KATHMANDU UNIVERSITY
End Semester Examination [C]
November/December, 2023

Marks Scored:

Level : B.E.		Course : EEEG 221
Year : II		Semester : II
Exam Roll No. :	Time: 30 mins.	F. M. : 10
Registration No.:		Date 07 DEC 2023

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate option.

1. Sampling is the operation used to convert ....
   a. a non-causal signal to a causal signal
   b. an analog signal to digital signal
   c. a CT signal to a DT signal
   d. a random signal to a deterministic signal

2. Is it **CORRECT** that the independent variable in the signal is always Time?
   a. Yes
   b. No
   c. No, but we assume that it is
   d. No, the dependent variable is Time

3. Every signal can be expressed as sum of its even and odd components. The odd component of the signal $x(t) = 2t^3 - t^2 - 3t - 1$ is..........
   a. $x(t) = 2t^3 - 1$
   b. $x(t) = 2t^3 - 3t$
   c. $x(t) = t^2 - 3t$
   d. $x(t) = t^2 - 3t - 1$

4. Which is the correct relationship between DT unit step and unit impulse signals?
   a. $u[n] = \sum_{k=-\infty}^{n} \delta[k]$
   b. $u[n] = \delta[n] - \delta[n-1]$
   c. $u[n] = \int_{-\infty}^{n} \delta[n]\ dn$
   d. $\delta[n] = \sum_{k=-\infty}^{n} u[k]$

5. Which of the following is not the correct property of the unit impulse signal?
   a. $\int_{-\infty}^{\infty} 2\,\delta(t)\,dt = 2$
   b. $\int_{-\infty}^{\infty} x(t)\,\delta(t-2)\,dt = x(2)$
   c. $\delta(t) = \delta(-t)$
   d. $\delta(2t) = 2\delta(t)$

6. Signals which change their values suddenly are modeled best by......
   a. unit impulse signals.
   b. unit step signals.
   c. unit ramp signals.
   d. exponential signals.

7. The Fourier transform of continuous time sinc signal is......
   a. a rectangular pulse
   b. constant
   c. a triangular pulse
   d. a sinc signal

8. A band-limited signal is sampled at twice its Nyquist rate. If the sampling frequency was 2000 Hz, the bandwidth of the signal is...........
   a. 1000 Hz
   b. 4000 Hz
   c. 2000 Hz
   d. 500 Hz

9. The homogeneous solution of a LCC differential equation is obtained using.........
   a. condition of initial rest.
   b. zero initial conditions.
   c. zero input.
   d. zero memory.

10. What will be the Fourier transform of a periodic sinusoidal function $x(t) = A\ cos(\omega_1 t)$

a. $\pi\ \delta(\omega - \omega_1) + \pi\ \delta(\omega + \omega_1)$.
b. $\pi\ \delta(\omega - \omega_1) - \pi\ \delta(\omega + \omega_1)$.
c. $\pi\ \delta(\omega - \omega_1)$
d. $\pi\ \delta(\omega + \omega_1)$

11. A real CT signal $x(t)$ has the set of FS coefficients a_k. If the signal is scaled in time to obtain $x(2t)$ with set of FS coefficients b_k, which of following statement holds correct?

a. $b_k = 2a_k$
b. $b_k = \frac{1}{2} a_k$
c. $b_k = a_{2k}$
d. $b_k = a_k$

12. For a power signal, the total energy is......

a. zero
b. constant
c. infinite
d. finite

13. Which of the following does not essentially involve filters?

a. noise removal
b. amplification
c. multiplexing
d. equilization

14. The signal processing used in up conversion and down conversion is......

a. sampling
b. mixing
c. filtering
d. convoluting

15. The frequency response of an ideal reconstruction system is.........

a. rectangular pulse
b. triangular pulse
c. sinc function
d. impulse function

16. Butterworth filter has ....ripples in its pass band.

a. infinite
b. N half
c. N full
d. zero

17. Aliasing is the phenomenon that appears when.........

a. sampling rate is larger than Nyquist rate
b. sampling rate is just equal to the Nyquist rate
c. sampling rate is smaller than the Nyquist rate
d. signal is not bandlimited

18. As the fundamental period of the periodic signals become larger and larger, the spectral coefficients are ....

a. farther separated in frequency axis
b. nearer in frequency axis
c. not changed in frequency
d. at same separation but different values

19. Correlation is the operation used for......

a. finding the output of the system
b. hanging the frequency band of the signal
c. finding the similarity between the systems
d. removing the noise from the signal

20. The A 50 kΩ resistor at 290 K with bandwidth of interest 3kHz has noise voltage equal to...

a. $1.2 \times 10^{-17} V$
b. $4.9\ pV$
c. $1.2\ nV$
d. $49\ nV$

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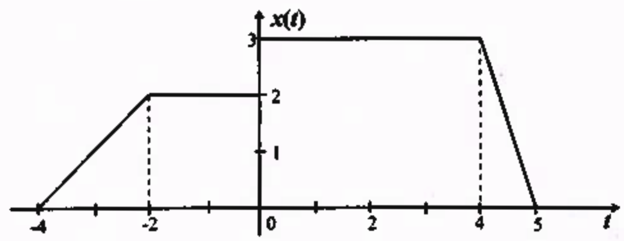
Course : EEEG 221
Semester : II
F. M. : 40

SECTION "B"
[5 Q. × 8 = 40 marks]

Attempt *ANY FIVE* questions. Symbols and abbreviations have usual meanings. Assume suitable values for missing data.

