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- (c) Sketch the graphs of the hyperbola $\frac{x^2}{4} - \frac{y^2}{9} = 1$ showing their vertices, foci and asymptotes.

3. (a) (i) Find the orthogonal projection of $\vec{v} = 3\mathbf{i} + \mathbf{j} + 2\mathbf{k}$ on $\vec{b} = 2\mathbf{i} + \mathbf{k}$ and then find the vector component of $\vec{v}$ orthogonal to $\vec{b}$.

- (ii) Find the two unit vectors that are orthogonal to both $\vec{u} = -7\mathbf{i} + 3\mathbf{j} + \mathbf{k}$ and $\vec{v} = 2\mathbf{i} + 4\mathbf{k}$.

- (b) (i) Use scalar triple product to determine whether the vectors $\vec{u}$, $\vec{v}$ and $\vec{w}$ lie in the same plane, where $\vec{u} = (4, -8, 1)$, $\vec{v} = (2, 1, -2)$ and $\vec{w} = (3, -4, 12)$.

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- (ii) Find the acute angle of intersection between the two planes

$$2x - 4y + 4z = 6 \text{ and } 6x + 2y - 3z = 4.$$

- (c) Find the magnitude and the equations of the line of shortest distance between the two lines

$$\frac{x-3}{2} = \frac{y+15}{-7} = \frac{z-9}{5} \text{ and } \frac{x+1}{2} = \frac{y-1}{1} = \frac{z-9}{-3}$$

4. (a) (i) Find parametric equations of the line L passing through the points P(5, -2, 1) and Q(2, 4, 2). Where does the line intersect the xy-plane?

- (ii) Find the distance D between the point (1, -4, -3) and the plane $2x - 3y + 6z + 1 = 0$.

(b) Find the equation of the plane passing through the points $P(2, 1, 4)$, $Q(1, 0, -3)$ and that is perpendicular to the plane $4x + y + 3z = 2$.

(c) Find the direction cosines of the line which is perpendicular to the lines with direction cosines proportional to $(1, -2, -2)$ and $(0, 2, 1)$.

5. (a) A plane passes through a fixed point (a, b, c) and cuts the axes in A, B, C . Show that the locus of the centre of the sphere $OABC$ is

$$\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = 2.$$

(b) Find two tangent planes to the sphere $x^2 + y^2 + z^2 - 4x + 2y - 6z + 5 = 0$, which are parallel to the plane $2x + 2y = z$.

(ii) Decide whether the equation $x^2 + 4xy + 4y^2 + 6x + 12y + 9 = 0$ represents an ellipse, a parabola, or a hyperbola.

(c) The coordinate axes are to be rotated through an angle α to produce an equation for the curve $3x^2 + 2\sqrt{3}xy + y^2 - 8x + 8\sqrt{3}y = 0$ that has no cross product term. Find α and the new equation. Identify the curve and plot the same.

2. (a) Find the equation of parabola that is symmetric about the y -axis, has its vertex at the origin and passes through the point $(5, 2)$.

(b) Find the equation for ellipse with the foci $(0, \pm 2)$ and major axis with end points $(0, \pm 4)$.

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UNIT - I

1. (a) The ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ is shifted 4 units to the right and 3 unit up to generate the new ellipse:

(i) Find the equation of new ellipse.

(ii) Find new ellipse's vertices, foci and center.

(iii) Plot the new vertices, foci, center and sketch the new ellipse.

- (b) (i) Find cartesian equation for the hyperbola centered at the origin that has a focus at (3,0) and the line $x = 1$ as the corresponding directrix.

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- (c) Find the equation of the sphere described on the join of A(2, -3, 4), B(-5, 6, -7) as diameter.

6. (a) Prove that the following cones are reciprocal

$$ayz + bzx + cxy = 0, \sqrt{ax} + \sqrt{by} + \sqrt{cz} = 0.$$

- (b) (i) Derive the general equation of the right circular cone with its vertex at (α, β, γ) , its

axis the line $\frac{x-\alpha}{l} = \frac{y-\beta}{m} = \frac{z-\gamma}{n}$, and its semi-verticle angel θ .

- (ii) Find the equation of the right circular cone which contain the three coordinate axes as generators.

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- (c) Find the equation of a right circular cylinder of radius 2 whose axis passes through (1,2,3) and has direction cosines proportional to (2,-3,6).

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6080

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Unique Paper Code : 2354001201

Name of the Paper : Analytic Geometry

Name of the Course : **COMMON PROG GROUP-GE**

Semester : II

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt all question by selecting **two** parts from each Question.
3. Part of the questions to be attempted together.
4. Each question carry equal marks.
5. Use of Calculator not allowed.

Note:-

All field as mentioned in the Performa are essential.