USN ☐☐☐☐☐☐☐☐☐☐ **10EE52**

Fifth Semester B.E. Degree Examination, June/July 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 the following with examples i) Signals and Systems ii) Power and Energy Signals **(05 Marks)**

b. A continuous time signal is described by

$$X(t) = \begin{cases} t; & 0 \le t \le 1 \\ 2-t; & 1 \le t \le 2 \end{cases}$$

Sketch even and odd component of the signal. **(05 Marks)**

c. A continuous time signal x(t) is shown in Fig Q1(c). Plot the following signals

i) $x[-2(t+1)]$ ii) $x\left(\frac{t}{2}+1\right)$ iii) $x(-2t-1)$

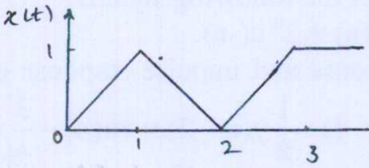

Fig. Q1(c)

(06 Marks)

d. Check whether sequence y(t) = log x(n) is Linear, Time invariant, Memory, causal and stable? **(04 Marks)**

2 a. Given input $x(n) = u(n) - u(n-3)$ and impulse response $h(n) = [1, \underset{\uparrow}{3}, 2, -1, 1]$. Determine the response y(n) using convolution sum. **(06 Marks)**

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

c. Determine the range of 'a' and 'b' for which the LTI system with impulse response

$$h(n) = \begin{cases} a^n; & n \ge 0 \text{ is stable} \\ b^n; & n < 0 \text{ is stable} \end{cases}$$

(02 Marks)

d. Check whether the system whose impulse response is $h(t) = e^{-t}\, u(t-1)$ i) Stable, Memory less and causal. **(04 Marks)**

3 a. Determine the complete response of system whose difference equation is $y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$ with input $x(n) = 2^n u(n)$ and initial conditions $y(-1) = 2$ and $y(-2) = -1$. **(08 Marks)**

b. Determine the natural response of the system whose differential equation is $\frac{d^2y(t)}{dt^2} + 4y(t) = 3\frac{dx(t)}{dt}$ with initial conditions $y(0) = 1, \frac{d}{dt}y(0) = 1$ **(06 Marks)**

c. Draw the direct form – I and direct form – II implementation of the following differential equation $\frac{2d^3y(t)}{dt^3} + \frac{dy(t)}{dt} + 3y(t) = x(t)$. **(06 Marks)**

4 a. State and explain following Fourier series properties.
   i) Frequency shift
   ii) Convolution. **(10 Marks)**

b. For the signal $x(t) = \sin \omega_o t$, find the Fourier series and draw its spectrum. **(05 Marks)**

c. Find the time domain signal corresponding to the DTFs coefficient

$$x(k) = \cos\left(\frac{16\pi}{17}k\right)$$ **(05 Marks)**

PART – B

5 a. State and explain Parsavel's theorem. **(06 Marks)**

b. Obtain the Fourier transform of the following signals
   i) $x(t) = e^{-at}\, u(t)\ ;\ a > 0$
   ii) $x(t) = \delta\,(t)$ **(08 Marks)**

c. The impulse response of a continuous time signal is given by $h\,(t) = \frac{1}{R_C}\; e^{-t/RC}\; u(t)$. Find the frequency response and plot the magnitude and phase response. **(06 Marks)**

6 a. State and explain following DTFT properties i) Time shift ii) Linearity. **(06 Marks)**

b. Determine the DTFT of the following signals
   i) $x(n) = u\,(n)$ ii) $x(n) = 2^n\, u(-n)$. **(07 Marks)**

c. Obtain frequency response and impulse response of the system described by the difference equation $y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = 3x(n) - \frac{3}{4}x(n-1)$ **(07 Marks)**

7 a. What is z – transform? Mention properties of Region of convergence (ROC). **(05 Marks)**

b. Determine z transformation and its ROC of the following signals
   i) $x(n) = u(n)$
   ii) $x(n) = \cos \Omega_o\, n u(n)$. **(07 Marks)**

c. Determine inverse z – transformation of following function x(z)

$$x(z) = \frac{1}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$$ for i) $|z| > 1$ ii) $|z| < ½$ iii) $½ < |z| < 1$. **(08 Marks)**

8 a. State and prove final value theorem of z transformation. **(06 Marks)**

b. Determine natural, forced and complete response of the system described by $y(n) - ½\; y(n-1) = 2\,x(n)$ with initial conditions $y(-1) = 3$ and input $x(n) = 2(-½)^n$. **(08 Marks)**

c. A DT – LTI system is given by

$$H(z) = \frac{3-4z^{-1}}{1-\frac{7}{2}z^{-1}+\frac{3}{2}z^{-2}}$$

Specify the ROC of H(z) and determine h(n) for
   i) Stable system
   ii) Causal system
   iii) Non causal system. **(06 Marks)**

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