1. Find orthogonal trajectories of the following function
\[ y = c/x^2. \]

2. Solve the following initial value problems.
\[ y'' + 2y' + 10y = 17 \sin x - 37 \sin 3x, \quad y(0) = 6.6, \quad y'(0) = -2.2 \]

3. Let
\[
A = \begin{bmatrix} 6 & -2 & -2 \\ 10 & -3 & 1 \\ -10 & 5 & 1 \end{bmatrix}, \quad B = \begin{bmatrix} 9 & 4 & -4 \\ 4 & 7 & 0 \\ -4 & 0 & 11 \end{bmatrix}, \quad a = \begin{bmatrix} 5 \\ 2 \end{bmatrix},
\]

please calculate \( AB, \ A^\top A, \ (A^\top)^2, \ a^\top Aa, \ a^\top (A + A^\top) a \)

4. Find a basis of eigenvectors and diagonalize the following matrix
\[
\begin{bmatrix} -1 & -1 & 0 \\ -1 & -1 & 0 \\ 0 & 0 & 2 \end{bmatrix}
\]

5. Find the Fourier cosine series as well as Fourier sine series of the following function.
\[ f(x) = \sin x, \quad (0 < x < \pi) \]

6. Find eigenvalues and eigenfunctions of the following problem.
\[ y'' + \lambda y = 0 \quad y(0) = y(\pi), \quad y'(0) = y'(\pi) \]

7. Using Laplace transform, solve the following integral equation
\[ y(t) + \int_0^t y(\tau) d\tau = 2 \]