EE 362: Signals and Systems Name: Solution

Spring 2019

Homework #1 (Due: Tuesday, January 29, 2019)

- Circle or box your answer (don't forget units).
- Show your steps.
- Use 8.5 x 11 paper, and trim off any ragged edges.
- Staple your work together and write your name neatly.

1- Find the magnitude and angle of the following complex numbers, [3 points]
   a) $x = -8 + j6$
   b) $x = 8 - j6$

2- Express the following functions in terms of sinusoidal functions, [3 points]
   a) $x = 5e^{-j2\theta}$
   b) $x = 3e^{-\theta}$

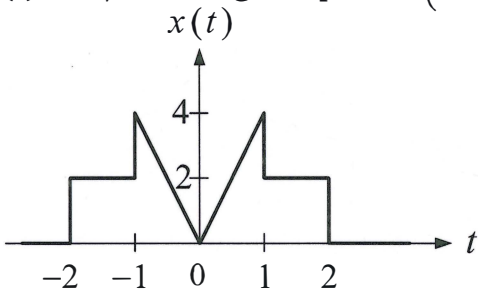
3- Find the derivative of the following functions with respect to ω, [3 points]
   a) $x = \frac{j2\omega}{5+j\omega}$
   b) $x = 2e^{-j\omega}$

4- Determine the relationship between the unit step, unit ramp, and unit impulse functions – use the derivative and integral properties. [4 points]

5- Prove the following property, [3 points]

$$f(t)\delta(t-2) = f(2)\delta(t-2)$$

6- Show that the following continuous-time signal is equal to the sum of rectangular pulses $P_\tau(t)$ and/or triangular pulses $\left(1 - \frac{2|t|}{\tau}\right) P_\tau(t)$. [3 points]



7- For the continuous-time signal given in problem 6, express the function in terms of shifted step functions $u(t - t_1)$ and/ or ramp functions $r(t - t_2)$. [3 points]

Total possible points: 22

"Solution"

① a) $|x| = \sqrt{(8)^2 + (6)^2} = 10$, $\angle x = \tan^{-1}\left(\frac{6}{-8}\right) + \pi$

$= 2.498 \text{ rad} = 143.13^\circ$

b) $|x| = 10$, $\angle x = \tan^{-1}\left(\frac{-6}{8}\right) = -36.87^\circ = -.644 \text{ rad}$

②

a) $x = 5\left(\cos(2\theta) - j\sin(2\theta)\right)$

b) $x = 3e^{-\theta}\left(\cos(0) + j\sin(0)\right)$

③ a) $\frac{dx}{dw} = \frac{(5+jw)(j2) - (j2w)(j)}{(5+jw)^2} = \frac{j10}{(5+jw)^2}$

b) $\frac{dx}{dw} = -2j\,e^{-jw}$

④ $\frac{du(t)}{dt} \rightarrow \delta(t)$, $\int \delta(t)dt \rightarrow u(t)$

$\int u(t)dt \rightarrow r(t)$, $\frac{dr(t)}{dt} \rightarrow u(t)$

⑤ Since $\delta(t-2)$ will have value only when $t=2$, then

$f(t)\delta(t-2) = f(2)\delta(t-2)$. More details in the textbook.

(6)

$$x(t) = 2P_4(t) + 2P_2(t) - 4\left(1 - \frac{2|t|}{2}\right)P_2(t)$$

(7)

$$x(t) = 2u(t+2) + 2u(t+1) - 4r(t+1) + 8r(t) - 4r(t-1)$$
$$- 2u(t-1) - 2u(t-2)$$