^n C_0 = 1, {}^n C_r = {}^n C_{n-r}, {}^n C_x = {}^n C_y$, then $x + y = n, {}^{n+1} C_r = {}^n C_{r-1} + {}^n C_r$.
- When all things are different.
- When all things are not different.
- Division into groups - e.g. distinct groups, identical groups.
- Mixed problems on permutation and combinations.

2. Trigonometry

(i) Angles and Arc lengths

- Angles: Convention of sign of angles.
- Magnitude of an angle: Measures of Angles; Circular measure.
- T- ratio of angles of any magnitude.
- The relation $S = r\theta$ where θ is in radians. Relation between radians and degree.
- Arc length and area of a sector of a circle.

(ii) Trigonometric Functions

- Trigonometric ratios.
- Relationship between trigonometric ratios.
- Proving simple identities.
- Signs of trigonometric ratios.
- Limits of trigonometric ratios.
- Trigonometric ratios of standard angles.
- Trigonometric ratios of allied angles.
- Periods of trigonometric functions.
- Graphs of simple trigonometric functions (only sketches).

(iii) Compound and multiple angles

- Addition and subtraction formula: $\sin(A \pm B)$; $\cos(A \pm B)$; $\tan(A \pm B)$; $\tan(A + B + C)$ etc., Double angle, triple angle, half angle and one third angle formula as special cases.
- Sum and differences as products $\sin C + \sin D = 2\sin\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right)$ etc.
- Product to sum or difference i.e. $2\sin A \cos B = \sin(A + B) + \sin(A - B)$ etc.

(iv) Trigonometric Equations

- Solution of trigonometric equations (General solution and solution in the specified range).
 - (a) Equations in which only one function of a single angle is involved e.g. $\sin 5\theta = 0$
 - (b) Equations expressible in terms of one trigonometric ratio of the unknown angle.
 - (c) Equations involving multiple and sub-multiple angles.
 - (d) Equations involving compound angles.
 - (e) Linear equations of the form $a\cos\theta + b\sin\theta = c$, where $|c| \leq \sqrt{a^2 + b^2}$ and $a, b \neq 0$

(v) Properties of Triangles

- Sine Rule (without proof).
- Projection formula: $a\cos B + b\cos A = c$, where a, b, c are lengths of the sides and A, B, C are corresponding angles of the triangle (without proof).
- Cosine Rule $a^2 = b^2 + c^2 - 2bc\cos A$ (without proof).
- Area of a triangle $= \frac{1}{2} bc \sin A$ etc., Hero's formula.
- Simple problems on solution of triangles and properties of triangle using the above formula.

NOTE: circum-radius, in-radius and described radii excluded.

3. Calculus

Differential calculus

(i) Relations and Functions

- (a) Ordered pairs, sets of ordered pairs.
- (b) Cartesian Product (Cross) of two sets, cardinal number of a cross product.

Relations as:

- an association between two sets.
 - a subset of a Cross Product.
- (c) Domain, Range and Co-domain of a Relation.
 - (e) Functions:
 - As special relations, concept of writing "y is a function of x" as $y = f(x)$.
 - Types: one to one/ many to one, into/onto.
 - Domain and range of a function.
 - Classification of functions.
 - Sketches of graphs of exponential function, logarithmic function, mod function, step function, and simple trigonometric functions like $\sin x, \cos x, \tan x$.

(ii) Limits

- Notion and meaning of limits.
- Fundamental theorems on limits (statement only).
- Limits of algebraic and trigonometric functions.

(iii) Continuity

- Continuity of a function at a point $x = a$.
- Continuity of a function in a range.
- Removable discontinuity.

(iv) Differentiation

- Meaning and geometrical interpretation of derivative.
- Derivatives of simple algebraic and trigonometric functions and their formulae.
- Differentiation using first principles.
- Derivatives of sum/difference.
- Derivatives of product of functions.
- Derivatives of quotients of functions.
- Derivatives of composite functions.
- Derivatives of implicit functions.
- Derivatives of parametric functions.

