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10EE52

Fifth Semester B.E. Degree Examination, June/July 2018
Signals and Systems

Time: 3 hrs.

Max. Marks:100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART - A

- 1 a. Sketch the even and odd components of the following signals.

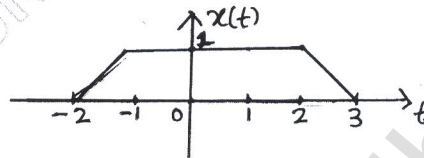


Fig Q1 a (i)

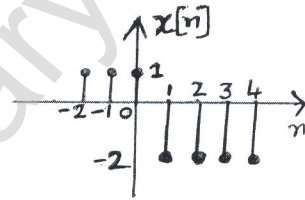


Fig Q1 a (ii)

(08 Marks)

- b. A continuous time signal $x(t)$ shown below. Draw the signal $y(t) = \{x(t) + x(2-t)\}u(1-t)$

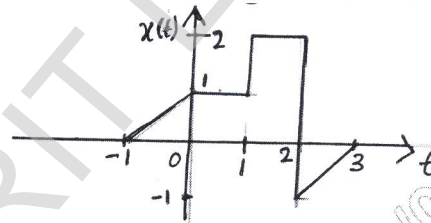


Fig Q1 (b)

(06 Marks)

- c. i) What is the average power of the triangular wave shown below?
ii) For the trapezoidal pulse shown below, find the total energy.

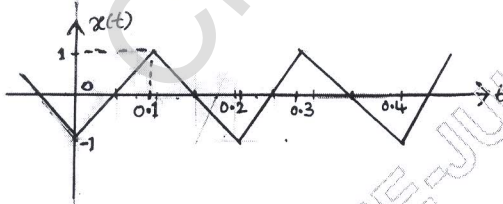


Fig Q1 c (i)

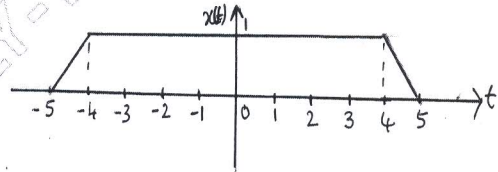


Fig Q1 c (ii)

(06 Marks)

- 2 a. Derive an expression for convolution sum. (06 Marks)
b. If $h(t) = u(t) - u(t - 3)$ and $x(t) = u(t) - u(t - 1)$, determine the output $y(t) = x(t) * h(t)$. (10 Marks)
c. Determine the convolution of the two sequence $x[n] = \{1, 2, 3, 4\}$ and $h[n] = \{1, 1, 3, 2\}$. (04 Marks)
- 3 a. Two LTI systems whose impulse responses are given by $h_1(t) = e^{-2t} u(t)$ and $h_2(t) = e^{-t} u(t)$ are connected in cascade. Find the overall impulse response $h(t)$ and check for stability. (06 Marks)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

- b. Find the natural and forced responses of the system described by the differential equation.

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t) + \frac{dx(t)}{dt}$$
 With $y(0) = 0$, $\left.\frac{dy(t)}{dt}\right|_{t=0} = 1$, $x(t) = 5u(t)$. (08 Marks)
- c. Draw the direct form I and direct form II for LTI system described by the difference equation $y[n] + \frac{1}{2}y[n-1] - \frac{1}{3}y[n-3] = x[n] + 2x[n-2]$ (06 Marks)
- 4 a. State and prove frequency and time shift properties of Fourier series. (08 Marks)
- b. Determine the DTFS representation for the sequence $x[n] = \cos^2\left[\frac{\pi}{4}n\right]$ (06 Marks)
- c. Find the Fourier series coefficient of the signal $x(t)$ shown below and draw its spectra.

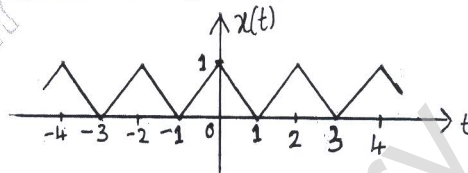


Fig Q4(c)

(06 Marks)

PART - B

- 5 a. State and prove convolution property of the Discrete Time Fourier Transform (DTFT). (06 Marks)
- b. Find DTFT of the sequence $x[n] = a^{|n|}$; $|a| < 1$. (04 Marks)
- c. Using appropriate properties, Find the DTFT of the signal $x[n] = \sin\left[\frac{\pi}{4}n\right] \left[\frac{1}{4}\right]^n u[n-1]$. (10 Marks)
- 6 a. State and prove Time differentiation and Frequency differentiation properties of the Fourier Transform (FT). (08 Marks)
- b. Find the Fourier Transform of the following : (06 Marks)
- i) $x(t) = e^{-3t}u(t-1)$ ii) $x(t) = t e^{-2t} u(t)$
- c. Find the Fourier Transform of the following signal using appropriate properties $x(t) = \sin(\pi t)e^{-2t} u(t)$. (06 Marks)
- 7 a. What is Region of Convergence (ROC)? List the properties of ROC. (06 Marks)
- b. Determine the z - Transform of the following : (08 Marks)
- i) $x[n] = \left[\frac{1}{3}\right]^n \sin\left[\frac{\pi}{4}n\right] u[n]$ ii) $x[n] = \left[\frac{1}{2}\right]^{|n|}$
- c. Using appropriate properties, find the z-transform of $x[n] = n\left[\frac{1}{2}\right]^n u[n-3]$. (06 Marks)
- 8 a. Solve the following difference equation using unilateral z-transform.

$$y[n] - \frac{3}{2}y[n-1] + \frac{1}{2}y[n-2] = x[n], n > 0$$
 With initial conditions $y[-1] = 4$, $y[-2] = 10$
 and $x[n] = \left[\frac{1}{4}\right]^n u[n]$. (10 Marks)
- b. If a system is described by the following equation $y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = x[n]$,
 Find the impulse response and step response. (10 Marks)