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SUBJECT CODE NO: - BB-2316
FACULTY OF SCIENCE AND TECHNOLOGY
B. Sc. (CBCGS) (Pattern 2022) F.Y SEM I
Examination November / December 2025
Mathematics -II Differential Calculus

[Time: 1:30 Hours]

[Max. Marks: 40]

Please check whether you have got the right question paper.

N. B

- 1) Attempt all questions.
- 2) Figures to the right indicate full marks.

Q1

A) Attempt any one:

05

- a. Prove that the union of two closed sets is a closed set.
- b. If a function is continuous in a closed interval, then prove that it is bounded there in.

B) Attempt any one:

05

- c. Show that,

$$\lim_{n \rightarrow \infty} \sqrt[n]{n} = 1$$

- d. Examine the continuity of the function

$$f(x) = \begin{cases} \sin(x-c) & \text{if } x \neq c \\ 0, & \text{if } x = c \end{cases}$$

Q2

A) Attempt any one:

05

- a. Find n^{th} derivative of $y = e^{ax} \cdot \sin(bx + c)$
- b. If a function f defined on $[a, b]$, is continuous on $[a, b]$ and derivable on $]a, b[$, then prove that there exists at least one real number c between a and b such that.

$$\frac{f(b) - f(a)}{b - a} = f'(c)$$

B) Attempt any one:

05

- c. If $I_n = \frac{d^n}{dx^n} (x^n \log x)$, Prove that $I_n = n I_{n-1} + (n-1)$
- d. Show that $\log(1+x)$ lies between $x - \frac{x^2}{2}$ and $x - \frac{x^2}{2(1+x)}$, $\forall x > 0$.

Q3

A) Attempt any one:

05

- a. If ϕ and ψ be two scalar point functions then prove that. $\text{Grad}(\phi \psi) = (\text{grad } \phi)\psi + \phi(\text{grad } \psi)$

- b. If ϕ be a scalar point function then prove that, $\nabla \times (\nabla \phi) = 0$

B) Attempt any one

05

- c. If $\frac{d\vec{a}}{dt} = \vec{r} \times \vec{a}$, $\frac{d\vec{b}}{dt} = \vec{c} \times \vec{b}$, then show that $\frac{d}{dt}(\vec{a} \times \vec{b}) = \vec{c} \times (\vec{a} \times \vec{b})$

- d. If $y = \log(\sin x)$, then show that $y_3 = \frac{2\cos x}{\sin^3 x}$

Q4 Choose the correct alternative:

10

1. The set $S = \{1, -1, \frac{1}{2}, \frac{-1}{2}, \frac{1}{3}, \frac{-1}{3}, \dots\}$ is

- a. Open but not closed
b. Closed but not open
c. Open as well as closed
d. Neither open nor closed

2. The sequence $\{-2^n\}$ is

- a. Diverges to ∞
b. Diverges to $-\infty$
c. Converges to 2
d. Converges to -2

3. If $y = \sin^{-1} x$ then, $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} =$

- a. $n^2 y_n$
b. $-n^2 y_n$
c. $-(n^2 + 1)y_n$
d. None of these

4. The n^{th} derivative of e^{mx} is

- a. $m^n e^{mx}$
b. $n^m e^{mx}$
c. $m e^{mx}$
d. $n e^{mx}$

5. The vector differential operator $\nabla =$

- a. $\vec{i} \frac{\partial}{\partial x} - \vec{j} \frac{\partial}{\partial y} - \vec{k} \frac{\partial}{\partial z}$
b. $\vec{i} \frac{\partial}{\partial x} + \vec{j} \frac{\partial}{\partial y} + \vec{k} \frac{\partial}{\partial z}$
c. $\vec{i} \frac{\partial}{\partial x} \times \vec{j} \frac{\partial}{\partial y} \times \vec{k} \frac{\partial}{\partial z}$
d. $\vec{i} \frac{\partial}{\partial x} - \vec{j} \frac{\partial}{\partial y} + \vec{k} \frac{\partial}{\partial z}$