(v) Application of derivatives

- Equation of Tangent and Normal approximation.
- Rate measure.
- Sign of derivative.
- Monotonocity of a function.

(vi) Integral Calculus

Indefinite integral

- Integration as the inverse of differentiation.
- Anti-derivatives of polynomials and functions $(ax + b)^n$, $\sin x$, $\cos x$, $\sec^2 x$, $\csc^2 x$.
- Integration by simple substitution.
- Integrals of the type $\sin^2 x$, $\sin^3 x$, $\cos^2 x$, $\cos^3 x$.
- Integrals of the type $f'(x)[f(x)]^n$, $\frac{f'(x)}{f(x)}$.

4. Coordinate Geometry

(i) Points and their coordinates

- Cartesian system of coordinates.
- Distance formula (without proof).
- Section formula (internal and external) (without proof).
- Centroid of a triangle (without proof).
- Incentre of triangle.
- Circumcenter and Orthocenter.
- Area of a triangle using the three vertices of a triangle.
- Area of a quadrilateral.
- Slope or gradient of a line.
- Angle between two lines.
- Condition of perpendicularity and parallelism.

(ii) Locus and its equation

- Definition of a locus.
- Methods to find the equation of a locus.

(iii) The straight line

- Various forms of equation of lines.
- Slope intercept form.
- Two point slope form.
- Intercept form.
- Perpendicular /normal form.
- General equation of a line.
- Distance of a point from a line.
- Distance between parallel lines.
- Equation to lines bisecting the angle between the lines.

(iv) Family of lines

- Lines parallel to $ax + by = c$ are of the form $ax + by = k$.
- Lines perpendicular to $ax + by = c$ are of the form $ay - bx = k$.

- Any line through the intersection of two lines L_1 and L_2 is of the form $L_1 + kL_2 = 0$, where $k \in R$.

NOTE : Solution of simultaneous inequations in 1 or 2 unknowns not included.

(v) Circles

Equations of a circle in:

- Standard form.
- Diameter form.
- General form.
- Parametric form.
- Given the equation of a circle, to find the centre and the radius.
- Finding the equation of a circle.
 - Given three non collinear points.
 - Given other sufficient data that the centre is (h, k) and it lies on a line and two points on the circle are given.
- Tangents:
 - Tangent to a circle at a given point (x_1, y_1) on the circumference of the circle.
 - Tangent to a circle when the slope of the tangent is given:

$$y = mx \pm a\sqrt{1+m^2}$$
 - Length of a tangent to a circle from an external point.
- Intersection:
 - Circle with a line hence to find the length of the chord.
 - Circle with a circle.
- Finding the equation of a circle through the intersection of two circles i.e. $S_1 + kS_2 = 0$.

5. Conics

- As a section of a cone.
- Definition of Foci, Directrix, Latus Rectum.
- $PS = ePL$ where P is a point on the conics, S is the focus, PL is the perpendicular distance of the point from the directrix.

(i) Parabola

- $e = 1$, $y^2 = 4ax$, $x^2 = 4ay$, $y^2 = -4ax$, $x^2 = -4ay$, $(y - \beta)^2 = 4a(x - \alpha)$, $(x - \alpha)^2 = 4a(y - \beta)$.
- The latus rectum, quadrants they lie in, coordinates of foci and vertex, equation of directrix and the axis and the rough sketch of the above mentioned.
- Finding equation of Parabola when Foci and directrix are given.
- Simple and direct questions based on the above.

(ii) Ellipse

- $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $e < 1$, $b^2 = a^2(1 - e^2)$
 $a > b$
- Vertices, major axis, minor axis, latus rectum, centre coordinates of focus, equation of directrix and the axis and rough sketch of the above mentioned ($a < b$).

