ONE TIME EXIT SCHEME

USN [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] **10EE52**

Fifth Semester B.E. Degree Examination, April 2018
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Missing data, if any, may be suitably assumed.

PART – A

1 a. Represent the given continuous time signal in graphical form :

$x(t) = t \quad 0 \le t \le 1$

$\quad = 1 \quad 1 \le t \le 2$

$\quad = 3 - t \quad 2 \le t \le 3$

Discretise the signal with sampling frequency $f_s = 2H_3$ and represent it in any one form. **(04 Marks)**

b. Determine whether the given signals are energy signal or power signals and calculate their energy or power.

i) $x(t) = e^{j(3t+\pi/2)}$

$x(t) = \begin{cases} \left(\frac{1}{2}\right)^n & \text{for } n \ge 0 \\ (3)^n & \text{for } n < 0 \end{cases}$. **(06 Marks)**

c. Perform the following operations on the giving signal in Fig.Q1(c).

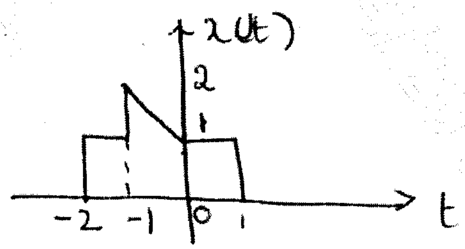

Fig.Q1(c)

i) $x(2t + 1)$ ii) $x(-2t + 1)$ iii) $x(-2t - 1)$. **(06 Marks)**

d. For the system given below, determine whether it is : i) memory-less ii) causal iii) liner iv) time invariant. $y[n] = x[n]\, x[n-2]$. **(04 Marks)**

2 a. Find the convolution sum of x[n] with h[n]. Given :

$x[n] = \{1\ \ {-1}\ \ \underset{\uparrow}{1}\ \ {-1}\}$ $h[n] = \{1\ \ \underset{\uparrow}{2}\ \ 3\}$. **(06 Marks)**

b. For each of the following impulse response, determine whether the corresponding system is:
i) Memoryless ii) Causal iii) Stable with proper justification.

i) $h(t) = e^{-2|t|}$ ii) $h[n] = 2^n u[-n]$. **(06 Marks)**

c. A system has an impulse response $h(t) = 4e^{-4t}\, u(t)$. Find the response $y(t) = h(t) - x(t)$ to an input $x(t) = u(t-1) - u(t-4)$. Hence plot the response y(t). **(08 Marks)**

3 a. Draw the direct form I and direct form II representation for the given difference equation :
$y[n] + \frac{1}{2}y[n-1] - \frac{1}{3}y[n-3] = x[n] + 2x[n-2]$. **(06 Marks)**

b. Obtain ZIR, ZSR for the system described by difference equation :
$y[n] - \frac{1}{4}y[n-2] = 2x[n] + x[n-1]$
for given input $x[n] = u[n]$ initial conditions $y[-2] = 8$; $y[-1] = 0$. **(06 Marks)**

c. Find the total solution for the system described by the differential equation :
$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2x(t)$$
Given $x(t) = \cos t\, u(t)$ $y(0) = -\frac{4}{5}$ $\left.\frac{dy(t)}{dt}\right|_{t=0} = \frac{3}{5}$. **(08 Marks)**

4 a. State and prove the following properties of DTFS
i) Time shifting property
ii) Time scaling property. **(06 Marks)**

b. Find the exponential Fourier series of the waveform shown in Fig.Q4(b). **(06 Marks)**

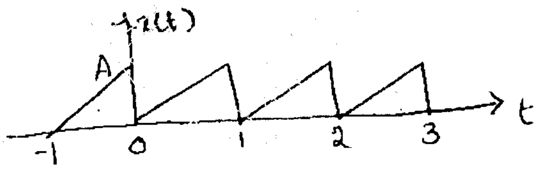

Fig.Q4(b)

c. Find the DTFS of the signal shown in Fig.Q4(C). Also find the magnitude and spa
spectrum. **(08 Marks)**

