

1. Find the Laplace transform of the given function.

$$(a) f(t) = \begin{cases} \frac{t}{2}, & 0 \leq t < 6 \\ 3, & t \geq 6 \end{cases}$$

$$(b) f(t) = (t^2 - 2t + 2)u_1(t)$$

$$(c) f(t) = \int_0^t (t - \tau)^2 \cos 2\tau d\tau$$

$$(d) f(t) = t \cos 3t$$

$$(e) f(t) = e^t \delta(t - 1)$$

2. Find the inverse Laplace transform of the given function.

$$(a) F(s) = \frac{2s + 6}{s^2 - 4s + 8}$$

$$(b) F(s) = \frac{e^{-2s}}{s^2 + s - 2}$$

3. Solve the initial value problem using the Laplace transform:

$$(a) \quad y'' + 4y = \begin{cases} t, & 0 \leq t < 1 \\ 1, & t \geq 1 \end{cases}, \quad y(0) = y'(0) = 0$$

$$(b) \quad y'' + 2y' + 3y = \delta(t - 3\pi), \quad y(0) = y'(0) = 0$$

(c) $y'' + 4y' + 4y = g(t)$, $y(0) = 2$, $y'(0) = -3$

4. Find A^{-1} if $A = \begin{pmatrix} 1+i & -1+2i \\ 3+2i & 2-i \end{pmatrix}$

5. Find BA if $A = \begin{pmatrix} 1+i & -1+2i \\ 3+2i & 2-i \end{pmatrix}$, $B = \begin{pmatrix} i & 3 \\ 2 & -2i \end{pmatrix}$

6. Find the general solution of the system

$$(a) \mathbf{x}' = \begin{pmatrix} 1 & 1 \\ 4 & -2 \end{pmatrix} \mathbf{x}$$

$$(b) \mathbf{x}' = \begin{pmatrix} -3 & -1 \\ 1 & -1 \end{pmatrix} \mathbf{x}$$

$$(c) \mathbf{x}' = \begin{pmatrix} -3 & 2 \\ -1 & -1 \end{pmatrix} \mathbf{x}$$