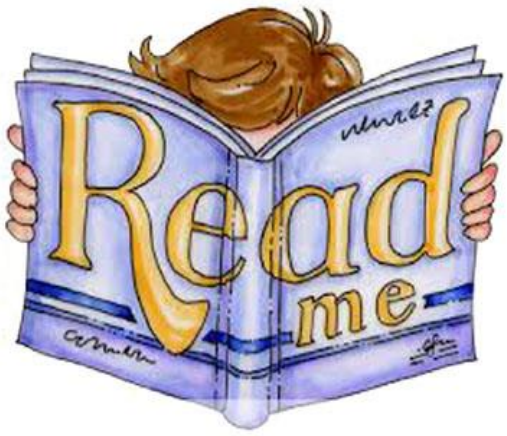

Course Syllabus

Syllabus

Preface

1. To enable candidates to acquire knowledge and to develop an understanding of the terms, concepts, symbols, definitions, principles, processes andformulae of Mathematics at the Senior Secondarystage.

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) 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.

SECTION A

Determinants and Matrices

(i). Determinants

- Order
- Minors
- Cofactors
- Expansion
- Properties of determinants

- Product of determinants (with out proof)(extra in 2015)
- 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 varibales is required to be covered.

(ii) Matrices

- Types of matrices (m x n; m, n ≤ 3), order; Identity matrix, Diagnonal 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)**

$a_1x + b_1y + e_1z = d_1$
$a_2x + b_2y + c_2z = d_2$
$a_3x + b_3y + c_3z = d_3$

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

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

- Simple problems based on above

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

Boolean algebra

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

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).] Major axis, minor axis; latus rectum; coordinates of vertices, focus and centre; and equations of directrices and the axes.

- Finding equation of ellise when focus and directrix are given.
- Simple and direct questions based on the above.
- Focal property i.e SP + SP' = 2a. – THE HIGHLIGHTED PART IS OF 2015.

(iii) Hyperbola

- Focal property i.e. SP + SPV = 2a.
- Rough sketch of the above.
- $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1, e<1, b^2=a^2(e^2-1)$
- Cases when coefficient y^2 is negative and coefficient of x^2 is negative.
- Transverse and Conjugate axis, Latus rectum, centre, coordinates of focus, equation of directrix and axis and rough sketch of the above mentioned; a < b.

- General second degree equation $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents a pair of lines if $abc + 2fgh - af^2 - bg^2 - ch^2 = 0$, otherwise it represents 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.

Inverse Trigonometric Function

- Principal values.
- sin-1x, cos-1x, tan-1x etc. and their graphs. $\text{Sin}^{-1}x = \text{Cos}^{-1}\sqrt{1-x^2} = \text{Tan}^{-1}\frac{x}{\sqrt{1-x^2}}$
- $\text{Sin}^{-1}x = \text{Cosec}^{-1}\frac{1}{x}$
- $\text{Sin}^{-1}x + \text{Sin}^{-1}x = \frac{\pi}{2}$

  Similar relations for $\text{Cos}^{-1}x$, $\text{Tan}^{-1}x$, etc as above.
- Addition formulae

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

  $\text{Cos}^{-1}x + \cos^{-1}y = \text{Cos}^{-1}(xy \pm \sqrt{1-y_2\sqrt{1-x_2}}$ similarly $\text{Tan}^{-1}x \pm \text{Tan}^{-1}y = \text{Tan}\ \frac{x+y}{1-xy}, xy < 1$

  Similarly establish formulae of $2\cos^{-1}x$ $3\tan^{-1}x$.
- Application of these formulae.

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 mea substitution.
- Derivatives of implicit functions and chain rule for 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 $y = x^{xx}$.
- 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, 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 f(x) < 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 f (x) $\geq$ g(x) ,

  e.g $\frac{x+1}{(x^2+3x+2)} = 1-\left(\frac{3x+1}{x^2+3x+2}\right)$
- 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: $\int \frac{dx}{a\cos x + b\sin x}, \int \frac{dx}{a + b\cos x}, \int \frac{dx}{a + b\sin x}$

  $\int \frac{1+x^2}{1+x^4}dx, \int \frac{dx}{1+x^4}, \sqrt{\tan x}dx, \int \sqrt{\cot x}dx$
- Properties of definite integrals questions based on it.

- Application of definite integrals – area of a curve included between x or y-axis.

Correlation and Regression

- Definition and meaning of correlation and regression coefficient.
- Use of Scatter diagrams(EXTRA)
- Line of best fit.
- Coefficient of Correlation by Karl Pearson. If x- $\bar{x}$, y – $\bar{y}$ are small fractionless numbers, we use

  $r = \dfrac{\sum(\bar{x}-x)(\bar{y}-y)}{\sqrt{\sum(x-x)^2}\sqrt{\sum(y-y)^2}}$ 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) and Kendall's methods.
- Lines of regression of x and y on x.

NOTE: Scatter diagrams and the following topics on regression are required.
i. the method of least square
ii. lines of best fit
iii. Regression coeffient of x and y and y on x.
iv. $b_{xy} \times b_{yx} = r_2$, $0 \leq b_{xy} \times b_{yx} \leq 1$
v. Identification of regression equations

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).

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

  $z.z = |z|^2$ and $\overline{z_1 \pm z_2} = z_1 \pm z_2$
- Triangle inequality.
- Square root of a complex number.
- Demoivre's theorem and its simple applications.
- Cube roots of unity: $1, w, w^2$, application problems.

Differential Equations

- Differential equations, order and degree.
- Solution of Differential equations
- Variable separable.
- Homogeneous equations and equations 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

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 $\Delta = \frac{1}{2}abSinC$

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

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.

Probability

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

NOTE: Theoritical probability distribution is to be limited to binomial distribution only

SECTION C

Discount

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

NOTE: Banker's gain is required to be covered

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.

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.

Application of derivatives in Commerce and Economics in the following

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

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).

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 centred moving average is to be found out and plotted.