



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) $E < \infty, P = 0$

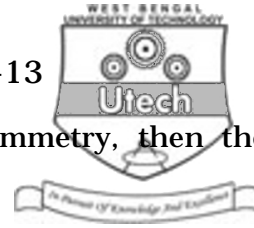
b) $P < \infty, E = 0$

c) $P < \infty, E = \infty$

d) $P = \infty, E = 0$

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[Turn over



- 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) neither 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. $3 \times 5 = 15$

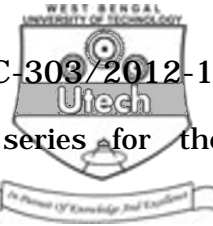
2. Define energy and power signal.

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 Ω_1 and Ω_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.

