

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (CSE)/SEM-8/CS-801C/2011

2011

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.*

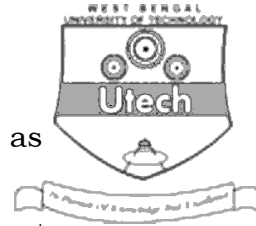
GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

- i) The 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.
- ii) The energy of constant amplitude complex valued exponential function $x(n) = A \exp(jn\omega)$ where A and ω constants is given by
- | | |
|--------------------|--------------------------|
| a) A^2 | b) $\frac{A^2}{2\omega}$ |
| c) $\frac{A^2}{2}$ | d) $\frac{A^2}{\omega}$ |



iii) Infinite memory system is also known as

- a) FIR system
- b) IIR system
- c) Digital system
- d) Analog system.

iv) The z-transform of $u(-n)$ is

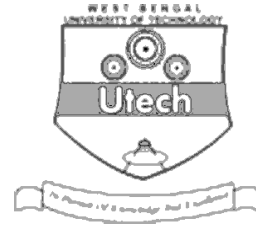
- a) $\frac{1}{(1 - z^{-1})}$
- b) $\frac{z}{(1 - z)}$
- c) $\frac{1}{(1 - z)}$
- d) $\frac{1}{(z - 1)}$.

v) If $x_1(n)$ and $x_2(n)$ are finite length sequences of sizes L and M respectively, their linear convolution has the length

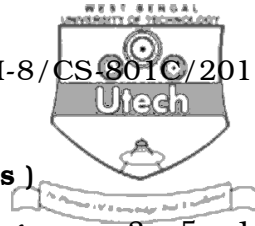
- a) $L + M - 2$
- b) $L + M - 1$
- c) $L + M$
- d) $\max \{ L, M \}$.



- vi) A digital filter is said to be IIR
- if present output depends on previous output only
 - if system function $H(z)$ has one or more non-zero denominator coefficients
 - if all the poles lie outside the unit circle
 - if system function has only zeros.
- vii) The Fourier transform of $\delta(n)$ is
- 1
 - 0
 - $\pi \delta(\omega)$
 - $\delta(\omega)$.
- viii) If $X(k)$ is z-transform of $x(n)$, then z transform of $x(n-k)$ is
- $z^k X(k)$
 - $z^{-k} X(k)$
 - $\frac{1}{z^k} X(k)$
 - $z^{-\frac{1}{k}} X(k)$.
- ix) A causal system always has
- right side sequences
 - left side sequences
 - both side sequences
 - none of these.



- x) Zero padding a signal
 - a) reduces aliasing
 - b) increase time resolution
 - c) increase frequency resolution
 - d) has no effect.
- xi) Fir filter is
 - a) recursive and linear
 - b) non-recursive and linear
 - c) recursive and non-linear
 - d) none of these.
- xii) The mapping from analog to digital domain in impulse invariant method is
 - a) one to many
 - b) many to one
 - c) one to one
 - d) none of these.



GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following.

3 × 5 = 15

2. Determine the z-transform of the following DT signal and find its ROC.

$$x(n) = (n + 0 \cdot 5) \left(\frac{1}{3} \right)^n u(n).$$

3. When a system is said to be stable ? Find whether the system with impulse response $h(n) = 2e^{-2|n|}$ is stable or not.

4. Determine the Fourier transform of the signal :

$$x(n) = 2^n u(-n) - 2^{-n} u(n)$$

5. Find out the DFT of $x(n) = \{ 0, 2, 4, 6 \}$.

6. Determine the response of the LTI system to the input signal

$$x(n) = 2^n u(n), \text{ whose impulse response is } h(n) = \left(\frac{1}{2} \right)^n u(n).$$



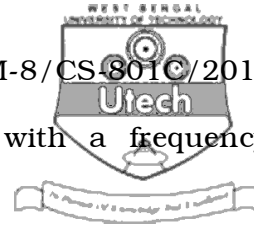
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.

3 × 15 = 45

7. a) Using Bilinear transformation, design a high-pass filter monotonic in pass band with a cut-off frequency of 1 kHz and down by 10 dB at 350 Hz while sampling frequency is 5 kHz. 7
- b) Determine the z-transform of the following signal and indicate their ROC along with pole zero plots.
- i) $x(n) = (a^n \cos \omega_0 n) u(n)$
- ii) $x(n) = a^n u(n) + b^n u(-n - 1), |a| < |b|.$ 4 + 4
8. a) Discuss about design method of low-pass filter.
- b) What is rectangular window ?
- c) How is a rectangular window used to design FIR filter ?
- d) Determine the IDFT of $x(k) = \{ 3, (2 + j), 2, (2 - j) \}.$
- 4 + 2 + 4 + 5
9. a) Compute the DFT of a sequence $(-1)^n$ for $N = 3.$ 4
- b) Explain the decimation in time FFT algorithm. 7
- c) Find the order of the Butterworth filter that has a – 2dB pass band attenuation at a frequency of 20 rad/sec and – 10 dB stop band attenuation at 30 rad/sec. 4



10. a) Design an ideal band pass filter with a frequency response

$$H_d(e^{j\omega}) = 1 \text{ for } \frac{\pi}{4} \leq \omega \leq \frac{3\pi}{4}$$

= 0 otherwise.

Find the values of $h(n)$ for $N = 11$ and plot the frequency response.

- b) Distinguish between FIR and IIR filter. 10 + 5

11. Write short notes on any *three* of the following : 3 × 5

- a) Circular convolution
- b) Utility of FFT over DFT
- c) BIBO stability in Z Domain
- d) Gibb's Phenomenon
- e) Periodic and aperiodic signal.

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