

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

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**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  $\varphi_1$  and  $\varphi_2$  be two planes defined by their equations:

$$\varphi_1 : x - 2y + 2z = 3$$

$$\varphi_2 : 2x + y - z = 1$$

- (i) Prove that  $\varphi_1$  and  $\varphi_2$  are not parallel.
- (ii) Find parametric equations of the line of intersection of the planes  $\varphi_1$  and  $\varphi_2$ .
- (iii) Find the distance between the point  $A(1, -1, 3)$  and the plane  $\varphi_1$ .

**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.