EE 321 Linear Systems I  Set 1  - Homework Assignment

Due: 23 Jun 04

Problems:

1. Show that each of these signals is equal to a sum of rectangular pulses $p_i(t)$ and/or triangular pulses \([1 - 2|t|/r] \ p_i(t)\).

![Diagram of signals](image)

(a)  
(b)  
(c)  
(d)  
(e)

2. Sketch the continuous-time signals below:

(a)  \[ x(t) = U(t+1) - 2U(t-1) + U(t-3) \]
(b)  \[ x(t) = U(t+1)U(t-1) - tU(t) - U(t-2) \]
(c)  \[ x(t) = e^tU(t) + e^t\exp(2-4) - 1)U(t-2) - e^tU(t-4) \]
(d)  \[ x(t) = \cos t [U(t+\pi/2) - 2U(t-\pi)] + (\cos t) U(t-3\pi/2) \]

3. For each of the signals in Problem 2, give the generalized derivative in analytical form, and sketch the generalized derivative.

4. Express each of the signals in Problem 2 in the form:

\[ x(t) = X_i(t) [U(t-t_i) - U(t-t_{i+1})] + X_{i+1}(t) [U(t-t_{i+1}) - U(t-t_{i+2})] + \ldots. \]

Give the signals $X_i(t), X_{i+1}(t), \ldots$ in the simplest possible analytical form.

5. Express each signal below in the form:

\[ x(t) = f_i(t) U(t-t_i) + f_{i+1}(t) U(t-t_{i+1}) + \ldots. \]

Give the signals $f_i(t), f_{i+1}(t), \ldots$ in the simplest possible analytical form.
1. (a) \( x(t) = P_0(t) + P_4(t) \)  
(b) \( x(t) = (4/3)(1 - (3\, d/4)P_0(t) - (1/3)(1 - d)P_0(t) \)  
(c) \( x(t) = 2P_0(t) + (1 - (d/2)P_0(t) \)  
(d) \( x(t) = \left\| P_0(t) \right\| \)  
(e) \( x(t) = \sum_{k=1}^{\infty} P_t(t-2k + (3/2)) \)  

2. Not Provided

3. (a) \( x'(t) = \delta(t + 1) - 2\delta(t - 1) + \delta(t - 3) \)  
(b) \( x'(t) = -U(t) + 2\delta(t - 1) + U(t - 1) - \delta(t - 2) \)  
(c) \( x'(t) = \epsilon^t U(t) + (\epsilon^t + \epsilon^{-t})U(t-2) \)  
(d) \( x'(t) = -\sin(t)U(t + \pi/2) + 2\sin(t)U(t - \pi) - \sin(t)U(t - 3\pi/2) + 2\sin(t - \pi) \)  

4. (a) \( x(t) = [U(t+1) - U(t-1)] - [U(t-1) - U(t-3)] \)  
(b) \( x(t) = -[U(t) - U(t-1)] + [U(t-1) - U(t-2)] \)  
(c) \( x(t) = e^t[U(t) - U(t-2)] + e^t[U(t-2) - U(t-4)] \)  
(d) \( x(t) = \cos(t)[U(t + \pi/2) - U(t - \pi)] - \cos(t)[U(t - \pi) - U(t - 3\pi/2)] \)  

5. (a) \( x(t) = U(t+1) - (3/2)(U(t-1) + (1/2)(t-3)U(t-3) \)  
(b) \( x(t) = U(t) - U(t-1)U(t-1) + (t-1)(U(t)-3) + U(t-5) \)  
(c) \( x(t) = \cos(t)[U(t + \pi/2) - U(t - \pi/2)] + \sin(t)[U(t - \pi/2) - \sin(t)]U(t - 3\pi/4) \)  
(d) \( x(t) = e^tU(t+1) + [e^t + e^{-t}]U(t) - e^{-t}U(t-2) \)