EX/ET/T/213/2019

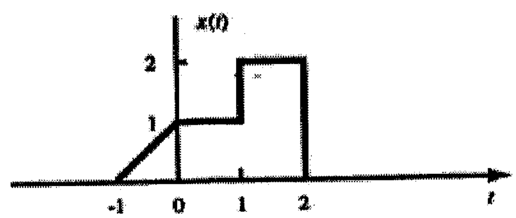
BETCE EXAMINATION, 2019
(2^{nd} Year 1^{st} Semester)
Signal Theory and Noise

Time: Three hours | Full Marks: 100

Answer all the questions of a unit in the same place

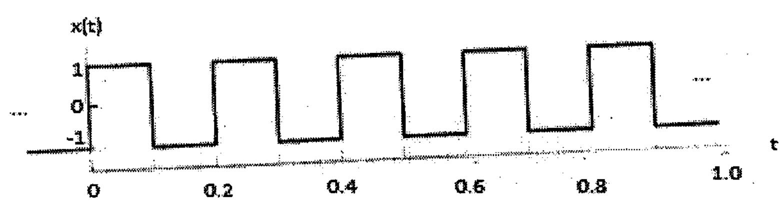
Unit-1
Answer any two questions (2x15)

1. a) For the continuous-time signal x(t) shown below, sketch the following signals: (3+3)
i) x(t) u(1-t)
ii) x(t) [u(t) – u(t-1)]

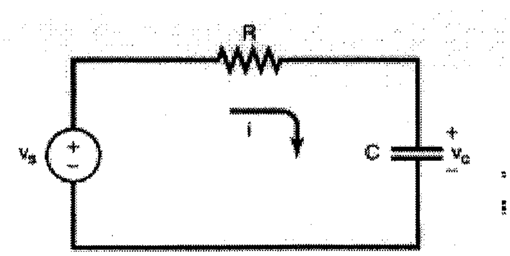


b) Find the even and odd components of the signal $x(t) = (1 + t^3) \cos^3 (10t)$. (1.5+1.5)

c) Determine the power of the wave shown below: (2)



d) Check the causality of the system described below: (2)



e) Evaluate $\int_0^{2\pi} t \sin(t/2)\, \delta(\pi - t)\, dt$ (2)

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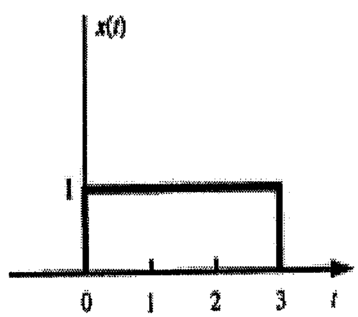
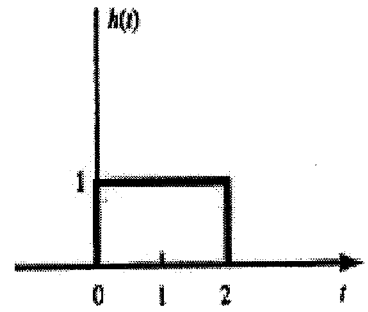
2. a) Compute the output y(t) for a continuous time LTI system whose impulse response h(t) and input x(t) are given below. (You can use either analytical technique or graphical method). (8)

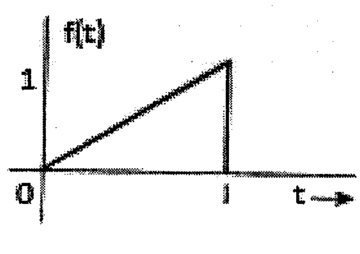


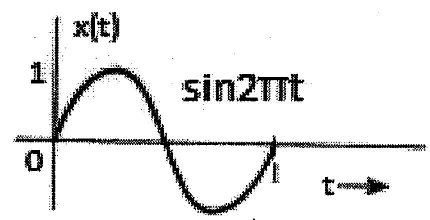


b) Sketch the waveform of the following signal: (4)

$x(t) = u(t+1) - 2u(t) + u(t-1)$

c) Find the optimum value of "c" in the approximation $f(t) \approx cx(t)$, where f(t) and x(t) are shown below: (3)





3. a) Define the time autocorrelation function of a signal. How does the autocorrelation operation differ from the convolution operation? State the significance of autocorrelation function in signal detection. (2+1+2)

b) Why is it necessary to define the essential bandwidth of a signal? (2)

