No. of Printed Pages : 7 **BCS–012**

BACHELOR OF COMPUTER APPLICATIONS (BCA) (REVISED)

Term-End Examination

June, 2026

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 :

$$\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = (a-b)(b-c)(c-a)$$ 5

(b) If $A = \begin{pmatrix} 2 & 3 \\ 4 & 6 \end{pmatrix}$, show that $A^2 = 8A$. 5

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

$2 + 4 + 6 + ... + 2n = n(n + 1) \ \forall \ n \in \mathbf{N}$ 5

(d) If pth term of an Arithmetic Progression (A.P.) is q and the qth term of the A.P. is p, show that the rth term of the A.P. is $p + q - r$. 5

(e) If $a + ib = (\cos \theta + i \sin \theta)^2$, show that :

$$a^2 + b^2 = 1$$ 5

(f) Find the sum to n terms of the series $1^2 + 3^2 + 5^2 + ...$ up to n terms. 5

(g) Find the roots of the equation

$$8x^3 - 14x^2 + 7x - 1 = 0$$ 5

given that the roots are in Geometric Progression.

(h) Show that :

$$\int_0^5 \frac{\sqrt{5-x}}{\sqrt{x}+\sqrt{5-x}}\,dx = \frac{5}{2}$$ 5

2. (a) Find the angle between the vectors

$\vec{a} = -\hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{b} = \hat{i} + 4\hat{j} + \hat{k}$. 5

(b) Use the first derivative test to find the local maxima and the local minima of $f(x) = x^3 - 27x + 5$. 5

(c) Find the nth term of the Harmonic Progression (H.P.) 5

$$\frac{1}{7}, \frac{2}{15}, \frac{1}{8}, \frac{2}{17}, \ldots\ldots$$

(d) Find the area bounded by $y = x^2$ and $y = x$. 5

3. (a) Use Cramer's rule to solve the system of equations : 5

$$3x + y + z = 6$$

$$x + y = 3$$

$$2y + z = 1$$

(b) Solve the inequality 5

$$\frac{3}{7 - x} < 2,\ x \in \mathbf{R}$$

where **R** is a set of real numbers.

(c) Evaluate 5

$$\int (2^x + 2^{-x})^2 dx$$

(d) If $\vec{a} = 2\hat{i} - \hat{j} + 5\hat{k}$ and $\vec{b} = 3\hat{i} + \hat{j} + \lambda\hat{k}$, find λ so that $\vec{a}$ and $\vec{b}$ at right angles. 5

4. (a) Find the intervals in which the function,

$$f(x) = \frac{1}{3}x^3 - 3x^2 + 5x + 11$$

is (i) increasing (ii) decreasing. 5

(b) Find the inverse of the matrix 5

$$A = \begin{pmatrix} 2 & -1 & 5 \\ 3 & 0 & 2 \\ 0 & 1 & 1 \end{pmatrix}$$

(c) Find the quadratic equation with real coefficients if one of its roots is $-3 + 4i$. 5

(d) Show that $f(x) = x^2 \ln\left(\frac{1}{x}\right)$, $x > 0$ has a local maximum at $x = \frac{1}{\sqrt{e}}$. 5

5. (a) If :

$$\vec{a} = \hat{i} + \hat{j},\ \vec{b} = \hat{j} + \hat{k}$$

and $\vec{c} = \hat{i} + \hat{k}$,

find $(\vec{a} \times \vec{b}) \times \vec{c}$. 5

(b) Find the shortest distance between the lines

$$\vec{r} = \hat{i} + 2\hat{j} + \hat{k} + \lambda(\hat{i} - \hat{j} + \hat{k})$$

and $\vec{r} = 2\hat{i} + \hat{j} - \hat{k} + \mu(2\hat{i} + \hat{j} + 2\hat{k})$ 5

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

$$1 + \frac{1}{3} + \frac{1}{3^2} + \dots + \frac{1}{3^n} < \frac{3}{2}$$

$\forall\, n \in \mathbf{N}$.

Here **N** is a set of natural numbers.

(d) Minimize :

$$Z = 4x + 3y$$

subject to

$$2x + y \geq 40$$

$$x + 2y \geq 50$$

$$x + y \geq 35$$

$$x \geq 0$$

$$y \geq 0.$$ 5

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