ME-221
PROBLEM SET 5

Problem 1

The impulse response of a dynamical system is given by :

$$g_1(t) = \varepsilon(t) - \varepsilon(t-1)$$

a) Sketch $g_1(t)$

b) Derive and sketch the results of the following mathematical expressions.
1. $\varepsilon(t) * \varepsilon(t)$
2. $g_1(t) * \varepsilon(t)$
3. $g_1(t) * g_1(t)$

Note that the symbol $*$ represents convolution operation defined as

$$f_1(t) * f_2(t) = \int_{-\infty}^{\infty} f_1(\tau) f_2(t-\tau) d\tau$$

Problem 2

The impulse response of an LTI system is given by $g(t) = e^{-t}\epsilon(t)$. Utilize the convolution operation to calculate the output if the input to the system is $u(t) = e^{-3t}\varepsilon(t)$.

Problem 3

The impulse response of a mechanical system is shown in Figure 1. Calculate and sketch the output of this system in response to unit step function (i.e. $u(t) = \varepsilon(t)$).

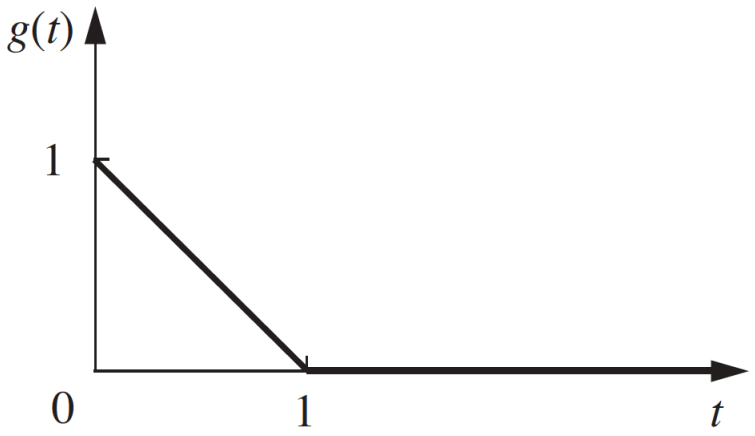

Figure 1: Impulse Response

Problem 4

The unit step response of an LTI system is given by $s(t) = (1 - e^{-4t})\varepsilon(t)$. Find the output of this system as a response to the input given in Figure 2.

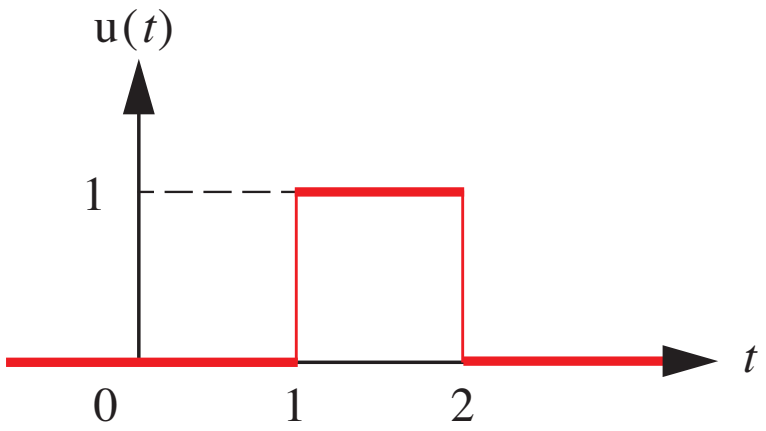

Figure 2: Input signal in the form of a pulse shifted in time (shown in red).