# Practice Quiz 6

(no calculators allowed)

Problems 1 and 2 refer to the following transfer functions

$$h_1(t) = e^{-t}u(t+1) \quad h_2(t) = \cos(t)u(t)$$
$$h_3(t) = \Pi\left(\frac{t}{2}\right) \qquad h_4 = u(t)$$

**1)** Which of these systems are **causal**?

**2)** Which of these systems are **BIBO stable**?

**3)** Is the system $y(t) = \sin\left(\frac{1}{x(t)-1}\right)$ **BIBO stable**? a) yes b) no

**4)** Is the system $y(t) = \frac{1}{e^{x(t)-1}}$ **BIBO stable?** a) yes b) no

**5)** Using Euler's identity, we can write $\cos(\omega t)$ as

a) $\frac{e^{j\omega t}+e^{-j\omega t}}{2j}$ b) $\frac{e^{j\omega t}-e^{-j\omega t}}{2}$ c) $\frac{e^{j\omega t}+e^{-j\omega t}}{2}$ d) $\frac{e^{j\omega t}-e^{-j\omega t}}{2j}$

**6)** Using Euler's identity, we can write $\sin(\omega t)$ as

a) $\frac{e^{j\omega t}+e^{-j\omega t}}{2}$ b) $\frac{e^{j\omega t}-e^{-j\omega t}}{2j}$ c) $\frac{e^{j\omega t}+e^{-j\omega t}}{2j}$ d) $\frac{e^{j\omega t}-e^{-j\omega t}}{2}$

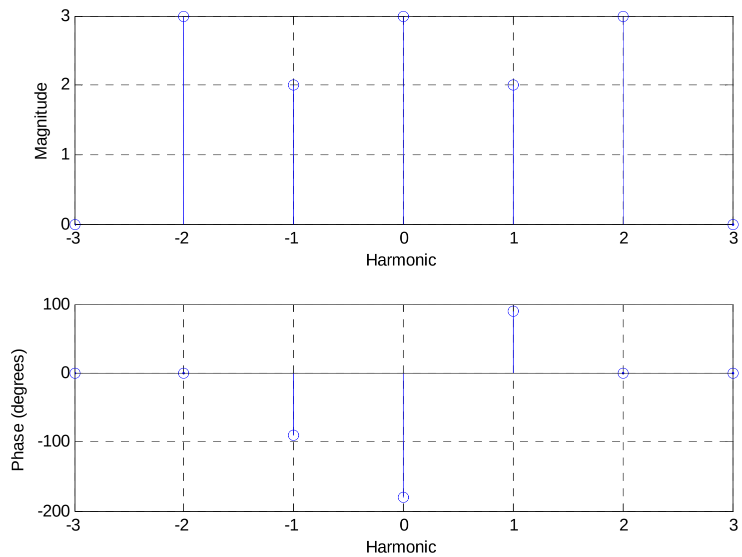
**7)** Assume we are going to synthesize a periodic signal $x(t)$ using $x(t) = \sum c_k e^{jk\omega_0 t}$ where $c_k = \frac{j}{1+k^2}$. Will $x(t)$ be a **real valued function**? a) Yes b) No

**8)** Assume we are going to synthesize a periodic signal $x(t)$ using $x(t) = \sum c_k e^{jk\omega_0 t}$ where $c_k = \frac{jk}{1+jk}$. Will $x(t)$ be a **real valued function**? a) Yes b) No

**9)** Assume $x(t)$ is a periodic function with period $T = 2$ seconds. $x(t)$ is defined over one period as $x(t) = t, \quad -1 < t < 1$. The **average power** in $x(t)$ (the power averaged over one period) is

a) 0 b) $\frac{1}{2}$ c) $\frac{1}{3}$ d) $\frac{2}{3}$

Problems 10-14 refer to the following spectrum plot for a signal $x(t)$ with fundamental frequency $\omega_o = 2$. All angles are multiples of 90 degrees.




