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

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

   i) The system $y(n) = x(n) + nx(n+1)$ is

      a) linear time invariant

      b) non-linear time invariant

      c) linear time variant

      d) none of these.

   ii) $e^{2n}\,u(n)$ is

      a) energy signal b) power signal

      c) both of these d) none of these.

   iii) If ROC of the Z-transform of a sequence is outside a circle of radius r, then the sequence is

      a) causal b) non-causal

      c) anticausal d) none of these.

iv) Z-transform of $u(n-1)$ is

a) $\frac{1}{1-z^{-1}}$ b) $\frac{z}{1+z^{-1}}$

c) $\frac{1}{z\left(1-z^{-1}\right)}$ d) $1+z^{-1}$.

v) For an analog signal = 3 cos 50 πt + 10 sin 300 πt, the Nyquist sampling rate is

a) 150 Hz b) 350 Hz

c) 25 Hz d) 50 Hz.

vi) poles of Butterworth filter lie on

a) circle b) ellipse

c) circle and ellipse d) none of these.

vii) If $x(n) = \{j, -j\}$ then

a) $X(k) = \{2j, 0\}$ b) $X(k) = \{0, 0\}$

c) $X(k) = \{0, 2j\}$ d) $X(k) = (-j, j\}$.

viii) A causal system always has

a) right side sequences b) left side sequences

c) both side sequences d) none of these.

ix) The fundamental period of the sequence

$x(n) = \cos\left(\frac{2\pi n}{3}\right)$ is

a) 1 b) 2

c) 3 d) 6.

x) The value of the twiddle factor W_8^2 is given by

a) 1 b) $-J$

c) $\frac{1}{\sqrt{2}} - \frac{j}{\sqrt{2}}$ d) -1.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Explain quadrature mirror filter (QMF) Bank.

3. Sketch the down sample version of the signal $X(n) = \{1, -1, 1, -1, 2, -2, 2, -2, 3, -3, 3, -3\}$ for sampling rate reduction factor

   a) $D = 2$

   b) $D = 3$.

4. Find the DFT of a sequence $x(n) = \{5, 6, 2, 3\}$.

5. Realize the trasnposed structure of the sequence $y(n) = -0{\cdot}1\, y(n-1) + 0{\cdot}72\, y(n-2) - 0{\cdot}7\, x(n) - 0{\cdot}252\, x(n-1)$.

6. Write a short note on rectangular window.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. Design an ideal HPF whose desired frequency response

   $H_d\left(e^{jw}\right) = 1,\ \pi \geq |w| \geq \pi/4$

   $= 0,\ |w| < \pi/4$

   using Hanning window method for $N = 11$.

8. Find $x(k)$ using DIT algorithm

   $x(n) = \{0{\cdot}5, 0{\cdot}5, 0{\cdot}5, 0{\cdot}5, 0, 0, 0, 0\}$.

9. a) State and prove the convolution property Z-transform.

   b) Find the inverse Z-transform using convolution method of $X(z) = \dfrac{z^2}{(z-1)(z-2)}$.

   c) Determine pole zero plot of the system

   $$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) - x(n-1).$$

   3×5

10. Explain the characteristic of a limit cycle oscillation with respect to the system described by the equation $y(n) = 0{\cdot}95\, y(n-1) + x(n)$ when the product quantization is up to 5-bits rounding. The system is excited by an input $x(n) = 0{\cdot}75$ for $n = 0$ and $x(n) = 0$ for $n \neq 0$. Also determine the dead band of the filter.

11. a) Design an analog Butterworth filter that has a – 2 dB pass band attenuation at frequency 20 rad/s and at least – 10 dB stop band attenuation at frequency 30 rad/s.

    b) $H(s) = \dfrac{2}{(s+1)(s+2)}$, T = 1s. Determine $H(z)$ impulse invariant method. 10 + 5