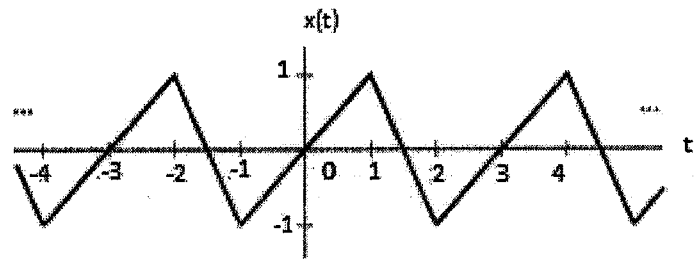
c) Find the essential bandwidth "B" of the signal $x(t) = 1/(t^2 + a^2)$, which will contain 99% of the total signal energy. (4)

d) Define interpolation or filtering function. State the significance of this function in signal processing operation. (3+1)

Unit-2

Answer any one question (1x15)

4. a) Use the defining equation for the Fourier series coefficients to evaluate the Fourier series representation of the following signal: (8)



b) Find the Inverse Fourier transform of $X(\omega) = 1/\,(2 - \omega^2 + j3\,\omega)$ (5)

c) Identify the interconnection between the Trigonometric Fourier spectra and Exponential Fourier spectra. (2)

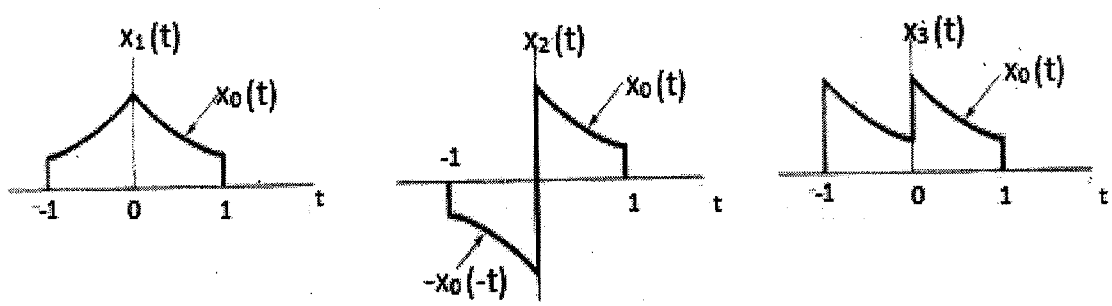
5. a) Explain the significance of the following properties of Fourier transform: (3+4)

i) Time shifting property

ii) Frequency shifting property

b) Determine the Fourier transform of each of the following signals using only transform of $x_0(t)$ and properties of Fourier transform where $x_0(t)$ is defined as: (8)

$$x_0(t) = \begin{cases} e^{-t} & 0 \le t \le 1 \\ 0 & \text{elsewhere} \end{cases}$$



Unit-3
Answer the following question (1x15)

6. a) Consider that a practical signal has been sampled at a Nyquist rate. It is desired to reconstruct the signal from its sampled version. Explain with necessary diagrams, how the phenomenon of aliasing occurs in this respect. How can this situation be handled by using an anti-aliasing filter? (4+4)

b) What do you mean by pulse modulation? State the significance of pulse modulation in communication system. (1.5+1.5)

c) Draw the neat sketch of a pulse position modulated signal. State one advantage and one disadvantage related to this modulation technique. (2+2)

Unit-4
Answer the following question (1x10)

7. a) Define the term Ensemble average related to a random process. How does Time average differ from the Ensemble average? (2.5+2.5)

b) In general, the Ensemble average is not equal to the Time average-justify this statement with suitable example. (5)

Unit-5
Answer the following question (1x30)

8. a) i) Discuss how atmospheric noise and thermal noise are generated. (3+4)
ii) How will you define white noise? (3)
iii) Calculate the equivalent noise resistance of a cascade of two amplifier stages. (5)

b) i) Assume that an integrator is placed before the demodulator to restrict noise from entering the system. Calculate the noise power present at the output of this integrator when the input noise is assumed to be white in nature. (5)

c) Consider that noise is a random process and represented as the superposition of the noise spectral components. Describe the statistical behavior of noise with the help of necessary mathematical derivations. (10)