*Name* : .....

*Roll No.* : .....

*Invigilator's Signature* : .....

**CS/B.TECH/ECE(NEW)/SEM-6/EC-602/2013**

**2013**

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

a) $L+M-2$ b) $L+M-1$

c) $L+M$ d) $\max(L, M)$.

ii) $z$-transform of unit step is

a) $(1-z^{-1})^{-1}$ b) $(1-z)^{-1}$

c) $(z-1)^{-1}$ d) $(1-z)$.

iii) FIR filter is

a) recursive and linear

b) non-recursive and linear

c) recursive and non-linear

d) recursive.

iv) Stability region of *z*-transform is
   a) within unit *z*-circle
   b) outside the unit *z*-circle
   c) on the unit *z*-circle only
   d) entire *z*-plane.

v) An LTI system described by impulse response $h(n) = a^n u(n)$ is stable if
   a) $|a| > 1$ b) $|a| < 1$
   c) $|a| \le 1$ d) $|a| \ge 1$.

vi) A signal $x(n)$ is called an energy signal if its energy $E$ and power $P$ satisfy
   a) both $E$ and $P$ infinite b) $E = \infty, P < \infty$
   c) $E < \infty, P = 0$ d) $E < \infty, P = \infty$.

vii) Final value theorem by *z*-transform is
   a) $x(\infty) = \underset{z \to 1}{Lt} (z-1) \times (z)$
   b) $x(\infty) = \underset{z \to 0}{Lt} (z-1) \times (z)$
   c) $x(\infty) = \underset{z \to \infty}{Lt} (z-1) \times (z)$
   d) $x(\infty) = \underset{z \to 1}{Lt} z \times (z)$.

viii) If the Fourier transform of a sequence $x(n)$ is $x(e^{j\omega})$, then the Fourier transform of $x(n-k)$ is
   a) 0 b) $(e^{-j\omega k}) \times (e^{j\omega})$
   c) $(e^{-j\omega}) \times (e^{j\omega})$ d) none of these.

ix) Between IIR and FIR filters,
   a) FIR has better phase response
   b) IIR has better stability
   c) FIR is recursive
   d) IIR is non-recursive.

x) FFT is a modification of DFT in terms of

a) computational speed b) noise

c) linearity d) none of these.

xi) Between circular convolution and linear convolution

a) length of linear convolution is greater

b) length of circular convolution is greater

c) lengths of both are same

d) none of these.

xii) Bit reversal is applicable to

a) DFT b) FFT

c) CFT d) none of these.

## GROUP – B

### ( Short Answer Type Questions )

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

2. The impulse response of one LTI system is $h(n) = \{1, 2, 1, -1\}$. Determine the response of the system to the input signal, $x(n) = \{1, 2, 3, 1\}$.

3. Determine and explain the relationship between *s*-plane and *z*-plane.

4. Distinguish between IIR and FIR filters.

5. Determine *z*-transform of $x(n) = \left(\frac{2}{3}\right)^n u(n) + \left(\frac{3}{4}\right) u_{n-1}$.

6. Draw direct form-II and cascade form of the following transfer function :

$$H(z) = \frac{1 + \left(\frac{1}{3}\right) z^{-1}}{1 - \left(\frac{3}{4}\right) z^{-1} + \left(\frac{1}{8}\right) z^{-2}}$$

7. Write down the difference equation for transfer function

$$H(z)=\frac{1+\left(\frac{1}{4}\right)z^{-1}+\left(\frac{1}{2}\right)z^{-2}+\left(\frac{1}{3}\right)z^{-3}}{1+z^{-1}+\left(\frac{1}{4}\right)z^{-2}-\left(\frac{1}{3}\right)z^{-3}+\left(\frac{1}{2}\right)z^{-4}}$$

## GROUP – C

### ( Long Answer Type Questions )

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

8. a) Determine linear convolution and circular convolution of sequences { 1, 2, 3, –1 } and { 3, 4, 2, –3 }. 5 + 5

   b) Describe correlation and multiplication using *z*-transform. 5

9. What is DFT ? What is FFT ? Describe time decimation of FFT computation. Explain how FFT is superior to DFT. 2 + 3 + 8 + 2

10. a) Describe windowing. Explain Gibbs oscillation in this context. Explain the function of rectangular and Hamming windows for filter realization. 4 + 3 + 5

    b) Explain ROC of transformation. 3

11. a) Describe Butterworth IIR filter using impulse invariant method. 6

    b) Explain aliasing error and overlapping. 4

    c) Describe mapping of DSP algorithm onto FPGA. 5

12. Write short notes on any *three* of the following : $3 \times 5$

    a) Energy and power signals

    b) Perseval's relation and its application

    c) Bilinear transformation

    d) Casual and non-casual signals.

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