

# BUSINESS MATHEMATICS (876)

## Aims:

1. To enable candidates to acquire the knowledge and develop an understanding of 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 foster acquisition of the skills of:
  - (a) computation,
  - (b) drawing geometrical figures and graphs, and
  - (c) reading tables, charts, graphs, etc.
4. To develop an interest in Mathematics.

## CLASS XI

There will be one paper of 3 hours duration of 100 marks divided into two parts.

**Part 1 (30 marks)** will consist of short answer questions, testing knowledge, application and skills relating to elementary / fundamental aspects of the entire syllabus.

**Part 2 (70 marks)** will be divided into three sections - A, B and C. Candidates will be required to answer **three** out of **five** questions from section A, **two** out of **three** questions from section B and **two** out of **three** questions from section C. Each question in this part shall carry 10 marks.

### SECTION A

#### 1. Algebra

- (i) Elementary Topics in Algebra: Remainder and Factor Theorems; Indices; Surds; Logarithms and their Properties (including change of base). Problems based on Properties.
- (ii) Quadratic Equations and Quadratic Functions: Solution of  $ax^2+bx+c = 0$  OR reducible to this form by factorisation and formula method; Theory of Quadratic Equations, Nature of Roots, Sum and Product of Roots, Value of Symmetric Functions. Forming Quadratic Equations with given roots. To find the condition when a relation between the two roots is given; Common roots; Quadratic Functions - Graph of Quadratic Function  $ax^2+bx+c$ ,  $a \neq 0$  - Sign of Quadratic Function  $ax^2+bx+c$  - Maximum/minimum value of a

Quadratic Function - Quadratic Inequalities and their solutions; solutions of inequations of the form  $f(x)/g(x) </> 0$  where  $f(x)$  and  $g(x)$  have linear factors only; Range of Values of Quadratic Fractions  $(ax^2+bx+c)/(px^2+qr+r)$ ,  $x \in R$ .

- (iii) Finite and Infinite Sequences:  $T_n$  and  $S_n$  of AP, GP - Insertion of Arithmetic and Geometric means between two Numbers. Sum to Infinity of a G.P. Sum to Infinite of G.P. ( $|r| < 1$ ). Recurring Decimals as G.P.; H.P. Insertion of H.M. between two Numbers; Special Sums i.e.  ${}^n\Sigma n$ ,  ${}^n\Sigma n^2$  and  ${}^n\Sigma n^3$  where  $n \in N$ .

- (iv) Partial Fractions.

Rational Functions of the form  $f(x)/g(x)$ , where  $f$  and  $g$  are polynomials (including monomials) in  $x$ .

**CASE I** degree of numerator  $<$  degree of the denominator

Type 1 Non repeated Linear Factors,

Type 2 Repeated Linear Factors,

Type 3 Quadratic Factors (may not be factorisable).

**CASE II** degree of numerator  $>$  degree of the denominator

Type 1 Non-repeated Linear Factors,

Type 2 Repeated Linear Factors.

## 2. Trigonometry

- (i) Angles and Arc Lengths: Angles - Convention of sign of angles - Magnitude of an angle - Measures of angles - Circular measures; T ratio of angles of any magnitude. The relation  $S = r\theta$ , where  $\theta$  is in radians. Relation between radians and degrees; Arc length and area of a sector of circle.
- (ii) Trigonometrical 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.
- (iii) Compound and Multiple Angles: Addition and subtraction formulas;  $\sin(A \pm B)$ ,  $\cos(A \pm B)$ ,  $\tan(A \pm B)$ ; sum and difference as products  $\sin C + \sin D = 2\sin\left[\frac{C+D}{2}\right] \cos\left[\frac{C-D}{2}\right]$ ; product to sum or difference  $2\sin A \cos B = \sin(A+B) + \sin(A-B)$  etc.; double angle formula; triple angle formula; half and one third angle formula; conditional identities (involving the angles of a triangle).
- (iv) Trigonometric Equations: Solution of Trigonometric Equations (General solution and solution in a specified range).

- Types
- (i) Equations in which only one function of a single angle is involved.
  - (ii) Equations expressible in terms of one trigonometric ratio of the unknown angle.
  - (iii) Equations involving multiple angles.
  - (iv) Equations involving compound angles.
  - (v) Inverse Trigonometric Functions: Meaning of inverse trigonometric functions; Principle value interval; Properties of inverse trigonometric functions (without proof); Use of the properties to represent inverse trigonometric functions in the simplest form.

