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10EE52

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***1.Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2.Sketch the signals neatly.

PART – A

1 a. Define the term "Signal". Explain the following :
(i) Continuous time and discrete time signals
(ii) Even and Odd signals **(10 Marks)**

b. Sketch even and odd part for the signal x(t) as shown in Fig.Q1(b).

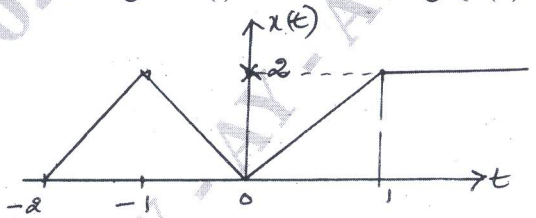

Fig.Q1(b) **(05 Marks)**

c. Sketch the signal x(t) if $x(t) = -u(t+3) + 2u(t+1) + u(t-3) - 2u(t-1)$ **(05 Marks)**

2 a. Determine the output signal y(n) if x(n) is given by,

$x(n) = 1$ for $0 < n < 4$
$= 0$ elsewhere

$h(n) = \alpha^n$; for $0 < n < 6$ where $\alpha > 1$
$= 0$ elsewhere

If $\alpha = 2$, plot y(n) vs n. **(10 Marks)**

b. Determine the output signal y(n) if $x(n) = u(n)$ and $h(n) = u(n-3)$. Sketch y(n) vs n. **(05 Marks)**

c. Find the signal y(t) if $h(t) = u(t)$ and $x(t) = e^{-at}.u(t)$. Sketch y(t) vs t. **(05 Marks)**

3 a. Prove that the impulse response h(n) or h(t) of a LTI system satisfies:
(i) The commutative property (ii) The distributive property. **(10 Marks)**

b. Determine the natural response of the system for the difference equation :

$$y(n) - \frac{9}{16}y(n-2) = x(n-1) \text{ , if } y(-1) = 1 \text{ and } y(-2) = -1$$ **(07 Marks)**

c. Calculate the step response of the system if $h(t) = t \cdot u(t)$ **(03 Marks)**

4 a. Determine the Fourier series representation for the signal $x(t) = \sin(2\pi t) + \cos(3\pi t)$. Sketch the magnitude and phase spectrum. **(05 Marks)**

b. Calculate the Fourier series coefficients for the signal x(t) as shown in Fig.Q4(b).

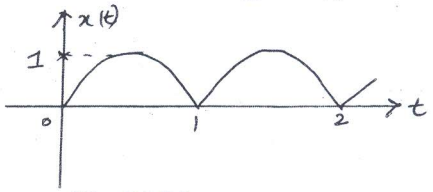

Fig.Q4(b) **(07 Marks)**

c. State and prove convolution property of Discrete Time Fourier Series (DTFS). **(08 Marks)**

PART – B

5 a. Determine the Fourier transform for the signal x(t) as shown in Fig.Q5(a).

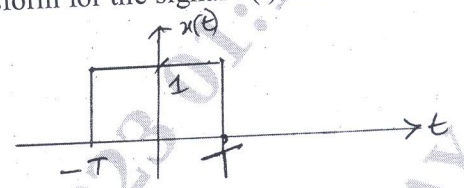

Fig.Q5(a) **(05 Marks)**

b. Calculate the time domain signal of

$X(jw) = \cos(w/2) + j\sin(w/2)\ ;\ |w| < \pi$

$= 0$ elsewhere **(05 Marks)**

c. Determine the impulse response of continuous time LTI system if

$$h(t) = \frac{1}{RC} e^{-t/RC}.u(t)$$

Find frequency response and plot magnitude and phase response. **(10 Marks)**

6 a. Calculate DTFT of a rectangular pulse if

$x(n) = 1$ for $|n| < M$

$= 0$ for $|n| > M$

Draw its spectrum. **(10 Marks)**

b. Determine DTFT if

(i) $x(n) = n\left(\frac{1}{2}\right)^{|n|}$ (ii) $x(n) = \sin\left(\frac{\pi}{4}n\right)\left(\frac{1}{4}\right)^{n} u(n-1)$ **(10 Marks)**

7 a. Determine the Z-transform of the following. Specify pole-zero location and ROC.

(i) $x(n) = y\left(\frac{1}{3}\right)^{n} u(n) - 6\left(\frac{1}{2}\right)^{n} u(n)$ (ii) $x(n) = -u(-n-1) + \left(\frac{1}{2}\right)^{n} u(n)$ **(10 Marks)**

b. State and prove the following properties of Z-transform :

(i) Time shifting (ii) Time reversal. **(10 Marks)**

8 a. Determine the sequence x(n) if

$$X(z) = \frac{-1+5z^{-1}}{\left(1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}\right)} \quad ;\ \text{if ROC} : |z| > 1$$

Use partial fraction expansion method. **(05 Marks)**

b. Using power series expansion method, determine x(n) if $x(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}$

if ROC $|z| > 1$. **(05 Marks)**

c. Determine the impulse response h(n) if $x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$

$y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$, using Z-transform method. **(10 Marks)**

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