

**BACHELOR OF COMPUTER**

**APPLICATIONS**

**(BCA) (REVISED)**

**Term-End Examination**

**December, 2025**

**BCS-012 : BASIC MATHEMATICS**

*Time : 3 Hours*

*Maximum Marks : 100*

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

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1. (a) Show that :

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

(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

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

(where  $\mathbf{N}$  is a set of natural numbers).

(d) If  $m \neq n$  and  $m$  times the  $m$ th term of an Arithmetic Progression (A.P.) is equal to  $n$  times the  $n$ th 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  $\mathbf{C}$  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

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

- (b) If  $x = a + b$ ,  $y = a\omega + b\omega^2$  and

$$z = a\omega^2 + b\omega, \text{ show that } xyz = a^3 + b^3.$$

[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  $y = \frac{e^x + e^{-x}}{e^x - e^{-x}}$ , find  $\frac{dy}{dx}$ . 5

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

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

(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  $\vec{b} = -2\hat{i} + \hat{j} - 2\hat{k}$ ,  
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 :

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

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

show that :

$$AB = BA = 6I_3.$$

Find  $A^{-1}$ .

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

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

- (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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