

Quiz Number: 1	Course Title: Digital Signal and Image Processing	Course Code: ELEC 421	Date: Tuesday, October 8, 2024	Duration of Quiz: 15 minutes	Number of Questions: 5	Instructor: Siamak Najarian, Ph.D., P.Eng.	University: UBC	Department: Electrical and Computer Engineering
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Please carefully read the following instructions and guidelines:

1. *This quiz is closed books/notes.*
2. *You will not get a negative mark for choosing the incorrect answer.*
3. *Each question carries 1 mark.*

Best of Luck!

Question 1:

Consider the signal $x(t) = 4 - 2 \cos(\omega_0 t)$. Based on the pattern matching method for Fourier series decomposition, which of the following sets of Fourier coefficients is correct?

- A) $a_0 = 4, a_1 = 1, a_{-1} = 1$, and $a_k = 0$ for all other k
- B) $a_0 = 4, a_1 = -1, a_{-1} = -1$, and $a_k = 0$ for all other k
- C) $a_0 = 2, a_1 = -2, a_{-1} = -2$, and $a_k = 0$ for all other k
- D) $a_0 = 0, a_1 = 2, a_{-1} = 2$, and $a_k = 0$ for all other k

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t} \quad a_k = \frac{1}{T} \int_0^T x(t) e^{-jk\omega_0 t} dt$$

Note that:

Question 2:

Which of the following conditions is **NOT** a valid reason why the Fourier series may fail to converge for a given signal?

- A) The signal has an infinite number of discontinuities distributed over each period.
- B) The signal approaches an asymptote, leading to an infinite area under the curve over one period.
- C) The signal exhibits infinite oscillations (wiggling) as it approaches the end of its period.
- D) The signal contains a finite number of discontinuities, but they occur at the same points in every period.

Question 3:

Consider the continuous signal $x(t)$. Which of the following statements about the Fourier transform and inverse Fourier transform is **correct**?

- A) The Fourier transform can only be applied to finite-length periodic signals, and it produces a discrete set of coefficients a_k .
- B) The inverse Fourier transform converts the signal from the omega domain to the time domain using the formula $X(\omega) = \int_{-\infty}^{\infty} x(t) e^{-j\omega t} dt$.
- C) The Fourier transform applies to both finite-length and infinite-length aperiodic signals, producing a continuous function $X(\omega)$ in the frequency domain.
- D) A periodic signal $x(t)$ will always have a Fourier series representation, regardless of whether it is finite or infinite in duration.

Question 4:

Which of the following statements correctly describes the Duality Property in signal processing?

- A) A delta function in the time domain results in a constant function in the frequency domain.
- B) A pair of impulses in the time domain corresponds to a cosine in the frequency domain, and a cosine in the time domain corresponds to a regular non-repeating pulse in the frequency domain.
- C) A pulse in the frequency domain results in a constant in the time domain.
- D) A sinc function in the time domain results in a delta function in the frequency domain.

Question 5:

We know that the Fourier transform of e^{-at} is $\frac{1}{a+j\omega}$. Given the input signal $x(t) = 2e^{-4t}u(t)$ and the impulse response $h(t) = 8e^{-2t}u(t)$, the output response $Y(\omega)$ in the frequency domain is given by what expression?

- A) $\frac{8}{(4+j\omega)(2+j\omega)}$
- B) $\frac{12}{(4+j\omega)(2+j\omega)}$
- C) $\frac{4}{(4+j\omega)(2+j\omega)}$
- D) $\frac{16}{(4+j\omega)(2+j\omega)}$

End of Questions