



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(ECE)(N)/SEM-3/EC-303/2011-12

2011

SIGNALS AND SYSTEM

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 :

$$10 \times 1 = 10$$

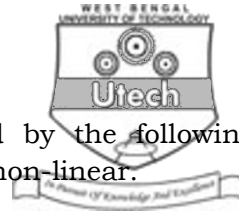
- i) Which of the following signals is power signal ?

- a) $x(n) = \left(\frac{1}{3}\right)^n u(n)$ b) $x(n) = e^{jn}$
c) $x(n) = e^{2n} u(n)$ d) $x(n) = e^{2n} u(n+1)$.

- ii) Determine the following discrete time systems are time invariant or not ?

- 1) $y(n) = \cos [x(n)]$
2) $y(n) = x(n) + x(n-1)$
3) $y(n) = x(-n)$

- a) 1 and 2 are time variant, 3 is time invariant
b) 1 and 3 are time variant, 2 is time invariant
c) 3 and 2 are time variant, 1 is time invariant
d) all are time variant system.



iii) Determine if the systems described by the following input-output equations are linear or non-linear.

1) $y(n) = x^2(n)$

2) $y(n) = nx(n)$

- a) 1 is linear, 2 is nonlinear
- b) 2 is linear, 1 is nonlinear
- c) 1 and 2 both are linear
- d) 1 and 2 both are nonlinear.

iv) Determine if the systems described by the following input-output equations are causal or non-causal.

1) $y(n) = x(n^2)$

2) $y(n) = \sum_{n=0}^{N-1} x(n)$

- a) 1 is causal but 2 is non-causal
- b) 2 is causal but 1 is non-causal
- c) 1 and 2 both are causal
- d) 1 and 2 both are non-causal.

v) The fundamental period of the sequence, $x(n) = \cos(2n\pi/3)$ is

- a) 1
- b) 2
- c) 3
- d) 6.

vi) The Fourier coefficient a_n can be evaluated as

a) $2/T \int_{-\infty}^{\infty} x(t) \cos n\omega t dt$

b) $2/T \int_0^T x(t) \cos n\omega t dt$

c) $2/T \int_{-T/2}^{T/2} x(t) \sin n\omega t dt$

d) $2/T \int_0^{\infty} x(t) \cos n\omega t dt.$

- 3204 (N)



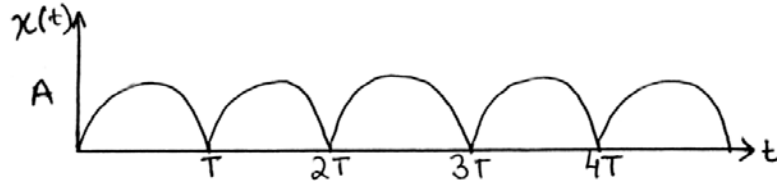
GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following

3 × 5 = 15

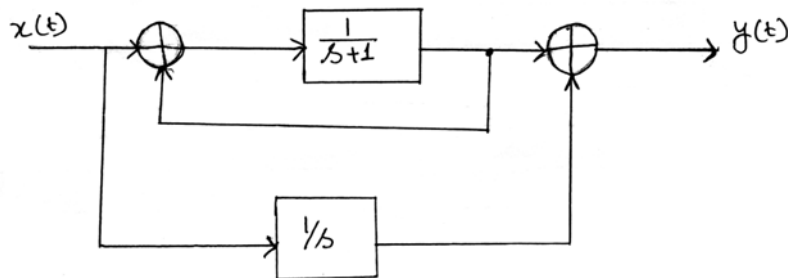
2. The waveform of a full wave rectifier output is shown below :



Show that its Laplace transform $X(s)$ is given by

$$X(s) = (A\omega) / (s^2 + \omega^2) \coth(sT/4).$$

3. A casual LTI system has the following block diagram :



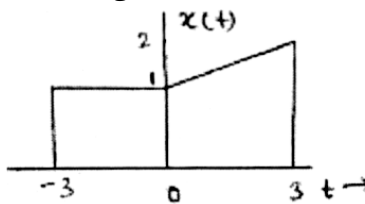
Determine a differential equation relating the output $y(t)$ with its input $x(t)$.

