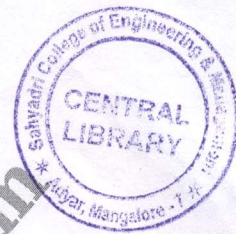


# CBCS SCHEME



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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)

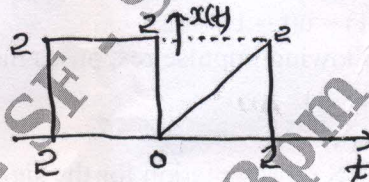


Fig.1(c)

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)  $x(n) = \{-3, 1, 2, -4, 2\}$ .

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

(08 Marks)

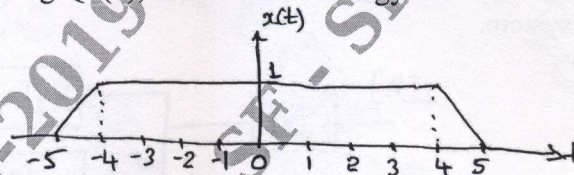


Fig.Q2(b)

- 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)

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.

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  $\beta$  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)

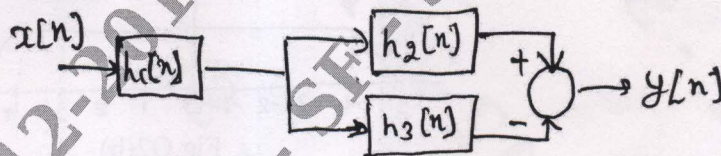


Fig.Q6(a)

- 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)

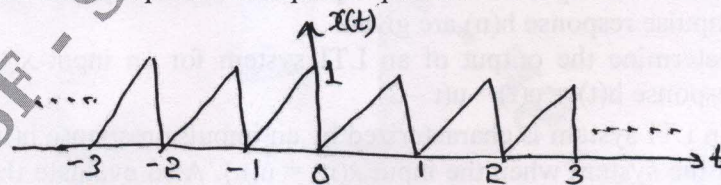
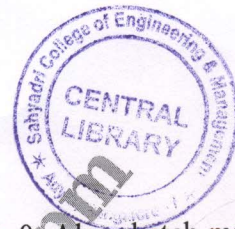


Fig.Q6(c)



**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 (08 Marks)
  - ii) Frequency differentiation. (04 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 :  
 $x[n] = 1 ; |n| \leq M$   
 $= 0 ; |n| > M$  (08 Marks)
- b. Specify the Nyquist rate for the following signals
  - i)  $x(t) = \cos(5\pi t) + 0.5 \cos(10\pi t)$  (04 Marks)
  - ii)  $x(t) = \sin c(200t)$ .
- c. Using properties of Fourier transform, find the Fourier transform of the signal :  
 $x(t) = \frac{d}{dt} [te^{-2t} \sin u(t)]$ . (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  $x(z) = \frac{1/4 z^{-1}}{(1 - 1/2 z^{-1})(1 - 1/4 z^{-1})}$  ROC  $|z| > 1/2$ . (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 :

$$h[n] = \begin{cases} (1/2)^n & ; 0 \leq n \leq 2 \\ 0 & ; \text{otherwise} \end{cases}$$

And  $x[n] = \delta[n] + \delta[n-1] + \delta[n-2]$ . (06 Marks)

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