

**King Fahd University of Petroleum and Minerals**  
 Department of Mathematical Sciences  
 MATH 201, Sections 8 and 11(041)  
 Quiz -4

Time: 15 Minutes

Marks: 9

Instructor : Dr. Abdul Rahim Khan

**Version (a)**

Suppose a surface  $S$  has equation:

$$z = 6 - 4x^2 - 3y^2$$

Find points(s) on  $S$  at which the tangent plane

(i) is parallel to the plane  $3x - y + 2z = 17$

(ii) is perpendicular to the line

$$x = 2 - 5t, \quad y = 7 + t, \quad z = 3 - 2t.$$

**Version (b)**

Find the maximum and minimum values of

$$f(x, y) = xy - x^3y^3 \text{ over the region}$$

$$R = \{ (x, y) : 0 \leq x \leq 1, \quad 0 \leq y \leq 1 \}.$$

**Version (c)**

Find a unit vector in the direction in which  $f(x, y, z) = 4e^{xy} \cos z$  decreases most rapidly at  $P \left( 1, 0, \frac{\pi}{4} \right)$ . Also find the rate of change of  $f$  at  $P$  in that direction.

**Version (d)**

(i) Let  $f(x, y) = \frac{y}{x+y}$ . Find a unit vector  $\vec{U}$  for which  $D_{\vec{U}}f(2, 3) = 0$ .

(ii) Locate local extrema and saddle points of  $f(x, y) = x^2 - 4xy + y^3 + 4y$