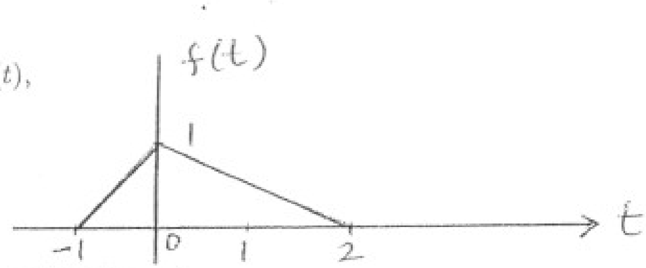
# EE 701 PROBLEMS SET-1

1. Consider the following signal $f(t)$,




(a) Find and sketch (i) $f(-t+1)$ and (ii) $f(2t-1)$

(b) Assume the above signal $f(t)$ is multiplied by a Delta function $\delta(t-1)$. Sketch the resulting function $f(t)\delta(t-1)$.

(c) Evaluate the integral, $\int_{-\infty}^{\infty} f(t)\delta(t-1)\, dt$. (4 pts.)

2. (a) The input/output relationship of a system is given by :

$$y(t) = 2tf(t)f(t-2).$$

Determine whether the system is (i) Causal, (ii) Linear and (iii) Time-Invariant. Justify your answers mathematically.

(b) For the input/output relationship of part-(a), plot the output $y(t)$ if the input signal is, $f(t) = 2u(t-1)$. (4 pts.)

3. An LTIC system is described by the following equation,

$$(D^2 + 8D + 15)y(t) = (D+1)f(t)$$

(a) Find the Characteristic Equation and the Characteristics Roots of this system.

(b) If the Initial conditions are given as, $y(0) = -2$ and $\dot{y}(0) = 2$, find $y_0(t)$, the zero-input component of the response $y(t)$ for $t \geq 0$.

(c) Using the classical method, solve the above Differential equation for the same set of initial conditions in part-b but with the input, $f(t) = u(t)$. (6 pts.)

4. (a) By direct integration, find the Laplace Transform of the signal

$$e^{-3t}\cos(4t)u(t)$$

(b) Verify your results in part-a using the Laplace Transform Table 6.1. (4 pts.)

5. Find the inverse (unilateral) Laplace Transform of the following function:

$$\frac{s^2+2}{s^2-3s-4}$$

(4 pts.)

6. An LTIC system is described by the following equation,

$$(D^2 + 8D + 15)y(t) = (D+2)f(t)$$

(a) Using Laplace Transform method, solve the above Differential equation for initial conditions, $y(0) = -2$ and $\dot{y}(0) = 2$. The input is $f(t) = u(t)$.

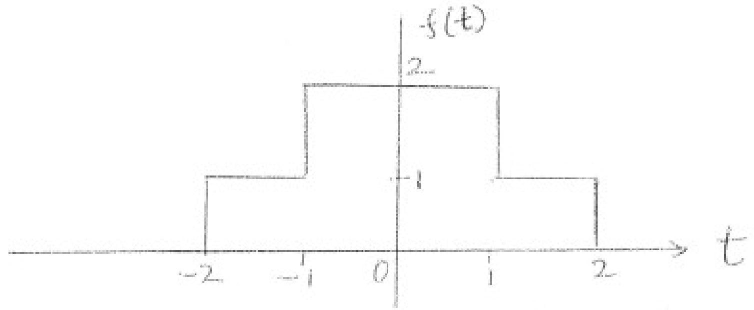
(b) For the problem above, determine the zero-input and zero-state components of the solution. (6 pts.)