**10)** What is the **average value** of $x(t)$? a) 13 b) $\frac{13}{7}$ c) $\frac{13}{5}$ d) 3 e) -3

**11)** What is the **average power** in $x(t)$? a) 13 b) $\frac{13}{7}$ c) 35 d) 3

**12)** What is the **average power** in the **DC component** of $x(t)$ ?

a) 0 b) 3 c) 6 d) 9 e) 18

**13)** What is the **average power** in the **second harmonic** of $x(t)$ ?

a) 3 b) 6 c) 9 d) 18

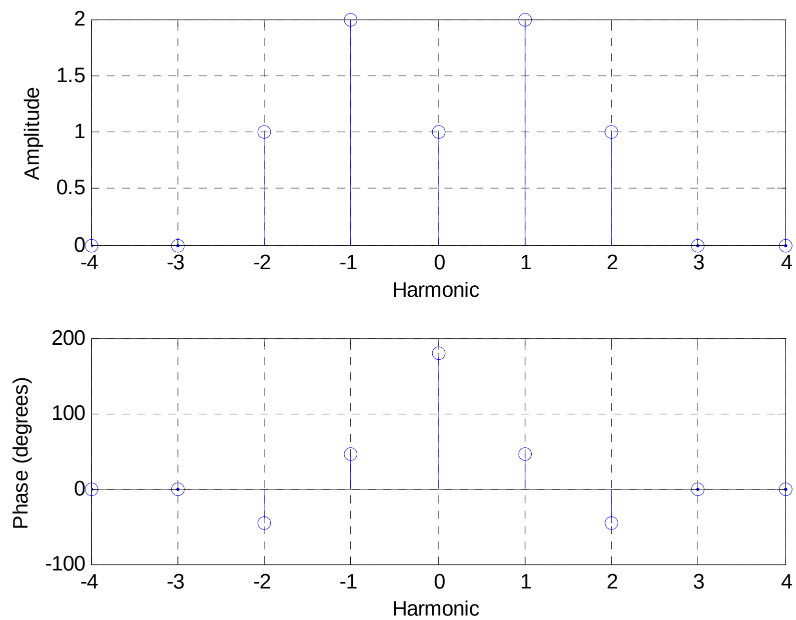
**14)** We can write $x(t)$ as

a) $x(t) = -3 + 4\cos(2t + 90^o) + 6\cos(4t)$ b) $x(t) = 3 + 4\cos(2t + 90^o) + 6\cos(4t)$

c) $x(t) = 3 + 2\cos(2t + 90^o) + 3\cos(4t)$ d) $x(t) = -3 + 2\cos(2t + 90^o) + 3\cos(4t)$

e) $x(t) = -3 + 4\cos(2t + 90^o) + 4\cos(-2t - 90^o) + 6\cos(4t) + 6\cos(-4t)$

Problems 15-17 refer to the following plot (all angles are multiples of 45 degrees)




**15)** Is this a **valid spectrum** plot for a real valued function $x(t)$? a) Yes b) No

**16)** Assuming the magnitude portion of the spectrum is correct, what is the **average power** in $x(t)$?

a) 4 b) 7 c) 11 d) 12

**17)** Assuming the plot is a valid spectrum plot for a real valued function $x(t)$, the **average value** of $x(t)$ is

a) 1 b) 2 c) $\frac{7}{4}$ d) -1

Problems 18 and 19 refer to the following Fourier series representation

$$x(t) = 2 + \sum_{k=-\infty}^{k=\infty} \frac{2}{2+jk} e^{\frac{jkt}{2}}$$

**18)** The **average value** of $x(t)$ is a) 0 b) 1 c) 2 d) 3

**19)** The **fundamental frequency** (in Hz) is a) $\frac{1}{2\pi}$ b) 0.5 c) $\frac{1}{4\pi}$ d) 2

**20)** Assume $x(t) = 2 + 2\cos(3t) + 5\cos(6t + 3)$ is the input to an LTI system with transfer function

$$H(j\omega) = \begin{cases} 2e^{-j\omega} & 1 < |\omega| < 4 \\ 4e^{-j2\omega} & 4 < |\omega| < 8 \\ 0 & else \end{cases}$$

The **steady state output** of the system is

a) $y(t) = 4\cos(3t - 3) + 20\cos(6t - 12)$ b) $y(t) = 4\cos(3t - 3) + 20\cos(6t - 6)$
c) $y(t) = 4\cos(3t - 3) + 10\cos(6t - 12)$ d) none of these

**21)** If $c_k = \text{sinc}\left(\frac{k}{3}\right)$, then $c_k$ will be zero for

a) $k = 0$ b) $k = \pm 1$ c) $k = \pm 3$ d) $k = \pm\pi$ e) none of these

For problems 22 and 23, assume $c_k = 1 - e^{-jk}$ and we want to write this as
$c_k = e^{j\alpha}\left(e^{j\beta} - e^{-j\beta}\right)$

**22)** The value of $\alpha$ is

a) 0 b) 1 c) $\frac{k}{2}$ d) $-\frac{k}{2}$ e) none of these

**23)** The value of $\beta$ is

a) 0 b) $\frac{k}{2}$ c) $-\frac{k}{2}$ d) $-\frac{k}{2}$ e) none of these

For problems 24 and 25, assume $c_k = e^{-j\pi k/2} - e^{-j\pi k}$ and we want to write this as $c_k = e^{j\alpha}\left(e^{j\beta} - e^{-j\beta}\right)$

**24)** The value of $\alpha$ is

a) $-\frac{k\pi}{2}$ b) $-\frac{3k\pi}{2}$ c) $-\frac{3k\pi}{4}$ d) none of these

**25)** The value of $\beta$ is

a) $\frac{k\pi}{4}$ b) $\frac{k\pi}{2}$ c) $\frac{3k\pi}{2}$ d) $\frac{3k\pi}{4}$ e) none of these

**26)** If $c_k = \frac{\sin(\frac{k\pi}{4})}{\frac{k}{4}}$**,** then we can write $c_k$ as

a) $c_k = \pi \text{sinc}\left(\frac{k\pi}{4}\right)$ b) $c_k = \text{sinc}\left(\frac{k\pi}{4}\right)$ c) $c_k = \pi \text{sinc}\left(\frac{k}{4}\right)$ d) $c_k = \text{sinc}\left(\frac{k}{4}\right)$

**27)** If $c_k = \frac{\sin(2k)}{2k}$, then we can write $c_k$ as

a) $c_k = \text{sinc}(\frac{2k}{\pi})$ b) $c_k = \pi \text{sinc}(\frac{2k}{\pi})$ c) $c_k = \text{sinc}(2k)$ d) none of these

**Answers:** *1-* $h_2, h_4$*, 2-* $h_1, h_3$*, 3-a, 4-a, 5-c, 6-b, 7-b, 8-a, 9-c,*
*10-e, 11-c, 12-d, 13-d, 14-a,*
*15-b, 16-c, 17-d, 18-d, 19-c, 20-d,*
*21-c, 22-d, 23-b, 24-c, 25-a, 26-c, 27-a*