(iii) Hyperbola

- Focal property i.e. $SP + SP' = 2a$.
- Rough sketch of the above.
- $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, $e > 1$, $b^2 = a^2(e^2 - 1)$,
 $a > b$.
- Transverse and Conjugate axis, Latus rectum, centre, coordinates of focus, equation of directrix and the axis and rough sketch of the above mentioned; $a < b$.
- General second degree equation $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents parabola if $h^2 = ab$, ellipse if $h^2 < ab$, and hyperbola if $h^2 > ab$.

6. Statistics

- Measures of central tendency.
- Quartiles: Upper and lower. Range, interquartile range.
- Standard deviation - by direct method, short cut method and step deviation method.
- Combined mean and standard deviation.

SECTION B

7. Vectors

- As directed line segments.
- Magnitude and direction of a vector.
- Types: equal vectors, unit vectors, zero vector.
- Position vector.
- Components of a vector.
- Vectors in two and three dimensions.
- $\hat{i}, \hat{j}, \hat{k}$ as unit vectors along the x, y and the z axes; expressing a vector in terms of the unit vectors.
- Operations: Sum and Difference of vectors; scalar multiplication of a vector.
- Position vector of a point dividing a given line segment in a given ratio.
- Section formula.
- Simple questions based on the above.
- **Dot Product**
 - Scalar or dot product.
 - $\vec{a} \cdot \vec{b} = a_1a_2 + b_1b_2 + c_1c_2$ & $\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}|\cos \theta$
In terms of the components and in terms of their magnitude and angle between them.
 - Use of the dot product to find the projection of a vector on another vector.
 - Use of dot product to show perpendicularity of two vectors e.g. the diagonals of a rhombus are perpendicular to each other (proving this using vectors).
 - Other related problems.

8. Co-ordinate geometry in 3-Dimensions

- As an extension of 2-D.
- Distance formula.
- Section and midpoint formula.
- Equation of x-axis, y-axis, z axis and lines parallel to them.
- Equation of xy - plane, yz - plane, zx - plane.
- Direction cosines, direction ratios.
- Angle between two lines in terms of direction cosines /direction ratios.
- Condition for lines to be perpendicular/parallel.

SECTION C

9. Statistics

- Median - direct and by using the formula.
- Quartiles- direct and by using the formula.
- Deciles- direct and by using the formula.
- Percentiles - direct and by using the formula.
- Mode - graphically, direct method and by using the formula.
- Estimation of median/quartiles from Ogives.

10. Stocks, Shares and Debentures

- Shares and their types.
- Face value and market value of a share and dividend.
- Stock and Brokerage.
- Calculation of income on stocks and shares.
- Market value of a stock.
- Sale and purchase of stocks.
- Shares debentures their sale/purchase and income thereon.

CLASS XII

There will be one paper of **three** hours duration of 100 marks. The syllabus is divided into **three** sections A, B and C. Section A is compulsory for all candidates. Candidates will have a choice of attempting questions from **either** Section B or Section C.

Section A (80 marks) will consist of 9 questions. Candidates will be required to answer **Question 1(compulsory)** and **five** out of the rest of the eight questions.

Section B/C (20 marks) Candidates will be required to answer **two** questions out of **three** from either Section B or Section C.

SECTION A

1. Determinants and Matrices

(i) Determinants

- Order.
- Minors.
- Cofactors.
- Expansion.
- Properties of determinants.
- Product of determinants (with out proof).
- Simple problems using properties of

determinants e.g. evaluate $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ etc.

• Cramer's Rule

- Solving simultaneous equations in 2 or 3 variables,

$$x = \frac{|D_x|}{|D|}, y = \frac{|D_y|}{|D|}, z = \frac{|D_z|}{|D|}$$

- Consistency, inconsistency.
- Dependent or independent.

