5E3109

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B.Tech. V Sem.(Main/Back) Exam. Dec. 2012

Electronics & Communication

5EC1 Signals and systems

Common for 5EI & 5BM1

Time : 3 Hours **Maximum Marks : 80**

Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five question** selecting **one question** from **each unit.** All Questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used / calculated must be stated clearly.*

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. **Nil** 2. **Nil**

Unit-I

Q1. (a) Show that if $x_1[n]$ is an odd signal , and $x_2[n]$ is an even signal, then 8

$x_1[n]\, x_2[n]$ is an odd signal.

(b) Let x(n) be an arbitrary signal with even and odd parts denoted by

$x_e[n] = Ev\ \{x[n]\}$

$x_o[n] = Od\ \{x[n]\}$

show that, $\sum_{n=-\infty}^{\infty} x^2[n] = \sum_{n=-\infty}^{\infty} x_e^{\,2}[n] + \sum_{n=-\infty}^{\infty} x_0^{\,2}[n]$ 8

1 (a) Given that $x(t) = \begin{cases} t & t>0 \\ -2t & t<0 \end{cases}$

(i) Sketch $x_e(t)$

(ii) Sketch $x_0(t)$ 8

(b) Show that the discrete time system whose input x(n) & output y(n) are related by :- $y[n] = Re\{x[n]\}$ is additive. Does this system remain additive if its input output relationship is changed to $y(n) = Re\{e^{j\pi/4}x[n]\}$ (Do not assume x(n) is real in this problem). 8

Unit-II

Q2. Consider the signal

$x(n) = \alpha^n 4(n)$

(i) Sketch the signal $g(n) = x(n) - \alpha x(n-1)$ 8

(ii) Use the result of part (a) in conjunction with properties of convolution in order to determine a sequence h(n) such that $x(n) * h(n) = (1/2)^n \{4(n+2) - 4(n-2)\}$ 8

OR

Q2. (a) suppose that the input to this system is

$$x[n] = \begin{cases} 0 & \text{if } h[-n] = 0 \\ \dfrac{h[-n]}{[h[-n]]} & \text{if } h[-n] \neq 0 \end{cases}$$

Does the input signal represent a bounded input ? If so, what is the smallest number B such that $|x[n]| < B$ for all n ? 8

(b) Justify that a discrete time LTI system is causal if and only if its response $\delta[n]$ is zero for $n<0$ 8

Unit-III

Q.3. Consider the signal

$$x(t) = \sum_{k=-\infty} \frac{\sin(k\pi/4)}{(k\pi/4)} \delta(t-k\pi/4)$$

(a) Determine g(t) such that, $x(t) = \dfrac{\sin t}{\pi t} g(t)$ 8

(b) Use the multiplication property of the fourier transform to argue that x(jw) is periodic specify x(jw) over one period. 8

Q.3. (a) Suppose that

$x(t) = t$ fo

Sketch $x(t)$

(b) Derive the

$x(n) * h($

Q4. (a) We are transf

(i)

(ii)

(iii)

(b)

Q4. (a)

OR

Q.3. (a) Suppose that x(t) is an odd - harmonic periodic signal with period 2 such that

$x(t) = t$ for $o < t < 1$

Sketch x(t) and its fourier series coefficients. 8

(b) Derive the convolution property

$x(n) * h(n) \leftrightarrow x(e^{jw})H(e^{jw})$ 8

Unit-IV

Q4. (a) We are given the following facts about a real signal x(t) with Laplace transform x(s) 8

(i) x(s) has exactly two poles.

(ii) x(s) has no zeros in the finite s plane

(iii) x(s) has a pole at $s = -1+j$

(iv) $e^{2t}x(t)$ is not absolutely integrable.

(v) $x(0)=8$

Determine x(s) & specify its ROC.

(b) Determine the laplace transform of $x(t) = e^{-|t|}$ with ROC. 8

OR

Q4. (a) Consider the linear, discrete time,shift - invariant system with input x(n) & output y(n)for which

$y(n-1)-10/3y(n)+ y(n+1) = x(n)$

The system is stable Determine the unit sample response. 8

(b) Find the inverse z- transform of

$x(z) = \log(1-2z)\ |z| < 1/2$

By using the power - series expansion

$$\text{Log}(1-w) = -\sum_{i=1}^{\infty} \frac{wi}{i},\ |w| < 1$$

Unit-V

Q5. Let x(t) be a band limited signal such that

$$x(jw) = o \text{ for } |w| \geq \pi|T.$$

(a) If x(t) is sampled using a sampling period T, determine an interpolating funcion g(t) such that

$$\frac{dx(t)}{dt} = \sum_{n=-\infty}^{\infty} x(nT)\, g(t-nT)$$

(b) Is the function g(t) unique ? specify (12+4)

OR

Q.5 (a) Define the following terms :

(i) Higher frequency component of the message signal.

(ii) Nyquist rate

(iii) Sampling rate or frequency 8

(b) Discuss real and Natural sampling. 8
