Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH (ECE-N)/SEM-6/EC-601/2011

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 fundamental p riod of the sequence

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

   a)   1   b)   2

   c)   3   d)   6.

ii)   A signal is a power signal if

   a) $E < \infty$, $P = 0$ b) $P < \infty$, $E = 0$

   c) $P < \infty$, $E = \infty$ d) $P = \infty$, $E = 0$

iii)   The Z-transform of $\delta(n)$ is

   a)   0   b) Z^{-1}

   c) $1/(1 - Z^{-1})$ d)   1.

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iv) The system described by $y[n] = nx[n]$ is

    a)   Linear, time varying and stable

    b)   Non-linear, time invariant and unstable.

    c)   Non-linear, time varying and stable.

    d)   Linear, time varying and unstable.

v)   For an analog signal $x(t) = 3\cos(50\pi t) + 10\sin(300\pi t)$. The Nyquist sampling rate is

    a)   150 Hz.

    b)   300 Hz.

    c)   25 Hz.

    d)   50 Hz.

vi)   Z-transform of $u[n-1]$ is

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

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

vii)   A discrete time LTI system is known as causal system if its,

    a) $h(n) = 0$, n < 0   b) $h(n) = 0$, $n > 0$

    c) $h(n)$ is positive, $n < 0$ d)   none of these.

viii) If $h(n) = \{1, 0, 1\}$ and $y(n) = x(n)*h(n) = \{1, -2, 4, -2, 3\}$, then $x(n)$ is

    a) $x(n) = \{1, -2, 1\}$ b) $x(n) = \{1, -1, 3\}$

    c) $x(n) = \{1, -2, 3\}$ d) $x(n) = \{1, -2, -3\}$.

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ix) If $x(n) = \{1, 0, 0, 1\}$, the DFT value $X(0)$ is

    a)   2   b) $1 + j$

    c)   0   d) $1 - j$.

x) Overlap save method is used to find

    a)   circular convolution

    b)   linear convolution

    c)   DFT

    d) Z transform.

xi) The direct evaluation of DFT require

    a) N^2 multiplications and N^2 additions.

    b) N^2 multiplications and $N(N-1)$ additions.

    c) $N(N-1)$ multiplica ions and N^2 additions.

    d) $N(N-1)$ multiplications and $N(N-1)$ additions.

xii) The poles of the Chebyshev filter lie

    a)   on an e lipse   b)   on a circle

    c)   on par bola   d)   on a rectangle.

GROUP – B

(Short Answer Type Questions)

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

2. Define energy and power signal.

Calculate the power of signal sequence given by

$$x[n] = \left(\frac{1}{3}\right)^n u[n].$$ $2 + 3$

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3. a) What is convolution sum ?

    b) Find the convolution sum of the signals :

        $x(n) = 1$, $n = -2$, 0, 1

        $= 2$, $n = -1$

        $= 0$, elsewhere

        $h(n) = \delta(n) - \delta(n-1) + \delta(n-2) - \delta(n-3)$

4. Find the inverse Z transform of

    $X(z) = z^2/(z^2 - 3z + 2)$; ROC : $|Z| > 2$

5. For the sequence $x(n) = \{1, 1, \quad 0, -1, -1, 0, 0\}$, determine the 8-point DFT.

6. How do you take care of warping effect for designing an IIR filter using bilinear t ansformation ?

GROUP – C

(Long Answer Type Questions)

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

7. a) Find the system function and impulse response of the system described by the difference equation

        $Y(n) = X(n) + 2X(n-1) - 4X(n-2) + X(n-3)$

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b) Find the linear convolution using circular convolution for the two sequences :

$x (n) = \{1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1 \}$

$h (n) = \{ 1, 2 \}$

c) What are the properties of ROC ? Find the Z transform and the ROC of the signal $X (n) = - b^{n} U (-n - 1)$

$$5 + 5 + 5$$

8. a) Find the Z-transform of the discrete tim signal

$$x [n] = \left(\frac{1}{3} \right)^{n-1} u[n-1]$$

b) Find the inverse Z-transform of

$$X (z) = \frac{z(z^2 - 4z + 5)}{(z-3)(z-1)(z-2)}$$

for ROC

i) $2 < |z| < 3$

ii) $|z| > 3$

iii $|z| < 1$.

9. a) What is the need for FFT ? Explain the decimation in time FFT algorithm.

b) Evaluate 8-point for the sequence using DIT-FFT algorithm :

$x (n) = 1, -3 \le n \le 3$

= 0, elsewhere.

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    c)   What is bit reversal ?

    d)   Differentiate between overlap-save method and overlap-add method. $1 + 5 + 6 + 1 + 2$

10. a)   Differentiate between FIR and IIR filters.

    b)   What is windowing ?

    c)   Find the order and cut-off frequency of a digital filter with the following specifications :

        $0.89 \leq |H(e^{jw})| \leq 1, \quad 0 \leq w \leq 0.4\pi$

        $|H(e^{jw})| \leq 0.18, \qquad 0.6\pi \leq w \leq \pi$

        Use impulse invariance me hod.

    d)   Write down the advantages of bilinear transformation over impulse invarian e. $3 + 2 + 8 + 2$

11. a)   Obtain the structures of cascade and parallel realization of the following transfer function :

        $H(z) = (1 - z^{-1})^3 / (1 - \frac{1}{8} z^{-1})(1 - \frac{1}{2} z^{-1})$

    b)   What is the difference between linear and circular convolutions ?

    c)   Compute the circular convolution of the following two sequences :

        $x_1(n) = \{ 2, 1, 2, 1 \}$
                $\uparrow$
        $x_2(n) = \{ 1, 2, 3, 4 \}$
                  $\uparrow$

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

a) Radix-2 DIF algorithm

b) Chebyshev filter

c) Causal & non-causal systems

d) Bilinear transformation

e) TMS 32OC 6713 architecture.

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