Practice Problems 02 20240227

1. Write the following complex signals in polar form, that is, in the form $x(t)=r(t)e^{j\theta(t)}$, $r(t),\theta(t)\in\mathbb{R}, r(t)>0$ for continuous-time signals and $x[n]=r[n]e^{j\theta[n]}, r[n],\theta[n]\in\mathbb{R}, r[n]>0$ for discrete-time signals.

   (a) $x(t)=\dfrac{t}{1+jt}$

   (b) $x[n]=nje^{n+j},\ n>0$

2. Write the following complex signals in rectangular form: $x(t)=a(t)+jb(t), a(t), b(t)\in\mathbb{R}$ for continuous-time signals and $x[n]=a[n]+jb[n], a[n],b[n]\in\mathbb{R}$ for discrete-time signals.

   (a) $x(t)=e^{(-2+j3)t}$

   (b) $x(t)=e^{-j\pi t}u(t)+e^{(2+j\pi)t}u(-t)$

3. Use the sampling property of the impulse to simplify the following expressions.

   (a) $x(t)=e^{-t}\cos(10t)\delta(t)$

   (b) $x(t)=\sin(2\pi t)\sum_{k=0}^{\infty}\delta(t-k)$

   (c) $x[n]=\cos(0.2\pi n)\sum_{k=-\infty}^{0}\delta[n-10k]$

4. Write the following complex signals in (i) polar form and (ii) rectangular form.

   Polar form: $x(t)=r(t)e^{j\theta(t)}, r(t),\theta(t)\in\mathbb{R}$ for continuous-time signals and $x[n]=r[n]e^{j\theta[n]}, r[n],\theta[n]\in\mathbb{R}$ for discrete-time signals.

   Rectangular form: $x(t)=a(t)+jb(t), a(t),b(t)\in\mathbb{R}$ for continuous-time signals and $x[n]=a[n]+jb[n], a[n],b[n]\in\mathbb{R}$ for discrete-time signals.

   (a) $x_1(t)=j+\dfrac{t}{1-j}$

   (b) $x_2[n]=jn+e^{j2n}$

5. Given in Figure P2.11 are the parts of a signal $x(t)$ and its odd part $x_o(t)$, for $t\geq 0$ only; that is, $x(t)$ and $x_o(t)$ for $t<0$ are not given. Complete the plots of $x(t)$ and $x_e(t)$, and give a plot of the even part, $x_e(t)$, of $x(t)$. Give the equations used for plotting each part of the signals.

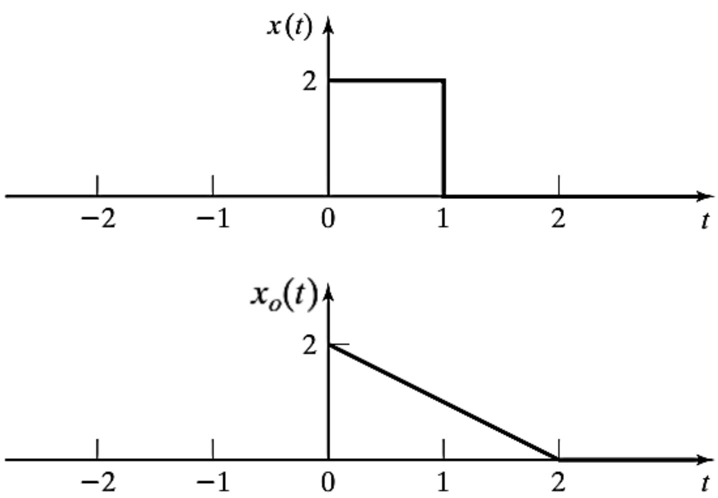

Figure P2.11

6. Evaluate the following integrals:

(i) $\int_{-\infty}^{\infty} \cos(2t)\delta(t)dt$

(ii) $\int_{-\infty}^{\infty} \sin(2t)\delta(t - {}^{\pi}/_{4})dt$

(iii) $\int_{-\infty}^{\infty} \cos[2(t - {}^{\pi}/_{4})]\delta(t - {}^{\pi}/_{4})dt$

(iv) $\int_{-\infty}^{\infty} \sin[(t - 1)]\delta(t - 2)dt$

(v) $\int_{-\infty}^{\infty} \sin[(t - 1)]\delta(2t - 4)dt$

7. Suppose that the signals $x_1[n]$, $x_2[n]$ and $x_3[n]$ are given by

$$x_1[n] = \cos\left(\frac{2\pi n}{10}\right), \quad x_2[n] = \sin\left(\frac{2\pi n}{25}\right), \text{ and } x_3[n] = e^{j2\pi n/20}.$$

(a) Determine whether $x_1[n]$ is periodic. If so, determine the number of samples per fundamental period.

(b) Determine whether $x_2[n]$ is periodic. If so, determine the number of samples per fundamental period.

(c) Determine whether $x_3[n]$ is periodic. If so, determine the number of samples per fundamental period.

(d) Determine whether the sum of $x_1[n]$, $x_2[n]$, and $x_3[n]$ is periodic. If so, determine the number of samples per fundamental period.

8. **(a)** Determine which of the given signals are periodic:

(i) $x[n] = \cos(\pi n)$	**(ii)** $x[n] = -3\sin(0.01\pi n)$
(iii) $x[n] = \cos(3\pi n/2 + \pi)$	**(iv)** $x[n] = \sin(3.15n)$
(v) $x[n] = 1 + \cos(\pi n/2)$	**(vi)** $x[n] = \sin(3.15\pi n)$

(b) For those signals in part (a) that are periodic, determine the number of samples per period.