

B.A./B.Sc. (Part-III) Examination - 2011

MATHEMATICS (THIRD PAPER)

(Vector Analysis and Geometry)

Note : Attempt questions from all sections.

Section - A

(Short Answer Type Questions)

Note : Attempt any seven questions. Each question has 2 marks (for B.A. Students), or 3 marks (for B.Sc. Students).

1. Prove that the vectors $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$

$\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{c} = 3\hat{i} - 4\hat{j} + 5\hat{k}$ are coplaner.

2. For any four vectors $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ prove the $(\vec{a} \times \vec{b}) \times (\vec{c} \times \vec{d}) = [\vec{a} \vec{b} \vec{c}] \vec{d} - [\vec{a} \vec{b} \vec{c} \vec{d}]$

3. If $\vec{a}', \vec{b}', \vec{c}'$ are reciprocal vectors of $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ respectively, then prove that $\vec{a} \times \vec{a}' + \vec{b} \times \vec{b}' + \vec{c} \times \vec{c}' = 0$.

4. If \hat{r} be a unit vector in the direction of \vec{r} , then show that

$$\frac{\hat{r} \times d\hat{r}}{r^2} = \vec{r} \times d\vec{r}$$

5. If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ s, show that $\nabla r^n = nr^{n-2}\vec{r}$; where r is magnitude of \vec{r} .

6. Find the centre of the conic.

$$x^2 - 3xy + y^2 + 10x - 10y = 0$$

7. Show the condition that the line $\frac{1}{r} = A \cos \theta + B \sin \theta$ may touch the conic

$$\frac{1}{r} = 1 + e \cos \theta \text{ is } (A - e)^2 + B^2 = 1$$

8. Show that the four point $(0, -1, 0), (2, 1, -1), (1, 1, 1)$ and $(3, 3, 0)$ are coplaner.

9. Prove that the lines $x = 3y + 4, z = 4y + 5$ and $x + 3y + 11, z = 2y + 6$ are perpendicular.

10. Show that intersection of two spheres is a circle.

Section-B

(Long Answer Type Questions)

Note : Attempt any two questions. Each questions has 10 marks (for B.A. students) or 14.5 marks (for B.Sc. Students).

1. Prove that :

$$\text{Curl } \frac{\vec{a} \times \vec{r}}{r^3} = -\frac{\vec{a}}{r^3} + \frac{3\vec{r}}{r^5} (\vec{a}, \vec{r})$$

Where \vec{a} is a constant vector ?

2. State and prove Gauss divergence theorem.
3. Trace the parabola

$$16x^2 - 24xy + 9y^2 + 77x - 64y + 95 = 0$$

and find the co-ordinates of its vertex and focus.

4. Find the condition that the general homogeneous equation of second degree in x, y, z represents a pair of planes.

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