October 2025
B.A./B.Sc.
Third Semester
MULTI-DISCIPLINARY COURSE – 3
MATHEMATICS
Course Code: MAO 3.11
(Vector Algebra)

Total Mark: 50 *Pass Mark: 20*
Time: 2 hours

I. Answer the following questions.

UNIT–I

1. (a) Find a vector in the direction of $5\hat{i}-\hat{j}+2\hat{k}$ which has a magnitude of 8 units. 4

   (b) A force of $\vec{F}=4\hat{i}-6\hat{j}+\hat{k}$ newton is applied to a point that moves a distance of 15 meters in the direction of vector $\hat{i}+\hat{j}+\hat{k}$. How much work is done? 5

   (c) Find the vector projection of $\vec{B}=6\hat{i}+3\hat{j}+2\hat{k}$ onto $\vec{A}=\hat{i}-2\hat{j}-2\hat{k}$. 3

UNIT–II

2. (a) Find the area of the parallelogram with vertices $A(1,2,3)$, $B(1,3,6)$, $C(3,8,6)$, $D(3,7,3)$. 5

   (b) A wrench 30 cm long lies along the positive y-axis and grips a bolt at the origin. A force is applied in the direction of the vector $\hat{j}-4\hat{k}$ at the end of the wrench. Find the magnitude of the force needed to supply 100 Nm of torque to the bolt. 5

   (c) Prove that $\left(\vec{a}-\vec{b}\right)\times\left(\vec{a}+\vec{b}\right)=2\left(\vec{a}\times\vec{b}\right)$. 2

UNIT–III

3. (a) Show that the lines L_1 and L_2 intersect and find their points of intersection: 4

$L_1 : x = 2 + t,\ y = 2 + 3t,\ z = 3 + t$

$L_2 : x = 2 + t,\ y = 3 + 4t,\ z = 4 + 2t$

(b) Find the equation of the plane passing through the point $(3, -1, 7)$ and perpendicular to the vector $\vec{n} = 4\hat{i} + 2\hat{j} - 5\hat{k}$. 3

(c) Find the distance D between a point $P_0(x_0, y_0, z_0)$ and the plane $ax + by + cz + d = 0$. 5

II. Answer <u>any two</u> *of the following questions.*

4. (a) Using vectors, show that the diagonals of a rhombus are at right angles. 4

(b) Find a unit vector that is parallel to the vector $\hat{i} + 3\hat{j} - 4\hat{k}$. 3

5. (a) Show that the vector $\vec{a} \times \vec{b}$ is orthogonal to both $\vec{a}$ and $\vec{b}$. 4

(b) Prove that $\vec{a} \times (\vec{b} \times \vec{c}) + \vec{b} \times (\vec{c} \times \vec{a}) + \vec{c} \times (\vec{a} \times \vec{b}) = 0$. 3

6. (a) Find the vector equation of the line in 3-space that passes through the points $P_1(2, 4, -1)$ and $P_2(5, 0, 7)$. 4

(b) Find the direction cosines of the joins of the pair of points $(6, 3, 2)$ and $(5, 1, 4)$. 3
