1. Compute the contour integral \( \int_C \frac{z^2 + 1}{(z-2)} \, dz \), where \( C \) is the given by \( \{ z \in \mathbb{C} \mid |z - 2| = 1 \} \), positively oriented.
2. Is the function $f(z) = e^{z(x^2 - iy^2)}$ analytic at $z = 0$? Here $z = x + iy$. Explain in details.
3. Let \( f(x, y) = x^3 - 3xy^2 \). Prove \( f(x, y) \) is harmonic. Find a harmonic conjugate \( g(x, y) \) of \( f(x, y) \).
4. Let $f(z) = z^2 - 3z + 2$. Find the maximum of $|f(z)|$ when $|z| \leq 1$. 