1. Let \( f(x, y, z) = z + \sin \frac{z}{y} \ln(x^2 - xy + y^2) \).

   (a) Find the partial derivatives \( f_x, f_y \) and \( f_z \).

   (b) Find the linear approximation of \( f \) nearby the point \( (1, 1, \pi/2) \) and estimate value of \( f(1.01, 1.02, \pi/2 + 0.03) \).
2. Let \( z = f(x, y) \) be the function implicitly defined by the equation \( e^z + z + xy = 3 \).

(a) Find the partial derivatives \( \frac{\partial z}{\partial x} \) and \( \frac{\partial z}{\partial y} \) [Hint: use Implicit Function Theorem].

(b) First verify that \( z = 0 \) when \( x = 2 \) and \( y = 1 \). Then find the linear approximation of \( z = f(x, y) \) nearby the point \((2, 1)\).
3. Let $D$ be a closed bounded set in $xOy$ plane defined by $\{(x, y) \in \mathbb{R}^2 \mid x^2 - 4 \leq y \leq 4 - x^2 \}$ and $f(x, y) = x^2 + y^2 - 6y + 4$ Find the maximum and minimum value of $f$ on $D$. 
4. Let $R$ be the rectangular region $D = [0, 1] \times [0, 2] = \{(x, y) \in \mathbb{R}^2 | 0 \leq x \leq 1, 0 \leq y \leq 2\}$. Estimate the integral $\int \int_R \ln(x^2 + y^2 + 1) \, dx \, dy$ using double Riemann sum. Divide $R$ into 8 0.5 by 0.5 squares and choose the sample point to be the upper right corner of each square.