CBCS SCHEME

USN | | | | | | | | | | |

17EC42

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Signals and Systems

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain with an example :
i) Even and odd signal
ii) Energy and power signal
iii) Time shifting
iv) Time scaling
v) Prescenduce rule. **(10Marks)**

b. Sketch the following :
$y(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$ **(02Marks)**

c. Given the signal x(t) as shown in the Fig.1(c) sketch the following :
i) $x(2t+2)$ and ii) $x(t/2 - 1)$. **(08Marks)**

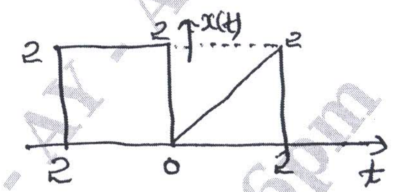

Fig.1(c)

OR

2 a. Find the even the odd components of the following signals :
i) $x(t) = \cos t + \sin t + \sin t \cdot \cos t$
ii) $x(n) = \{-3, 1, \underset{\uparrow}{2}, -4, 2\}$. **(06 Marks)**

b. For the signal shown in Fig.Q2(b), find the total energy. **(08 Marks)**

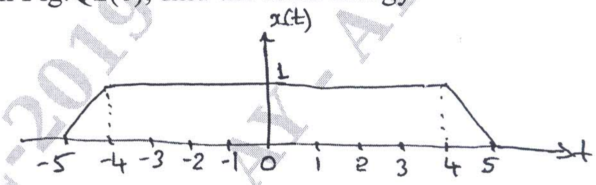

Fig.Q2(b)

c. Verify the following system for linearity and time invariance :
i) $y(t) = t \cdot x(t)$ ii) $y(n) = x[n] + n$. **(06 Marks)**

Module-2

3 a. What do you mean by impulse response of an LTI system? Starting from fundamentals, deduce the equation for the response of an LTI system if the input sequences x(n) and the impulse response h(n) are given. **(08 Marks)**

b. Determine the output of an LTI system for an input $x(t) = u(t) - u(t-2)$ and impulse response $h(t) = u(t) - u(t-2)$. **(06 Marks)**

c. An LTI system is characterized by an impulse response $h(n) = (3/4)^n u(n)$. Find the response of the system when the input $x(n) = u(n)$. Also evaluate the output of the system at $n = +5$ and $n = -5$. **(06 Marks)**

OR

4 a. LTI system has an impulse response :

$$h(n)=\begin{cases}1 & ; \; n=+/-1\\ 2 & ; \; n=0\\ 0 & ; \; \text{otherwise}\end{cases}$$

Determine the output of this system in response to the input :

$$x(n)=\begin{cases}2 & ; \; n=0\\ 3 & ; \; n=1\\ -2 & ; \; n=2\\ 0 & ; \; \text{otherwise}\end{cases}$$

(06 Marks)

b. Determine the discrete time convolution of input $x(n) = \beta^n u(n)$ and impulse response $h(n) = u(n-3)$. Assume magnitude of β to be less than 1. **(08 Marks)**

c. Prove $[x(n) * h_1(n)] * h_2(n) = x(n) * [h_1(n) * h_2(n)]$. **(06 Marks)**

Module-3

5 a. Evaluate the step response for the following impulse responses

i) $h(n) = (\frac{1}{2})^n u(n)$

ii) $h(t) = u(t+1) - u(t-1)$. **(08 Marks)**

b. Check for the following impulse responses memoryless, causal and stable.

i) $h(t) = e^{2t} u(t-1)$

ii) $h(n) = (\frac{1}{2})^n u(n)$. **(06 Marks)**

c. Evaluate the DTFS representation for the signal :

$$x[n] = \sin\left[\frac{4\pi}{21}n\right] + \cos\left[\frac{10\pi}{21}n\right] + 1$$