## 3. Coordinate Geometry

- (i) Points and their Coordinates in 2D: Cartesian system of coordinates - distance formula - section formula (internal and external) - centroid of a triangle - incentre of a triangle; area of a triangle using the three vertices of a triangle; area of a quadrilateral; slope/gradient of a straight line; angle between two lines; Conditions for lines to be parallel and perpendicular; slope/gradient of a line joining two points.
- (ii) Locus and its Equation: Definition of a locus; illustrations of the equation of locus; methods to find the equation of a locus.
- (iii) The Straight Line: Various forms of the equation of a line - slope intercept form - point slope form - two points form - two intercept form - perpendicular/normal form - parametric form - general equation of a line - distance of a point from a line; equation of the perpendicular bisector of a line segment - distance between parallel lines - equations of lines bisecting the angle between given lines; families of lines - lines parallel to  $ax+by+c = 0$  are the form  $ax+by+k = 0$  - lines perpendicular to  $ax+by+c = 0$  are the form  $ay-bx+k = 0$  - any line through intersection of two lines  $L_1$  and  $L_2$  is of the form  $L_1+KL_2 = 0$  where  $K \in \mathbb{R}$ ; Solution of simultaneous linear inequations in one or two unknowns e.g.  $3x+2y > 5$ ,  $y > 2$ ;  $3x+2y < 5$ ,  $x+y > 1$ .
- (iv) Circles
  - (a) Equation of circles in - standard form - diameter form - general form - parametric form.
  - (b) Given the equation of a circle to find the centre and radius.
  - (c) Finding the equation of a circle - given 3 non-colinear points - given other sufficient data; condition for tangency - equations of tangents to a circle at a point on the circumference from an external point - equation of a normal - length of a tangent to a circle from an external point - finding the equation of a circle given the centre and tangent line.

#### 4. Calculus

- (i) Differential Calculus: Functions/limits and continuity - concept of real valued functions. Domain and Range of a function - classification of functions - sketches of graphs of exponential functions, logarithmic functions and mod functions, trigonometric functions, namely  $\sin x$ ,  $\cos x$  and  $\tan x$ ; notion and meaning of limits - fundamental theorem on limits - evaluation of limits of algebraic functions and trigonometric functions - problems on algebraic functions based on factorisation, rationalisation with  $x \rightarrow 0$ ,  $x \rightarrow a$ ,  $x \rightarrow \infty$  only.

Problems on trigonometric functions based on limits  $x \rightarrow 0$ ,  $\sin x/x$ ,  $\cos x$  and  $\tan x/x$  only; continuity - continuity of a function at a point  $x=a$  and in an interval; differentiation - meaning and geometrical interpretation of derivative - derivatives of simple algebraic and trigonometric functions - derivatives of sum/difference product and quotient of function - derivatives of composite functions implicit functions parametric functions - derivatives of 2nd order; application of derivative - equation of tangent and normal - approximation - rates measure.

- (ii) Integral Calculus: Indefinite integral (anti derivative) - integration as the inverse of differentiation, anti derivative of polynomials and the functions  $(ax+b)^n$ ,  $\sin x$ ,  $\cos x$ ,  $\sec x$ ,  $\tan x$ ,  $\sec^2 x$ ,  $\operatorname{cosec}^2 x$  - trigonometric transformations; simple substitutions - indefinite integrals of the form  $\sin^2 x dx$ ,  $\sin^3 x dx$ ,  $\cos^2 x dx$ ,  $\cos^3 x dx$ ,  $\int f'(x) [f(x)]^n dx$ .

#### SECTION B

##### 5. Ratio and Proportion

##### 6. Simple Interest and Compound Interest

##### 7. Stocks and Shares

8. **Depreciation:** emphasis on industrial and commercial applications e.g. insurance.

#### SECTION C

##### 9. Statistics

- (i) Data representation: classification and tabulation of data; graphical representation of data.
- (ii) Measures of central tendency: mean, mode, median.
- (iii) Quartiles and Percentiles: estimation of median/quartiles from the ogive.

### CLASS XII

*There will be one paper of 3 hours duration of 100 marks divided into two parts.*

**Part 1 (30 marks)** will consist of compulsory short answer questions testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.

**Part 2 (70 marks)** will consist of four sections - A, B, C and D. Candidates will be required to answer **four** out of **six** questions from section A, **two** out of **three** questions from section B, **two** out of **three** questions from section C and **two** out of **three** questions from section D. Each question in this part shall carry 7 marks.

#### SECTION A

##### 1. Algebra

- (i) Binomial Theorem: Binomial Theorem - of any index (without proof) - general term of the expansion  $(x \pm y)^n$ ,  $(1 \pm x)^n$ : series infinite if  $n \in \mathbb{Q}$ , but finite if  $n \in \mathbb{Z}^+$  - application to approximation using binomial theorem; mathematical induction - illustration of the method of proof - elementary applications only.
- (ii) Determinants and Matrices: Determinants - of order 2 and 3 - minors and co-factors of a determinant - expansion of determinant - properties of determinant and their use in

evaluation of a determinant - solution of a system of simultaneous equations in 2 or 3 variables using Cramer's rule - condition for consistency of 3 equations in two unknowns; matrices - rectangular arrays of order  $m \times n$ , where  $m, n \leq 3$ , including case  $m = n$  - addition/subtraction of matrices - multiplication by a scalar - multiplication of matrices - square matrix of order  $2 \times 2$  and  $3 \times 3$  - singular and non singular matrices of order  $2 \times 2$  and  $3 \times 3$  - adjoint and inverse of a square matrix of order  $2 \times 2$  and  $3 \times 3$  - use of matrices to solve simultaneous linear equations in 2 or 3 unknowns.