4. Determine the inverse z-transform of the following using contour integration method.

$$X(z) = 1 / (1 - 1.5z^{-1} + 0.5z^{-2}), \quad z > 1$$

5. a) What do you mean by even signal and odd signal ?
b) Consider the signal shown below. Draw the even and odd parts of the signal.

1 + 4





6. Define autocorrelation function. What are the properties of autocorrelation function ?
7. Determine whether following systems are linear : $2\frac{1}{2} + 2\frac{1}{2}$

a) $5 \frac{dy}{dt} + 3y(t) = 4 \frac{d^2x}{dt^2} + x(t)$

b) $\frac{dy}{dt} + 2y(t) = 3x(t)$.

GROUP – C

(Long Answer Type Questions)

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

8. a) Calculate the coefficient to Trigonometric Fourier series. Write down the Dirichlet conditions.
- b) Find out the Trigonometric Fourier series for the periodic signal, which is defined as

$$x(t) = e^{-t/2} \quad 0 < t < \pi$$

Fundamental frequency $= \omega_0 = 2 \text{ rad/sec.} \quad (5 + 2) + 8$

9. a) Find the direct form II realization of the following :

$$H(z) = \frac{1 - \frac{7}{4} \cdot z^{-1} - \frac{1}{2} \cdot z^{-2}}{1 + \frac{1}{4} \cdot z^{-1} - \frac{1}{8} \cdot z^{-2}}$$

b) If $H(z) = \frac{1}{(1 - \frac{1}{4} \cdot z^{-2})}$ and $h(n) = A_1 \alpha_1 u(n) + A_2 \alpha_2 u(n)$.

Determine the values of $A_1, \alpha_1, A_2, \alpha_2$.

- c) Use convolution to find $x(n)$ if $X(z)$ is given by

$$X(z) = \frac{1}{(1 - \frac{1}{2} z^{-1}) \cdot (1 + \frac{1}{4} z^{-1})} \quad 5 + 5 + 5$$

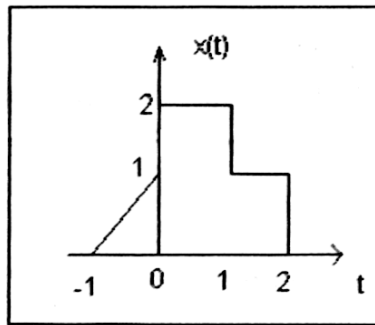


10. a) What do you mean by S-plane ?
 b) Find the Laplace transform and ROC of the following signal :

$$e^{-at}u(t)$$

 c) State and prove the time scaling property of Laplace transform.

$$3 + 6 + (2 + 4)$$
11. a) For the signal $x(t)$ shown in following figure, find the signals :



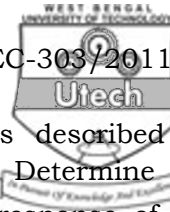
- i) $x(t - 2)$
 ii) $x(2t + 3)$
 iii) $x(3/2) \times t$.
- b) State and explain the non-linearity property of a system.
 c) Determine whether the system described by the following input-output equation is linear or non-linear.

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

$$(3 \times 3) + 3 + 3$$
12. a) State and prove the time shifting property of Z-transform.
 b) Determine the z-transform of

$$X(n) = (1/2)^n u(n) + 2^n u(n-1)$$

 Determine the region of convergence and the location of poles and zeros.



- c) A casual discrete time LTI system is described by $y(n) - 3/4y(n-1) + 1/8y(n-2) = x(n)$. Determine the system function $H(z)$ and the step response of the system.
13. a) Define discrete probability distribution, cumulative probability distribution function, joint probability function, marginal probability function and conditional density function.
- b) A continuous random variable has the density function
- $$f(x) = \begin{cases} 2/9(x-1) & 1 < x < 4 \\ 0 & \text{otherwise} \end{cases}$$
- Determine the distribution function of the random variable.
- c) The joint density function of two continuous random variables x and y is given by
- $$f(x, y) = \begin{cases} 2 & \text{for } 0 < x < 1, 0 < y < x \\ 0 & \text{otherwise} \end{cases}$$

Determine the conditional density functions.

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