

CS/B.Tech/ECE/Odd/Sem-3rd/EC-303/2014-15

EC-303

## SIGNAL AND SYSTEMS

Time Allotted: 3 Hours

Full Marks: 70

*The questions are of equal value.**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. Answer any ten questions.

10×1 = 10

- (i) If a signal  $f(t)$  has energy  $E$ , the energy of the signal  $f(2t)$  is equal to  
 (A)  $E$  (B)  $E/2$   
 (C)  $2E$  (D)  $4E$
- (ii) The odd and even components of signal  $u(t)$  are  
 (A)  $\cos t, \sin t$  (B)  $\sin t, -\cos t$   
 (C)  $\cos t, j\sin t$  (D)  $\cos t, -j\sin t$
- (iii) The system  $y(n+2) + y(n+1) = x(n+2)$  is  
 (A) causal and memoryless (B) causal and has memory  
 (C) causal (D) non-causal
- (iv) The Fourier series of a real, even periodic signal will contain only  
 (A) cosine terms (B) sine terms  
 (C) even terms (D) odd harmonics
- (v) The Fourier transform of a rectangular pulse is  
 (A) another rectangular pulse (B) triangular pulse  
 (C) sine function (D) impulse

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(vi) The Fourier transform of a dc signal with unity strength is

- (A) zero (B) 1  
 (C)  $2\pi\delta(\omega)$  (D)  $2\delta(\omega)$

(vii) ROC of causal LTI system

- (A) is the entire S plane (B) is the right half of S plane  
 (C) is the left half of S plane (D) does not exist

(viii) ROC of  $X(s)$  contain

- (A) zeros (B) poles  
 (C) no zero (D) no pole

(ix) The z-transform of  $\delta(n-m)$  is

- (A)  $z^{-n}$  (B)  $z^{-m}$   
 (C)  $\frac{1}{z-n}$  (D)  $\frac{1}{z-m}$

(x)  $y(n) = n[x(n)]$ 

- (A) linear and time invariant system  
 (B) linear and time variant system  
 (C) nonlinear time invariant system  
 (D) nonlinear time variant system

(xi) A signal will be called power signal if

- (A)  $P = \text{finite}, E = \infty$  (B)  $P = \infty, E = \text{finite}$   
 (C)  $P = \infty, E = 0$  (D) none of these

(xii) The period of the function  $\cos[\pi/4(t-1)]$  is

- (A)  $\frac{1}{8}$  sec (B) 8 sec  
 (C) 4 sec (D)  $\frac{1}{4}$  sec

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**GROUP B**  
(Short Answer Type Questions)

Answer any three questions.

3×5 = 15

2. Express the output of a linear time invariant discrete time system as a convolution sum of the input signal  $x[n]$  and the system impulse response function  $h[n]$ . 5
3. Show that the Dirac comb function given by  

$$\chi(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$$
 is a self-Fourier transform function, i.e., the Fourier transform will also be Dirac comb function, where  $T$  is the time period such that  $\delta(t - T) = \delta(t)$ . 5
4. A continuous time signal  $x(t) = \cos(t)$  is periodic with period  $\pm k2\pi$  and the fundamental period is  $2\pi$ , where  $k$  is zero or an integer. Show that a discrete signal  $x[n] = \cos[n]$  is not periodic,  $n$  being zero or an integer. 5
5. A signal has Laplace transform  $X(s) = \frac{s+2}{s^2+4s+5}$ . Find the Laplace transform  $Y(s)$ , of the signal  $y(t) = t * x(t)$ , where  $*$  is a convolution operation. 5
6. Sketch the signal  $x(t) = t^2$  for all  $t$  and find the trigonometric Fourier series coefficients over the interval  $(-1, 1)$ . 5

**GROUP C**  
(Long Answer Type Questions)

Answer any three questions.

3×15 = 45

7. (a) Explain the steps to compute the convolution sum. 4
- (b) Find the convolution of the following signals using graphical method: 7
- $$x(n) = 3\delta(n+1) - 2\delta(n-1) + \delta(n-2)$$
- $$h(n) = \delta(n) + 4\delta(n-2) + 2\delta(n-3)$$

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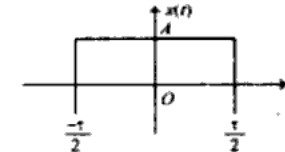
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- (c) Find the step response of an LTI system if the impulse response  $h(n) = u(n)$ . 4

8. (a) Derive the Exponential Fourier Series representation of continuous time Periodic signal from Trigonometric form. 6
- (b) Find the Fourier transform and plot the Magnitude spectrum of the following waveform. 7



- (c) Write down the Dirichlet condition for the existence of Fourier series. 2

9. (a) Using Laplace transform, find the transfer function and impulse response of an LTI system described by the differential equation  

$$\frac{d^2 y(t)}{dt^2} - \frac{dy(t)}{dt} - 2y(t) = x(t)$$
 6

- (b) List the properties of ROC of Laplace transform. 3
- (c) What do you mean by pole zero plot? 3
- (d) Find out the relationship between Laplace transform and Z-transform. 3

10. (a) State the Sampling theorem for low pass signal. 2
- (b) Define Nyquist rate. Determine the Nyquist rate and Nyquist interval of the following signals 7

- (i)  $-10\sin(40\pi t)\cos(300\pi t)$
- (ii)  $2\cos(400\pi t) + 6\sin(640\pi t)$

- (c) What is aliasing effect? How we overcome from this effect? 3+3

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

- (a) Parseval's relation
- (b) Evolution of Fourier series coefficient
- (c) Sample and hold circuit.
- (d) Probability density function
- (e) Energy signal and power signals.

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