BIRZEIT UNIVERSITY

BIRZEIT UNIVERSITY
Faculty of Engineering
Electrical Engineering Department
Signals and Systems - ENEE334
First Exam

Instructors: Mr. A Rimawi **Dec.9, 2012**

Problem 1 (10 pts):

State whether each of the following statements is True or False, justify your answer

a. If a signal $f(t)$ is odd then $-f(-t)$ is an even signal.

b. A time-invariant system must also be linear.

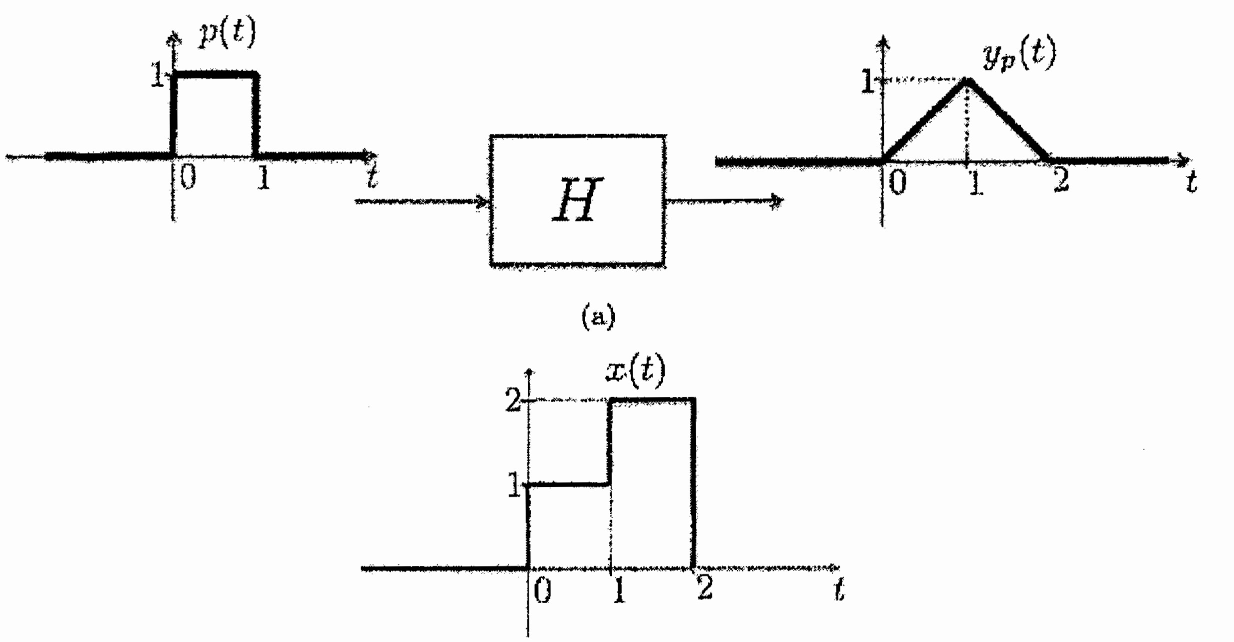
c. A periodic signal $f(t)$ is equal to its Fourier series representation for all $t \in \mathbb{R}$.

d. The signal $x(t) = \cos(\sqrt{2}\,\pi t) + \sin(2\sqrt{2}\,\pi t)$ is periodic.

e. Periodic signals are always finite energy signals.

Problem 2 (20pts):

Let H be a continuous-time Linear-Invariant system (LTI), such that the system's response to a pulse input $p(t) = u(t) - u(t-1)$ is $H\{p(t)\} = y_p(t)$. Both signals are depicted in Figure 1(a).



(a)

(b)

Figure 1

Given only the information above we want to calculate the system's response input $x(t)$ depicted in Figure 1(b). Let's break down the problem into two parts.

a. Note that $x(t)$ can be written as a sum of scaled and time-shifted versions of $p(t)$. In particular

$$x(t) = a\,p(t) + b\,p(t - t_0)$$

Find the adequate values of $a, b\ and\ t_0$

b. Use what you know about the system and the result of part (a) to plot the system's response to input $x(t)$.

Problem 3 (20pts):

Consider the periodic signal $x(t)$ given by the expression

$$x(t) = (2 + 2j)e^{-j3t} - 3je^{-j2t} + 5 + 3j\, e^{j2t} + (2 - 2j)e^{j3t}$$

a. What is the period and fundamental frequency of $x(t)$.

b. Justify that $x(t)$ is a real signal and write the corresponding compact trigonometric Fourier series representation.

c. Sketch both the exponential Fourier spectra and trigonometric Fourier spectra of the signal.

d. What is the power of $x(t)$.

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Second Exam

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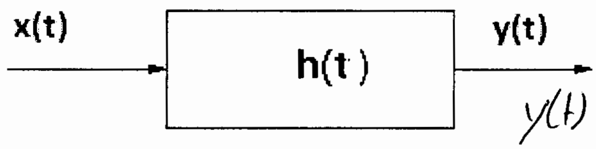
Instructors: Mr. Ashraf Al- Rimawi **Dec.22, 2013**

