UNIVERSITY OF JORDAN
DEPARTMENT OF ELECTRICAL ENGINEERING
SIGNALS AND SYSTEMS

SECOND EXAM — 30 MARKS — 23/4/2013

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NAME: _____ SERIAL NO. 50
Please write your name in arabic

0119203

SERIAL NO. ☐

SECTION:
- ☑ SECTION 1, SUN, TUE, THUS 09:00-10:00
- ☐ SECTION 2, SUN, TUE, THUS 11:00-12:00
- ☐ SECTION 3, MON, WED 09:30-11:00

12x1.5

d

Write your answers here													
1	d	2	a	3	b	4	c	5	a	6	d	7	a
8	c	9	b	10	c	11	e	12	b	13	b	14	c
15	a	16	b	17	c	18	a	19	b	20	b	21	d
22	d												

18/30

1. Given that $X(\omega) = \dfrac{\cos(4\omega)\sin(2\omega)}{\omega}$, find the value of $\displaystyle\int_{-\infty}^{\infty} x(t)dt$

   a. 1
   b. zero
   c. 1/2
   d. infinity
   e. 2

2. A signal $x(t)$ can be written as

$$x(t) = \frac{1}{2} + \cos t - \frac{1}{3}\cos 3t + \frac{1}{5}\cos 5t - \frac{1}{7}\cos 7t + \cdots$$

   What is the power in the signal UP TO the fundamental harmonic?

   a. 5/4
   b. 5/8
   c. 3/4
   d. 3/8
   e. none of these

3. Let $x(t) = \begin{cases} t, & 0 \le t \le 2 \\ 1, & 2 < t \le 3 \end{cases}$, be a periodic function with fundamental period equal to 3. The average value of the signal is

   a. 3
   b. 1
   c. none of these
   d. 2
   e. 6

4. A periodic function is given over one period by $x(t) = |t|$, $-\pi < t < \pi$. Which of the following statements is correct for the trignometric Fourier series of $x(t)$

   a. $a_n = 0$ for $n = 0, 1, 2, \cdots$.
   b. $a_n = 0$ for all odd integers n, but not for any even integers n.
   c. $a_n = 0$ for all even integers n, but not for any odd integers n.
   d. $a_n = 0$ for $n = 1, 2, 3, \cdots$, but $a_0 \neq 0$.
   e. none of these

5. Consider the signal $x(t) = \text{rect}\left(\dfrac{t}{2}\right) + \text{rect}\left(\dfrac{t}{4}\right)$. Evaluate the integral $\displaystyle\int_{-\infty}^{\infty} X(\omega)e^{-j\frac{3}{2}\omega}d\omega$

   a. 2π
   b. 2
   c. none of these
   d. 1
   e. 4π

6. Consider the following statements regarding the signal $x(t) = \sin(3t) + e^{j\frac{2}{7}t}$

   S1: The exponential Fourier coefficients $c_{\pm 21} = \frac{1}{2j}$.

   S2: The fundamental frequency of $x(t)$ is $\omega_0 = 2/7$.

   a. none of these
   b. S1 and S2 are true
   c. S1 is false but S2 is true
   d. S1 is true but S2 is false
   e. S1 and S2 are false

7. Find the Fourier transform of $x(t) = \delta(t+1) + \delta(t-1)$

   a. $2\cos(\omega)$
   b. $2\pi\cos(\omega)$
   c. $\cos(\omega)$
   d. none of these
   e. $\pi\cos(\omega)$

8. When the signal

$$x(t) = 5 + \cos(12t + \pi/4)$$

   is applied to a system, the output is

$$y(t) = 6\sin(12t) + \cos(24t + \pi/4)$$

   Which of the following statements is true

   S1: The system is LTI with $H(0) = 0$ and $|H(j12)| = 6$

   S2: The system is not LTI because the cos function becomes a sin function

   S3: The system is not LTI because the constant term disappears at the output

   a. All are false
   b. S1 is false but both S2 and S3 are true
   c. S2 only is true
   d. S3 only is true
   e. S1 only is true

9. The Fourier transform of $x(t) = \mathrm{sgn}(2t)$ is

   a. none of these
   b. $2/(j\omega)$
   c. $2/(2j\omega)$
   d. $1/(2j\omega)$
   e. $1/(j\omega)$

