Student Name:

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Chapter 1-1

1. Determine the values of P_∞ and E_∞

(a) $x_1(t) = e^{-2t}u(t)$ (b) $x_2(t) = e^{j(2t+\pi/4)}$

(c) $x_3(t) = \cos(t)$ (d) $x_1[n] = (\frac{1}{2})^n u[n]$

(e) $x_2[n] = e^{j(\pi/2n+\pi/8)}$ (f) $x_3[n] = \cos(\frac{\pi}{4}n)$

2. Let x[n] be a signal with x[n] = 0 for n<-2 and n>4. For each signal given below, determine the values of n for which it is guaranteed to be zero.

(a) $x[n-3]$ (b) $x[n+4]$ (c) $x[-n]$ (d) $x[-n+2]$ (e) $x[-n-2]$

3. Let x(t) be a signal with x(t) = 0 for t<3. For each signal given below, determine the values of t for which it is guaranteed to be zero.

(a) $x(1-t)$ (b) $x(1-t)+x(2-t)$ (c) $x(1-t)x(2-t)$ (d) $x(3t)$ (e) $x(t/3)$

4. Determine whether or not each of the following signals is periodic. If a signal is periodic, specify its fundamental period.

(a) $x_1(t) = je^{j10t}$ (b) $x_2(t) = e^{(-1+j)t}$ (c) $x_3[n] = e^{j7\pi n}$

(d) $x_4[n] = 3e^{j3\pi(n+1/2)/5}$ (e) $x_5[n] = 3e^{j3/5(n+1/2)}$

5. Determine the fundamental period of the signal

$$x(t) = 2\cos(10t+1) - \sin(4t-1)$$

6. Determine the fundamental period of the signal

$$x[n] = 1 + e^{j4\pi n/7} - e^{j2\pi n/5}$$

7. Consider a system S with input x[n] and output y[n]. This system is obtained through a series interconnection of a system S_1 following by a system S_2. The input-output relationship for S_1 and S_2 are

$$S_1: \quad y_1[n] = 2x_1[n] + 4x_1[n-1]$$

$$S_2: \quad y_2[n] = x_2[n-2] + \frac{1}{2}x_2[n-3]$$

Where x_1[n] and x_2[n] denote the input signals.

(a) Determine the input-output relationship for system S.

(b) Does the input-output relationship of system S change if the order in which S_1 and S_2 are connected in series is reversed (i.e., if S_2 follows S_1)?

8. Consider a continuous-time system with input x(t) and output y(t) related by y(t) = x(sin(t)).
   (a) Is this system causal?
   (b) Is this system linear?
9. Consider a discrete-time system with input x[n] and output y[n] related by

$$y[n]=\sum_{k=n-n_0}^{n+n_0} x[k]$$

   Where n_0 is a finite positive integer.
   (a) Is this system linear?
   (b) Is this system time-invariant?
   (c) If x[n] is known to be bounded by a finite integer B (i.e., |x[n]|<B for all n), it can be shown that y[n] is bounded by a finite number C. We conclude that the given system is stable. Express C in term of B and n_0.
10. A continuous-time linear system S with input x(t) and output y(t) yields the following input-output pairs:

$$x(t)=e^{j2t}\xrightarrow{S}y(t)=e^{j3t}$$

$$x(t)=e^{-j2t}\xrightarrow{S}y(t)=e^{-j3t}$$

   (a) If x_1(t) = cos(2t), determine the corresponding output y_1(t) for system S.
   (b) If x_2(t) = cos(2(t-1/2)), determine the corresponding output y_2(t) for system S.