Sketch magnitudes and phase spectra. **(06 Marks)**

OR

6 a. An inter connection of LTI system is shown in Fig.Q6(a). The impulse responses are $h_1(n) = (\frac{1}{2})^n u(n+2)$, $h_2(n) = \delta(n)$ and $h_3(n) = u(n-1)$. Find the impulse response h(n) of the overall system. **(06 Marks)**

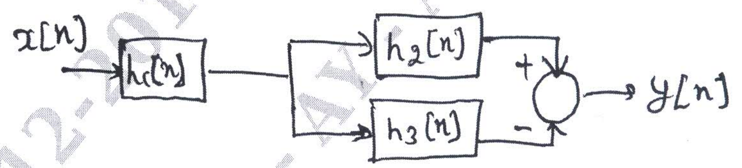

Fig.Q6(a)

b. State the following properties of continuous time Fourier series

i) Convolution ii) Time shift iii) Linearity iv) Differential in time domain. **(04 Marks)**

c. Find the complex Fourier coefficient for the periodic waveform x(t) as shown in the Fig.Q6(c). Also draw the amplitude and phase spectra. **(10 Marks)**

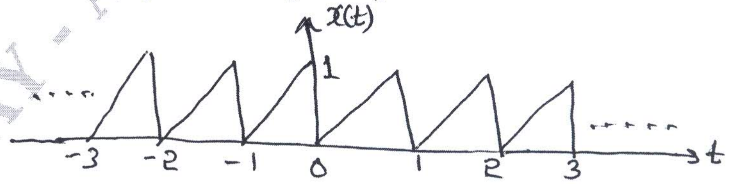

Fig.Q6(c)

Module-4

7 a. Find the Fourier transform of the signal $x(t) = e^{-at}$; $a > 0$. Also sketch magnitude and phase spectra. **(08 Marks)**

b. State and prove the following properties of discrete time Fourier transform.
   i) Convolution
   ii) Frequency differentiation. **(08 Marks)**

c. Find the DTFT of the signal $x[n] = u[n] - u[n-6]$. **(04 Marks)**

OR

8 a. Obtain the DTFT of the rectangular pulse is defined as :
$x[n] = 1 \, ; |n| \le M$
$= 0 \, ; |n| > M$ **(08 Marks)**

b. Specify the Nyquist rate for the following signals
   i) $x(t) = \cos(5\pi t) + 0.5 \cos(10\pi t)$
   ii) $x(t) = \sin c\,(200t)$. **(04 Marks)**

c. Using properties of Fourier transform, find the Fourier transform of the signal :
$$x(t) = \frac{d}{dt}\left[te^{-2t} \sin u(t)\right].$$ **(08 Marks)**

Module-5

9 a. Determine the Z–transform of the signal $x[n] = a^n u[n]$. Indicate the ROC and locations of poles and zeros of $X(z)$ in the z–plane. **(06 Marks)**

b. Find the Z-transform and the ROC of the discrete sinusoid signal $x(n) = \sin[\Omega n)\, u(n)$. **(08 Marks)**

c. Find the inverse Z–transform of $x(z) = \dfrac{\frac{1}{4}z^{-1}}{(1-\frac{1}{2}z^{-1})(1-\frac{1}{4}z^{-1})}$ ROC $|z| > \frac{1}{2}$. **(06 Marks)**

OR

10 a. Find the impulse response for the following difference equation :
$y(n) - 4y(n-1) + 3y(n-2) = x(n) + 2x(n-1)$. **(08 Marks)**

b. Find the Z –transform and ROC of $x(n) = a^{n-1} u(n-1)$ using properties of Z–transforms. **(06 Marks)**

c. Using Z-transform find the convolution of the following two sequences :
$$h[n] = \begin{cases} \left[\frac{1}{2}\right]^n; & 0 \le n \le 2 \\ 0 \;; & \text{otherwise} \end{cases}$$
And $x[n] = \delta[n] + \delta[n-1] + \delta[n-2]$. **(06 Marks)**

* * * * *