

CBD-5426-W

**B. A./B. Sc./B. Sc. B. Ed.
(Fourth Semester) (End Semester)**

EXAMINATION, 2022

MATHEMATICS

MTS-SE-411

(Vector Calculus)

Time : Three Hours] [Maximum Marks : 60

Note : The questions paper is divided into three Sections. Attempt questions as per direction.

Section—A

(Objective Type Questions)

Note : Choose the correct option. Each question carries 1 mark. $10 \times 1 = 10$

1. The value of $[a \ a \ b]$ is :

(a) 0

(b) 1

(c) -1

(d) None of the above

2. If $\vec{a}, \vec{b}, \vec{c}$ are coplanar vectors, the value of $[\vec{a} \ \vec{b} \ \vec{c}]$ is :

(a) 0

(b) 3

(c) 1

(d) None of the above

3. Unit vector and its derivative are :

(a) Parallel

(b) Orthogonal

(c) Along the same direction

(d) None of the above

4. If $\vec{r} = a \cos t \vec{i} + a \sin t \vec{j} + bt \vec{k}$, then $\left| \frac{d\vec{r}}{dt} \right|$

is :

- (a) $a^2 + b^2$
 - (b) a^2
 - (c) b^2
 - (d) $\sqrt{a^2 + b^2}$
5. If ϕ is a differentiable scalar point function, then the value of $\text{div grad } \phi$ is :
- (a) 0
 - (b) ϕ
 - (c) $\nabla^2 \phi$
 - (d) $\vec{0}$
6. A vector point function \vec{F} is said to be solenoidal if and only if :
- (a) $\nabla \cdot \vec{F} = 0$

P. T. O.

(b) $\nabla^2 \vec{F} = 0$

(c) $\nabla \cdot \vec{F} = 0$

(d) $\nabla \times \vec{F} = 0$

7. If $\text{div } \vec{F}$ of any vector \vec{F} is zero, then it is :

- (a) invariant
 - (b) irrotational
 - (c) solenoidal
 - (d) harmonic
8. For a constant vector \vec{v} , value of $\text{curl } \vec{v}$ is :
- (a) 3
 - (b) $\vec{0}$
 - (c) $3\vec{v}$
 - (d) 1
9. If $f(t) = |t| \vec{i}$ then the value of $f'(0)$ is :
- (a) \vec{i}
 - (b) 0
 - (c) does not exist
 - (d) None of the above

10. Any vector point function \vec{F} is irrotational if :

- (a) $\nabla \times \vec{F} = 0$
- (b) $\nabla \cdot \vec{F} = 0$
- (c) $\nabla \cdot (\nabla F) = 0$
- (d) $\nabla F = 0$

Section—B

(Short Answer Type Questions)

Note : Attempt any *four* questions. Each question carries 5 marks. 4×5=20

1. Prove that necessary condition that $\vec{a}(t)$ is a vector of constant magnitude is $\vec{a} \cdot \frac{d\vec{a}}{dt} = 0$.

2. Define cross product of two vectors and find $\text{grad } r^2$.

P. T. O.

3. Find $\text{div} (\text{curl } \vec{F})$, where $\vec{F} = x^2y \vec{i} + xy \vec{j} + 2yz \vec{k}$.

4. Write a note on various properties of scalar product of two vectors.

5. If $\vec{F} = xy^2\hat{i} + 2x^2yz\hat{j} - 3yz^2\hat{k}$, then find $\text{div } \vec{F}$ and at $(1, -1, 1)$.

6. Prove that $\text{curl grad } r^m = \nabla \times \nabla r^m = \vec{0}$.

Section—C

(Long Answer Type Questions)

Note : Attempt any *three* questions. Each question carries 10 marks. 3×10=30

1. Show that :

$$\nabla^2 f(r) = f''(r) + \frac{2}{r} f'(r)$$

2. Find the unit vector normal to the $\phi = x^2 + y^2 + z^2$ at $(1, -1, 2)$.

3. Find the directional derivative of $f = x^2 + y^2 + z^2$ at $(1, 2, 3)$.

4. If \vec{a} is a constant vector, show that :

$$\text{curl} (\vec{r} \times \vec{a}) = -2 \vec{a}$$

5. A particle moves along a curve $x = e^{-t}$, $y = 2 \cos 3t$, $z = 2 \sin 3t$, where t is time, then find magnitude of velocity and acceleration at $t = 0$.

<https://www.dhsgsu.com>

Whatsapp @ 9300930012

Send your old paper & get 10/-

अपने पुराने पेपर्स भेजे और 10 रुपये पायें,

Paytm or Google Pay से