National University of Computer and Emerging Sciences 0054

Lahore Campus

Signals & Systems (EE2008) Final Exam

Date: May 21, 2025

Course Instructor(s)

Mr. Dr. S.M. Sajid

Mr. Khalid Ijaz

Total Time (Hrs): 3

Total Marks: 100

Total Questions: 6

Roll No _____ Section _____ Student Signature _____

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Attempt all the questions.

CLO # 1: Express different types of signals and systems.

Q1: Express the types of operations involved in the given signal x(t) as shown in Figure 1 for the following transformations. Also, sketch the resulting signals derived from x(t). **[5+5+5+5 marks]**

a) $x(t-3)$
b) $x(t/2)$
c) $x(-t)$
d) $x(2t-4)$

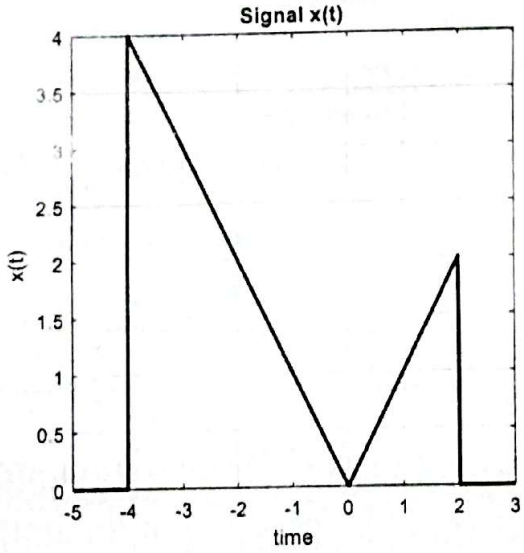

Fig-1

CLO # 2: Apply mathematical and graphical convolution techniques to analyze CT and DT systems.

Q2: Consider the following two signals x(t) and h(t) as shown in Figure 2. **Apply** graphical convolutional technique to compute the convolution of these two signals. **[20 marks]**

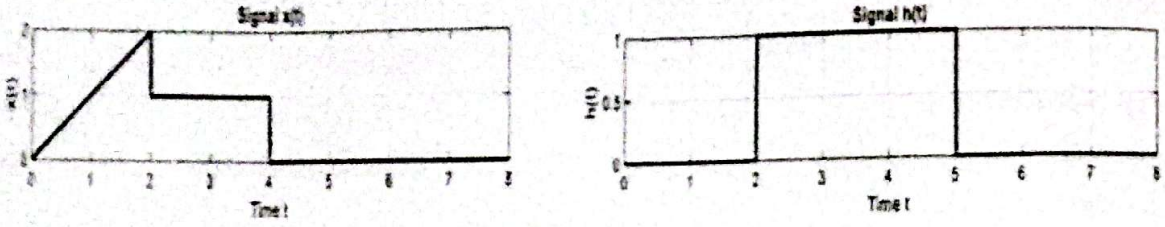

Fig-2

CLO # 3: Analyze signals using Fourier series representation.

Q3: Analyze the periodic signal shown in Fig-3, calculate all the coefficients of trigonometric Fourier series and also write the final expression of trigonometric Fourier series. **[20 marks]**

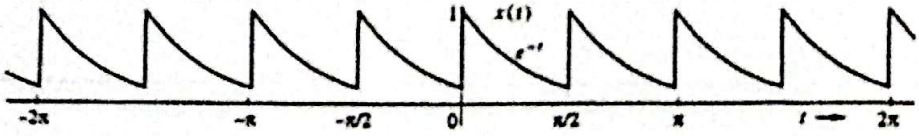

Fig-3

The following mathematical expressions can be used:

$$\int x^2 e^{ax}\,dx = \frac{e^{ax}}{a^3}(a^2x^2 - 2ax + 2)$$

$$\int e^{ax} \sin bx\,dx = \frac{e^{ax}}{a^2 + b^2}(a \sin bx - b \cos bx)$$

$$\int e^{ax} \cos bx\,dx = \frac{e^{ax}}{a^2 + b^2}(a \cos bx + b \sin bx)$$

CLO # 4: Analyze signals using Fourier transform and its properties.

Q4: Analyze the signal given below, find and sketch the Fourier transform of the modulated signal $x(t)\cos(20t)$ in which $x(t)$ is a gate pulse represented by $rect\left(\frac{t}{8}\right)$ as illustrated in figure given below. **[15 marks]**

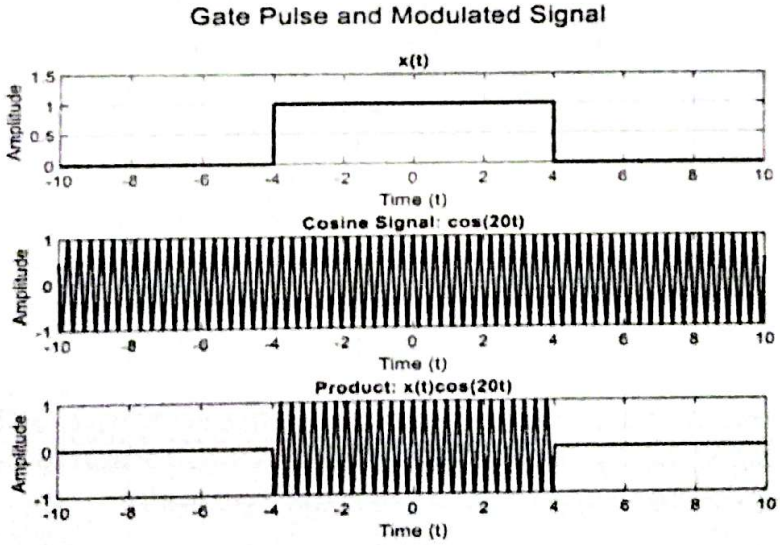

Fig-4

$4\,\mathrm{sinc}(4(\omega-20)) + 4\,\mathrm{sinc}(4(\omega-20))$.

CLO # 4: Analyze signals using Fourier transform and its properties.

Q5: Analyze and find the Fourier transform of $e^{-|t|}\cos(2t)$ using appropriate property of Fourier transform. **[15 marks]**

CLO # 5: Describe and use the sampling theorem.

Q6: A television signal (video and audio) has a bandwidth of 5 MHz. This signal is sampled, quantized, and binary coded to obtain a PCM signal. **[10 marks]**

a) **Describe** what the sampling rate will be if the signal is to be sampled at a rate 25% above the Nyquist rate.

b) If the Nyquist samples are quantized into 1024 levels and then binary coded, **describe** the appropriate number of binary digits required to encode a sample.

c) **Describe** the appropriate number of binary pulse rate (bit/s) required to encode the video and audio signal.