(iii) Permutations and Combinations: factorial notation; fundamental principle; concept of  ${}^n P_r$  - permutation of like things - restricted permutations - circular permutations; concept of  ${}^n C_r$  - restricted combinations - distribution of different things into groups - open selection of items from different things/from like things; mixed problems on permutation and combination.

## 2. Co-ordinate Geometry

(i) Conics: As sections of a cone; foci and directrix; equation of a parabola, ellipse, hyperbola in standard form simple problems; general equation for a conic when focus, directrix and eccentricity are given.

## 3. Calculus - Differential

(i) Differential Calculus: Derivatives of exponential functions, logarithmic functions, inverse trigonometric functions reduceable to simple form by substitution; logarithmic differentiation; successive differentiation upto 2<sup>nd</sup> order; condition of maxima and minima, application of maxima and minima to simple problems relating to positive integers, trigonometric functions; rectangles, semi circles, spheres, cylinders and cones.

(ii) Integral Calculus: Revision of formulae of integration from Class XI. Standard methods of integration - substitution or by change of independent variable, formulae for integrals of functions  $e^x$ ,  $\tan x$ ,  $\cot x$ ,  $\sec x$ ,  $\operatorname{cosec} x$ ;

integrals of the type:  $\int \frac{dx}{x^2 \pm a^2}$ ,  $\int \frac{dx}{a^2 - x^2}$ ,

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

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

Integration of rational functional functions by partial fractions; Integration by parts, integrals of

the type:  $\int \sin^{-1} x dx$ ,  $\int \log x dx$ ,  $\int \frac{dx}{a + b \cos x}$ ,

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

## SECTION B

### 4. Calculus - Integral

Definite integrals: evaluation of definite integrals, transformation of definite integrals by substitution, following properties of definite integrals:

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

$$\int_a^b f(x) dx = \int_a^c f(x) dx + \int_c^b f(x) dx,$$

$$\int_0^{2a} f(x) dx = \int_0^a f(x) dx + \int_0^a f(2a - x) dx,$$

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

$$\int_0^{2a} f(x) dx = 2 \int_0^a f(x) dx \text{ if } f(2a - x) = f(x),$$

$$= 0 \text{ if } f(2a - x) = -f(x)$$

Evaluation of some integrals using the above properties.

5. Application of definite integrals: area bounded by a curve between two ordinates and x-axis; area between two curves; volume of a solid of revolution about x or y-axis.

### 6. Differential Equations

(i) Meaning of differential equations, order and degree of a differential equation.

- (ii) Solution of differential equations (1st order, 1st degree) of the type; variable separable; homogeneous equations;  $dy/dx + Py = Q$  where P & Q are functions of x.
- (iii) Solution of differential equation of the type  $d^2y/dx^2 = f(x)$  (general and particular solutions).

### SECTION C

#### 7. Measures of Dispersion

- (i) Meaning of dispersion; quartile deviation; standard deviation; coefficient of variation.
- (ii) Combined mean and standard deviation of two groups only.
- (iii) Mean deviation from the mean or median.

#### 8. Correlation and Regression

- (i) Scatter diagrams and correlation: definition and meaning of correlation and regression coefficient; use of scatter diagram to interpret the values of correlation coefficient; calculation of coefficient of correlation by Karl Pearson's method for ungrouped data only; calculation of Spearman's rank correlation coefficient with correction for repeated data.
- (ii) Regression: meaning of regression; calculation of regression; coefficient and the two lines of regression by the method of least squares; use of lines of regression for prediction.

#### 9. Index Numbers and Moving Averages

- (i) Index numbers: meaning and purpose of index numbers; methods of calculating index numbers - simple aggregate method - simple average of price relative method - weighted average of price relative method - weighted aggregate method.

- (ii) Moving averages: calculation of moving averages with the given periodicity and plotting on a graph.

#### 10. Probability

- (i) Events: sure events; impossible events; mutually exclusive events; equally likely events; independent and dependent events.
- (ii) Definition of probability of an event.
- (iii) Laws of probability; addition and multiplication laws, conditional probability; Baye's theorem.  
**((i), (ii) & (iii) without proof)**
- (iv) Theoretical probability distribution; Probability density function; Binomial distribution - its mean, variance and S.D. **(without proof)**.
- (v) Mathematical expectations: Calculating mean, variance and S.D. using expectations.

### SECTION D

#### 11. Discount

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

#### 12. Average due date

Zero date, equated periods; insurance policies, premiums.

#### 13. Annuities

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

#### 14. Application of derivatives in Commerce and Economics in the following:

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