Q:1 (3 points) Find the Laplace transforms:

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

(b) \( \mathcal{L} \left\{ \int_0^t e^\tau \cos 2(t - \tau) d\tau \right\} \)

Q:2 (4 points) Solve the differential equation \( y'' + 16y = f(t) \) with \( y(0) = 0 \) and \( y'(0) = 1 \)

and \( f(t) = \begin{cases} 
\cos 4t, & 0 \leq t < \pi \\
0, & t > \pi 
\end{cases} \)
Q:3 (4 points) Solve the integral equation \( f(t) + 2 \int_0^t f(\tau) \cos(t - \tau) d\tau = 4e^{-t} + \sin t. \)

Q:4 (4 points) Solve the differential equation \( y'' + 4y' + 13y = \delta(t - \pi) + \delta(t - 3\pi) \)

with \( y(0) = 1 \) and \( y'(0) = 0. \)