

Code : 031510

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B.Tech 5th Semester Exam., 2017

SIGNALS AND SYSTEM

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

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1. Fill in the blanks of the following (any seven) :  $2 \times 7 = 14$

(a) The lengths of two discrete time sequences  $x_1(n)$  and  $x_2(n)$  are 5 and 7, respectively. The maximum length of a sequence  $x_1(n) * x_2(n)$  is \_\_\_\_\_.

(b) For a signal  $x(t)$ , the Fourier transform is  $X(f)$ . Then the inverse Fourier transform of  $X(3f + 2)$  is \_\_\_\_\_.

(c) Two discrete time systems with impulse responses

$$h_1[n] = \delta[n-1] \text{ and } h_2[n] = \delta[n-2]$$

are connected in cascade. The overall impulse response of the cascaded system is \_\_\_\_\_.

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( Turn Over )

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(d) For a periodic signal  $v(t) = 30 \sin 100t + 10 \cos 300t + 6 \sin(500t + \pi/4)$  the fundamental frequency in rad/s is \_\_\_\_\_.

(e) A discrete time system has impulse response  $h(n) = 2^n u(n-4)$  \_\_\_\_\_.

Write 'Yes' if the system is stable or 'No' if the system is not stable.

(f) The impulse response of a system is  $h(t) = tu(t)$

For an input of  $u(t-2)$  the output is \_\_\_\_\_.

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(g) The average power in the signal  $s(t) = 10 \cos(20\pi t - \pi/2) + 6 \sin(15\pi t)$  is \_\_\_\_\_.

(h)  $\int_{-r}^r \delta(t) dt =$  \_\_\_\_\_.

(i) The ROC of Laplace transform does not contain any \_\_\_\_\_.

(j) Z-transform is used for \_\_\_\_\_ time signal.

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$2 \times 7 = 14$

2. Define the following :

(a) Stability

(b) Causality

(c) Random signal

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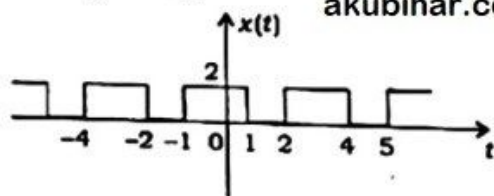
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- (d) Time-variant system
- (e) Linear system
- (f) Delta function
- (g) Memoryless system

3. (a) Consider the system  $y[n] = 2 \times [n^2]$ . Determine whether it is memoryless, causal, linear and time-invariant. 7
- (b) Determine the average power of the given signal  $x(t)$ . 7



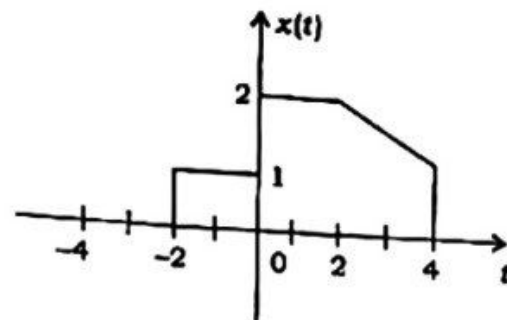
4. A continuous time signal  $x(t)$  is shown in the figure. Sketch the following signals :  $2 \times 7 = 14$

- (a)  $x(3-t)$
- (b)  $x(4t+1)$
- (c)  $[x(t) + x(-t)]u(t)$
- (d)  $[\delta(t+1) + \delta(t-1)]x(t)$
- (e)  $x(t)x(t-5)$

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- (f)  $x(t)\delta(t-3)$
- (g)  $x(2t-5)$



5. (a) (i) Find the inverse Fourier transform of  $X(\omega) = \frac{1}{2 - \omega^2 + j3\omega}$

$$X(\omega) = \frac{1}{2 - \omega^2 + j3\omega}$$

- (ii) Consider a causal LTI system with frequency response

$$H(j\omega) = \frac{1}{j\omega + 3}$$

For a particular input  $x(t)$  this system is observed to produce the output  $y(t) = e^{-3t}u(t) - e^{-4t}u(t)$ .

Determine  $x(t)$ .

- (b) Find the inverse z-transform of

$$X(z) = \frac{z}{z(z-1)(z-2)^2} \quad |z| > 2$$

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6. Find the Laplace transform and the associated ROC for each of the following signals : 2×7=14

(a)  $x(t) = \delta(t - t_0)$

(b)  $x(t) = u(t - t_0)$

(c)  $x(t) = e^{-2t} [u(t) - u(t - 5)]$

(d)  $x(t) = \sum_{k=0}^{\infty} \delta(t - kT)$

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(e)  $x(t) = \delta(at + b)$ ,  $a, b$  real constants

(f)  $x(t) = i/t$

(g)  $x(t) = \sin t$

7. Determine whether or not each of the following signals is periodic. If a signal is periodic, determine its fundamental time period : akubihar.com 2×7=14

(a)  $x[n] = \sin(\pi^2 n)$

(b)  $x(t) = \cos t + \sin 3t$

(c)  $x[n] = \cos \frac{n}{4}$

(d)  $x[n] = \cos^2 \frac{\pi}{8} n$

(e)  $x(t) = \sin t + \sin 2t$

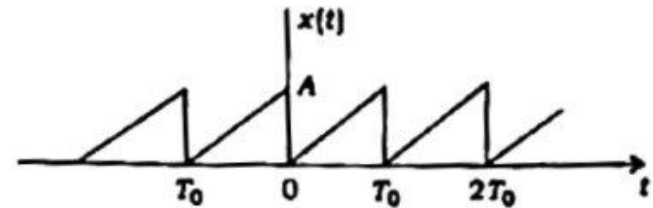
(f)  $x(n) = \sin(5\pi n)$

(g)  $x(t) = e^{-j3\pi/4}$

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8. (a) Calculate the Fourier series coefficient  $a_k$  for the continuous time periodic signal. 7



(b) The system is described by

$$y'(t) + 2y(t) = x(t) + x'(t)$$

Find the impulse response of the LTI system if the system is causal. 7

9. Write short notes on any two of the following : akubihar.com 7×2=14

(a) Even and odd symmetric signal

(b) Initial and final value theorem of Laplace transform

(c) Random and deterministic signals

(d) Force voltage analogy

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