Signals and systems
Homework #3 Part 2/2

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Spring 97-98
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Deadline : 14 Ordibehesht, 1398 [23:55]

- Homeworks will not be accepted after the deadline.
- For theoretical problems, gather them in a single ***.pdf** file.
- For the matlab problems, provide both these materials:
  - **codes [*.m files]**
  - a simple **report** that includes all plots and screenshots.
- Notice that the homeworks will be **checked by plagiarism detectors**, avoid any similarities.
- Matlab problems and theoretical problems will be graded seperately (both will be graded out of 100), but their weights may be different and is determined by the course professor.

Question 1 (10 points)

Determine the Fourier transform of the following signals

[a] $e^{-3|t|}\sin\left(2t\right)$

[b] $\frac{d}{dt}\left(2te^{-2t}u\left(t\right)\right)$

[c] $\frac{1}{3 + 2t^2}$

[d] $\sin\left(\pi t\right)\Pi\left(t-\frac{1}{2}\right) = \begin{cases}\sin\left(\pi t\right) & 0 \le t \le 1\\ 0 & otherwise\end{cases}$

[e] $t\cos\left(2\pi f_0 t\right)$

Question 2 (10 points)

Determine the inverse Fourier transform of the following signals

[a] $X(j\omega) = 3\delta(\omega - 3)$

[b] $X\left(j\omega\right) = \begin{cases} \cos(\omega) & |\omega| < \pi \\ 0 & otherwise \end{cases}$

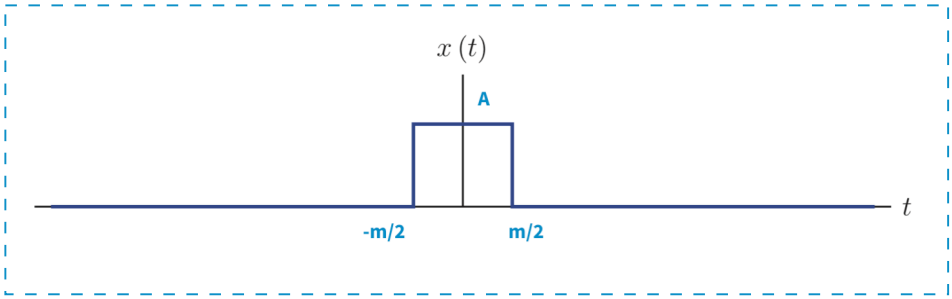
[c] $X\left(j\omega\right) = \pi e^{-|\omega|}$

[d] $1 + \cos\left(6\pi t + \frac{\pi}{8}\right)$

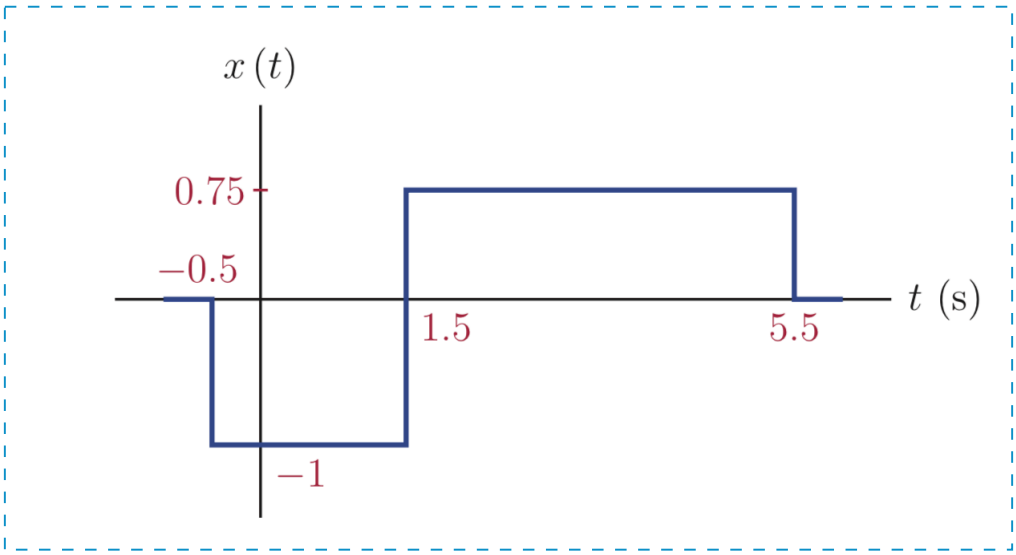
[e] $X\left(j\omega\right) = \frac{5j\omega + 12}{(j\omega)^2 + 5j\omega + 6}$

Question 3 (10 points)

[a] Find the Fourier transform of the “Rectangular pulse signal” using Fourier transform definition

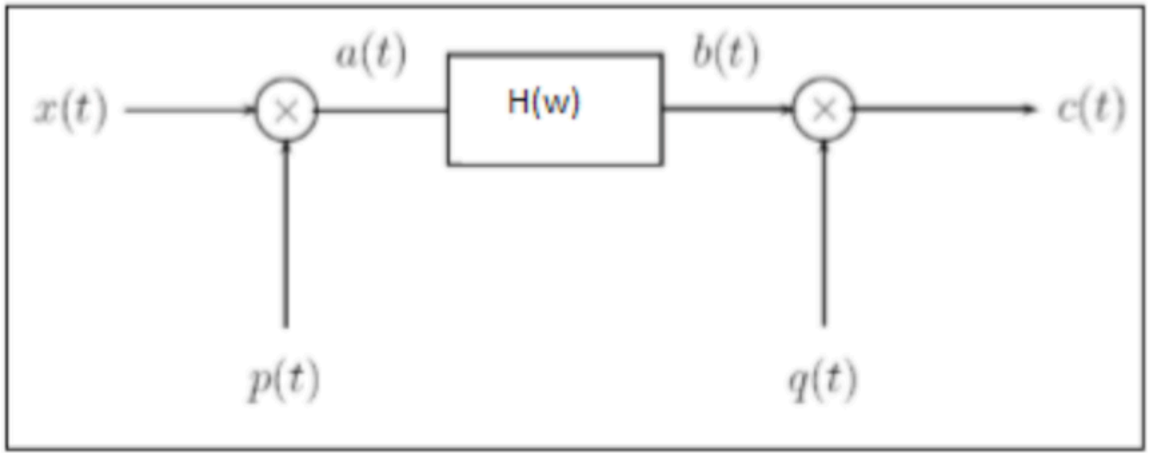


[b] using the result of part a and Fourier transform properties, find the Fourier transform of the following signal



Question 4 (10 points)

Consider the following system :



$$x(t) = \frac{\sin(\pi t)}{\pi t},\ p(t) = \cos(4\pi t),\ q(t) = \frac{\sin(5\pi t)}{\pi t},\ H(\omega) = \begin{cases} 1 & \omega \geq 2\pi \\ 0 & \omega < 2\pi \end{cases}$$

Determine $A(\omega)$, $B(\omega)$ and $C(\omega)$.

Question 5 (5 points)

Determine the energy spectral density of the signal

$$x(t) = \mathrm{sinc}(10t)$$

Question 6 (5 points)

Consider a pulse $p(t) = u(t+1) - u(t-1)$, using its Fourier transform and parseval's energy relation, show that :

$$\int_{-\infty}^{+\infty} \left(\frac{\sin(\omega)}{\omega} \right)^2 d\omega = \pi$$