10. For the trignometric Fourier series of $x(t)$ defined over one period as $x(t) = t$, $-2 \le t \le 2$, the coefficient $b_1 =$

    a. $2/\pi$

b. zero

c. $4/\pi$

d. 1

e. $\pi/4$

11. The Fourier transform of the signal $x(t) = u(t-1) * \delta(t-1)$ is

a. $e^{-j\omega}/(j\omega) + \pi\delta(\omega - 1)$

b. $e^{-j2\omega}/(j\omega) + \pi\delta(\omega)$

c. $e^{-j2\omega}/(j\omega) + \pi\delta(\omega - 1)$

d. none of these

e. $e^{-j\omega}/(j\omega) + \pi e^{-j\omega}\delta(\omega)$

12. Consider the function $x(t) = \begin{cases} 2, & -2 \le t \le -1 \\ |t|, & -1 < t < 1 \\ -2, & 1 \le t \le 2 \end{cases}$. At $t = 1$ the Fourier series converges to

a. none of these

b. $-1/2$

c. zero

d. -2

e. -1

13. Given a periodic function $x(t) = \delta(t)$ with period π. The exponential Fourier series coefficient of $y(t) = x(t - \pi/2)$ is

a. $\frac{1}{\pi}e^{j\pi n}$

b. $\frac{1}{\pi}e^{-j\pi n}$

c. $\frac{1}{\pi}e^{-j\frac{\pi}{2}n}$

d. none of these

e. $\frac{2}{\pi}e^{-j\frac{\pi}{2}n}$

14. The auto-correlation function of a rectangular pulse of duration 2 seconds is

a. a triangular pulse of duration 4 seconds

b. a rectangular pulse of duration 2 seconds

c. a triangular pulse of duration 2 seconds

d. a rectangular pulse of duration 4 seconds

e. need more information

15. Consider the signal $x(t) = \sin 4\pi t + \cos 6\pi t$. One possible representation of the Fourier series coefficients is

a. $c_n = \frac{1}{2}\delta[n+3] - \frac{1}{2j}\delta[n+2] + \frac{1}{2j}\delta[n-2] + \frac{1}{2}\delta[n-3]$

b. $c_n = \frac{1}{2}\delta[n+6\pi] + \frac{1}{2j}\delta[n+4\pi] + \frac{1}{2j}\delta[n-4\pi] + \frac{1}{2}\delta[n-6\pi]$

c. none of these

d. $c_n = \frac{1}{2}\delta[n+2] - \frac{1}{2j}\delta[n+1] + \frac{1}{2j}\delta[n-1] + \frac{1}{2}\delta[n-2]$

e. $c_n = \frac{1}{2}\delta[n+3\pi] - \frac{1}{2j}\delta[n+2\pi] + \frac{1}{2j}\delta[n-2\pi] + \frac{1}{2}\delta[n-3\pi]$

16. The value of phase (in radians) at $\omega = 1$ rad/s of the signal $x(t) = 10\delta(t-2)$ is

a. -0.5

b. -2

c. 1

d. 10

e. -0.2

17. The inverse Fourier transform of $X(\omega) = \frac{1}{1+\omega^2}$ is

a. e^{-t}

b. none of these

c. $\frac{1}{2}e^{-|t|}$

d. $\frac{1}{2}e^{|t|}$

e. $\frac{1}{2}e^{-|t|}u(t)$

18. The input signal $x(t) = \cos(t)$ is applied to a system with frequency response $H(\omega) = \frac{2}{1+j\omega}$, the output signal will be

a. $2\cos(t)$

b. $\sqrt{2}\cos(t)$

c. $\sqrt{2}\cos(t+\pi/4)$

d. $\sqrt{2}\cos(t-\pi/4)$

e. none of these

19. The frequency response function of a system described by the diffrential equation

$$2\frac{d^2y(t)}{dt^2} + 3y(t) = 4\frac{dx(t)}{dt}$$

is

a. $\frac{4}{2j\omega^2+3}$

b. none of these

c. $\frac{4j\omega}{3-2\omega^2}$

d. $\frac{4j\omega}{2j\omega^2+3}$

e. $\frac{4}{2(j\omega)^2+3}$

20. If the Fourier transform of $x(t)$ is $X(\omega)$, then the Fourier transform of $4x(8-4t)$ is

a. none of these

b. $X\left(\frac{-w}{4}\right)e^{j\omega 8}$

c. $X\left(\frac{w}{8}\right)e^{j\omega 4}$

d. $X\left(\frac{-w}{4}\right)e^{-j\omega 2}$

e. $X\left(\frac{w}{4}\right)e^{-j\omega 8}$

21. Let the signal $x(t)$ be periodic with period $T = 4$ and the Fourier coefficients $c_n = e^{jn}$, $-3 \le n \le 3$ and zero otherwise. What is the power of the signal $x(t)$?

a. 7/4

b. 3

c. 4

d. 7

e. 3/4

22. Consider the system with impulse response $h(t) = te^{-3t}u(t)$. What is the average value of the output if the input is

$$x(t) = 3 + 2\cos(t + \pi/3) + \sin(2t + \pi/4)$$

a. zero

b. 1/3

c. none of these

d. 1/9

e. 1