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10EE52

Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. What is continuous time and discrete time signals? Explain, with examples. **(04 Marks)**

b. Sketch and label for each of the following for the given signal x(t) shown in Fig.Q1(b). **(08 Marks)**

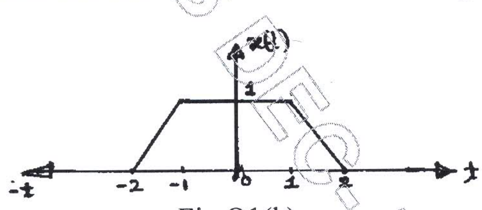


Fig.Q1(b)

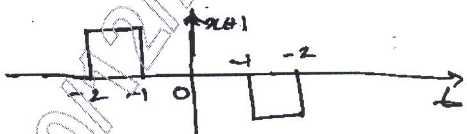


Fig.Q1(c)

i) $x(2t + 3)$ ii) $x(-3t + 2)$ iii) $x(2(t/3 - 1))$.

c. For the signal x(t) shown in Fig.Q1(C) find the energy in that signal. **(04 Marks)**

d. A system has an input x(t) and corresponding output is $y(t) = \frac{d}{dt}\left\{e^{-t}x(t)\right\}$ determine whether the system is : i) memoryless ii) stable iii) causal iv) linear v) time invariant. **(04 Marks)**

2 a. A system is characterized by impulse response $h(t) = \delta(t) - \delta(t - 1)$. Determine the step response and sketch that. **(06 Marks)**

b. Using convolution integral, determine output of LTI system for input $x(t) = e^{-at};\ 0 \le t \le T$ impulse response $h(t) = 1;\ 0 \le t \le 2T$. **(08 Marks)**

c. Check whether the system whose impulse response is $h(t) = e^{-t}\, u(t - 1)$ is stable, memory less and causal. **(06 Marks)**

3 a. Determine the output of the system described by the following differential equation with input and initial conditions specified.

$$\frac{d^2}{dt^2}y(t) + 6\frac{d}{dt}y(t) + 8y(t) = 2x(t),\ y(0^-) = -1,\ \left.\frac{d}{dt}y(t)\right|_{t=0} = 1,\ x(t) = e^{-t}u(t).$$ **(10 Marks)**

b. Draw direct Form – I and Form – II implementation for the following difference equations :

i) $y[n] - \frac{1}{9}y[n - 2] = x[n - 1]$

ii) $y[n] + \frac{1}{2}y[n - 1] - y[n - 3] = 3x[n - 1] + 2x[n - 2]$. **(10 Marks)**

4 a. What are the conditions that x(t) should satisfy to have Fourier series? **(04 Marks)**

b. Find the complex Fourier co-efficient x(k) for the given x(t) in Fig.Q4(b). Draw the amplitude and phase spectra of x(k). **(11 Marks)**

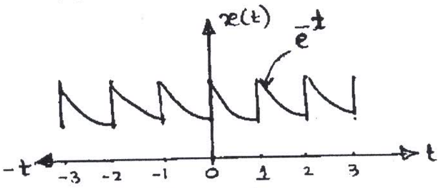


Fig.Q4(b)

c. Determine the complex exponential Fourier series representation of the following signals.

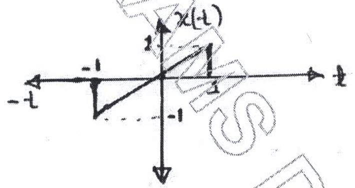
i) $x(t) = \cos \omega_0 t$ ii) $x(t) = \sin \omega_0 t$. **(05 Marks)**

PART – B

5 a. Find the Fourier transform of the following signals.

i) $x(t) = e^{-2t}u(t-1)$

ii)



iii) $x(t) = u(t+1) - u(t-1)$. **(15 Marks)**

b. Prove that differentiation in time domain is equal to multiplication of $X(\omega)$ by $j\omega$ in the frequency domain. **(05 Marks)**

6 a. Use the properties and table of transforms to find discrete time Fourier transformer [DTFT] of :

i) $x[n] = (\frac{1}{3})^n u(n+2)$

ii) $x[n] = (n-2)[u(n+4) - u(n-5)]$. **(10 Marks)**

b. A causal discrete time LTI system is described by $y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = x[n]$. Determine the frequency response and impulse response of the system. **(10 Marks)**

7 a. Determine the z–transform, the ROC and locations of pole zero of x(z) for the following signals :

i) $x[n] = -(\frac{1}{2})^n u(-n-1) - (\frac{1}{3})^n u(-n-1)$

ii) $x[n] = -(\frac{3}{4})^n u(-n-1) + (-\frac{1}{3})^n u(n)$. **(10 Marks)**

b. Use the properties of z – transforms to determine x(z) for the given signal :

i) $a^{n+1}u(n+1)$

ii) $n\,a^{n-1}u(n)$

iii) $a^{-n}u(-n)$

Name the property used in each. **(10 Marks)**

8 a. Use the method of partial fraction expansion to find inverse – z transform of given X(z)

$$X(z) = \frac{1 + \frac{7}{6}z^{-1}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 + \frac{1}{3}z^{-1}\right)}$$ with following conditions : i) $|z| > \frac{1}{2}$ ii) $|z| < \frac{1}{3}$ iii) $\frac{1}{3} < z < \frac{1}{2}$.

(10 Marks)

b. For the given difference equations and associated input and initial conditions determine the output y[n].

$3y[n] - 4y[n-1] + y[n-2] = x[n]$

With $x[n] = (\frac{1}{2})^n$ and $y[-1] = 1$, $y[-2] = 2$. **(10 Marks)**

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