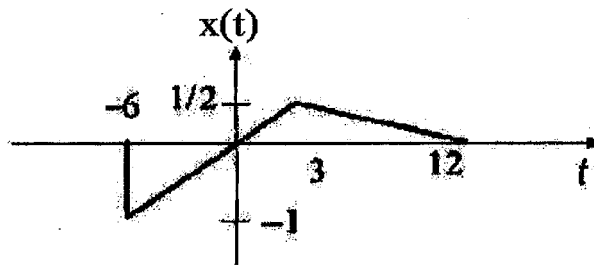


BETCE SUPPLEMENTARY EXAMINATION, 2024**(2nd Year 1st Semester)****Signals and Systems****Full Marks: 100****Time: 3 hours**

*Answer all the questions under a particular CO in the same place.
Also, write the answers of all parts of a question in the same place*

CO-1
(Marks: 25)

Q1. a) For the given signal below, sketch $x(2t-4)$. [3]



b) Sketch the following signal:

$$f(t) = r(t) - 2r(t-1) + 2r(t-3) - r(t-4).$$

Sketch each part of $f(t)$ by mentioning its slope and then combine all parts to get $f(t)$. [6]

c) Can a signal be both energy signal as well as power signal? Explain. [2]

d) Given, $x(t) = 2\cos(10t + 1) - \sin(4t - 1)$. Find, whether the given signal $x(t)$ is periodic or not. If periodic, then find the time period of the signal. [4]

Q2. a) How will you determine the energy of a signal through Parseval's theorem? [6]

b) The correlation coefficient of two signals is "-1". What does it signify? If the correlation coefficient of two signals is "0", how will you modify your explanation? Explain with suitable diagrams. [4]

CO-2
(Marks: 15)

Q3. a) If $X(\omega)$ is the Fourier transform of a signal $x(t)$, then find the Fourier transform of $x(t+T) + x(t-T)$. [5]

[Turn over

- b) Find the Exponential Fourier series for the signal $g(t) = e^{-t/2}$ over the interval $0 \leq t \leq \pi$ and draw its corresponding spectra. [7+3]

CO-3
(Marks: 10)

- Q4.** a) What do you mean by Aliasing effect? Explain with proper diagrams. [4]
b) How can you handle this problem with the help of an Anti-aliasing filter? Draw necessary diagrams in the favour of this. [4]
c) Considering a sinusoidal baseband signal and a period train of impulses as the carrier signal, draw the waveform of Pulse Amplitude Modulated (PAM) signal. [2]

CO-4
(Marks: 15)

- Q5.** a) Determine if the following system described by $y(n) = x(n) + n x(n+1)$ is [2+2+3+3]

- i) Static
ii) Causal
iii) Linear
iv) Time-invariant

- b) Sketch the block diagram of the discrete-time system described by the difference equation that relates the output $y(n)$ and the input $x(n)$ as follows:

$$y(n) - 2y(n-1) = x(n) + 3x(n-1) \quad [5]$$

CO-5
(Marks: 10)

- Q6.** a) A random variable X follows the distribution as stated below:

$$F(x) = \begin{matrix} x/15 & x = 1, 2, 3, 4, 5 \\ 0 & \text{elsewhere} \end{matrix}$$

Find the mean and variance of X . [6]

- b) Differentiate between Ensemble Average and Time Average. [4]

CO-6
(Marks: 25)

- Q7.** Consider that noise can be represented as the superposition of noise spectral components. Also consider that $n_k(t)$ is the spectral component associated with k^{th} frequency interval as described by $n_k(t) = a_k \cos 2\pi k \Delta f t + b_k \sin 2\pi k \Delta f t$.

- a) Show that a_k and b_k are uncorrelated to each other at k^{th} frequency interval as well as with a_l and b_l associated with l^{th} frequency interval. [9]

b) Show that a_k and b_k are Gaussian random variables. [6]

Q8. a) Consider a cascade of two amplifier stages where A_1 is the gain and R_1 is the total input noise resistance of the first stage; A_2 is the gain and R_2 is the total input noise resistance of the second stage and R_3 is the output resistance. Calculate the equivalent resistance of the cascaded amplifier. [7]

b) Explain the term “AWGN” [3]