(ii) Matrices

- Types of matrices ($m \times n$; $m, n \leq 3$), order; Identity matrix, Diagonal matrix.
- Symmetric, Skew symmetric.
- Operation – addition, subtraction, multiplication of a matrix with scalar, multiplication of two matrices (the compatibility).

E.g. $\begin{bmatrix} 1 & 1 \\ 0 & 2 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix} = AB(\text{say})$ but BA is not possible.

- Singular and non-singular matrices.

• Inverse ($2 \times 2, 3 \times 3$) $A^{-1} = \frac{AdjA}{|A|}$

• Martins Rule (i.e. using matrices)

$$a_1x + b_1y + c_1z = d_1.$$

$$a_2x + b_2y + c_2z = d_2.$$

$$a_3x + b_3y + c_3z = d_3.$$

$$A = \begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \quad B = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix} \quad X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$AX = B \Rightarrow X = A^{-1}B$$

- Simple problems based on above.

2. Boolean Algebra

Boolean algebra as an algebraic structure, principle of duality, boolean function. Switching circuits, application of boolean algebra to switching circuits.

3. Pairs of straight lines

- Finding equation of straight line passing through the line of intersection of two lines L_1 and L_2 .

$L_1 + kL_2 = 0$; finding k using an additional condition e.g. it is parallel to or perpendicular to $y + x - 1 = 0$ or it passes through the origin.

- General equation of second degree
 $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$

Represents two lines if

$$\begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix} = 0$$

- Angle between two lines

$$\tan \theta = \frac{2\sqrt{h^2 - ab}}{a + b}$$

- Condition for perpendicularity i.e. $a + b = 0$ and parallel i.e. $h^2 = ab$.
- Finding the equation of straight lines when the second degree expression is given.
- Finding the point of intersection.
- Finding the combined equation of angle bisectors to the given pair of straight lines.

$$\text{i.e. } \frac{x^2 - y^2}{a - b} = \frac{xy}{h}$$

Simple questions based on the above.

4. Conics

- (a) Equations of tangent and normal at a point on (i) Parabola (ii) Ellipse (iii) Hyperbola.
- (b) Condition for a line to be a tangent to the Conics.

5. Inverse Trigonometric Function

- Principal values.
- $\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$ etc.
- Its graphs.
- $\sin^{-1}x = \cos^{-1}\sqrt{1-x^2} = \tan^{-1}\frac{x}{\sqrt{1-x^2}}$.
- $\sin^{-1}x = \operatorname{cosec}^{-1}\frac{1}{x}$.
- $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$.
- Similar relations for $\cos^{-1}x$, $\tan^{-1}x$, etc as above.

- Addition formulae.

$$\sin^{-1}x + \sin^{-1}y = \sin^{-1}\left(x\sqrt{1-y^2} + y\sqrt{1-x^2}\right)$$

$$\cos^{-1}x + \cos^{-1}y = \cos^{-1}\left(xy - \sqrt{1-y^2}\sqrt{1-x^2}\right)$$

$$\text{similarly } \tan^{-1}x + \tan^{-1}y = \tan^{-1}\frac{x+y}{1-xy}, xy < 1$$

Similarly, formulae of $2\tan^{-1}x$ $3\tan^{-1}x$

- Use of these formulae to simplify expressions.

6. Calculus

(i) Differential Calculus

- Revision of topics done in Class XI - mainly the differentiation of product of two functions, quotient rule, etc.
- Derivatives of trigonometric functions.
- Derivatives of exponential functions.
- Derivatives of logarithmic functions.
- Derivatives of inverse trigonometric functions - differentiation by means of substitution.
- Derivatives of implicit and chain rule of composite functions.
- Differentiating function with respect to another function e.g. differentiate $\sin x^3$ with respect to x^3 .
- Logarithmic Differentiation - Finding dy/dx when $y = x^{x^{x^{\dots}}}$.
- Successive differentiation up to 2nd order.
- L'Hospital's theorem.
- $\frac{0}{0}$ form, $\frac{\infty}{\infty}$ form, 0^0 form, ∞^∞ form etc.
- Rolle's Mean Value Theorem - its geometrical interpretation.
- Lagrange's Mean Value Theorem - its geometrical interpretation.
- Maxima and minima.