7. An LTIC system is described by the following transfer function,

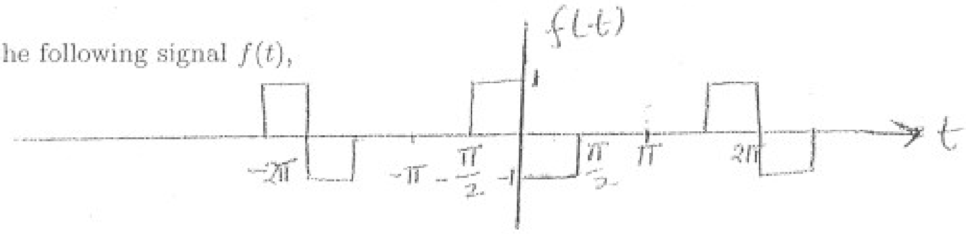
$$H(s) = \frac{s+1}{s^2+5s+6}$$

Find the steady-state response if the input is given by, $10\cos(4t + 45°)$. (4 pts.)

8. Find the Fourier Transform of the following function:




9. Consider the following signal $f(t)$,




(a) Derive the Trigonometric form of the Fourier Series of the above signal.

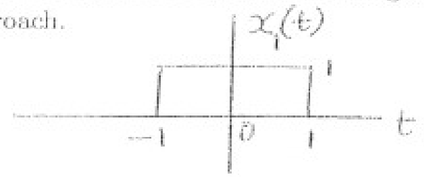
(b) Express the Fourier series found in part-(a) in Compact form. Draw the Magnitude and Phase spectra using the Compact form.

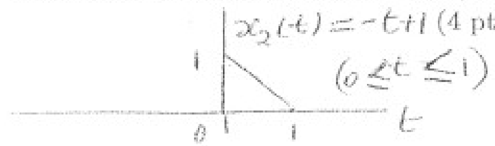
(c) Derive the Exponential form of the Fourier Series of the above signal. Draw the Magnitude and Phase spectra.

(d) Mathematically explain how the spectra drawn in items (b) and (c) are related to each other.

(7 pts.)

10. Perform Convolution of the following two signals. You may use either graphical or analytical approach.




(4 pts.)

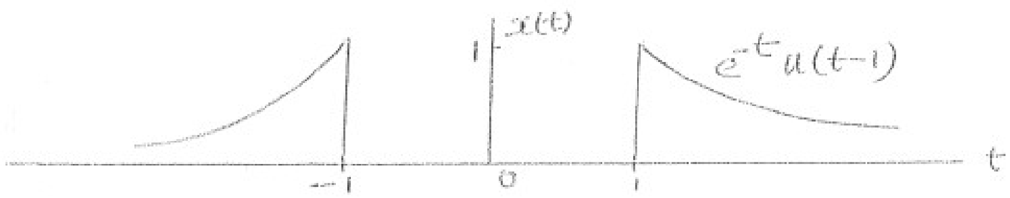
11. A first order LTIVC system is described by the following equation,

$$(D+1)y(t) = 2f(t)$$

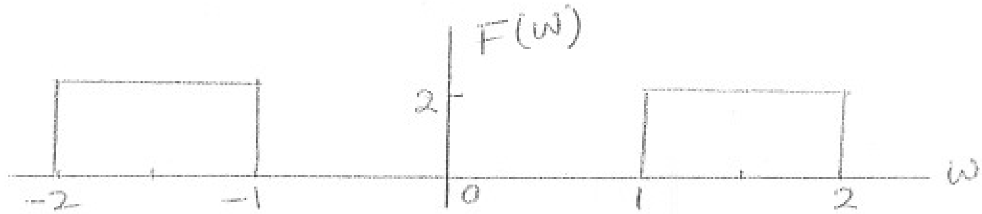
(a) Using Laplace Transform method, solve the above Differential equation for initial conditions, $y(0^-) = 1$. The input is given by, $f(t) = 3e^{-2t}u(t)$.

(b) For the problem above, determine the zero-input and zero-state components. (6 pts.)

12. (a) Find the Fourier Transform of the following signal,




(b) Find the Inverse Fourier Transform of the following signal,




(7 pts.)