

SECOND MID TERM EXAMINATION, SEM. II, 2025
DEPT. MATH., COLLEGE OF SCIENCE
KING SAUD UNIVERSITY
MATH: 107 FULL MARK: 25 TIME: 90 MIN.

Q1. [2+2+2=6]

- (a) A constant force $\mathbf{F} = \langle 5, -3, 1 \rangle$ moves a body from point $P(1, 1, 1)$ to point $Q(9, 4, 7)$ along a straight line. Find the work done.
- (b) Consider the vectors $\mathbf{a} = \langle x, 0, 0 \rangle$, $\mathbf{b} = \langle 0, y, 0 \rangle$ and $\mathbf{c} = \langle 0, 0, z \rangle$ with $\mathbf{a} + 2\mathbf{b} + 3\mathbf{c} = \langle 1, 2, 3 \rangle$. Find values of x , y and z .
- (c) Show that the vectors \mathbf{a} , \mathbf{b} and \mathbf{c} are mutually orthogonal.

Q2. [3+2+2+2=9]

- (a) Find an equation of the plane through the points $P(1, -2, 0)$, $Q(2, 0, 3)$ and $R(0, -2, -3)$.
- (b) Let \wp_1 and \wp_2 be two planes defined by their equations:

$$\wp_1 : x - 2y + 2z = 3$$

$$\wp_2 : 2x + y - z = 1$$

- (i) Prove that \wp_1 and \wp_2 are not parallel.
- (ii) Find parametric equations of the line of intersection of the planes \wp_1 and \wp_2 .
- (iii) Find the distance between the point $A(1, -1, 3)$ and the plane \wp_1 .

Q3. [3+4+3=10]

- (a) Let $\mathbf{r}(t) = \ln(1-t)\mathbf{i} + \sin t\mathbf{j} + t^2\mathbf{k}$. Find the domain of \mathbf{r} . Also, find $\mathbf{r}'(t)$ and $\mathbf{r}''(t)$.
- (b) If $\mathbf{r}(t) = e^t(\cos t\mathbf{i} + \sin t\mathbf{j} + \mathbf{k})$ is the position vector of a moving point P , find its velocity, acceleration, and speed at $t = \frac{\pi}{2}$.
- (c) Sketch the graph of the surface $9(x^2 + z^2) + 4y^2 = 36$ in an xyz coordinate system, describe the traces on the coordinate system, and identify the surface.