
2. If \( \gamma_1 \) and \( \gamma_2 \) are two simple oriented \( C^1 \) curves with the same initial point \((x_0, y_0)\) and same terminal point \((x_1, y_1)\), show that

\[
\int_{\gamma_1} (2xy + \cos 2y) \, dx + (x^2 - 2x \sin 2y) \, dy = \int_{\gamma_2} (2xy + \cos 2y) \, dx + (x^2 - 2x \sin 2y) \, dy.
\]

3. If \( f(x, y) \) is harmonic in \( \mathbb{R}^2 \), i.e., \( f \) is of class \( C^2 \) and satisfies Laplace’s equation

\[
\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} = 0,
\]

then show that \( \int_C \frac{\partial f}{\partial y} \, dx - \frac{\partial f}{\partial x} \, dy = 0 \) for any simple closed contour \( C \).