MIDTERM 3

1. Find the equation of the tangent plane to the surface \( x^2 - y^2 + z^2 + 1 = 0 \) at the point \((1, 3, \sqrt{7})\).

2. Find the maximum and minimum values of \( f(x, y) = x^2 - y^2 \) over \( D = \{(x, y) : x^2 + y^2 \leq 1\} \).

3. What are the dimensions of the rectangular box, open at the top, which has maximum volume when the surface area is 48?

4. Evaluate \( \iint_S (x + y) \, dA \), where \( S \) is the triangular region with vertices \((0, 0), (0, 4), \) and \((1, 4)\).

5. Find the area of the region inside the circle \((x - 2)^2 + y^2 = 4\) and outside the circle \(x^2 + y^2 = 4\) (Hint: change to polar coordinates).

Each problem is worth 20 points.