No. of Printed Pages : 7 **BCS–012**

BACHELOR OF COMPUTER APPLICATIONS

(BCA) (REVISED)

Term-End Examination

December, 2025

BCS-012 : BASIC MATHEMATICS

Time : 3 Hours *Maximum Marks : 100*

Note : *Question No.* ***1*** *is compulsory. Attempt any* ***three*** *questions from the remaining questions.*

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1. (a) Show that : 5

$$\begin{vmatrix} -a^2 & ab & ac \\ ba & -b^2 & bc \\ ca & cb & -c^2 \end{vmatrix} = 4a^2b^2c^2$$

(b) If $A = \begin{pmatrix} -1 & -2 \\ 3 & 6 \end{pmatrix}$, show that $A^2 = 5A$. 5

(c) Use principle of mathematical induction to show that : 5

$$1 + 3 + \ldots\ldots\ldots + (2n - 1) = n^2, \ \forall n \in \mathbf{N}$$

(where **N** is a set of natural numbers).

(d) If $m \neq n$ and m times the mth term of an Arithmetic Progression (A.P.) is equal to n times the nth term of the A.P., then show that $(m + n)$th term of the A.P. is zero. 5

(e) If $z \in \mathbf{C}$ and $|z - i| = |z + i|$, show that $\text{Im}(z) = 0$, where z is a complex number and **C** is a set of complex numbers. 5

(f) Find the roots of the equation :

$$x^3 - 13x^2 + 15x + 189 = 0$$

given that one root exceeds the other by 2 and the roots are integers. 5

(g) Evaluate integral (I) given below : 5

$$I = \int \frac{x^3}{(x+1)^2} dx$$

(h) Show that the diagonals of a rhombus are at right angles. 5

2. (a) Find the 10th term of the Harmonic Progression (H.P.) : 5

$$\frac{1}{5}, \frac{1}{11}, \frac{1}{17}, \frac{1}{23}, \ldots\ldots\ldots\ldots$$

(b) If $x = a + b$, $y = a\omega + b\omega^2$ and $z = a\omega^2 + b\omega$, show that $xyz = a^3 + b^3$.

[Here $\omega \neq 1$ is a cube root of unity.] 5

(c) Find the direction cosines of the line joining (0, 1, – 1) and (3, 2, 1). 5

(d) If $y = \dfrac{e^x + e^{-x}}{e^x - e^{-x}}$, find $\dfrac{dy}{dx}$. 5

3. (a) If $y = \ln \left[e^x \left(\dfrac{x - 2)}{x + 2} \right)^{3/4} \right]$, show that

$$\frac{dy}{dx} = \frac{x^2 - 1}{x^2 - 4}.$$ 5

(b) Find the intervals in which the function $f(x) = 3x^{5/2} - 5x^{3/2}, x > 0$ is (i) increasing, and (ii) decreasing. 5

(c) Evaluate : 5

$$\int \frac{3^x + 2^x}{6^x} dx .$$

(d) If $\vec{a} = 4\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{b} = -2\hat{i} + j - 2\hat{k}$, find a unit vector perpendicular to both $\vec{a}$ and $\vec{b}$. 5

4. (a) If $x \in \mathbb{R}$, solve the inequality :

$$\frac{9}{x-3} < 5$$

(where $\mathbb{R}$ is a set of real numbers.) 5

(b) If $a, b, x, y \in \mathbb{R}$, $a \neq 0$ and $b \neq 0$:

$$(a - ib)\,(x + iy) = (a^2 + b^2)i,$$

find x and y. 5

(c) Use Cramer's rule to solve the system of equations : 5

$$2x - y + z = 4$$

$$3x - y = 5$$

$$2y - z = 1$$

(d) If : 5

$$A = \begin{pmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{pmatrix}$$

and $$B = \begin{pmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{pmatrix},$$

show that :

$$AB = BA = 6I_3.$$

Find A^{-1}.

5. (a) Use mathematical induction to show that : 5

$$1 + \frac{1}{2} + \frac{1}{2^2} + \ldots.. + \frac{1}{2^n} < 2 \quad \forall\, n \in \mathbf{N}.$$

(b) Find quadratic equation with real coefficients, one of its roots is $-2 + 3i$. 5

(c) If $\vec{a} = -\hat{i} + \hat{j} + 2\hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} - \hat{j} + 2\hat{k}$, find $(\vec{a} \times \vec{b}) \cdot \vec{c}$. 5

(d) Maximize : 5

$$P = 5x + 2y$$

subject to :

$$10x + 2y \geq 2100$$

$$x + \frac{1}{2}y \leq 600$$

$$y \leq 800$$

$$x \geq 0,\ y \geq 0.$$

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