Practice Quiz 6

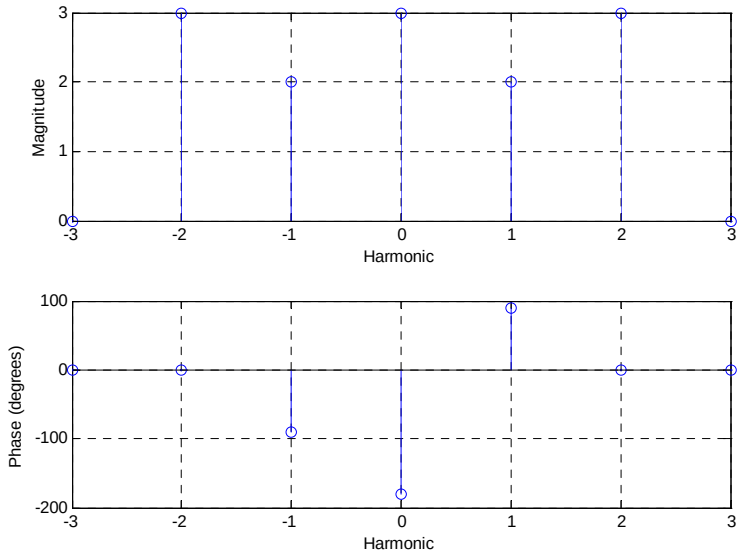
(no calculators allowed)

1) Assume $x(t)$ is a periodic function with Fourier series representation $x(t) = \sum c_k^x e^{jk\omega_o t}$. $x(t)$ is the input to an LTI system with output $y(t) = 3\dot{x}(t-2)$. The Fourier series coefficients c_k^y are related to the c_k^x in which of the following ways

a) $c_k^y = 3jk\omega_0 e^{+jk\omega_o 2} c_k^x$ b) $c_k^y = -3jk\omega_0 e^{-jk\omega_o 2} c_k^x$

c) $c_k^y = 3jk\omega_0 e^{-jk\omega_o 2} c_k^x$ d) $c_k^y = -3jk\omega_0 e^{+jk\omega_o 2} c_k^x$

Problems 2-5 refer to the following spectrum plot for a signal $x(t)$ with fundamental frequency $\omega_o = 2$. All angles are multiples of 90 degrees.



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

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

4) If $x(t)$ is the input to a system with transfer function

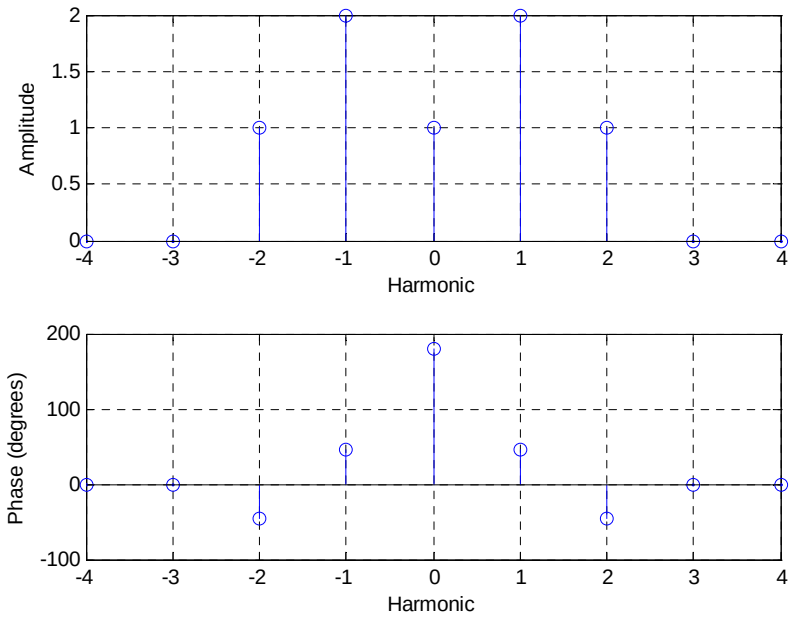
$$H(\omega) = \begin{cases} 2 & 1 < |\omega| < 3 \\ 0 & else \end{cases}$$

the output $y(t)$ in steady state will be

a) $12\cos(2t)$ b) $4\cos(2t+90^o)$ c) $8\cos(t+90^o)$ d) $8\cos(2t+90^o)$ e) $6\cos(2t)$