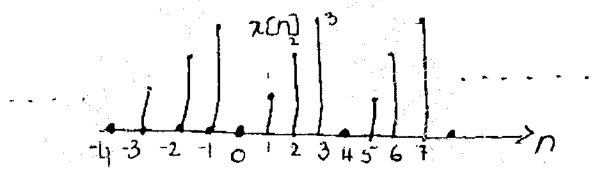

Fig.Q4(c)

PART – B

5 a. State and prove the following properties of CTFT. i) Convolution ii) Linearity. **(06 Marks)**

b. Find the inverse Fourier transform of x(w) for the spectra shown in Fig.Q5(b). **(06 Marks)**

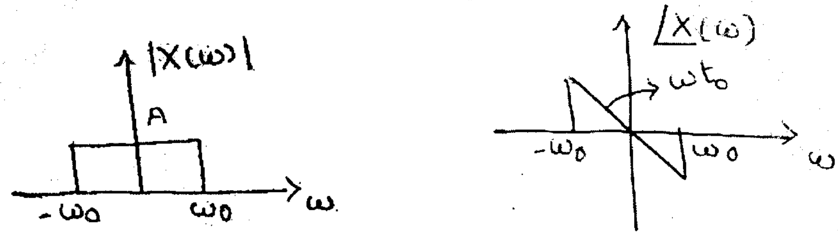

Fig.Q5(b)

c. The input and output of a causal LIT system is described by the differential equation :
$$\frac{d^2y(t)}{dt^2} + \frac{3dy(t)}{dt} + 2y(t) = x(t)$$
i) Find the frequency response of the system
ii) Find the impulse response of the system
iii) What is the response of the system if $x(t) = r^{-t} u(t)$. **(08 Marks)**

6 a. Using the appropriate property, find the DTFT of the following signals.
i) $x_1[n] = (\frac{1}{2})n\ u[n-2]$
ii) $x_1[n] = \left\{\underset{\uparrow}{1}\ 2\ 3\ 4\right\}$ $x_2[n] = \left\{\underset{\uparrow}{2}\ 3\ 4\ 1\right\}$. Find $x_1[n] * x_2[n]$. **(06 Marks)**

b. Prove that DTFT of the rectangular pulse given below is :

$$x[n] = \begin{cases} 1 & -N_1 \le n \le N_1 \\ 0 & \text{otherwise} \end{cases}$$

$$X_{(j\omega)} = \frac{\sin \Omega(N_1 + \frac{1}{2})}{\sin(\Omega/2)}.$$ **(06 Marks)**

c. A causal system is represented by the difference equation is :
$y[n] + \frac{1}{4} y[n-1] = x[n] + \frac{1}{2}x[n-1]$.
Use DTFT to determine the following :
i) The frequency response of the system
ii) The impulse response
iii) Response of the system to input $x[n] = (\frac{1}{2})n\ u[n]$. **(08 Marks)**

7 a. From the definition of z transform, find the z transform of the following signals and also specify their ROC.
i) $x[n] = a^n u[-n-1]$
ii) $x[n] = (\frac{1}{2})^n u[n] + (\frac{1}{3})^n u[n]$. **(06 Marks)**

b. Using the properties of z transform find the z transform of the following :
$x[n] = na^n u[n]$
$x[n] = a^{(2n-1)} u[n+3]$. **(06 Marks)**

c. Determine the inverse 7 transform of $x(z) = \frac{3}{1-1.5z^{-1} + 0.5z^{-2}}$ by using power series expansion method for : i) ROC |Z|>| ii) ROC |Z|<0.5. **(08 Marks)**

8 a. State and prove the following properties of z transform
i) Differentiation is z domain
ii) Scaling in z domain. **(06 Marks)**

b. A linear LTI system is characterized by the system function :
$H(z) = \frac{3-4z^{-1}}{1-3.5x^{-1} + 1.5x^{-2}}$ specify ROC of H(z) and determine h[n] for :
i) Stable system ii) Causal system **(06 Marks)**

c. A discrete LTI system is characterized by the following difference equation :
$y[n] - y[n-1] - 2y[n-2] = x[n]$ with input $x[n] = 6u[n]$ and the initial conditions are $y(-1) = -1$, $y(-2) = 4$
i) Find the zero input response – ZIR
ii) Find the zero state response – ZSR
iii) Find the total response. **(08 Marks)**

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