

Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech (ECE-VLSI)/SEM-2/MVLSI-202/2013

2013

DIGITAL SIGNAL PROCESSING & APPLICATIONS

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

1. Choose the correct alternatives for any *fourteen* of the following : $14 \times 1 = 14$

i) Digital signals are

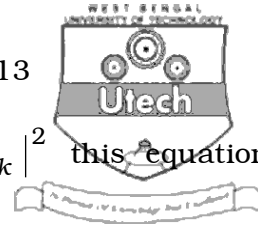
- a) discrete in time and discrete in amplitude
- b) discrete in amplitude and quantized in amplitude
- c) discrete in time and continuous in amplitude
- d) discrete in amplitude and quantized in time.

ii) $x(n) = (1/3)^n u(n)$ is a

- a) power signal
- b) energy signal
- c) both (a) and (b)
- d) none of these.

iii) $e^{j\omega n}$ is periodic only if

- a) ω is multiple of π
- b) n is multiple of π
- c) ω is multiple of 2π
- d) both (b) & (c).



iv) $(1/N) \sum_{n=-N}^N |x(n)|^2 = \sum_{k=-N}^N |C_k|^2$ this equation states the

- a) Parseval's relation
 - b) Power of the signal $x(n)$
 - c) Energy of the signal
 - d) Both (a) & (b).
- v) Sufficient condition for existence of DTFT for an aperiodic sequence $x(n)$ is
- a) $\sum_{n=0}^{\infty} |x(n)| < \infty$
 - b) $\sum_{n=0}^{\infty} |x(n)| > \infty$
 - c) $\sum_{n=-\infty}^{\infty} |x(n)| < \infty$
 - d) $\sum_{n=-\infty}^{\infty} |x(n)| > \infty$.
- vi) ROC of the $X(z)$ is the
- a) set of some values of z for which $X(z)$ attains a finite value
 - b) the value of z for which only $X(z)$ attains the finite value
 - c) the value of $X(z)$ for which a finite region can be defined
 - d) set of all values of z for which $X(z)$ attains a finite value.



vii) Which of the following statement(s) is/are true ?

1. ROC can contain pole
2. If $x(n)$ is causal sequence ROC is entire z-plane except $z = 0$
3. ROC of a LTI stable system contains the unit circle.

- | | |
|------------------|----------------|
| a) All of these | b) Only 2 & 3 |
| c) None of these | d) Only 1 & 3. |

viii) Frequency response of the system $H(z) = 1/(1 - 3z^{-1})$ is

- a) $|H(e^{j\omega})| = \infty$ & $\angle H(e^{j\omega}) = 2\pi n$
- b) $|H(e^{j\omega})| = 1$ & $\angle H(e^{j\omega}) = \tan^{-1} 1/(1 - 3\cos\omega)$
- c) $|H(e^{j\omega})| = 1$ & $\angle H(e^{j\omega}) = \tan^{-1} (1 - 3\cos\omega)$
- d) $H(e^{j\omega})$ does not exist.

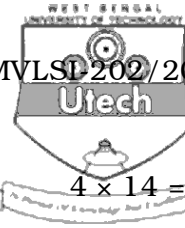
ix) Two non-intersecting DTLTI system in cascade have impulses $g(n)$ and $h(n)$. The impulse response of the combination is

- | | |
|----------------------|---------------------------------|
| a) $g(n) \cdot h(n)$ | b) $g(n) + h(n)$ |
| c) $g(n) * h(n)$ | d) $[g(n) \cdot h(n)]^{-1/2}$. |

x) $x(n) = \{1, 0, 0, 1\}$ and $X(k)$ is the DFT of $x(n)$. Now $X(0) =$

- | | |
|------|--------------|
| a) 2 | b) $1 + j$ |
| c) 0 | d) $1 - j$. |

- 30310 (M.Tech)



GROUP – B

Answer any *four* of the following. $4 \times 14 = 56$

2. What is warping effect ? How can you remove it ?

Design a Butterworth filter for the following specification. Use Bilinear transformation technique.

i) 3 dB attenuation at 1.5 kHz

ii) 10 db attenuation at 3 kHz

iii) Sampling frequency $F = 8000$ Hz. 5 + 9

3. What is DFT ? Find out 4-point DFT of $x(n)$, where $x(n) = \{1, 2, 3, 4\}$. Use matrix method.

What is FFT ? Find out 8-point FFT of $x(n)$, where $x(n) = \{0, 1, 2, 3\}$. Use DIT algorithm. 5 + 9

4. Obtain the Direct form I, Direct form II, Cascade & parallel form realization of following system.

$$y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$$



5. Classify discrete time signals with examples. What is the causality condition for an LTI system ? Determine the following system is

$$y(n) = 3y^2(n-1) - nx(n) + 4x(n+1) - x(n+1) \quad n \geq 0$$

- i) Static/Dynamic
- ii) Causal/Non-causal
- iii) Linear/Non-linear
- iv) Time invariant/Time variant
- v) Stable/Unstable
- vi) FIR/IIR.

6 + 2 + 6

6. What is convolution sum ? What are the properties convolution sum follows ? Find out the convolution of the two signals given

$$x(n) = (1/3)^n u(-n-1)$$

$$h(n) = u(n-1)$$

Determine the impulse response of the given causal system.

$$y(n) + y(n-1) - 2y(n-2) = x(n-1) + 2x(n-2)$$

1 + 2 + 3 + 8



7. Determine & sketch the magnitude phase response of the following signal.

$$x(n) = n \left(\frac{1}{2} \right)^{|n|}$$

Determine the system function $H(z)$, impulse response of the given discrete time system described by the difference equation.

$$y(n) - y(n-1) + \left(\frac{3}{16} \right) y(n-2) = x(n) - \left(\frac{1}{2} \right) x(n-1)$$

Determine the stability of the system. Plot the pole-zero diagram.

6 + 8

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