CBCS SCHEME

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15EC44

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Signals and Systems

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define a signal and a system. Explain any two properties of a system. **(06 Marks)**

b. A continuous signal x(t) is shown in Fig Q1(b). sketch and label each of the following :

i) $x(t)\cdot u(1-t)$

ii) $x(t)\cdot[u(t)-u(t-1)]$

iii) $x(t)\cdot\sigma(t-3/2)$

iv) $x(t)\cdot[u(t+1)-u(t)]$

v) $x(t)\cdot u(t-1)$

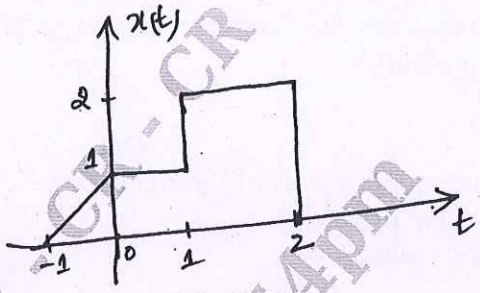

Fig Q1(b) **(10 Marks)**

OR

2 a. Distinguish between :

i) Energy and power signal

ii) Even and odd signal **(04 Marks)**

b. Determine whether the continuous – time signal $x(t) = x_1(t) + x_2(t) + x_3(t)$ is periodic or not. If periodic find the fundamental period. Where $x_1(t)$, $x_2(t)$ and $x_3(t)$ have periods of 8/3, 1.26 and $\sqrt{2}$ respectively. **(06 Marks)**

c. For the following system, determine whether the system is

(i) Linear (ii) Time – invariant (iii) Memory less and (iv) Causal.

$y(t) = e^{x(t)}$ **(06 Marks)**

Module-2

3 a. Determine the convolution sum of the given sequence

$x(n) = \left\{ \underset{\uparrow}{1},2,3,1 \right\}$ and $h(n) = \left\{ 1,\underset{\uparrow}{2},1,-1 \right\}$ **(04 Marks)**

b. Evaluate the discrete time convolution sum given and also plot the output y(n)

$$y(n) = \left(\frac{1}{2}\right)^n \cdot u(n-2) * u(n)$$ **(06 Marks)**

c. For the system with impulse response shown, determine whether the system in stable, memory less and causal $h(t) = e^{-2|t|}$. **(06 Marks)**

OR

4 a. Compute the o/p y(t) for an continuous time LTI system whose impulse response h(t) and its input x(t) are given by

$h(t) = e^{-t} \cdot u(t)$

$x(t) = u(t) - u(t-2)$ **(10 Marks)**

b. Prove the following convolution properties of impulse function

i) $x(t) * \sigma(t) = x(t)$

ii) $x(t) * \sigma(t - t_0) = x(t - t_0)$

iii) $x(t) * \sigma(t + t_0) = x(t + t_0)$ **(06 Marks)**

Module-3

5 a. Find the overall impulse response of a cascade of two systems having identical impulse responses $h(t) = 2[u(t) - u(t-1)]$ **(06 Marks)**

b. Find the unit step response of the following system given by their impulse response

$h(n) = \left(\frac{1}{2}\right)^n \cdot u(n)$ **(04 Marks)**

c. State the condition for the Fourier series to exist. Also prove the convergence condition (Absolute Integrability) **(06 Marks)**

OR

6 a. Prove the following properties of Fourier series:

i) Convolution property

ii) Parasevals relationship **(04 Marks)**

b. Determine the Fourier – series of the signal $x(t) = 3\text{Cos}\left(\frac{\pi}{2}t + \frac{\pi}{3}\right)$. Plot the magnitude and phase spectra. **(06 Marks)**

c. Show that if x(n) is real and even, its Fourier coefficient are real. Hence find the DTFS coefficients for the signal

$x[n] = \sum_{p=-\infty}^{\infty} \sigma[n - 2p]$ **(06 Marks)**

Module-4

7 a. State and prove the following properties of Fourier transform :

i) Frequency shift property

ii) Differentiation in time property **(04 Marks)**

b. Find the Fourier transform of

$x(t) = e^{-at} \cdot u(t)$. Also plot magnitude and phase spectra. **(06 Marks)**

c. For the rectangular pulse shown in Fig Q7(c), Evaluate the Fourier Transform and draw its spectrum. **(06 Marks)**

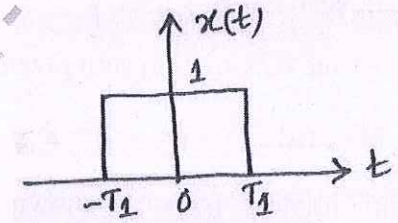

Fig Q7(c)

OR

8 a. Determine the DTFT of the following signal and draw its spectrum.

$$x(n) = \left(\frac{1}{2}\right)^n \cdot u(n-4)$$ **(06 Marks)**

b. Define the DTFT of a signal. Establish the relation between DTFT and z-transform. **(05 Marks)**

c. Find the NyQuist rate and Nyquist interval for the following signal.
$x(t) = 5\ Cos1000\ \pi t + 2Sin\ 500\pi t$. **(05 Marks)**

Module-5

9 a. Describe the properties of Region of convergence and sketch the ROC of two sided, right sided and left sided sequence. **(08 Marks)**

b. Determine the z-transfer of

(i) $x[n] = -u[-n-1] + \left(\frac{1}{2}\right)^n \cdot u(n)$

(ii) $x[n] = \left(\frac{1}{2}\right)^{|n|}$

Find the ROC and pole zero locations of x(z). **(08 Marks)**

OR

10 a. Find the inverse z – transform of

$$x(z) = \frac{z(z^2 - 4z + 5)}{(z-3)(z-1)(z-2)}$$ with : i) $|z| > 3$ ii) $|z| < 1$. **(08 Marks)**

b. A discrete LTI system is characterized by the difference equation
$y(n) = y(n-1) + y(n-2) + x(n-1)$

i) Find the system function H(z)
ii) Plot poles and zeros of H(z)
iii) Indicate the ROC of system is stable and causal
iv) Determine the impulse response of the stable system. **(08 Marks)**

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