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Roll No.

PAPER ID—14529

B.C.A. EXAMINATION, 2023

(First Semester)

MATHEMATICS

Code : BCA123

Time : 3 Hours

Maximum Marks : 80

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : The question paper will consist of nine questions in all. Q. No. 1 will consist of total eight parts (short answer type questions) covering the entire syllabus and will carry 16 marks. In addition to the compulsory question there will be four Units i.e. Unit I

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to Unit IV. Each of the four Units (I-IV) will contain two questions (each carrying 16 marks) and the students shall be asked to attempt *one* question from each Unit. Q. No. 1 will be compulsory.

1. (a) Find the value of a, b, c, d from the matrix equation : 2

$$\begin{bmatrix} a+3 & 2b-8 \\ c+1 & 4d-6 \end{bmatrix} = \begin{bmatrix} 0 & -6 \\ -3 & 2d \end{bmatrix}$$

- (b) If $\begin{vmatrix} 4 & x \\ -3 & 5 \end{vmatrix} = 8$ find the value of x . 2

- (c) If $f(x) = 2x+1$, find the range if domain is $\{-1, 2, 3\}$ and hence find the function. 2

- (d) Evaluate : 2

$$\lim_{x \rightarrow 0} \frac{\sin ax}{bx}$$

- (e) Write down the derivative of : 2

$$\frac{1}{\sqrt{2-9x}}$$

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(f) Find $\frac{dy}{dx}$, if $x = \sin 2t$, $y = 2 \cos t$. 2

(g) Evaluate : 2

$$\int \sec x (\sec x + \tan x) dx.$$

(h) Evaluate : 2

$$\int_0^{\frac{\pi}{2}} \sin^2 x dx.$$

Unit I

2. (a) If $U = \{1, 2, 3, 4, 5, 6, 7, 8\}$,
 $A = \{1, 2, 3, 4\}$, $B = \{3, 4, 6\}$ and
 $C = \{5, 6, 7, 8\}$, then verify that : 8

(i) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

(ii) $(A \cap B)' = A' \cup B'$.

(b) Out of 40 students in a class, 16 study English, 22 Accountancy and 26 Economics. 5 study English and Economics, 14 Accountancy and Economics and 2 study all the three subjects. If each student studies at least one

of the three subjects, find the number of students who study : 8

(i) English and Accountancy

(ii) English and Accountancy but not Economics.

3. (a) If $A = \begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix}$, show that : 8

$$A^3 - 6A^2 + 11A - I_3 = 0$$

(b) Find the inverse of the following matrices : 8

$$\begin{bmatrix} 3 & 4 & 6 \\ 1 & 2 & 3 \\ 8 & 5 & 10 \end{bmatrix}$$

Unit II

4. (a) If $f: \mathbb{R} \rightarrow \mathbb{R}$ is defined as

$$f(x) = \frac{5x+3}{7}, x \in \mathbb{R}; \text{ prove that } f \text{ is}$$

bijjective function and hence find the inverse of f . 8

(b) Let N denote the set of all natural numbers and R be the relation on $N \times N$ defined by $(a, b) R (c, d) \Leftrightarrow ad(b+c) = bc(a+d)$. Show that R is an equivalence relation on $N \times N$. 8

5. (a) Evaluate : 8

(i) $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x \sin x}$.

(ii) $\lim_{x \rightarrow \infty} \frac{\sin 2x + \sin 6x}{\sin 5x - \sin 3x}$.

(b) Discuss the continuity of the function f where f is defined by : 8

$$f(x) = \begin{cases} 2x, & \text{if } x < 0 \\ 0, & \text{if } 0 \leq x \leq 1 \\ 4x, & \text{if } x > 1 \end{cases}$$

Unit III

6. (a) Differentiate the following w.r.t. x : 8

$$x^{\cot x} + \cos x^{\sin x}$$

(b) Differentiate $x^{-\frac{3}{4}}$ from first principle. 8

7. (a) Find $\frac{dy}{dx}$: 8

(i) $y = \frac{\sin x + \cos x}{\sin x - \cos x}$

(ii) $y = x + \sqrt{x^2 - 1}$, prove that :

$$(y-x) \frac{dy}{dx} - y = 0.$$

(b) Find $\frac{dy}{dx}$ if : 8

(i) $y = \tan^{-1} \left(\frac{\sqrt{1+x^2} + 1}{x} \right)$

(ii) $y = \tan^{-1} (\sqrt{1+x^2} + x).$

Unit IV

8. (a) Evaluate : 8

$$\int \frac{2x-1}{2x^2+2x+1} dx$$

(b) Evaluate :

8

$$\int (3x-2)\sqrt{x^2+x+1} dx$$

9. Evaluate :

16

$$\int_0^{\frac{\pi}{2}} \frac{\sin^2 x}{\cos x + \sin x} dx$$

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