

BETCE SUPPLEMENTARY EXAMINATION, 2023

(2nd Year 1st Semester)

Signals and Systems

Full Marks: 100

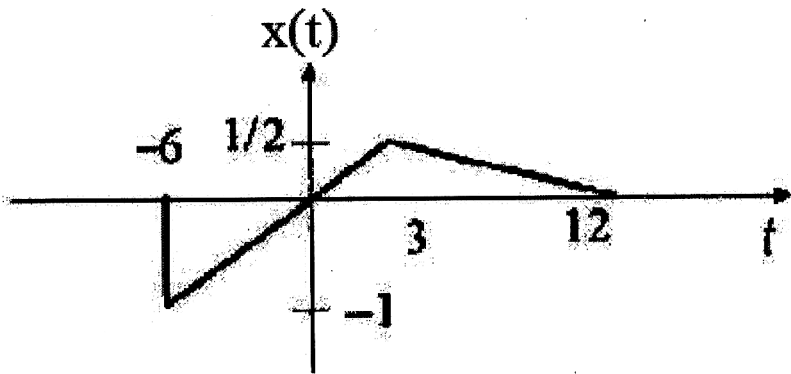
Time: 3 hours

Answer all the questions of a unit in the same place. Also, write answers of all parts of a question in the same place

Unit-1

(Marks: 25)

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



b) Determine whether or not the signal $(1+e^{-5t})u(t)$ is energy/power signal. [4]

c) Find even and odd components of the signal $x(t) = \cos t + \sin t + \cos t \sin t$ [4]

d) Given, $x(t) = \cos[(1/3)t] + \sin[(1/4)t]$. Find whether the given signal $x(t)$ is periodic or not. If periodic, find the time period of the signal. [4]

Q2. a) Prove that time domain convolution between two signals leads to frequency domain multiplication. [6]

b) The correlation coefficient of two signals is “-1”. What does it signify? Explain with a suitable diagram. [4]

Unit-2

(Marks: 15)

Q3. a) Find the Fourier transform of the following signal:

$$x(t) = (1/2)[\delta(t+1) + \delta(t+0.5) + \delta(t-0.5) + \delta(t-1)] \quad [5]$$

[Turn over

- b) A signal $g(t)$ has been multiplied by a sinusoid of frequency ω_0 . [4+2]
- i) What happens to the resulting signal? Explain with necessary mathematical expressions and diagrams.
- ii) Does this phenomenon have any special significance in communication systems?
- c) How is trigonometric Fourier series related to exponential Fourier series? [4]

Unit-3

(Marks: 10)

- Q4.** a) Considering a sinusoidal baseband signal and a period train of impulses as the carrier signal, draw the waveforms of Pulse Width Modulated (PWM) signal and Pulse Position Modulated (PPM) signal. [5]
- b) A waveform $(\sin 200\pi t + \sin 1000\pi t)$ is to be sampled periodically and reproduced from these samples. Find the maximum allowable time interval between sample values. How many sample values are required to be stored in order to produce 1 sec of this waveform. [5]

Unit-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) Find the odd and even components of the following signal $x(n) = \{1, 0, -1, 2, 3\}$ where, “n” lies in the range $[0, 4]$ and the sequence starts with the sampled value for $n=0$. [5]

Unit-5

(Marks: 10)

- Q6.** a) If $f(x) = 2(1+x)^2 \quad 0 < x < 1$
 $= 0 \quad \text{elsewhere}$

is the Probability Density Function (PDF) of a random variable X , find $E[6X+3X^2]$ where $E[X]$ is the expectation of X . [6]

- b) Differentiate between ensemble average and time average of a random process. [4]

Unit-6**(Marks: 25)**

- Q7.** a) 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 $n_k(t) = a_k \cos 2\pi k \Delta f t + b_k \sin 2\pi k \Delta f t$. Develop the statistical model of noise with the help of necessary mathematical derivations. [15]
- b) Consider a cascade of two amplifiers. The first amplifier has a power gain of G_1 and Noise Figure of F_1 . For the second amplifier, these values are G_2 and F_2 respectively. Calculate the Overall Noise Figure of the cascade. [6]
- c) Explain the term AWGN [4]