1. Use Laplace transform to solve the initial value problem.

\[ x''(t) + 5x'(t) + 4x(t) = f(t), \quad x(0) = x'(0) = 0, \]

\[ f(t) = \begin{cases} 
 1 & \text{if } 0 \leq t < 2 \\
 0 & \text{if } t \geq 2 
\end{cases} \]

2. Use Laplace transform to solve the initial value problem

\[ x'' + 6x' + 18x = \cos 2t; \quad x(0) = 1, \quad x'(0) = -1 \]

3. Find the general solution of the system

\[
\begin{align*}
  x_1' &= 5x_1 + 5x_2 + 2x_3, \\
  x_2' &= -6x_1 - 6x_2 - 5x_3, \\
  x_3' &= 6x_1 + 6x_2 + 5x_3
\end{align*}
\]

4. Find the general solution of the system.

\[ x' = \begin{bmatrix} 1 & -4 \\ 4 & 9 \end{bmatrix} x \]

5. Find the general solution of \( x' = AX \).

\[ A = \begin{bmatrix} 1 & 0 & 0 & 0 \\
 2 & 2 & 0 & 0 \\
 0 & 3 & 3 & 0 \\
 0 & 0 & 4 & 4 \end{bmatrix} \]

6. Solve the initial value problem without using Laplace transform.

\[ y'' + 2y' + 2y = \sin 3x; \quad y(0) = 2, \quad y'(0) = 0 \]

7. Solve the initial value problem without using Laplace transform.

\[ 2y^{(3)} - 3y'' - 2y' = 0; \quad y(0) = 1, \quad y'(0) = -1, \quad y''(0) = 3 \]
8. Find a basis for the solution space of the following homogeneous linear system.

\[x_1 + 3x_2 + 4x_3 = 0\]
\[3x_1 + 8x_2 + 7x_3 = 0\]

9. Show that every invertible matrix is a product of elementary matrices.

10. Find the general solution of the differential equation. Primes denote derivatives with respect to \(x\).

\[(x^2 - 1)y' + (x - 1)y = 1\]