

nmnEME

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)

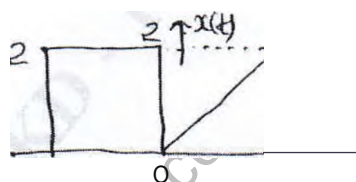


Fig.1(c)

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

(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 $h(n) = (3/4)^n \cdot 0.04$, 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. LT1 system has an impulse response :

$$1 ; n = +/ -1$$

$$h(n) = 2 ; n = 0$$

$$0 ; \text{otherwise}$$

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 $x(n)$ and impulse response $h(n) = u(n - 3)$. Assume magnitude of 13 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) $h(n) = u(n)$

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) $h(n) = (1)^n u(n)$. (06 Marks)

- c. Evaluate the DTFS representation for the signal :

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

Sketch magnitudes and phase spectra. (06 Marks)

OR

- 6 a. An inter connection of LT1 system is shown in Fig.Q6(a). The impulse responses are $h_1(n) = (1)^n u(n+2)$, $h_2(n) = 5(n)$ and $h_3(n) = u(n-1)$. Find the impulse response $h(n)$ of the overall system. (06 Marks)

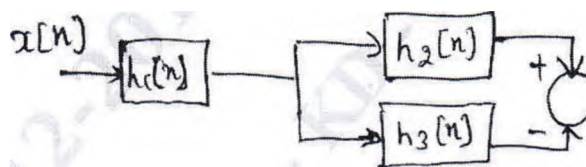


Fig.Q6(a)

- 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)

AAA

17EC42

Module-4v.:

- 7 a. Find the Fourier transform of the signal $x(t) =$ sketch magnitude and phase spectra. (08 Marks)
- b. State and prove the following properties of discrete time Fourier transform.
- Convolution
 - 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 :
 $x[n] = 1$
 $= 0; |n| > M$ (08 Marks)
- b. Specify the Nyquist rate for the following signals
- $x(t) = \cos(51\pi t) + 0.5 \cos(107\pi t)$
 - $x(t) = \sin c(200t)$. (04 Marks)
- c. Using properties of Fourier transform, find the Fourier transform of the signal :
 $x(t) = \int_{-\infty}^{\infty} t e^{-2t} \sin u(t) dt$. (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 $x(n) = \sin[en] u(n)$. (08 Marks)
- c. Find the inverse Z-transform of $x(z) = \frac{1/4 z^{-1}}{12 z^{-1} (1 - 4z^{-1})}$ ROC $|z| > 1$. (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 $x(n) = a^{-1} u(n-1)$ using properties of Z-transforms. (06 Marks)
- c. Using Z-transform find the convolution of the following two sequences :
 $h[n] = \begin{cases} 2^n & 0 \leq n \leq 2 \\ 0 & \text{otherwise} \end{cases}$
 And $x[n] = 8[n] + 8[n-1] + 8[n-2]$. (06 Marks)