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10EE52

Fifth Semester B.E. Degree Examination, Dec.2015/Jan.2016
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

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.

PART – A

1 a. Define signals and systems. Explain classification of signals. **(06 Marks)**

b. State whether the following signals given are periodic or not. If periodic, find the fundamental period:

i) $x[n] = \cos\left(\frac{\pi n}{2}\right) + \sin\left(\frac{\pi n}{4}\right)$

ii) $x(t) = \cos(2\pi t).\sin(4\pi t)$ **(06 Marks)**

c. Consider the system whose output is $y(t) = \cos\omega_c + x(t)$. Determine whether it is:

i) memoryless ii) causal iii) linear

iv) time invariant v) stable **(08 Marks)**

2 a. The impulse response of a linear time invariant system is $h[n] = \{1, -\underset{\uparrow}{1}, 1, -1\}$. Determine the response of the system to the input signal $x[n] = \{1, \underset{\uparrow}{2}, 3, 1\}$. **(06 Marks)**

b. Compute y[n] in the Fig.Q2(b). Given $h_1[n] = \left(\frac{1}{2}\right)^n u[n]$, $h_2[n] = u[n-2]$, $h_3[n] = \delta[n] + \delta[n-1]$.

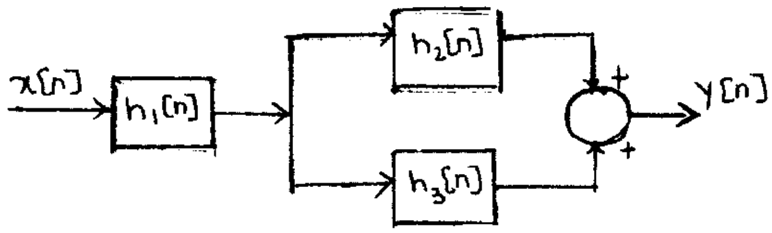

Fig.Q2(b) **(06 Marks)**

c. Let the impulse response of a LTI system be $e^{-2(t+1)}u(t+1)$. Find the output y(t) if the input is u(t). Also plot y(t). **(08 Marks)**

3 a. Determine the conditions so that the continuous time system with impulse response $h(t) = e^{at}u(-t)$ is stable. Also find out whether the system is (i) causal, (ii) memoryless. **(06 Marks)**

b. Represent the differential equation given below in direct form I and II:

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = \frac{d^2x(t)}{dt^2} + \frac{dx(t)}{dt}$$ **(06 Marks)**

c. Find the zero input response (ZIR) and forced response for the system described by the difference equation: $y[n] - \frac{1}{4}y[n-2] = 2x[n] + x[n-1]$. Given x[n] = u[n]; y(-2] = 8; y[-1] = 0. **(08 Marks)**

4 a. State and prove Parseval's theorem in Continuous Time Fourier Series (CTFS). **(06 Marks)**

b. Find the complex Fourier coefficient for the periodic waveform shown in Fig.Q4(b).

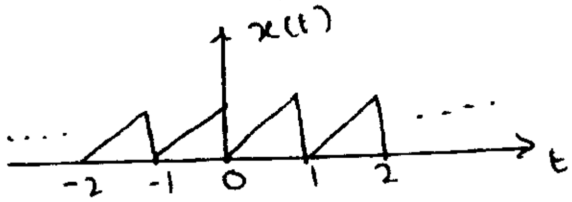

Fig.Q4(b) **(06 Marks)**

c. Determine the Fourier coefficient for the periodic sequence x[n] shown in Fig.Q4(c).

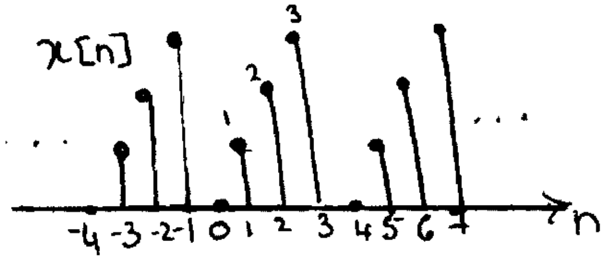

Fig.Q4(c) **(08 Marks)**

PART – B

5 a. State and prove the following properties in continuous time Fourier transform:

i) Time shifting

ii) Differentiation in time **(06 Marks)**

b. Given that x(t) has the Fourier transform $X(j\omega)$, express the Fourier transform of the signals listed below in terms of $X(j\omega)$.

i) $x_1(t) = x(t-1) + x(-2-t)$

ii) $x_2(t) = x(6-3t)$

iii) $x_3(t) = \dfrac{d^2x(t-4)}{dt^2}$ **(06 Marks)**

c. The differential equation of a system is given by,

$$\frac{d^2y(t)}{dt^2} + \frac{3dy(t)}{dt} + 2y(t) = \frac{dx(t)}{dt}.$$

Find out the frequency response of the system. Also find the impulse response. **(08 Marks)**

6 a. Find the Fourier transform of the rectangular pulse given below:

$$x[n] = 1 \quad \text{for} \quad -2 \le n \le 2$$
$$= 0 \quad \text{otherwise}$$

Also obtain the magnitude plot. **(06 Marks)**

b. Use DTFT properties to find the Fourier transform of the following signals:

i) $x_1[n] = (n-5)\,u(n-5) - u(n-6)$

ii) $x_2[n] = \left(\frac{1}{3}\right)^n u[n-3]$ **(06 Marks)**

c. Using DTFT, find the total solution to the difference equation for discrete time $n \ge 0$, $5y[n+2] - 6y[n+1] + y[n] = (0.8)^n u[n]$. **(08 Marks)**

7 a. Define Region of Convergence (ROC) in Z transforms and list out any five properties of ROC. (06 Marks)

b. Using the properties of Z transform, find the Z transform of these signals:

i) $x_1[n] = n\left(\frac{5}{8}\right)^n u[n]$

ii) $x_2[n] = (0.9)^n u[n] * (0.6)^n u[n]$

iii) $x_3[n] = \left(\frac{2}{3}\right)^n u[n+2]$ (06 Marks)

c. Find the inverse Z transform of $X(z) = \frac{z}{2z^2 - 3z + 1}$.

i) By partial fraction method for $|z| < \frac{1}{2}$.

ii) By power series expansion method for $|z| > 1$. (08 Marks)

8 a. Using the basic definition of z transform and linearity property of z transform, find the z transform of $x[n] = a^{|n|}$ for $0 < a < 1$. Also give its ROC. (06 Marks)

b. A linear LTI system is characterized by the system function $H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$. Determine h[n] for system is (i) stable, (ii) causal. (06 Marks)

c. Determine the output of the system y[n], for the system described by the difference equation $y[n] + 3y[n-1] = x[n] + x[n-1]$ if the input is $x[n] = \left(\frac{1}{2}\right)^n u[n]$ and y(-1) = 2 is the initial condition. (08 Marks)

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