1. Find the following Laplace Transforms:

a) \( \mathcal{L}\{3e^{2t}\sin 4t\} \)

b) \( \mathcal{L}\{5u_1(t)(t-1) - 2u_2(t)(t+1) + u_4(t)e^{2t-8}\} \)
c) \[ \mathcal{L}\left\{\int_{0}^{t} e^{5(t-\tau)} \sin 4\pi \, d\tau\right\} \]

d) \[ \mathcal{L}\{u_3(t)(t+7)^2\} \]
2. Find the following inverse Laplace Transforms:

a) \( \mathcal{L}^{-1} \left\{ \frac{s}{s^2 + s - 2} \right\} \)

b) \( \mathcal{L}^{-1} \left\{ \frac{se^{-10s} + \pi}{s^2 + 25} \right\} \).
3. Let \( f(t) = \begin{cases} 
0 & , 0 \leq t < 1 \\
2 & , 1 \leq t < 3 \\
(t-3)^2 & , 3 \leq t < 4 \\
0 & , 4 \leq t 
\end{cases} \)

a) Sketch \( f(t) \)

b) Re-write the function \( f(t) \) using step functions
4. Use the definition of the Laplace Transform to find $\mathcal{L}\{te^{at}\}$
5. (a) Use Laplace Transforms to solve $y'' + y = \sin 2t$, $y(0) = 2$, $y'(0) = 1$

(b) Use the Method of Undetermined Coefficients to verify that (a) is correct.
6. Use Laplace Transforms to solve \( y'' + 9y = \delta(t-2), \quad y(0) = -1, \quad y'(0) = 8 \)
7. Use Laplace Transforms to solve \[ y'' + 4y = \sin t - u_{2\pi} (t) \sin(t - 2\pi), \quad y(0) = y'(0) = 0 \]