USN

10EE52

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020

Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Find the even and odd parts of the signal, $x(t) = \text{Cos}(t) + \text{Sin}(t) + \text{Sin}(t)\text{Cos}(t)$ **(04 Marks)**

b. Find whether the following signals are periodic or not. If periodic determine the fundamental period.

i) $x(n) = \text{Sin}\left(\frac{6\pi n}{7} + 1\right)$

ii) $x(t) = V(t) + V(-t)$ where $v(t) = \text{Cos}(t)\,u(t)$ **(06 Marks)**

c. Check whether the following signal is energy or power signal and find the corresponding value $x(t) = \begin{cases} t, & \text{for}, 0 \le t \le 1 \\ 2-t & \text{for}, 1 \le t \le 2 \\ 0 & \text{otherwise} \end{cases}$ **(04 Marks)**

d. For the signal x(t) shown in Fig Q1(d) (i) x(3t + 2) (ii) $x\left(-\frac{t}{2}+1\right)$ (iii) x(2(t – 1))

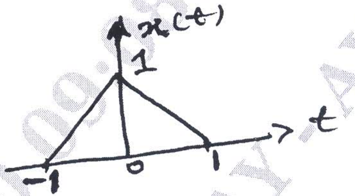

Fig Q1(d) **(06 Marks)**

2 a. The impulse response of a Linear time invariant system is given by h(n) = δ(n + 1) +2δ (n – 1) – δ(n – 2) + δ(n – 3). Determine the response of the system for the input x(n) = u(n) – u(n – 3) **(06 Marks)**

b. Determine the output y(t) of a linear time invariant system with impulse response $h(t) = e^{-2t}u(t)$ and input x(t) = u(t + 2). **(08 Marks)**

c. Find the expression for the impulse response relating the input to the output in terms of the impulse response of each subsystem for linear time invariant system shown in Fig Q2(c)

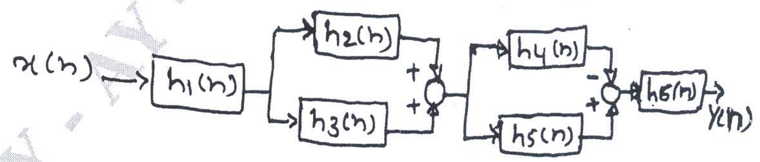

Fig Q2(c) **(06 Marks)**

3 a. For each Impulse response given below determine whether the corresponding system is memoryless, causal and stable.
   i) $h(t) = u(t+1) - 2u(t-1)$
   ii) $h(n) = e^{2n}\,u(n-1)$. **(06 Marks)**

b. Determine the output of the system described by the following differential equation

$$\frac{d}{dt}y(t) + 10y(t) = 2x(t)$$

Given x(t) u(t) and y(0) = 1. **(08 Marks)**

c. Draw the direct form – I and direct form – II implementations for difference equation

$$y(n) - \frac{1}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + x(n-1) + \frac{1}{2}(n-2)$$ **(06 Marks)**

4 a. State and prove the following properties of Discrete Time Fourier series (i) Linearity (ii) Time Shift. **(06 Marks)**

b. Determine the D.T.F.S co-efficient to evaluate D.T.F.S representation of the following signal. Sketch the magnitude and phase spectra. $x(n) = (-1)^n, -\infty \le n \le \infty$ **(08 Marks)**

c. Determine the complex exponential Fourier co-efficient for the signal $x(t) = \sin(2\pi t) + \cos(3\pi t)$. Also sketch magnitude and phase spectra. **(06 Marks)**

PART – B

5 a. State and prove the following properties of Fourier transform.
(i) Frequency shift (ii) Time differentiation. **(06 Marks)**

b. Find the Fourier transform of the signals. (i) $x(t) = t\,e^{-2t}u(t)$ (ii) $x(t) = e^{at}u(-t)$ **(08 Marks)**

c. Find the inverse Fourier transform of $X(jw) = \dfrac{(5jw+12)}{((jw)^2 + 5jw + 6)}$. Using partial fraction expansion. **(06 Marks)**

6 a. Find the D.T.F.T of the following (i) $x(n) = \left(\frac{1}{2}\right)^{n-2} u(n-2)$ (ii) $x(n) = \delta(n)$. **(06 Marks)**

b. Find the inverse D.T.F.T of $X(e^{j\Omega}) = \dfrac{6}{(e^{-j2\Omega} - 5e^{-j\Omega} + 6)}$ **(06 Marks)**

c. Determine the frequency response and impulse response for the system described by the difference equation, $y(n) + \frac{1}{2}y(n-1) = x(n) - 2x(n-1)$ **(08 Marks)**

7 a. Find the z-transform of the following
   i) $x(n) = \left(\frac{1}{2}\right)^n u(n) + \left(\frac{1}{3}\right)^n u(-n-1)$
   ii) $x(n) = \left(\frac{1}{2}\right)^n u(n-2)$
   iii) $x(n) = n^2 u(n)$ **(12 Marks)**

b. Find the inverse z-transform of the following using partial fraction expansion method.
   i) $X(z) = \dfrac{1}{1 - z^{-2}}, |z| < 1$
   ii) $X(z) = \dfrac{8z^2 + 4z}{4z^2 - 4z + 1}, |z| > \dfrac{1}{2}$ **(08 Marks)**

8 a. Determine the transfer function and impulse response of the system described by the following difference equation

$$y(n)-\frac{1}{2}y(n-1)=2x(n-1)$$ **(06 Marks)**

b. A system is described by the following difference equation

$$y(n)-\frac{1}{4}y(n-2)=6x(n)-7x(n-1)+3x(n-2)$$

Find the transfer function. Also find the transfer function of the inverse system and check whether the inverse system is both stable and causal. **(06 Marks)**

c. Solve the following difference equation using z-transform method.

$y(n) + 3y(n-1) = x(n)$ with input $x(n) = u(n)$ and the initial condition $y(-1) = 1$. **(08 Marks)**

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