USN

10EE52

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Signals and Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish between :
i) Energy signal and power signal
ii) Even and odd signal
iii) Periodic and non-periodic signal. **(06 Marks)**

b. Determine whether or not the following signal is periodic. If it is periodic, determine its fundamental period :

i) $x[n]=\sin\left[\frac{1}{3}(\pi n)\right]\cdot\cos\left[\frac{1}{5}(\pi n)\right]$

ii) $x[n]=\cos\frac{1}{3}n$. **(04 Marks)**

c. For the given signal x(t) as shown in Fig.Q1(c) sketch the following :

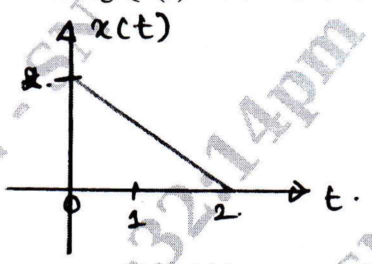

Fig.Q1(c)

i) $x[2(t-2)]$ ii) $x(-2t-1)$ iii) $x\left(\frac{t}{2}+2\right)$ iv) $x(-t)$. **(04 Marks)**

d. Determine whether the system given below is :
i) Linear ii) Time invariant iii) causal iv) Memoryless $y(t)=e^{x(t)}$. **(06 Marks)**

2 a. Determine the convolution of $x_1(t)=e^{-3t}\,u(t)$ and $x_2(t)=u(t+2)$. Also sketch the result. **(08 Marks)**

b. Find the step response of an LTI system if the impulse response $h(t)=t^2\cdot u(t)$. **(06 Marks)**

c. Determine the convolution sum of the sequences.
$x_1[n]=\{1,1,\underset{\uparrow}{0},1,1\}$ and $x_2[n]=\{1,-2,-3,\underset{\uparrow}{4}\}$. **(06 Marks)**

3 a. Distinguish between forced response and natural response. Find the forced response for the system given by : $\frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t)=x(t)+\frac{d}{dt}x(t)$ input $x(t)=5\cdot u(t)$. **(08 Marks)**

b. Draw the direct form – I and direct form – II implementations for the system described by the difference equation : $y[n]-\frac{1}{4}y[n-1]+\frac{1}{8}y[n-2]=x[n]+\frac{1}{2}x[n-1]$. **(06 Marks)**

c. For each of the impulse responses, determine whether the corresponding system is memoryless, causal and stable.
i) $h(t)=e^{2t}\cdot u(t-2)$
ii) $h[n]=2^n\cdot u[-n]$. **(06 Marks)**

4 a. State and prove time shift property as applied to Fourier series. (06 Marks)

b. Determine the Fourier coefficients for the signal x(t) as shown in Fig.Q4(b). Plot its magnitude spectrum and phase spectrum.

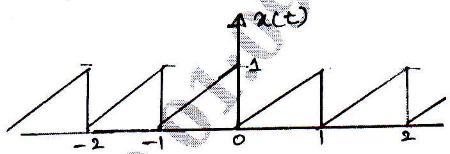

Fig.Q4(b) (08 Marks)

c. State and prove Parseval's theorem in case of Discrete Time Fourier Series (DFTS). (06 Marks)

PART – B

5 a. State and prove convolution property of discrete time Fourier transforms. (06 Marks)

b. Obtain Fourier transform of the following signals :

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

ii) $x(t) = e^{-a|t|}$. (06 Marks)

c. Obtain Fourier transform of the following sequences :

i) $x[n] = -a^{n}\cdot u[-n-1]$

ii) $x[n] = \delta[n]$

iii) $x[n] = a^{n}\cdot u[n]$. (08 Marks)

6 a. State and prove low pass sampling theorem. (10 Marks)

b. The system produces the output of $y(t) = e^{-t}\cdot u(t)$ for an input of $x(t) = e^{-2t}\cdot u(t)$. Determine the impulse response and frequency response of the system. (10 Marks)

7 a. Define Z – transform of a signal. What does ROC mean? Mention the properties of ROC. (08 Marks)

b. Find the Z – transform of :

i) $x[n] = \alpha^{n}\cdot u[n]$

ii) $x[n] = -u[-n-1] + \frac{1}{2}^{n}\cdot u[n]$

Mention their ROC. (06 Marks)

c. Find the inverse Z – transform of the following using partial fraction expansion method :

$$x[z] = \frac{z+1}{3z^2 - 4z + 1} \quad \text{ROC } |z| > 1.$$ (06 Marks)

8 a. A causal LTI system is described by the difference equation :

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

Find the system function H[z]. Plot the poles and zeros and indicate the ROC. Also determine the impulse response of the system. (06 Marks)

b. Solve the following difference equation using unilateral Z – transform.

$$y[n] - \frac{3}{2}y[n-1] + \frac{1}{2}y[n-2] = x[n]$$

for $n \geq 0$ with initial conditions, $y[-1] = 4$, $y[-2] = 10$ and $x[n] = [\frac{1}{4}]^{n}.\ u[n]$. (10 Marks)

c. Discuss the stability, causality and anticausality of the system from the nature of their transfer function. (04 Marks)

* * * * *