

B.Tech/ECE/3rd Sem/ECEN-2103/2015

2015

SIGNALS AND SYSTEMS
(ECEN 2103)

Time Alloted : 3 Hours

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five)
from Group B to E, taking at least one from each group.

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

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : [10×1=10]
- i) Energy of a power signal is
(a) finite (b) zero
(c) infinite (d) between 1 and 2
- ii) The minimum sampling frequency associated with a signal of bandwidth B Hz is
(a) 2B (b) 4B
(c) B (d) 3B
- iii) An LTI system represented by the difference equation $y(n) = x(n) - x(n - 1)$ is
(a) low-pass filter (b) high-pass filter
(c) band-pass filter (d) all-pass filter

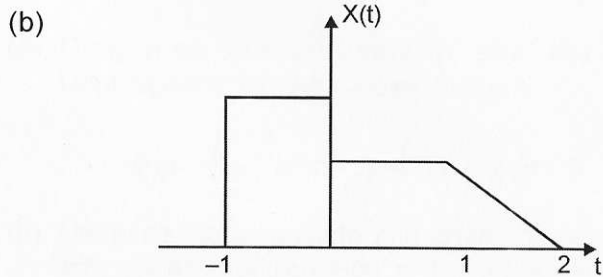
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- iv) The z-transform of $\delta(n - m)$ is
(a) z^{-m} (b) z^{-m-n}
(c) z^{n-m} (d) z^{m-n}
- v) A system described by $y[n] = nx[n]$ is
(a) linear, time varying & stable
(b) non-linear, time invariant & unstable
(c) non-linear, time varying & stable
(d) linear, time varying & unstable
- vi) The signal $\alpha^n u[n]$ is an energy signal if
(a) $|\alpha| < 1$ (b) $|\alpha| > 1$
(c) $|\alpha| = 1$ (d) $|\alpha| = 0$
- vii) The impulse response of a system described by the differential equation $\frac{d^2 y(t)}{dt^2} + y(t) = x(t)$ is
(a) a constant
(b) an impulse function
(c) a sinusoid
(d) an exponentially decaying function
- viii) Classify the following two systems as per causality
1. Weather forecasting system
2. Aircraft collision detection systems
(a) Causal, causal (b) Non causal, causal
(c) Causal, non causal (d) Non causal, non causal
- ix) A discrete time filter system function is given by $H(z) = \frac{1 - 1.6z^{-1} + z^{-2}}{1 - 1.5z^{-1} + 0.8z^{-2}}$. What is the amplitude response at dc?
(a) 0 (b) 1
(c) 1.33 (d) 1.6

- x) The unit step response of an LTI system with impulse response $h[n] = \delta[n] - \delta[n - 1]$ is
- (a) $\delta[n - 1]$ (b) $u[n - 1]$
 (c) $\delta[n]$ (d) $u[n]$

GROUP - B

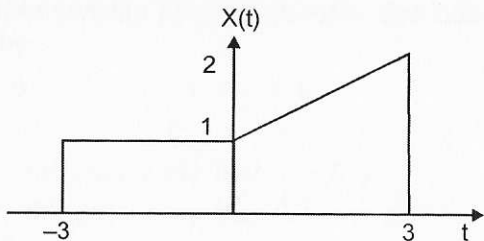
2. (a) Determine the linearity of $(dy/dt) + 4ty(t) = 2x(t)$.



Perform the transformation $x(-t+1)$ of the above function.

- (c) Evaluate whether the following signals are energy or power signals
- (i) $x(t) = \exp[j(2t + \pi/4)]$
 (ii) $x(t) = \cos t$ **3+3+6 = 12**

3. (a) (i) What do you mean by odd and even signal?
 (ii) Consider the signal shown below. Draw the even and odd parts of the signal.



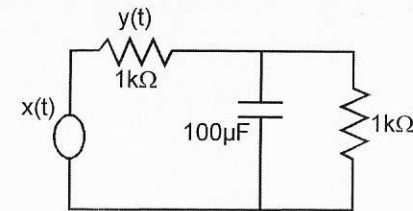
- (b) Determine the impulse response of the following recursive LTI system
- $$y[n] - 3y[n - 1] - 4y[n - 2] = x[n] + 2x[n - 1]$$
- (2+3)+7 = 12**

GROUP - C

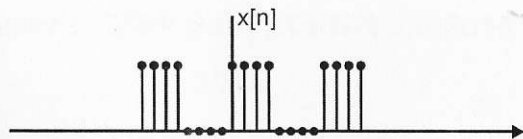
4. (a) State whether the following signal is periodic
 $x(t) = 4\cos(5\pi t)$
- (b) Find out the Fourier transform of unit step function.
- (c) Given $x(t) = 2 + 4\cos(2\omega_0 t)$. Find the exponential Fourier series co-efficients of $x(t)$. **2+7+3 = 12**
5. (a) Let $x[n] = \delta[n] + 2\delta[n - 1] - \delta[n - 3]$ and $h[n] = 2\delta[n + 1] + 2\delta[n - 1]$
 Compute $y[n] = x[n + 2] * h[n]$ using graphical method.
- (b) Find the auto-correlation of the signal $x(t) = A \sin(\omega_0 t + \phi)$. **6+6 = 12**

Group - D

6. (a) Use Laplace Transform to determine the voltage $y(t)$ in the circuit shown below for an applied voltage $x(t) = 3e^{-10t}u(t)$ V. The voltage across the capacitor at time $t = 0^-$ is 5V.



- (b) Determine the Fourier coefficients for the periodic sequence $x[n]$ shown below



7+5 = 12

7. (a) Determine the z-transform and the Region of Convergence for the following signal

$$x[n] = -\left(\frac{1}{2}\right)^n u[-n-1] - \left(-\frac{1}{3}\right)^n u[-n-1]$$

- (b) Compute the magnitude and phase response of a filter with system function $H(z) = 1 + z^{-1} + z^{-2} + z^{-3} + z^{-4} + z^{-5} + z^{-6} + z^{-7} + z^{-8}$, if the sampling frequency $f_s = 1\text{kHz}$. Determine the frequencies of the analog sinusoid that cannot pass through the filter.

4+8 = 12

GROUP - E

8. (a) Explain flat-top sampling.
 (b) What are the properties of a probability density function?
 (c) A random variable has a probability distribution function given by

$$F(x) = 0 \quad -\infty < x \leq 0$$

$$= 1 - e^{-2x} \quad 0 \leq x < \infty$$

- Find (i) the probability that $x > 0.6$
 (ii) the probability that $0.4 < x \leq 0.8$

4+4+4 = 12

9. Write short notes on any four of the following :
- (i) Significance of the Region of Convergence
 - (ii) Aliasing
 - (iii) Discrete Time Fourier Series
 - (iv) Noise in communication systems
 - (v) Digital Low Pass Filter and High Pass Filter
 - (vi) Stability of a system

4×3 = 12