Midterm Exam

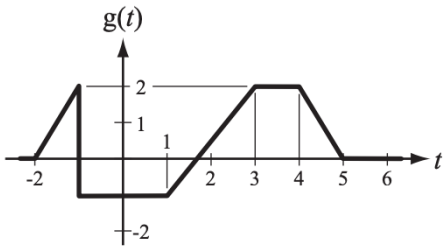
Signal and System, Fall 2021
School of BioMedical Convergence Engineering, PNU
Oct. 18. 15:00 - 17:00

I. REMARK

- This is a closed book exam. You are permitted on three pages of notes.
- There are a total of 100 points in the exam. Each problem specifies its point total.
- You must SHOW YOUR WORK to get full credit.

II. PROBLEM SET

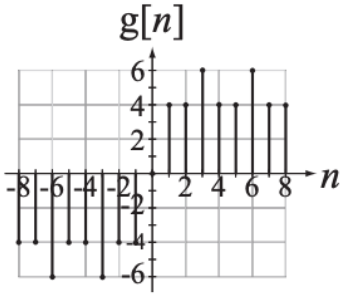
1) [20 points] The graphical definition of a function is given in the figure below.



$g(t) = 0, \quad t < -2$ or $t > 6$

a) Graph $g(\frac{t-3}{2})$ and $-g(\frac{-t}{2} - 3)$.
b) Graph $g(t) * \delta(t-1)$ and $g(-t) * \delta(t+1)$.
c) Graph the even and odd parts of the function $g(t)$.
d) Find the signal energy of the function $g(t)$.

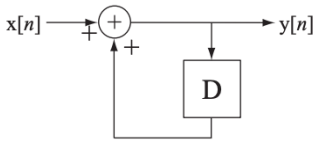
2) [20 points] The graphical definition of a function is given in the figure below.



$g[n] = 0, \; |n| > 8$

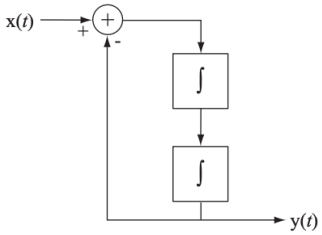
a) Graph $g[-2n-2] * \delta[n+2] * \delta[n-3]$.
b) Graph $g[n] * u[n]$.
c) Graph the even and odd parts of the function $g[n]$.
d) Find the signal energy of the function $g[n]$.

3) [15 points] A system is given as



a) Show that the system is linear and time-invariant (LTI).
b) Find the impulse response h[n] of the system.
c) Find the response of $x[n] = \delta[n] + 2\delta[n-1] + 3\delta[n-2]$.

4) [10 points] A system is given as



a) Find the zero-input response of the system.
b) Is this system BIBO stable?

5) [15 points] Answer the following questions.
a) The impulse response of one system is given as $h(t) = \text{rect}(t-1)$, Find the response of the signal $x(t) = \text{rect}(t/2)$. Graph the response.
b) Derive that if $x(t)$ is even and real-valued, $c_x[k]$ (CTFT of $x(t)$) is even and real-valued.

6) [20 points] Answer the following questions (Don't use just the CTFS table. If then, the score is just 0.)
a) The signal is given as $x(t) = 10\cos 20\pi t$. Find the CTFS of the signal using the Time $T = 1/5$. Also, find the CTFS of the signal using $T = 1/10$.
b) Suppose $T_0 > w$. Derive that the CTFT of the signal $x(t) = \text{rect}(t/w) * \delta_{T_0}(t)$ using the time $T = mT_0$ is $c_x[k] = (w/T_0)\text{sinc}(wk/mT_0)\delta_m[k]$.
c) If the CTFT of the signal $x(t)$ is $c_x[k]$ using the time $T = T_0$, what is the CTFT of the signal $x(mT)$ using the $T = mT_0$?. Explain the reason. (Assume m is positive integer.)