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## Fifth 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 operations performed on the independent variables of a continuous time signals. (06 Marks)
- b. Explain even and odd component of the signal and derive its equation. Also find and sketch the even and odd component of the signal.  $x(t) = e^{-t/4} u(t)$ . (06 Marks)
- c. Sketch the signal :
  - i)  $x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$
  - ii)  $x(t) = r(t+1) - r(t) + r(t-1)$ . (08 Marks)

OR

2. a. Explain energy and power signals with its equation. (06 Marks)
- b. For the system, determine whether the system is linear, time invariant, memoryless, causal and stable.  $H\{x(n)\} = x(n - n_d)$ . (06 Marks)
- c. Find total energy of
  - i)  $x(t) = \begin{cases} \frac{1}{2}[\cos \omega t + 1]; & -\frac{\pi}{2} \leq t \leq \frac{\pi}{2} \\ 0; & \text{otherwise} \end{cases}$
  - ii)  $x(n) = \begin{cases} n; & 0 \leq n \leq 5 \\ 10 - n; & 5 < n \leq 10. \\ 0; & \text{otherwise} \end{cases}$  (08 Marks)

### Module-2

3. a. Find the total response of the system given by :  $\frac{d^2 y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2x(t)$   
 With  $y(0) = -1$  and  $\left. \frac{d}{dt} y(t) \right|_{t=\infty} = 1$  and  $x(t) = \cos u(t)$ . (06 Marks)
- b. Find the difference equation corresponding to the block diagram shown in Fig.Q3(b). (06 Marks)

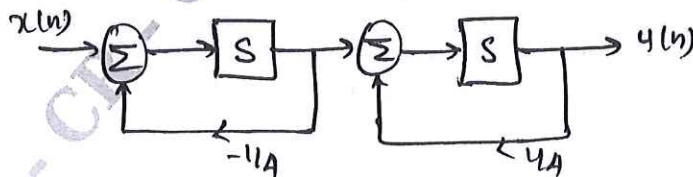


Fig.Q3(b)

- c. Evaluate the convolution of  $x(n)$  and  $h(n)$ , where  
 $x(n) = 1; 0 \leq n \leq 4; h(n) = \alpha^n; 0 \leq n \leq 6$   
 $= 0; \text{ otherwise}; \quad = 0; \text{ otherwise}$  (08 Marks)

1 JAN 2020

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. Find the forced response of the system described by the difference equation :

$$y(n) = \frac{5}{6}y(n-1) + \frac{1}{6}y(n-2) = x(n)$$

Where  $x(n) = 2^n : n \geq 0$

$= 0 : \text{elsewhere}$

(06 Marks)

- b. Explain the following properties of impulse response representation of LTI system

i) Distributive ii) Associative iii) Causal.

(06 Marks)

- c. Evaluate  $y(t) = x(t) * h(t)$  for  $x(t) = e^{-3t} \{u(t) - u(t-2)\}$  and  $h(t) = e^{-t}u(t)$ .

(08 Marks)

**Module-3**

- 5 a. Describe the following properties of CTFT :

i) Parsavel's theorem  
ii) Frequency differentiation  
iii) Frequency shift.

(06 Marks)

- b. Obtain the CTFT of the signal  $x(t) = e^{-at}u(t)$ ,  $a > 0$ . Draw its magnitude and phase spectra.

(06 Marks)

- c. Find CTFT of the signal :

i)  $x(t) = t e^{-2t} u(t)$ . Obtain its magnitude and phase spectra.

ii)  $x(t)$  is describe by the following Fig.Q5(c).

(08 Marks)

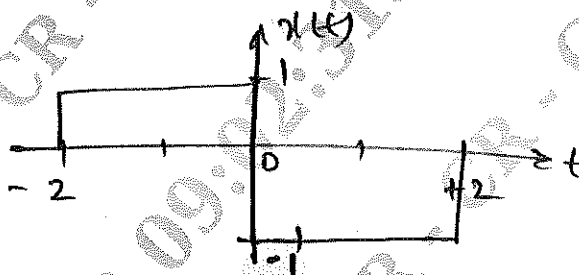


Fig.Q5(c)

OR

- 6 a. Explain the following properties of CTFT.

i) Scaling  
ii) Integration  
iii) Modulation.

(06 Marks)

- b. Find the Fourier transform of the signum function described by

$$\text{sgn}(t) = 1 : t > 0;$$

$$= -1 : t < 0$$

Draw its magnitude and phase spectra.

(06 Marks)

- c. Evaluate the Fourier transform of the signal

$$x(t) = 1 + \cos \pi t : |t| \leq 1$$

$$= 0 : |t| > 1$$

$x(t) = e^{-3(t)} \sin 2t$  : using appropriate properties.

(08 Marks)

**Module-4**

- 7 a. Discuss the properties of DTFT for i) Linearity ii) Scaling iii) Modulation. (06 Marks)
- b. Find the DTFT of the signal i)  $x(n) = \alpha^n u(n) ; |\alpha| < 1$ . Draw its magnitude spectrum  
 $x(n) = \{1, 3, 5, 3, 1\}$  and evaluate DTFT at  $\Omega = 0$ .  $[X(e^{i\Omega}) \text{ at } \Omega = 0]$ . (06 Marks)
- c. Find the DTFT of the signal with the magnitude spectrum :  
 i)  $\delta(n)$   
 ii)  $x(n) = 1 : |n| \leq m$   
 $= 0 |n| > m$   
 Where  $x(n)$  is an rectangular pulse. (08 Marks)

OR

- 8 a. Describe the properties of DTFT for i) Time shift ii) Time scaling iii) Convolution. (06 Marks)
- b. Find the DTF of the signal described by : i)  $x(n) = u(n)$  ii)  $x(n) = u(n) - u(n - 6)$ . (06 Marks)
- c. Find the DTFT of the signal  
 i)  $x(n) = a^{|n|} ; |a| < 1$   
 ii)  $x(n) = \{1, 1, 0, 0, 0, 1, 1\}$   
 Derive the expression for phase and magnitude spectra. (08 Marks)

**Module-5**

- 9 a. Define region of convergence and derive an equation for ROC. (06 Marks)
- b. Find the Z-transform of the signal  $x(n) = 7\left(\frac{1}{3}\right)^n u(n) - 6\left(\frac{1}{2}\right)^n u(n)$  also find the ROC. (06 Marks)
- c. Describe the following properties of Z-transform :  
 i) Scaling in Z-domain  
 ii) Time reversal  
 iii) Time expansion. (08 Marks)

OR

- 10 a. Describe the properties of region of convergence in z - plane. (06 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 location s of  $X(z)$  in Z plane. (06 Marks)
- c. Using appropriate properties, find the Z-transform of the signal,  
 i)  $x(n) = 3.2^n u(-n)$   
 ii)  $x(n) = n^2 \left(\frac{1}{2}\right)^n u(n-3)$ . (08 Marks)

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