Short Answer Review

1) 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 function? a) Yes b) No

2) 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 function? a) Yes b) No

3) 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 4 and 5 refer to the following Fourier series representation of a periodic signal

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

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

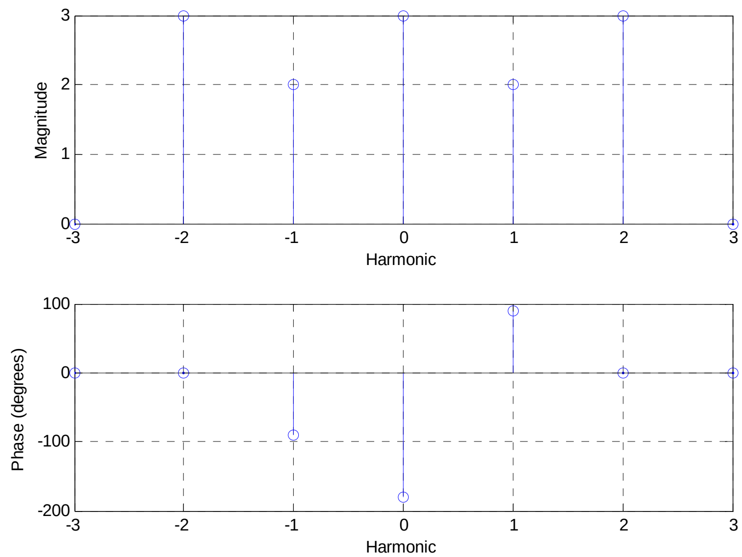
5) The fundamental frequency (in Hz) is a) $\frac{1}{2\pi}$ b) 0.5 c) $\frac{1}{4\pi}$ d) 2

6) 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 7-10 refer to the following spectrum plot for a signal $x(t)$ with fundamental frequency $\omega_o = 2$. All angles are multiples of 90 degrees.



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

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

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

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

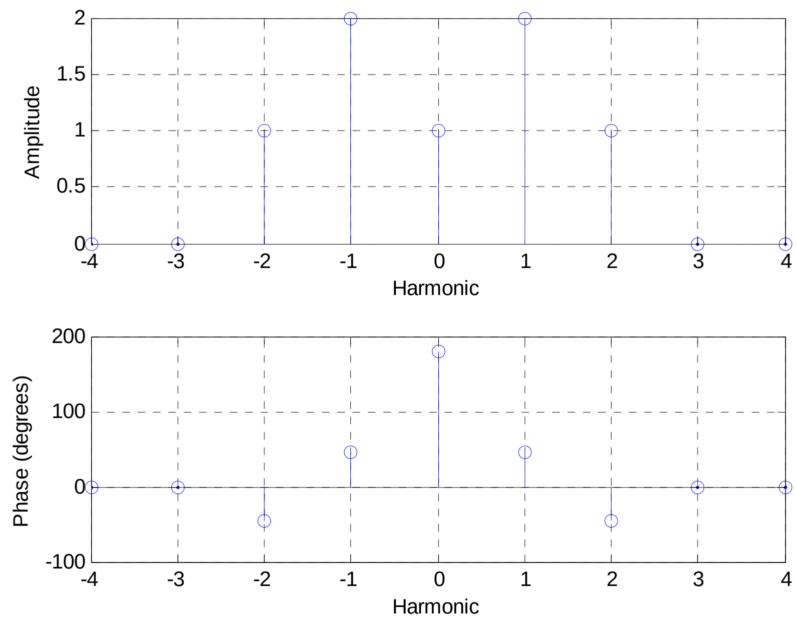
the output $y(t)$ in steady state will be

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

10) The average power in y(t) is

a) 4 b) 8 c) 16 d) 32

Problems 11-13 refer to the following plot (all angles are multiples of 45 degrees)



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

12) 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

13) 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 14-18 refer to the following Fourier series representation of a periodic signal

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

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

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

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

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

16) 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) $6 + 3.58\cos(0.5t - 26.6^o)$

17) 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

18) 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 19-21, assume $x(t) = 1 + 3\sin(2t + 45^o)$

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

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

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

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

21) Assuming $\omega_0 = 2$, c_1 is equal to

a) 3 b) $\frac{-3j}{2}$ c) $\frac{3e^{j\frac{\pi}{4}}}{2}$ d) $\frac{3e^{-j\frac{\pi}{4}}}{2}$

Problems 22 and 23 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

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

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

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

23) 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

Problems 24 and 25 refer to the following transfer functions

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

24) Which of these systems are causal?

25) Which of these systems are BIBO stable?

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

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

28) Assume V_1 and V_2 are voltages, and that P_{V1} and P_{V2} are the power absorbed by a 1Ω resistor when the corresponding voltage is applied to it. We know that the ratio of the two powers, $\frac{P_{V_1}}{P_{V_2}}$, can be expressed in dB as -40dB. This is equivalent to

a) $\frac{V_1}{V_2} = 0.01$. b) $\frac{V_1}{V_2} = 0.0001$ c) $\frac{V_1}{V_2} = 0.1$ d) none of these

29) Assume V_1 is the voltage across a $1\,\Omega$ resister, and we measure $P_{V_1} = 10\ dBm$. This means V_1 is equal to

a) 0.01 b) 0.1 c) 1 d) 10

30) Assume we measure the average power in the fundamental frequency of a periodic signal as $40\ dBmV$. This means $|c_1|$ is equal to

a) $\frac{1}{\sqrt{2}}10^{-1}$ b) 10^{-1} c) 5 d) none of these

Answers:

1) b 2) a 3) c 4) d 5) c 6) c 7) e 8) c 9) d 10) d

11) b 12) c 13) d

14) c 15) e 16) c 17) c 18) d

19) b 20) c 21) d 22) d 23) a 24) h_2 *and* h_4 25) h_1 *and* h_3

26) a 27) a 28) a 29) b 30) a