(ii) Integral Calculus

- Revision of formulae from Class XI.
- Integration of $1/x$, e^x , $\tan x$, $\cot x$, $\sec x$, $\operatorname{cosec} x$.
- Integration by parts.
- Integration by means of substitution.
- Integration using partial fractions,

Expressions of the form $\frac{f(x)}{g(x)}$ when $f(x) < g(x)$

$$\text{E.g. } \frac{x+2}{(x-3)(x+1)} = \frac{A}{x-3} + \frac{B}{x+1}$$

$$\frac{x+2}{(x-2)(x-1)^2} = \frac{Ax+B}{(x-1)^2} + \frac{C}{x-2}$$

$$\frac{x+1}{(x^2+3)(x-1)} = \frac{Ax+B}{x^2+3} + \frac{C}{x-1}$$

$$\frac{x^2+1}{(x^2+2)(x+1)} = \frac{Ax^2+Bx+C}{x^2+2} + \frac{D}{x+1}$$

When $f(x) \geq g(x)$,

$$\text{e.g. } \frac{x^2+1}{x^2+3x+2} = 1 - \left(\frac{3x+1}{x^2+3x+2} \right).$$

- Integrals of the type:

$$\int \frac{dx}{x^2 \pm a^2}, \int \frac{dx}{\sqrt{x^2 \pm a^2}}, \int \frac{px+q}{ax^2+bx+c} dx, \int \frac{pxq}{\sqrt{ax^2+bx+c}} dx$$

and expressions reducible to this form

- $\int \frac{dx}{a \cos x + b \sin x}$ by substituting

$$\cos x = \frac{1-t^2}{1+t^2} \text{ and } \sin x = \frac{2t}{1+t^2} \text{ where}$$

$$t = \tan \frac{x}{2}$$

- Integrals of the type $\int \frac{1+x^2}{1+x^4} dx$
- Properties of definite integrals - questions based on it.
- Definite integral as a limit of sum.
- Application of definite integrals - area of a curve included between x or y-axis, volume of revolution about the x-axis or y-axis.

7. Measures of dispersion

Revision of standard deviation, quartile deviation, combined mean and standard deviation of two groups.

8. Correlation and Regression

- Definition and meaning of correlation and regression coefficient.
- Coefficient of Correlation by Karl Pearson.

If $x - \bar{x}$, $y - \bar{y}$ are small fractionless numbers, we use

$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2} \sqrt{\sum (y - \bar{y})^2}}$$

If x and y are small numbers, we use

$$r = \frac{\sum xy - \frac{1}{N} \sum x \sum y}{\sqrt{\sum x^2 - \frac{1}{N} (\sum x)^2} \sqrt{\sum y^2 - \frac{1}{N} (\sum y)^2}}$$

Otherwise, we use assumed means

A and B , and $u = x - A$, $v = y - B$

$$r = \frac{\sum uv - \frac{1}{N} (\sum u)(\sum v)}{\sqrt{\sum u^2 - \frac{1}{N} (\sum u)^2} \sqrt{\sum v^2 - \frac{1}{N} (\sum v)^2}}$$

- Rank correlation by Spearman's (Correction included).

9. Probability

- Random experiments and their outcomes.
- Events: sure events, impossible events, mutually exclusive events, independent events and dependent events.
- Definition of probability of an event.
- Laws of probability: addition and multiplication laws, conditional probability.

10. Complex Numbers

- Complex numbers as an ordered pair of real numbers in the form $a + ib$, (a, b) .
- Geometrical representation in complex plane - Argand diagram for z (a complex

number), $1/z$, z and \bar{z} ; equality of two complex numbers; absolute value (modulus).

