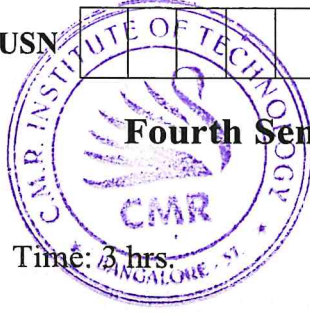


# CBCS SCHEME

15EC44

USN 

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## Fourth Semester B.E. Degree Examination, July/August 2021 Signals and Systems

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions.**

- 1 a. Check whether the following system is i) linear or nonlinear ii) Time invariant or time variant iv) Stable or unstable v) invertible or non invertible  $y(n) = \log(x(n))$  (06 Marks)
- b. Sketch the following signals and determine their even and odd components  $x(n) = u(n+2) - 3u(n-1) + 2u(n-5)$  (06 Marks)
- c. Represent the given signal  $x(t)$  shown in Fig Q1(c) using basic signals.

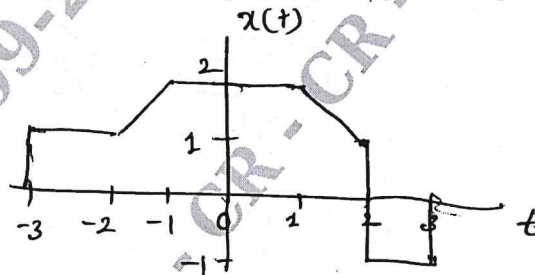


Fig Q1(c)

(04 Marks)

- 2 a. Check whether the following signal are periodic or not. If periodic, determine the fundamental period :
  - i)  $x(n) = \cos\left(\frac{\pi n}{7}\right) \sin\left(\frac{\pi n}{3}\right)$
  - ii)  $x(t) = \left[2\cos^2\left(\frac{\pi t}{2}\right) - 1\right] \cos(\pi t) \sin(\pi t)$  (06 Marks)
- b. A rectangular pulse  $x(t) = \begin{cases} A, & \text{for } 0 \leq t \leq T \\ 0, & \text{Elsewhere} \end{cases}$  is applied to an integrator circuit, find the total energy of the output  $y(t)$  of the integrator. (05 Marks)
- c. A staircase signal  $x(t)$  that may be viewed as a superposition of four rectangular pulses. Starting with rectangular pulse shown in Fig Q2(c), constant and express  $x(t)$  in forms of  $g(t)$

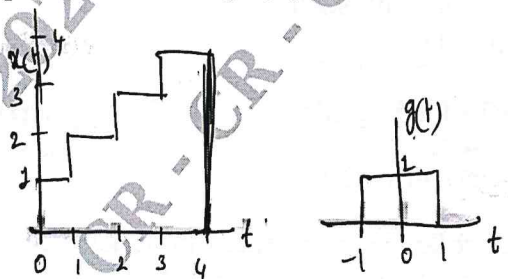


Fig Q2(c)

(05 Marks)

- 3 a. Find the overall impulse response of a cascade of two systems having identical impulse responses,  $h(t) = 2[u(t) - u(t-1)]$ . (08 Marks)
- b. Find the discrete time convolution sum given below.  $y(n) = \beta^n u(n) * \alpha^n u(n)$ ;  $|\beta| < 1$ ;  $|\alpha| < 1$ . (08 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.

- 4 a. A LTI system has impulse response  $h(t) = t u(t) + (10 - 2t) u(t - 5) - (10 - t) u(t - 10)$ . Determine the output for the following input  $x(t) = \delta(t + 2) + \delta(t - 5)$ . (05 Marks)
- b. Evaluate the discrete time convolution sum given below  $y(n) = u(n) \times u(n - 3)$ . (08 Marks)
- c. State three properties of discrete time convolution. (03 Marks)

- 5 a. Find the step response of a system whose impulse response is given by  $h(t) = u(t + 1) - u(t - 1)$ . (04 Marks)
- b. A system consists of several subsystem connected as shown in Fig Q5(b). Find the operator H relating  $x(t)$  and  $y(t)$  for the following subsystem operators.

