KATHMANDU UNIVERSITY
End Semester Examination [C]
June/July 2024

Marks Scored:

Level : B.Sc.
Year : II

Course : EEEG 221
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date 03 JUL 2024

SECTION "A"
[20Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate answer.

1. An image stored in a .bmp file is a
   a. continuous-time analog signal.
   b. discrete-time analog signal.
   c. continuous-time digital signal.
   d. discrete-time digital signal.

2. The signal $e^{-t}u(t)$ has
   a. infinite average power.
   b. infinite energy.
   c. finite non-zero energy.
   d. finite non-zero average power.

3. A signal $x(2t)$ represents
   a. delayed $x(t)$. b. compressed $x(t)$. c. expanded $x(t)$. d. amplified $x(t)$.

4. Physical systems are
   a. causal and anticipatory.
   b. causal and non-anticipatory.
   c. non-causal and non-anticipatory.
   d. non-causal and anticipatory.

5. An identity buffer system given by $h(t) = \delta(t)$ is
   a. stable and memory-less.
   b. unstable and memory-less.
   c. stable and not memory-less.
   d. unstable and not memory-less.

6. In parallel interconnection of two systems with impulse responses $h_1(t)$ and $h_2(t)$, the impulse response $h(t)$ of the resulting system is given by
   a. multiplication of $h_1(t)$ and $h_2(t)$.
   b. sum of $h_1(t)$ and $h_2(t)$.
   b. convolution of $h_1(t)$ and $h_2(t)$.
   d. difference of $h_1(t)$ and $h_2(t)$.

7. The Fourier series coefficient of a real-even signal is
   a. real-odd b. imaginary-odd c. real-even d. imaginary-even

8. The complex Fourier series representation of $sin(\omega_0 t)$ has a_1 = _____ & a_{-1}= _____.

9. If the spectrum of the output of a system in terms of the spectrum of the input signal $X(j\omega)$ and the frequency response of the system $H(j\omega)$ is given by $Y(j\omega) = X(j\omega)H(j\omega)$, then, using the inverse Fourier transform, $y(t)$ in terms of $x(t)$ and $h(t)$ is given by _____.

10. If a signal is compressed in time domain, then its spectrum in the frequency domain will be
a. narrower and taller. b. narrower but flatter.
c. wider but taller. d. wider and flatter.

11. Using computer programs, we generally evaluate the following.
a. Continuous Time Fourier Series (CTFS).
b. Continuous Time Fourier Transform (CTFT)
c. Discrete Time Fourier Transform (DTFT).
d. Fast Fourier Transform (FFT).

12. The discrete-time Fourier transform (DTFT) is
a. continuous valued with period π. b. continuous valued with period 2π.
c. discrete valued with period π. d. discrete valued with period 2π.

13. A signal-sampler operates at 4 kHz clock frequency. An ideal anti-aliasing filter before the sampler can only have maximum cut-off frequency of less than
a. 8 kHz. b. 4 kHz. c. 2 kHz. d. 1 kHz.

14. Sampling rate can be lowered in digital signal processing by using a technique called
a. convolution. b. mixing. c. interpolation. d. decimation.

15. Autocorrelation may be used for
a. filtering noise. b. signal detection in noise.
c. signal modulation. d. signal mixing.

16. Pink noise is characterized by a
a. spectrum with similar amplitudes for the entire frequency range.
b. spectrum with random amplitudes for the entire frequency range.
c. spectrum with decreasing amplitudes at higher frequencies.
d. spectrum with increasing amplitudes at higher frequencies.

17. A signal mixer can be realized using a
a. low pass filter. b. high-pass filter. c. divider. d. multiplier.

18. A filter that blocks a range of mid-band frequencies is called
a. low-pass filter. b. band-pass filter. c. notch filter. d. high-pass filter.

19. An elliptic filter has ripple in its frequency response in
a. both pass & stop bands. b. in pass band but not in stop band.
c. neither in pass nor in stop band. d. in stop band but not in pass band.

