1. Solve the initial value problems
   (10%) (a) \( y'' + 4y' + 4y = 0 \), \( y(0) = 1 \), \( y'(0) = 1 \).
   (10%) (b) \( y''' - 4y' = 10 \cos x + 5 \sin x \), \( y(0) = 3 \), \( y'(0) = -2 \), \( y''(0) = -1 \).

2. (15%) Find the inverse Laplace transform of the function \( \ln \left(1 + \frac{w^2}{s^2}\right) \).

3. (5%) Find all vectors \( \mathbf{v} = [v_1, v_2, v_3]^T \) orthogonal to \( \mathbf{a} = [1, 2, 0]^T \).

4. (10%) Using gradients, find a unit normal vector \( \mathbf{n} \) of the cone of revolution \( z^2 = 4(x^2 + y^2) \) at the point \( P: (1, 0, 2) \).

5. (15%) Find the Fourier transform of \( e^{-ax^2} \), where \( a > 0 \).

6. (10%) Represent \( (2.6 + 0.38i)^2 \) in polar form, with the principal argument.

7. (10%) If \( f(z) = \sum_{n=0}^{\infty} a_n z^n \) is even (i.e., \( f(-z) = f(z) \)), show that \( a_n = 0 \) for odd \( n \).

8. (15%) Find a basis of eigenvectors and diagonalize for the matrix \( \begin{bmatrix} 2 & 1 \\ 2 & 1 \end{bmatrix} \).