CS/B.Tech /(ECE-New)/SEM-3/EC-303/2013-14

2013

SIGNAL & SYSTEMS

Time Allotted : 3 Hours | *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Laplace transform of e^{-at} is

a) $\frac{1}{(S+a)}$ b) $\frac{1}{(S-a)}$

c) $\frac{a}{(S+a)}$ d) $\frac{a}{(S-a)}$.

ii) $x(t) = a \sin \omega t$ is an

a) odd signal b) even signal

c) both (a) and (b) d) either (a) or (b).

iii) The signal $x(n) = 1 + e^{j(4\pi n/7 - \pi/2)}$ is periodic with period of

a) $\frac{5}{7}$ b) $\frac{7}{5}$

c) $\frac{4}{7}$ d) $\frac{4}{5}$.

iv) The system defined as $y(n) = 2x(n) + 3x(n^2)$ is

a) static, causal b) dynamic, causal

c) static, non-causal d) dynamic, non-causal.

v) ROC of unit step function is

a) $|z| < 1$ b) $|z| > 1$

c) $|z| = 1$ d) none of these.

vi) The discrete time system defined a $H(z) = \frac{(z^3 - 3z^2 + 2z)}{\left(z^2 + \frac{1}{2}z - \frac{1}{4}\right)}$ is

a) causal

b) non-causal

c) none of these.

vii) Which one of the following rules determines the mapping of s-plane to z-plane ?

a) Right half of s-plane maps into outside of unit circle in z-plane

b) Left half of s-plane maps into inside of unit circle in z-plane

c) Imaginary axis of s-plane maps into circumference of unit circle in z-plane

d) all of these.

viii) Energy of power signal is

a) finite b) zero

c) infinite d) between 1 and 2.

ix) A system with input $x(n)$ & output $y(n)$ is given as $y(n) = \sin(5/6\,\pi n)\, x(n)$. The system is

a) linear, stable & invariant

b) non-linear, stable & variant

c) linear, stable & variant

d) linear, unstable & invariant.

x) The Fourier transform of a conjugate symmetric function is

a) imaginary

b) real

c) conjugate asymmetric

d) conjugate symmetric.

xi) Energy density function is always

a) even b) odd

c) neither even nor odd d) both (a) & (b).

xii) A discrete time system is stable if and only if the ROC of $H(z)$

a) excludes $|z| = 1$ b) includes $|z| = 1$

c) both (a) & (b) d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What is meant by aliasing ? What is an anti-aliasing filter ? 2 + 3

3. Explain the properties of ROC of $X(Z)$.

4. What is time-invariant system ? Determine whether the following signal is time-invariant or not : 2 + 3

$Y(t) = x(-t)$

5. State and prove Initial Value theorem of *Z*-transform. 2 + 3

6. Determine the energy and power of the following signals :

a) $x(t) = tu(t)$ b) $x(n) = 2e^{j3\pi n}$. 3 + 2

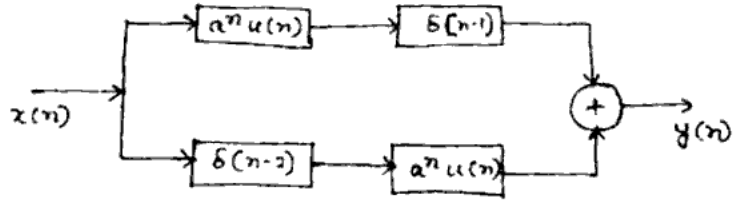
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

a) LTI system can be completely characterized by its impulse response. Explain.

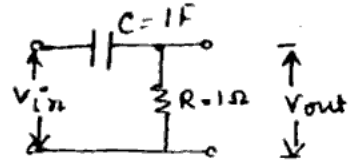
b) Find the overall impulse response of the system shown in the figure :



c) Using Z-transformation find the convolution of two sequences :

$x_1(n) = \{1, 2, -1, 0, 3\}; x_2(n) = \{1, 2, -1\}$. 5 + 5 + 5

a) Find out the output of the system shown in figure given below for the input $e^{-2t}u(t)$ using Laplace transform :



b) Sketch the convolution of the following two signals :

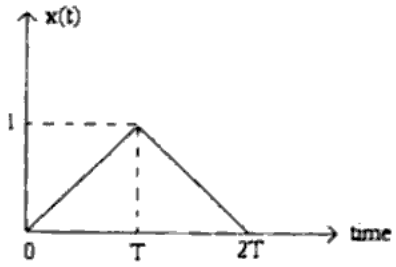
$$x(t) = \begin{cases} t+1, & 0 \le t \le 1 \\ 2-t, & 1 \le t < 2 \\ 0, & \text{elsewhere} \end{cases}$$

and $h(t) = \delta(t+2) + 2\delta(t-1)$. 7 + 8

9. a) Define s-plane. Describe the concept of poles & zeros in complex plane.

b) If $X(s)$ is the Laplace transform of $x(t)$, then show that $L[x(at)] = 1/|a|\ X(s/a)$.

c) Determine Laplace transform of given signal below :



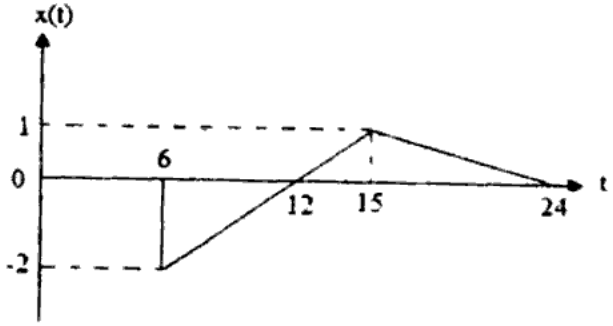
5 + 4 + 6

10. a) Sketch the given signal $x(t) = A[u(t+a) - u(t-a)]$ for $a > 0$. Also determine whether the given signal is a power signal or an energy signal or neither.

b) From the given impulse response $h(n) = 5^n u(3-n)$, check the causality & stability of the system.

c) What is half-wave symmetry ?

d) The signal $x(t)$ is shown below :



Sketch the signal $x(3t)$. 6 + 4 + 1 + 4

11. a) What is inverse Z-transform ? Find inverse Z-transform of the following :

$$X(Z) = \frac{(Z + 0 \cdot 5)}{(Z + 0 \cdot 6)(Z + 0 \cdot 8)}$$ (using Residue method).

b) State the properties of ROC. (2 + 10) + 3

12. Write short notes on any *three* of the following : 3 × 5

a) Dirichlet's condition for Fourier series

b) Time scaling of a signal

c) Causal system & non-causal system

d) Conditional probability

e) Scalar signal & vector signal.

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