20. An input signal $x(t) = cos(2\pi \times 1000t) + sin(2\pi \times 2000t) + cos(2\pi \times 4000t)$ was filtered and the output obtained was $y(t) = 0.01\, sin(2\pi \times 2000t) + cos(2\pi \times 4000t)$. The filter is a
a. low-pass filter. b. high-pass filter c. band-pass filter. d. a band-stop filter.

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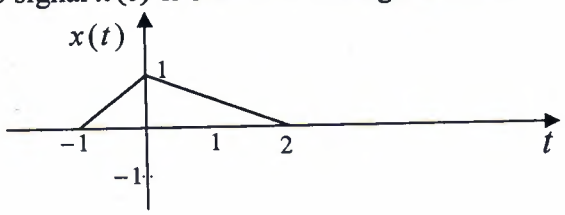
Semester : II
F.M. : 55

SECTION "B"
[5 Q. × 8 = 40 marks]

Attempt *ANY THREE* questions.

1. a. Illustrate and state use or occurrence of following types of elementary signals in the real world. [4]
   i. Unit step signal
   ii. Rectangular pulse signal
   iii. Real exponential signal
   iv. Periodic signal

   b. A continuous time signal $x(t)$ is shown in the figure below. [4]



   Sketch and label following signals derived from it.

   (i) $x(t-1)$ (ii) $x\left(\frac{t}{2}\right)$ (iii) $x(3t)$ (iv) $\frac{dx(t)}{dt}$

2. a. What do you understand by the impulse response of a system? How can it be used to characterize a LTI system? Briefly describe the process of obtaining system response from its impulse response in case of discrete time and continuous time LTI systems. [4]

   b. Plot the given discrete time signal $x[n]$ and system impulse response $h[n]$. Determine and sketch the system output $y[n] = x[n] * h[n]$. [4]

   $$x[n] = u[n] - u[n-5] \quad \text{and} \quad h[n] = \left(\frac{3}{4}\right)^n \{u[n] - u[n-3]\}$$

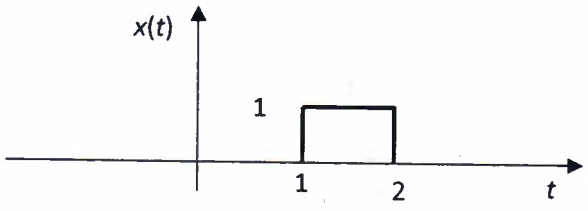
3. a. A continuous time system is represented by the following differential equation. [4]

   $$\frac{dy(t)}{dt} + 2y(t) = x(t)$$

   Find the output of the system $y(t)$ for the input $x(t) = 5e^{3t}u(t)$. Assume initial rest condition.

   b. How can Fourier Series coefficients of periodic signals be used in the analysis of electrical and electronic systems? Discuss the concept of line spectrum of a periodic signal and frequency response of an LTI system. [4]

4. a. Evaluate Fourier transform of the given signal and plot its magnitude spectrum. [4]



b. Discuss the significance of the following properties of a continuous time Fourier transform in signal processing. [4]
   i. Time-shifting
   ii. Convolution
   iii. Multiplication or modulation
   iv. Time-scaling

5. a. Determine and plot the magnitude and phase spectrum of the following signal using the concept of discrete time Fourier series. [4]

$$x[n] = 1 + 2\,sin\left(\frac{\pi}{4}\right)n + 3\cos\left(\left(\frac{\pi}{4}\right)n + sin\left(\frac{\pi}{2}\right)n + cos\left(\frac{\pi}{2}n + \frac{\pi}{4}\right)\right.$$

b. Describe briefly any modern electrical or electronic system that uses sampling, analog to digital conversion, and digital to analog conversion in its signal processing. Why do we need to avoid aliasing during sampling and what is the significance of Nyquist sampling rate? [4]

6. a. Distinguish between correlation, cross-correlation and autocorrelation. [2]
   b. List some of the important properties of a discrete-time random signal. [2]
   c. How does an ideal signal mixer work? [2]
   d. List basic filter types. Illustrate their ideal frequency responses. [2]