

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.TECH(ECE-N)/SEM-3/EC-303/2012-13**

**2012**

**SIGNALS & 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 × 1 = 10

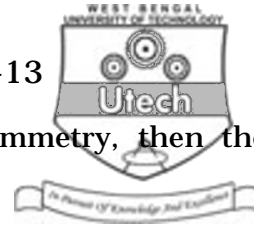
i) The fundamental period of the sequence

$$x [ n ] = \sin \left( \frac{2\pi n}{3} \right) \text{ is}$$

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

ii) A signal is a power signal if

- |                             |                        |
|-----------------------------|------------------------|
| a) $E < \infty, P = 0$      | b) $P < \infty, E = 0$ |
| c) $P < \infty, E = \infty$ | d) $P = \infty, E = 0$ |



- iii) If a signal  $x(t)$  has half wave symmetry, then the Fourier series will have only
- a) Odd harmonics of sine terms
  - b) Constant term and even harmonics of cosine terms
  - c) Even harmonics of sine and cosine terms
  - d) Odd harmonics of sine and cosine terms.
- iv) The system described by  $y[n] = nx[n]$  is
- a) Linear, time varying and stable
  - b) Non-Linear, time invariant and unstable
  - c) Non-linear, time varying and stable
  - d) Linear, time varying and unstable.
- v) A signal is given by the equation  $\left(\frac{1}{3}\right)^n u(n)$ . The signal is
- a) an energy signal
  - b) a power signal
  - c) both energy and power signal
  - d) netither energy nor power signal.



- vi) The signal  $x(n) = e^{j\frac{3}{5}(n + \frac{1}{2})}$
- is periodic with period  $\frac{3}{5}$
  - is periodic with period  $\frac{1}{2}$
  - is non-periodic
  - none of these.
- vii) The Fourier series coefficient  $b_n$  contains
- only cosine terms
  - only sine terms
  - only dc and cosine terms
  - only dc and sine terms.
- viii) The z-transform of a sequence  $x(n)$  is  $X(z)$ . The z-transform of  $nx(n)$  is
- $z \frac{d}{dz} X(z)$
  - $\frac{d}{dz} X(z)$
  - $-z \frac{d}{dz} X(z)$
  - None of these.
- ix) The minimum sampling frequency associated with a signal of bandwidth B Hz is
- 2B Hz
  - 4B Hz
  - B Hz
  - 3B Hz.



x) The ROC of the signal

$$x(n) = \left(\frac{1}{2}\right)^n u(n) + \left(\frac{1}{3}\right)^n u(-n-1) \text{ is}$$

a)  $\frac{1}{3} < |z| < \frac{1}{2}$

b)  $\frac{1}{2} < |z| < \frac{1}{3}$

c)  $\frac{1}{3} = |z| < \frac{1}{2}$

d) The z-transform of the signal does not exist.

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

a)  $z^{-m}$

b)  $z^{-m-n}$

c)  $z^{n-m}$

d)  $z^{m-n}$ .

**GROUP - B**

**( Short Answer Type Questions )**

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

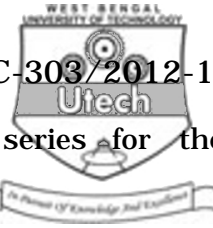
2. Define energy and power signal.

Calculate the power of signal sequence given by,

$$x[n] = e^{j\left(\frac{\pi n}{2} + \frac{\pi}{4}\right)} \quad 2 + 3$$

3. Find the system function and impulse response of the system described by the difference equation

$$Y(n) = X(n) + 5X(n-2) - 3X(n-3) + X(n-4).$$



4. Find the compact trigonometric Fourier series for the exponential  $e^{-t/2}$  over the interval  $0 \leq t \leq \pi$ .
5. Find the Fourier transform of the signal  $e^{-a|t|}$  for  $a > 0$ .
6. Find the Laplace transform of the signal  $\frac{t^{n-1}}{(n-1)!} e^{-at}$ .
7. Determine the z-transform of the following sequence and find its ROC :

$$x(n) = \{ 2, -1, 3, 2, 1 \uparrow, 0, 2, 3, -1 \}$$

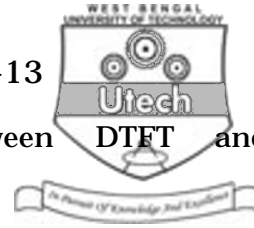
**GROUP - C**

**( Long Answer Type Questions )**

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

8. a) Write various forms of Fourier series representation for continuous time periodic signal.
- b) How do we get the frequency representation of aperiodic signal ?
- c) State the condition required for existence of Fourier Transform.
- d) State and prove Parseval's theorem for energy signal.
- e) State the F.T. of the signal  $x(t) = e^{-at} u(t)$ . Hence find out F.T. of the signal

$$x(t - t_0) = e^{-(t - t_0)} u(t - t_0). \quad 3 + 2 + 2 + 3 + 5$$



9. a) What is the relationship between DTFT and Z-transform ?

b) State and prove convolution theorem of Z-transform.

c) Find z-transform and ROC of

$$x(n) = [3(3)^n - 4(2)^n] u(n).$$

d) Find the inverse z-transform using Residue method

$$X(z) = (1 - \frac{1}{4}z^{-1}) / (1 - \frac{1}{9}z^{-1}), \text{ ROC : } |z| > 1/3.$$

2 + 3 + 5 + 5

10. a) State and prove time convolution theorem for CTFT.

b) Find out Fourier Transform of

i)  $\cos \omega_0 t$

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

c) The input and the output of a causal LTI system are related by differential equation

$$\frac{d^2 y(t)}{dt^2} + 6 \frac{dy(t)}{dt} + 8y(t) = 2x(t)$$

Find the impulse response of the system. 5 + 5 + 5

11. a) State and prove Sampling theorem.

b) What is aliasing effect ? How can we overcome from this effect ?



- c) Two signals  $x_1(t)$  and  $x_2(t)$  are multiplied together and the product is sampled by a periodic impulse train

$$p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT). \text{ If the signal } x_1(t) \text{ and } x_2(t)$$

are band limited to  $\Omega_1$  and  $\Omega_2$  respectively. That is

$$X_1(j\Omega) = 0 \text{ for } |\Omega| > \Omega_1$$

$$X_2(j\Omega) = 0 \text{ for } |\Omega| > \Omega_2$$

Determine the maximum sampling interval  $T$  that recovers the signal from its sampling. 5 + 5 + 5

12. Write short note on any *three* of the following : 5 + 5 + 5

- a) Probability Density Function
- b) Stability of a system
- c) Power Spectral Density and Energy Spectral Density
- d) Significance of ROC.

