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 (without 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.

NOTE: the consistency condition for three equations in two variables is required to be covered.

(ii) Matrices

- Types of matrices (m x n; m, n ≤ 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. $\begin{bmatrix} 1 & 1 \\ 0 & 2 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix} = AB(say)$ but BA is not possible.
- Singular and non-singular matrices.
- Existence of two non-zero matrices whose product is a zero matrix.
- Inverse (2x2, 3x3) $A^{-1} = \frac{AdjA}{|A|}$
- **Martin's 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.

NOTE: The conditions for consistency of equations in two and three variables, using matrices, are to be covered

2. Boolean Algebra

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

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

(ii) Ellipse

- $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $e < 1$, $b^2 = a^2(1 - e^2)$
- Cases when a > b and a < b.
- Rough sketch of the above.
- Major axis, minor axis; latus rectum; coordinates of vertices, focus and centre; and equations of directrices and the axes.
- Finding equation of ellipse when focus and directrix are given.
- Simple and direct questions based on the above.
- Focal property i.e. SP + SP′ = 2a.

(iii) Hyperbola

- $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, $e > 1$, $b^2 = a^2(e^2 - 1)$
- Cases when coefficient y^2 is negative and coefficient of x^2 is negative.
- Rough sketch of the above.
- Focal property i.e. SP - S'P = 2a.
- Transverse and Conjugate axes; Latus rectum; coordinates of vertices, foci and centre; and equations of the directrices and the axes.
- General second degree equation $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents a parabola if $h^2 = ab$, ellipse if $h^2 < ab$, and hyperbola if $h^2 > ab$.

Condition that y = mx + c is a tangent to the conics.

4. Inverse Trigonometric Function

- Principal values.
- $\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$ etc. and their graphs.
- $\sin^{-1}x = \cos^{-1}\sqrt{1-x^2} = \tan^{-1}\frac{x}{\sqrt{1-x^2}}$.
- $\sin^{-1}x = \operatorname{cosec}^{-1}\frac{1}{x}$; $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$ and similar relations for $\cot^{-1}x$, $\tan^{-1}x$, etc.
- Addition formulae.

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

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

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

  Similarly, establish formulae for $2\sin^{-1}x$, $2\cos^{-1}x$, $2\tan^{-1}x$, $3\tan^{-1}x$ etc. using the above formula.
- Application of these formulae.

5. 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 functions and chain rule for composite functions.
- Differentiation of a function with respect to another function e.g. differentiation of $\sin x^3$ with respect to x^3.

- Logarithmic Differentiation - Finding dy/dx when y = $x^{x^{x^{\cdot^{\cdot}}}}$.
- Successive differentiation up to 2^{nd} 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, tanx, cotx, secx, cosecx.
- Integration by parts.
- Integration by means of substitution.
- Integration using partial fractions,

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

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

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

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

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

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

- Integrals of the type:

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

and expressions reducible to this form.

- Integrals of the form:

$$\int\frac{dx}{a\cos x + b\sin x}, \int\frac{dx}{a+b\cos x}, \int\frac{dx}{a+b\sin x},$$

$$\int\frac{1\pm x^2}{1+x^4}dx,$$

$$\int\frac{dx}{1+x^4}, \int\sqrt{\tan x}\,dx, \int\sqrt{\cot x}\,dx.$$

- Properties of definite integrals.

  Problems based on the following properties of definite integrals are to be covered.

$$\int_a^b f(x)dx = \int_a^b f(t)dt$$

$$\int_a^b f(x)dx = -\int_b^a f(x)dx$$

$\int_a^b f(x)dx = \int_a^c f(x)dx + \int_c^b f(x)dx$ where a < c < b

$$\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$$

$$\int_0^a f(x)dx = \int_0^a f(a-x)dx$$

$$\int_0^{2a} f(x)dx = \begin{cases} 2\int_0^a f(x)dx, if \quad f(2a-x) = f(x) \\ 0, \qquad f(2a-x) = -f(x) \end{cases}$$

$$\int_a^{-a} f(x)dx = \begin{cases} 2\int_0^a f(x)dx, \text{if } f \text{ is an even function} \\ 0, \text{if } f \text{ is an odd function} \end{cases}$$

- Application of definite integrals - area bounded by curves, lines and coordinate axes is required to be covered.

6. 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 non - fractional 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, where 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).
- Lines of regression of x on y and y on x.

NOTE: Scatter diagrams and the following topics on regression are required.

i) The method of least squares.

ii) Lines of best fit.

iii) Regression coefficient of x on y and y on x.

iv) $b_{xy} \times b_{yx} = r^2$, $0 \le b_{xy} \times b_{yx} \le 1$

v) Identification of regression equations

7. 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 (excluding Baye's theorem).

8. Complex Numbers

- 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 -

$$z.\bar{z} = |z|^2; \ \overline{z_1 \pm z_2} = \bar{z}_1 \pm \bar{z}_2 \text{ and } \overline{\left(\frac{z_1}{z_2}\right)} = \frac{\bar{z}_1}{\bar{z}_2}$$

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

9. 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.

NOTE: Equations reducible to variable separable type are included. The second order differential equations are excluded.

SECTION B

10. Vectors

- Scalar (dot) product of vectors.
- Cross product - its properties - area of a triangle, collinear vectors.
- Scalar triple product - volume of a parallelopiped, co-planarity.

Proof of Formulae (Using Vectors)

- Sine rule.
- Cosine rule
- Projection formula
- Area of a Δ = ½absinC

NOTE: Simple geometric applications of the above are required to be covered.

11. Co-ordinate geometry in 3-Dimensions

(i) Lines

- Cartesian and vector equations of a line through one and two points.
- Coplanar and skew lines.
- Conditions for intersection of two lines.
- Shortest distance between two lines.

NOTE: Symmetric and non-symmetric forms of lines are required to be covered.

(ii) Planes

- Cartesian and vector equation of a plane.
- Direction ratios of the normal to the plane.
- One point form.
- Normal form.
- Intercept form.
- 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.

12. Probability

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

NOTE: Theoretical probability distribution is to be limited to binomial distribution only.

SECTION C

13. Discount

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

NOTE: Banker's gain is required to be covered.

14. Annuities

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

NOTE: Annuity due is required to be covered.

15. 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.

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

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

17. Index numbers and moving averages

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

NOTE: Under moving averages the following are required to be covered:

- Meaning and purpose of the moving averages.
- Calculation of moving averages with the given periodicity and plotting them on a graph.
- If the period is even, then the centered moving average is to be found out and plotted.