

Paper Code : 21304

F-404

B.C.A. (First Semester)

Examination, 2021-22

(New Course)

Paper-No. BCA-104-N

MATHEMATICS-I

Time : Three Hours] [Maximum Marks : 70

Note : Attempt any **five** questions. **All** questions carry equal marks. Symbols used have their usual meanings.

1. (a) Show that the limit of a product is equal to the product of limits.
- (b) Evaluate the following limits, if they exist :

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

(1)

P.T.O.

(ii) $\lim_{x \rightarrow 0} \frac{1}{x} \cdot e^{1/x}$

2. A function $f(x)$ is defined as follows :

$$f(x) = \begin{cases} (x^2/a) - a & ; x < a \\ 0 & ; x = a \\ a - (a^2/x) & ; x > a \end{cases}$$

Prove that the function $f(x)$ is continuous at $x=a$.

3. (a) Explain the types of discontinuity.
- (b) Show that the function :

$$f(x) = \begin{cases} 1 + x & ; \text{if } x \leq 2 \\ 5 - x & ; \text{if } x > 2 \end{cases}$$

continuous at $x=2$.

4. (a) Find the n^{th} derivative of $y=(ax+b)^m$.
- (b) (i) If $y^{1/m} + y^{-1/m} = 2x$, prove that

$$(x^2 - 1)y_{n+2} + (2n+1)xy_{n+1} + (n^2 - m^2)y_n = 0.$$

(2)

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(ii) If $u = \log(x^3 + y^3 + z^3 - 3xyz)$, show that

$$\left(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}\right)^2 u = \frac{-9}{(x+y+z)^2}.$$

5. (a) Solve : $\frac{dy}{dx} = \frac{2x+2y-2}{3x+y-5}$.

(b) Solve : $(D^2 + 1)y = \sin x \sin 2x$.

6. (a) Evaluate : $\int_0^{\pi/4} \sqrt{\tan \theta} d\theta$.

(b) Write reduction formula for $\int x \sin^n x dx$.

7. (a) If $u = x+y+z$, $v = x^2+y^2+z^2$ and $w = yz+zx+xy$,
prove that:

$$(\text{grad } u) \cdot [(\text{grad } v) \times (\text{grad } w)] = 0.$$

(b) Prove that $\nabla \cdot \{ \nabla(v \cdot a) - \nabla \times (v \times a) \} = \text{div } v$;

where 'a' is a constant unit vector.

8. (a) Solve : $\frac{d^2 y}{dx^2} = \sec ax$

(b) Solve : $(D^2 - 2D + 1)y = x^2 e^{3x}$.

9. (a) Find the equation of the ellipse whose eccentricity is $\frac{4}{5}$ and axis are along the co-ordinate axis and with foci at $(0, \pm 4)$.
- (b) A triangle ABC has vertices at points $A = (8, 1)$, $B = (-1, 4)$ and $C = (6, -3)$. Determine the measure of the centre and radius of a circumscribed circle.

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