$H_1 : y_1(t) = x_1(t) x_1(t - 1)$   
 $H_2 : y_2(t) = |x_2(t)|$   
 $H_3 : y_3(t) = 1 + 2x_3(t)$   
 $H_4 : y_4(t) = \text{Cos}(y_3(t))$

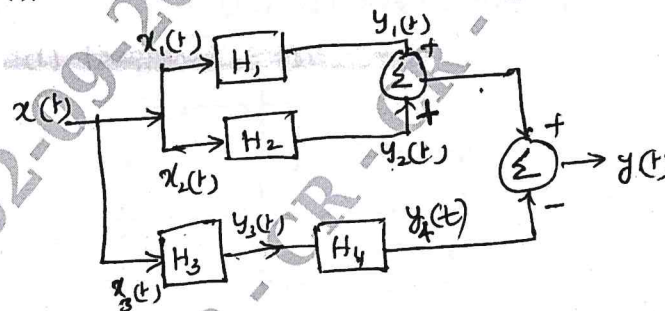


Fig Q5(b)

- c. Obtain the DTFS coefficient of  $x(n) = \text{Cos}\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$ . (05 Marks)
- Draw : i) Magnitude spectrum ii) Phase spectrum. (07 Marks)

- 6 a. State the following properties of DTFS.  
 i) Linearity ii) Time shift iii) frequency shift iv) Parseval's Relationship v) Convolution vi) Modulation. (06Marks)
- b. Evaluate the FS representation for the signal,  $x(t) = \text{Sin}(2\pi t) + \text{Cos}(3\pi t)$ . Sketch the magnitude and phase spectra. (07 Marks)
- c. For the impulse response  $h(n)$  given below determine whether the corresponding system is  
 i) memoryless ii) causal iii) stable.  
 $h(n) = 2u(n) - 2u(n - 1)$ . (03 Marks)

- 7 a. Compute the DTFT of the signal  
 $x(n) = \left(\frac{1}{2}\right)^n \{u(n+3) - u(n-2)\}$  (06 Marks)
- b. State and prove the following properties of Fourier Transform.  
 i) Frequency differentiation ii) Linearity. (06 Marks)
- c. State Sampling theorem. (04 Marks)

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- 8 a. Specify the Nyquist rate and Nyquist intervals for the following signals.  
 i)  $g(t) = \text{Sin} c(200t)$  ii)  $g_2(t) = \text{Sinc}^2(200t)$ . (04 Marks)
- b. Obtain the Fourier transform of the signal  $x(t) = e^{-at} u(t)$ ;  $a > 0$ . Draw its magnitude and phase spectra. (06 Marks)
- c. State and explain the significance of following terms under DTFT  
 i) Parseval's relation ii) Convolution iii) Time shift. (06 Marks)

- 9 a. Explain the properties of ROC. (04 Marks)
- b. Determine the z-transform of  $x(n) = -u(-n-1) + \left(\frac{1}{2}\right)^n u(n)$ . Find the ROC and pole-zero locations of  $x(z)$  in the Z-plane. (06 Marks)
- c. A causal system has input  $x(n]$  and output  $y(n]$ . Find the impulse response of the system, if
- $$x(n) = \delta(n) + \frac{1}{4}\delta(n-1) + \frac{1}{8}\delta(n-2)$$
- $$y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$$
- (06 Marks)
- 10 a. State and prove the following properties Z-transform i) Initial value theorem ii) Time reversal property. (06 Marks)
- b. Find the inverse Z-transform of  $x(z) = \frac{z^{-1}}{-2z^{-2} - z^{-1} + 1}$  ROC :  $|z| < 2$ . (06 Marks)
- c. Determine whether the system is causal and stable  $H(z) = \frac{2z+1}{z^2+z-5/16}$ . (04 Marks)

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