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) $\frac{e^{j\omega t}-e^{-j\omega t}}{2}$

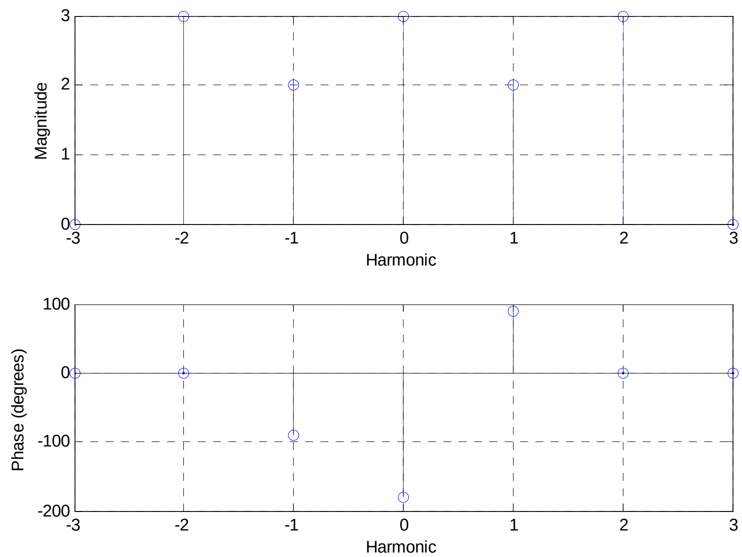
7) Assume we are going to synthesize a periodic signal $x(t)$ using $x(t) = \sum c_k e^{jk\omega_0 t}$ where $c_k = \frac{j}{1+k^2}$. Will $x(t)$ be a **real valued function**? a) Yes b) No

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

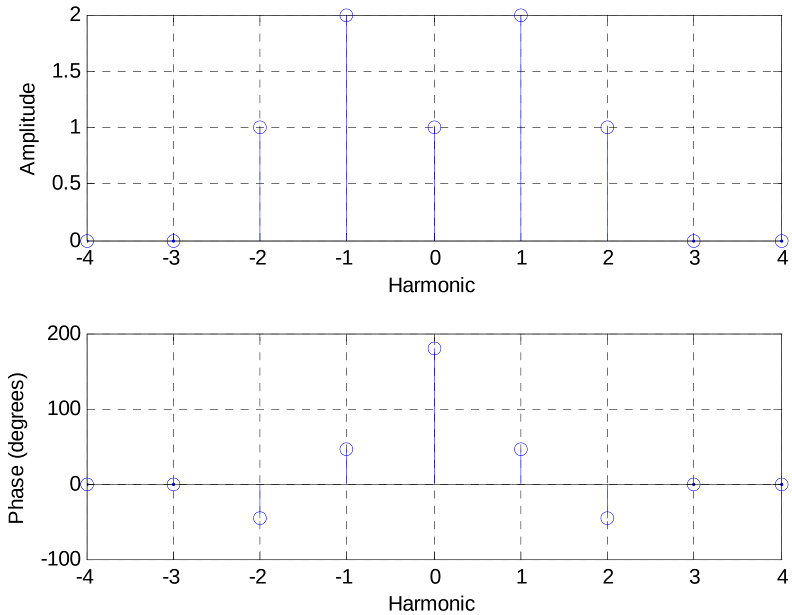
14) We can write $x(t)$ as

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

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