Ans-2 Given

$y = mx + h$ & $P(x, y)$

i) perform translation & Rotation to move the given line on x-axis

Translation $T = T(0, -h)$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -h \\ 0 & 0 & 1 \end{bmatrix}$$

Rotation $R = R(-\theta)$

$$= \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Now, We've got the given line $y = mx + h$ on the x-axis.
Now, we apply reflection(s)

ii) Reflecting.

$$S = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

3) inverse of step(1)

$$T^{-1} = T(0, h)$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & h \\ 0 & 0 & 1 \end{bmatrix}$$

$$R^{-1}(-\theta) = (R(\theta)) = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

4) concating step (1), (2) & (3)

$$(T^{-1}(R^{-1}(S(R(T))))) = M = \begin{bmatrix} \cos 2\theta & \sin 2\theta & -b\sin 2\theta \\ \sin 2\theta & -\cos 2\theta & b\cos\theta \\ 0 & 0 & 1 \end{bmatrix}$$

Ques-3 Given two 2D-Points.

$P_1 = (x_1, y_1)$ $P_2 = (x_2, y_2)$

Let V_1 be the vector

$$V_1 = P_2 - P_1$$

a) the parametric line expression in vector form:

$$\begin{aligned} P(\alpha) &= P_1 + \alpha V_1 \\ &= P_1 + \alpha (P_2 - P_1) \\ &= \alpha P_2 + P_1 (1 - \alpha) \end{aligned}$$

b) the parametric line expression in individual coordinates:

$$x(\alpha) = \alpha x_2 + x_1 (1 - \alpha)$$
$$y(\alpha) = \alpha y_2 + y_1 (1 - \alpha)$$

Ques - 4

Let be three 3D Vertex

$V_1 = (x_1, y_1, z_1)$

$V2 = (x_2, y_2, z_2)$

$V3 = (x_3, y_3, z3)$

the Value

if a area of triangle is equal to "zero", then given three vertices are Collinear.

Area of triangle $= \frac{1}{2} \| \vec{A} \times \vec{B} \|$

$A = V_2 - V_1 = [(x_2 - x_1), (y_2 - y_1), (z_2 - z_1)]$

$B = V_3 - V_1 = [(x_3 - x_1), (y_3 - y_1), (z_3 - z_1)]$

$$\vec{A} \times \vec{B} = \begin{vmatrix} i & j & k \\ (x_2 - x_1) & (y_2 - y_1) & (z_2 - z_1) \\ (x_3 - x_1) & (y_3 - y_1) & (z_3 - z_1) \end{vmatrix}$$

$$(A \times B) = \underbrace{[(y_2 - y_1)(z_3 - z_1) - (y_3 - y_1)(z_2 - z_1)]}_{(A \times B)x} - \underbrace{[(x_2 - x_1)(z_3 - z_1) - (x_3 - x_1)(z_2 - z_1)]}_{(A \times B)y} + \underbrace{[(x_2 - x_1)(y_3 - y_1) - (x_3 - x_1)(y_2 - y_1)]}_{(A \times B)z}$$

Area of triangle $= \frac{1}{2} \sqrt{(A \times B)_x^2 + (A \times B)_y^2 + (A \times B)_z^2} = 0$