In all Questions assume the system diagram as shown in figure 1

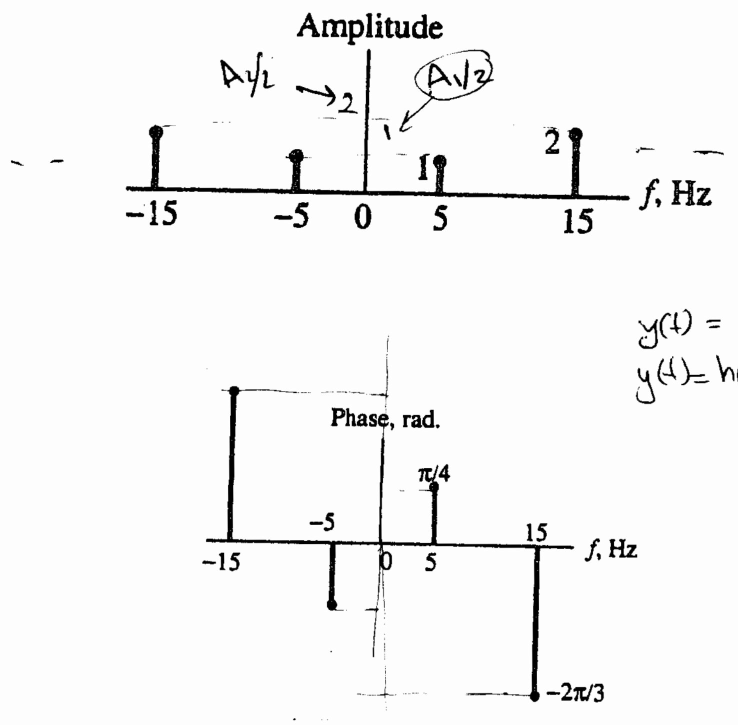


$y(t) = 4\sin(30\pi t - \pi/6)$

Fig1

Problem 1 (30pts):

For the following double-sided amplitude and phase spectrum of the input signal, $x(t)$ is shown in figure 2



$f_1 = 5 \quad T_1 = \frac{1}{5}$

$f_2 = 15 \quad T_2 = \frac{1}{15}$

$y(t) = h(t-\lambda)\int_{-\infty}^{\infty} x(\lambda)\, d\lambda$

$y(t) = h(t-\lambda)\left[\int_0^5 2\cos(\;t+\frac{\pi}{4})\,dt + \int_0^{15} 4\cos(30\pi t - \frac{2\pi}{3})\right.$

Fig 2

a. Find $x(t)$

b. Find $h(t)$, $H(f)$

c. Calculate the average power of the input signal $x(t)$, and output signal $y(t)$

d. Design the LTI system, $h(t)$

$(0, 2)$

slope $= \frac{4}{6} = \frac{2}{3}$

$y - 2 = \frac{2}{3}(x)$

$y = \frac{2}{3}x + 2$

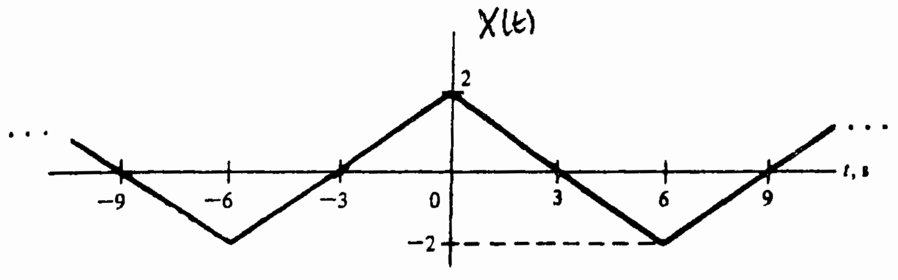
$(-6, -2)$

$y = \frac{2}{3}\left(x + \frac{1}{3}\right)$

Problem 2 (35pts):

Consider the input signal; $x(t)$, and amplitude and phase spectrum of the system, $h(t)$ are shown in figure 3, and figure 4, respectively

$(0, 2)$



$(6, -2)$

slope $= \frac{4}{-6} = -\frac{2}{3}$

$y - 2 = -\frac{2}{3}x$

$y = -\frac{2}{3}x + 2$

Fig3

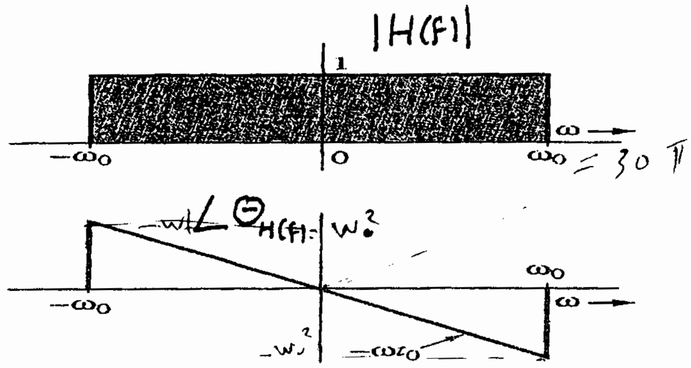


Fig4

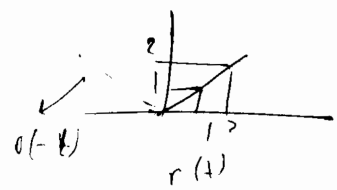
$y(t) = -\omega t$

$-r(t + \omega_0)$

$-\omega t_0 + 0$

$-\omega(t_0 + \ldots$

$-\omega\,\delta(t)$



a. Find $x(t)$, and $X(f)$

b. Plot the input spectrum signal, $X(f)$

c. Find the system response, $h(t)$

d. Find the output signal, $y(t)$, and its spectrum, $Y(f)$

Problem 3 (30pts):

Consider the system response, $h(t)$ is given as

$$h(t) = u(t) + e^{-3t}u(t)$$

$$2\left(\frac{e^{j(10\pi t + \frac{\pi}{4})} + e^{-j(10\pi t + \pi/4)}}{2}\right)$$

a. Find the Laplace Transform of the system response, $h(t)$

b. Find the Region of Convergence ROC

c. Plot the s-plane for the system

d. Design the system

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