1. a. Given the CT signal below, find and sketch the following: [3]

   i) $x(-2-0.5t)$
   ii) $x(4-2t)$
   iii) $x(t-3)u(t)$



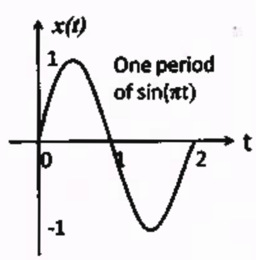
   b. Define following signal classifications with figures and examples [3]
      i) Odd-even signals
      ii) CT and DT signals

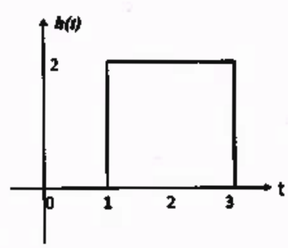
   c. Define the requirement for a system to be called '*linear*'. Check if the system represented by following input output equation is linear or not. [2]

$$y[n] = 2x[n] - 3$$

2. a. State and prove the commutative and associative properties of convolution. Hence explain their consequences in analysis of LTI systems. [3+1]

   b. Determine and sketch (approximate) the convolution of the following two signals: [4]

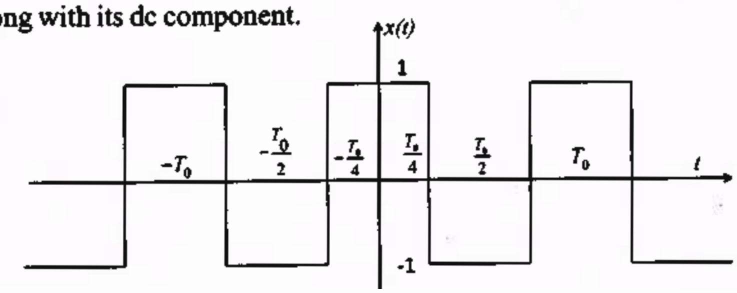




3. a. State and prove the convolution property of CTFT. [2]

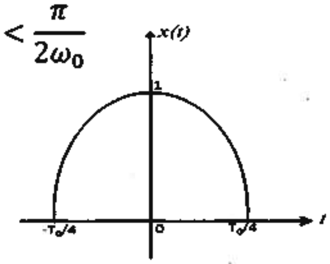
   b. What do you understand by Gibb's phenomena in CTFS? [2]

   c. A periodic rectangular pulse train is shown in figure below. Compute the expression for its exponential Fourier series coefficients. Also compute the values of first two coefficients along with its dc component. [4]



4. a. A cosine pulse is shown below. Find the Fourier transform of the pulse. [3]

$$x(t) = \begin{cases} Cos\omega_0 t, & -\frac{\pi}{2\omega_0} < t < \frac{\pi}{2\omega_0} \\ 0, & otherwise \end{cases}$$



b. LTI systems may possess different properties. Derive and explain the conditions for a LTI system to be memoryless, causal, and stable. Use relevant examples. [3]

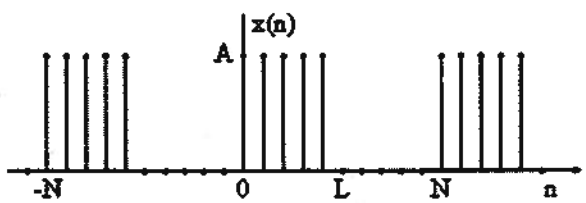
c. What is the significance of Parseval's relation? Explain ESD and PSD. [2]

5. a. A pulse in frequency domain is defined as below: [3]

$$X(j\omega) = \begin{cases} 2, & -\frac{W}{2} < \omega < \frac{W}{2} \\ 0, & elsewhere \end{cases}$$

Using the definition of Fourier transform and inverse Fourier transform, obtain the signal $x(t)$whose Fourier transform is $X(j\omega)$.

b. A DT periodic pulse train is shown in figure below. Find its DTFS coefficients for L=6, N=12 and A=2. [3]



c. What is signal mixing? Where is it done? [2]

6. a. CT signals can be represented by its samples if the sampling satisfies the Nyquist criteria. State, derive and explain the Nyquist criteria for sampling baseband signals. [3]

b. Define signal energy and power. Compute the total energy of the DT signal $x[n] = \begin{cases} 1, & 0 \le n \le 5 \\ 0, & otherwise \end{cases}$ [2]

c. Explain different types of filter based on its frequency responses. Use figures and expressions when needed. [3]