

ROWAN UNIVERSITY
ECE Department

Signals and Systems

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Quiz 4

- Type your name and sign the statement on the answer sheet.
- Write your choice beside each item on the answer sheet.
- Only upload the answer sheet on canvas
- There are 10 problems in the quiz.
- The problems are not in order of difficulty. We recommend that you read through all the problems, then do the problems in whatever order suits you best.

Name

Problem 1

Which of the following is an odd function?

- A. $\sin(5t) \cos(3t)$
- B. $\sin(4t) \sin(7t)$
- C. $\sin(10t + \pi/2)$
- D. $|t + 5|$
- E. e^{6t}
- F. $u(t + 7) - u(t - 7)$, where $u(t)$ is the unit-step function.

Problem 2

What is the period of $\sin(\pi t/2) + \sin(4t)$?

- A. It is aperiodic.
- B. 0.5
- C. 0.5π
- D. 1
- E. π
- F. 2
- G. 2π

Questions 3, 4 and 5 pertain to the system

$$y(t) = S[x(t)] = \sin(t + 3) \cos(x(t - 3))$$

Note that $x(t)$ is the input and $y(t)$ is the output.

Problem 3

Which statement is true?

- A. The system is causal.
- B. The system is not causal.

Problem 4

Which statement is true?

- A. The system is time-invariant.
- B. The system is not time-invariant.

Problem 5

Which statement is true?

- A. The system is bounded-input bounded-output (BIBO) stable.
- B. The system is not bounded-input, bounded-output (BIBO) stable.

Problem 6

What is the region of convergence of the Laplace transform of $(t-1)^2u(t-1)$ where $u(t)$ is the unit step function?

- A. All values of s
- B. All values of s except $s = 0$
- C. $\text{Real}(s) < 0$
- D. $\text{Real}(s) > 0$
- E. $\text{Real}(s) < 1$
- F. $\text{Real}(s) > 1$

Problem 7

Which of the following is the Laplace inverse of

$$X(s) = \frac{4}{s(s+2)^2}$$

Note that $u(t)$ is the unit-step function.

- A. $x(t) = [1 - 2te^{-2t} - e^{-2t}]u(t)$
- B. $x(t) = [1 - 2t^2e^{-2t} - e^{-2t}]u(t)$
- C. $x(t) = [1 - 2te^{-2t}]u(t)$
- D. $x(t) = [1 - 2t^2e^{-2t}]u(t)$
- E. $x(t) = [1 - 2e^{-2t}]u(t)$

Problem 8

The unit step response of a system is

$$s(t) = [0.5 - e^{-t} + 0.5e^{-2t}] u(t)$$

Note that $u(t)$ is the unit step function. Which of the following is the transfer function $H(s)$ of the system

A.

$$H(s) = \frac{1}{s^2 + 3s + 2}$$

B.

$$H(s) = \frac{1}{2} - \frac{1}{s^2 + 3s + 2}$$

C.

$$H(s) = \frac{0.5 s}{s^2 + 3s + 2}$$

D.

$$H(s) = \frac{1}{0.5 s (s^2 + 3s + 2)}$$

Problem 9

Consider the periodic signal

$$x(t) = 1 + \cos(2\pi t) - \cos(6\pi t) \quad (1)$$

Note that the formula for the trigonometric Fourier series is given by

$$x(t) = c_0 + \sum_{k=1}^{\infty} 2c_k \cos(k\Omega_0 t) + \sum_{k=1}^{\infty} 2d_k \sin(k\Omega_0 t) \quad (2)$$

where Ω_0 is the fundamental frequency of $x(t)$.

Then, the trigonometric Fourier Series coefficients of $x(t)$ are zero except the following coefficients

A. $c_0 = 1, c_1 = 1, c_2 = -1$

B. $c_0 = 1, c_1 = 1, c_3 = -1$

C. $c_0 = 1, c_2 = 1, c_6 = -1$

D. $c_0 = 1, c_1 = \frac{1}{2}, c_2 = -1$

E. $c_0 = 1, c_1 = \frac{1}{2}, c_3 = -1$

F. $c_0 = 1, c_2 = \frac{1}{2}, c_6 = -1$

G. $c_0 = 1, c_1 = 1, c_2 = -\frac{1}{2}$

H. $c_0 = 1, c_1 = 1, c_3 = -\frac{1}{2}$

I. $c_0 = 1, c_2 = 1, c_6 = -\frac{1}{2}$

J. $c_0 = 1, c_1 = \frac{1}{2}, c_2 = -\frac{1}{2}$

K. $c_0 = 1, c_1 = \frac{1}{2}, c_3 = -\frac{1}{2}$

L. $c_0 = 1, c_2 = \frac{1}{2}, c_6 = -\frac{1}{2}$

Problem 10

The transfer function of a causal LTI system is given by

$$H(s) = \frac{Y(s)}{X(s)} = \frac{s + 1}{s^2 + 3s + 4}$$

where $Y(s)$ is the Laplace Transform of the output $y(t)$ and $X(s)$ is the Laplace Transform of the input $x(t)$.

The input to the system is $x(t) = 1 + \cos(t + \pi/4)$. Which of the following is the corresponding output $y(t)$ of this system?

A. $y(t) = \frac{1}{4} + \frac{1}{3} \cos(t + \pi/4)$

B. $y(t) = \frac{1}{3} \cos(t + \pi/4)$

C. $y(t) = \frac{1}{4} + \frac{1}{3} \cos(t)$

D. $y(t) = \frac{1}{3} \cos(t)$

E. $y(t) = \frac{1}{4} + \frac{1}{3} \sin(t + \pi/4)$

F. $y(t) = \frac{1}{3} \sin(t + \pi/4)$

G. $y(t) = \frac{1}{4} + \frac{1}{3} \sin(t)$

H. $y(t) = \frac{1}{3} \sin(t)$