- Argument and conjugate of complex numbers
- Sum, difference, product and quotient of two complex numbers additive and multiplicative inverse of a complex number.
- Simple locus question on complex number; proving and using -

$$z \cdot \bar{z} = |z|^2 \text{ and } \overline{z_1 \pm z_2} = \bar{z}_1 \pm \bar{z}_2$$

- Triangle inequality.
- Square root of a complex number.
- De Moivre's theorem and its applications.
- Cube roots of unity: $1, \omega, \omega^2$; application problems.
- Fourth roots of unity.

11. Differential Equations

- Differential equations, order and degree.
- Solution of differential equations.
- Variable separable.
- Homogeneous equations and equations reducible to homogeneous form.
- Linear form $\frac{dy}{dx} + Py = Q$ where P and Q are functions of x only. Similarly for dx/dy.
- Differential equation of second order $\frac{d^2y}{dx^2} = f(x)$

SECTION B

12. Co-ordinate geometry in 3-Dimensions

- Symmetrical equations of a line through one and two points.
- Coplanar and skew lines.

- Conditions for intersection of two lines.
- Shortest distance between two lines.

(i) Planes

- General equation of a plane $ax + by + cz + d = 0$, a, b, c - direction ratios of the normal to the plane.
- One point form:
 $a(x - x_1) + b(y - y_1) + c(z - z_1) + d = 0$,
- Normal form: $lx + my + nz = p$.
- Intercept form: $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$.
- Distance of a point from a plane.
- Angle between two planes, a line and a plane.
- Equation of a plane through the intersection of two planes i.e. -
 $P_1 + kP_2 = 0$.

Simple questions based on the above.

(ii) Sphere

- Equation:
 $(x - a)^2 + (y - b)^2 + (z - c)^2 = r^2$
centre (a, b, c) radius r.
- General form:
 $x^2 + y^2 + z^2 + 2ux + 2vy + 2wz + d = 0$,
centre (-u, -v, -w) and radius $\sqrt{u^2 + v^2 + w^2 - d}$
- Diametric form:
 $(x - x_1)(x - x_2) + (y - y_1)(y - y_2) + (z - z_1)(z - z_2) = 0$.
- Equation of sphere through the intersection of: sphere and plane, sphere and a sphere.
- Direct and simple questions based on the above.

13. Vectors

- Revision of scalar dot product.
- Cross product - its properties - area of a triangle, collinear vectors.

- Scalar triple product - volume of a parallelepiped, co-planarity.
- Vector triple product and related questions - $a \times (b \times c) \neq (a \times b) \times c$.

Geometrical application of vectors to 2- dimensional geometry i.e. angle in a semi- circle is a right angle; A line joining the mid-points of any two sides of a triangle is parallel to the third side and half of it; concurrency of medians, altitudes, perpendicular bisectors, cosine rule, etc.

14. Probability

Baye's theorem; theoretical probability distribution, probability distribution function; binomial distribution – its mean and variance.

SECTION C

15. Discount

True discount; banker's discount; discounted value; present value; cash discount, bill of exchange.

16. Annuities

Meaning, formulae for present value and amount; deferred annuity, applied problems on loans, sinking funds, scholarships.

17. Linear Programming

Introduction, definition of related terminology such as constraints, objective function, optimization, isoprofit, isocost lines; advantages of linear programming; limitations of linear programming; application areas of linear programming; different types of linear programming (L.P.), problems, mathematical formulation of L.P problems, graphical method of solution for problems in two variables, feasible and infeasible regions, feasible and infeasible solutions, optimum feasible solution.

18. Application of derivatives in Commerce and Economics in the following

Cost function or marginal cost, revenue function and break even point.

19. Index numbers and moving averages

- Price index or price relative.
- Simple aggregate method.
- Simple average of price relatives.
- Weighted average of price relatives (cost of living index, consumer price index).