HOMEWORK #4
(Not to be turned in)

Problem 1:
For the following circuit $v_{in}(t) = (5 \cos(t) e^{-3t}) u(t)$. Find the zero-state output $v_o(t)$.

Problem 2:
The input, $x(t)$, and output, $y(t)$, of a linear system are related via the differential equation bellow. If the input is $x(t) = 5 \cos(t) e^{-3t} u(t)$, find the output $y(t)$.

\[
\frac{d^2}{dt^2} y(t) + 5 \frac{d}{dt} y(t) + 6 y(t) = \frac{d^2}{dt^2} x(t) + 6 \frac{d}{dt} x(t) + 10 x(t).
\]

Problem 3:
The input, $x(t)$, and output, $y(t)$, of a linear system are related via the differential equation bellow. If the input is $x(t) = 2e^{-2t} u(t) - 2e^{-3t} u(t)$, find the output $y(t)$.

\[
\frac{d^2}{dt^2} y(t) + 2 \frac{d}{dt} y(t) + y(t) = \frac{d^2}{dt^2} x(t) + 3 \frac{d}{dt} x(t) + 2x(t).
\]

Problem 4:
The response of a linear system to the input $v_{in}(t) = e^{-2t} u(t)$ is observed be $v_o(t) = e^{-t} u(t) - e^{-3t} u(t)$. Determine the impulse response, $h(t)$.

Problem 5:
Let $f(t) = t u(t)$. Evaluate the convolution of $f(t)$ with itself.

Problem 6:
Evaluate the convolution of $f(t)$ and $g(t)$ for the following:

a) $f(t) = (\frac{\sin t}{t})^2$
   
   $g(t) = (\frac{\sin \pi t}{\pi t})$

b) $f(t) = 3(\cos 2t + \sin 2t) e^{-2t} u(t)$
   
   $g(t) = (1+2t^2) e^{-2t} u(t)$