5) The average power in y(t) is a) 4 b) 8 c) 16 d) 32

Problems 6-8 refer to the following plot (all angles are multiples of 45 degrees)



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

7) 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

8) 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 9-13 refer to the following Fourier series representation of a periodic signal

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

9) The average value of $x(t)$ is

a) 1 b) 2 c) 3 d) 4

10) The average power in the DC component of $x(t)$ is

a) 1 b) 2 c) 4 d) 8 e) 9 f) 18

11) If $x(t)$ is the input to a system with transfer function

$$H(\omega) = \begin{cases} 2 & |\omega| < 0.4 \\ 0 & else \end{cases}$$

the output $y(t)$ in steady state will be

a) 0 b) 3 c) 6 d) $1.79\cos(0.5t - 26.6^o)$ e) $6 + 3.58\cos(0.5t - 26.6^o)$

12) If $x(t)$ is the input to a system with transfer function

$$H(\omega) = \begin{cases} 2 & |\omega| > 0.4 \\ 0 & else \end{cases}$$

the output $y(t)$ in steady state will be

a) $2x(t)$ b) $2x(t) - 3$ c) $2x(t) - 6$ d) none of these

13) If $x(t)$ is the input to a system with transfer function

$$H(\omega) = \begin{cases} 0 & 0.4 < |\omega| < 0.6 \\ 2 & else \end{cases}$$

the output $y(t)$ in steady state will be

a) $1.79\cos(0.5t - 26.6^o)$ b) $3.58\cos(0.5t - 26.6^o)$
c) $2x(t) - 1.79\cos(0.5t - 26.6^o)$ d) $2x(t) - 3.58\cos(0.5t - 26.6^o)$

For problems 14 and 15, assume $x(t) = 1 + 3\sin(2t + 45^o)$

14) The average value of $x(t)$ is

a) 0 b) 1 c) 2 d) 4

15) The average power in $x(t)$ is

a) 1 b) $\frac{13}{4}$ c) 5.5 d) 19

Problems 16 and 17 refer to the periodic function $x(t)$ defined over one period $T_0 = 3$ as $x(t) = t \quad 0 \le t < 3$ which has the Fourier series representation

$$x(t) = \frac{3}{2} + \sum_{k \neq 0} \frac{3j}{k2\pi} e^{jk\frac{2\pi}{3}t}$$

16) The average power in $x(t)$ is

a) 0 b) $\frac{3}{2}$ c) $\frac{9}{4}$ d) 3 e) $\frac{9}{2}$

17) If this signal is the input to a transfer function $H(j\omega) = 0.5e^{-j0.25\omega}$, the steady state output will be

a) $0.5(t - 0.25)$ b) $0.5te^{-j0.25\omega}$ c) $0.5(t + 0.25)$ d) none of these

18) 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 19 and 20, assume $c_k = 1 - e^{-jk}$ and we want to write this as $c_k = e^{j\alpha}\left(e^{j\beta} - e^{-j\beta}\right)$

19) The value of α is

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

20) The value of β is

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

For problems 21 and 22, assume $c_k = e^{-j\pi k/2} - e^{-j\pi k}$ and we want to write this as $c_k = e^{j\alpha}\left(e^{j\beta} - e^{-j\beta}\right)$

21) The value of α is

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

22) The value of β 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

23) 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) $c_k = \text{sinc}\left(\frac{k}{4}\right)$

24) 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

Problems 25 and 26 refer to the following transfer functions

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

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

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

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

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

29) 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

30) 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

31) 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) $\frac{2}{3}$

Answers: 1) c 2) e 3) c 4) d 5) d
6) b 7) c 8) d
9) c 10) e 11) c 12) c 13) d
14) b 15) c 16) d 17) a 18) c 19) d 20) b
21) c 22) a 23) c 24) a 25) h_2, h_4 26) h_1, h_3 27) a
28) a 29) b 30) a 31) c