1. Solve \[ \frac{d^2 x}{dt^2} + 10x - 4y = 0 \]
\[ -4x + \frac{d^3 y}{dt^3} + 4y = 0 \]
subject to \( x(0) = 0, \frac{dx(0)}{dt} = 1, y(0) = 0, \frac{dy(0)}{dt} = -1. \)

2. Solve the nonhomogeneous equation \[ x^2y'' - 3xy' + 3y = 2x^4e^x. \]

3. Find the solution \( u(x,t) \) of the problem \( (20\%) \)
   - Differential equation \( u_t = ku_{xx}, \quad 0 < x < L, \quad t > 0 \)
   - Boundary conditions \( u_x(0,t) = 0, \quad u_x(L,t) = 0, \quad t > 0 \)
   - Initial condition \( u(x,0) = f(x), \quad 0 < x < L. \)

4. Find the eigenvalues and eigenvectors of \( (15\%) \)
   \[ A = \begin{bmatrix} 9 & 1 & 1 \\ 1 & 9 & 1 \\ 1 & 1 & 9 \end{bmatrix}. \]

5. Evaluate \( \iint_R xy \, dA \) over the region \( R \) as shown. \( (15\%) \)

   ![Fig. 5](image)

6. The period excitation shown is applied to the base of a punch press. Determine the resulting motion. \( (20\%) \)

   ![Fig. 6](image)