1. **(25 points)** Suppose $z = f(x, y)$ is a differentiable function, where

\[ x = s^2 + t^2 \quad \text{and} \quad y = s^2 - t^2. \]

Show that

\[ \frac{z_s}{s} + \frac{z_t}{t} = 4z_x. \]

**Solution:**
2. **(25 points)** Find the extreme values of the function

\[ f(x, y) = 2x^2 + 3y^2 - 4x - 5 \]

on the region \( D = \{ (x, y) : x^2 + y^2 \leq 16 \} \).

Solution:
3. **(25 points)** Find the extreme values of the function

\[ f(x, y) = \arctan(x^2 + y^2) \]

on the set \( S = \{(x, y) : 0 \leq x, y \leq 1\} \).

**Solution:**
4. **(25 points)** Compute the double integral

\[ \int_{R} \int (\sin(2\pi x) + y) \, dA, \]

where \( R = [0, 1] \times [-1, 1] \).

Solution: