

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (EEE)/SEM-7/EEE-703/2010-11
2010-11
DIGITAL SIGNAL PROCESSING

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)

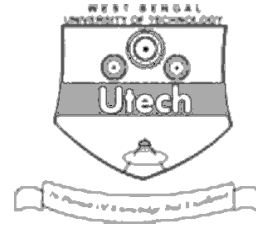
1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) ROC of $x(n) = a^n$ for $n \geq 0$ is

- a) $|z| < a$ b) $|z| > a$
c) difficult to define d) none of these.

ii) A system having impulse response $h(t)$ will be BIBO stable if

- a) $\int_{-\infty}^{\infty} |h(t)| dt < \infty$ b) $\int_{-\infty}^{\infty} h(t) dt < \infty$
c) $\int_{-\infty}^{\infty} |h(t)| dt > \infty$ d) $\int_{-\infty}^{\infty} |h(t)| dt = 0.$



- iii) A digital system in $y[n] = x[n^2]$ is
- a) linear and causal
 - b) linear and non-causal
 - c) non-linear and causal
 - d) non-linear and non-causal.
- iv) A digital filter is said to be IIR
- a) if present output depends on previous output only
 - b) if system function $H(z)$ has one or more non-zero denominator coefficients
 - c) if all the poles lie outside the unit circle
 - d) if system function has only zeros.
- v) A sinusoid of 1.4 kHz is sampled at intervals of 1 ms. The sampled signal will appear with frequencies as
- a) 2.4 kHz
 - b) 0.4 kHz
 - c) both (a) & (b)
 - d) none of these.
- vi) The convolution of $u[n]$ with $u[n-4]$ at $n = 5$ is
- a) 5
 - b) 2
 - c) 1
 - d) 0.
- vii) The signal $x(n) = (1/3)^n$ is a/an
- a) energy signal
 - b) power signal
 - c) none of these
 - d) all of these.



viii) If $X(z)$ is the z-transform of $x(n)$, then z-transform of $x(n+k)$ is

- a) $z^k x(k)$ b) $z^k x(z)$
c) $z^{-k} x(k)$ d) $z^{-k} x(z)$.

ix) A causal signal has a z-transform with ROC

- a) within a circle
b) on a circle
c) outside a circle
d) as a ring in the Z-plane.

x) If $X_1[n]$ and $X_2[n]$ are finite length sequences of size L and M respectively, their linear convolution has the length

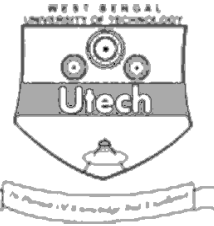
- a) $L + M - 2$ b) $L + M - 1$
c) $L + M$ d) $\max \{ L, M \}$.

xi) The region of convergence of $x(n) = 2^n U(n) + 3^n U(-n-1)$ is

- a) $|z| > 3$ b) $|z| < 2$
c) $2 < |z| < 3$ d) $2 > |z| > 3$.

xii) "Twiddle factor" is used in

- a) DFT b) FFT
c) FIR filter designing d) z-transform.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.

$$3 \times 5 = 15$$

2. What is warping effect and what is prewarping ?
3. Find out the inverse z-transform of $X(z) = Y(n) = \frac{3}{4} y(n-1) - \frac{1}{8} y(n-2) + x(n) + \frac{1}{3} x(n-1)$ using convolution method.
4. a) Prove that a linear time invariant system is stable, if its impulse response is absolutely summable.

b) Test the stability of a system whose impulse response is given by $h(n) = \left(\frac{1}{2}\right)^n u(n)$. 2 + 3
5. The impulse response of an LTI system is $h(n) = \{1, 2, 2, 1\}$.

Determine the response to the input signal $x(n) = \{1, 2, 3, 4\}$.
6. Determine the discrete time Fourier transform of $x(n) = (1/2)^{|n-1|}$.



GROUP – C

(Long Answer Type Questions)

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

7. a) Using first order section, obtain a cascade realization for

$$H(z) = \frac{\left(1 + \frac{1}{8}z^{-1}\right)\left(1 + \frac{1}{4}z^{-1}\right)}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)\left(1 - \frac{1}{10}z^{-1}\right)}$$

- b) Find inverse z-transform for

$$X(z) = \frac{\left(1 - \frac{1}{3}z^{-1}\right)}{(1 - z^{-1})(1 + 2z^{-1})} \text{ for } |z| > 2. \quad 8 + 7$$

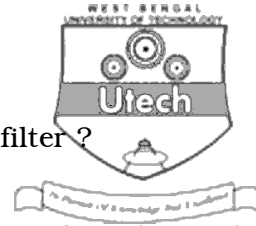
8. a) An analog filter has a transfer function

$$H(s) = \frac{10}{s^2 + 7s + 10}. \text{ Design a digital filter equivalent to}$$

this by impulse invariant method.

- b) Determine $H(z)$ that results when the bilinear transform

$$\text{is applied to } H_a(s) = \frac{(s^2 + 0.384)}{(s^2 + 0.5185s + 0.504)}. \quad 8 + 7$$



9. a) What is characteristic of Butterworth filter ?
- b) Determine the transfer function of 4th order Butterworth filter with unity 3 dB cut-off frequency.

6 + 9

10. a) Find the circular convolution of two finite duration sequences $X_1(n) = \{1, -1, -2, 3, -1\}$ and $X_2(n) = \{1, 2, 3\}$ using,

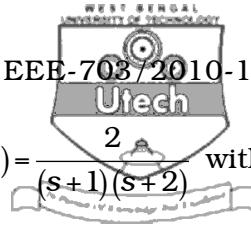
- i) graphical method
- ii) matrix method.

- b) If $x(n) = \{1, 3, 2\}$ and $y(n) = \{1, 2\}$, find the linear convolution $x(n) * y(n)$ using DFT based approach. 9 + 6

11. a) Determine z-transform of $X(n) = 2^n u(n-2)$.

- b) Explain the following terms :

- i) Pass-band ripple
- ii) Stop-band ripple
- iii) Transition band.



- c) Apply bilinear transformation to $H(s) = \frac{2}{(s+1)(s+2)}$ with

$T = 1$ sec and find $H(z)$.

- d) What do you mean by the term 'window' in designing

FIR filters ?

- e) Why is FIR filter called 'all zero filter' ? $3 + 3 + 4 + 3 + 2$

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