總分 100 分，請依序作答，並詳列計算過程。

1. 設解名詞：何謂 Partial differential equation?
   Linear differential equation?
   Solution of differential equation? (12%)

2. Find the solution of DE: \( y'' - 3y' + 2y = \cos(e^x) \) (20%)

3. Solve the initial value problem: \( y'' - 4y' + 12y = 45(t-2); y(0) = 0, y'(0) = 1 \) (16%)

4. Evaluate the line integral with respect to arc length: \( \int_C yz \; ds \)
   with \( C \) the parabola: \( z = y^2, x = 1 \) for \( 0 \leq y \leq 2 \). (12%)

5. For systems of linear differential equations, \( \mathbf{X}' = A \mathbf{X}, A = \begin{bmatrix} 3 & 0 & -2 \\ 0 & 2 & 0 \\ -2 & 0 & 0 \end{bmatrix} \)
   Please find out if \( A \) is diagonalizable (show clearly the processes),
   also find the fundamental matrix, and the general solution. (16%)

6. For a thin, homogeneous bar of length \( L \), given the initial temperature throughout the
   bar is \( f(x) \), the temperature at both ends at all time are zero,
   i.e. \( \frac{\partial \theta}{\partial t} = \alpha \frac{\partial^2 \theta}{\partial x^2}, 0 < x < L, t > 0, \theta(0, t) = \theta(L, t) = 0, \) and \( \theta(x, 0) = f(x) \)
   Please determine the temperature distribution \( \theta(x, t) \) on the bar. (16%)

7. Please find all \( z \) such that \( e^z - 2 + i \) (8%)