CS/B.Tech/EVEN/EE/SEM-6/EE-605A/2014

2014

Digital Signal Processing

Time Allotted : 3 Hours   **Full Marks : 70**

The figure 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) A signal is given by the equation $\left(\frac{1}{3}\right)^n$ u(n). The signal is –

   (a) energy signal

   (b) power signal

   (c) both energy and power signal

   (d) neither energy nor power signal

ii) The fundamental period of the sequence $x[n] = \sin(\frac{2\pi n}{3})$ is–

   (a) 1   (b) 2   (c) 3   (d) 6

iii) 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

1098   1   [Turn over]

iv) The z-transform of a sequence x(n) is X(z). The z-transform of nx(n) is –

   (a) $z\dfrac{d}{dz}X(z)$ (b) X(z) (c) $-z\dfrac{d}{dz}X(z)$ (d) none of these

v) Determine the ROC of the signal

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

   (a) $\dfrac{1}{3}<|z|<\dfrac{1}{2}$ (b) $\dfrac{1}{2}<|z|<\dfrac{1}{3}$

   (c) $\dfrac{1}{3}=|z|<\dfrac{1}{2}$ (d) z-transform does not exist

vi) If B Hz is the bandwidth of a message signal then the minimum rate of sampling is –

   (a) 4B Hz   (b) 8B Hz   (c) 2B Hz   (d) 3B Hz

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

   (a) L+M–2   (b) L+M

   (c) L+M–1   (d) None of these

viii) A system having impulse response h(t) will be BIBO stable if–

   (a) $\displaystyle\int_{-\infty}^{\infty}|h(t)|\,dt<\infty$ (b) $\displaystyle\int_{-\infty}^{\infty}h(t)\,dt<\infty$

   (c) $\displaystyle\int_{-\infty}^{\infty}|h(t)|\,dt>\infty$ (d) $\displaystyle\int_{-\infty}^{\infty}|h(t)|\,dt=0$

ix) Given a system with $h(n) = a^n u(n)$ is a constant then the system is –

   (a) IIR system   (b) FIR system

   (c) both IIR and Fir system   (d) None of these

x) The value of the twiddle factor W_4^8 is given by –

   (a) 1   (b) –j   (c) $\dfrac{1}{\sqrt{2}}-\dfrac{j}{\sqrt{2}}$ (d) –1

xi) Overlap save method is used to find –

   (a) Circular convolution   (b) Linear convolution

(c) DFT   (d) Z-transform

xii) FIR filter is –

    (a) recursive and linear   (b) non recursive and linear

    (c) recursive and non linear   (d) None of these

xiii) System function of digital filter is expressed as

    $H(z) = b^k z^{-k}$ represents –

    (a) IIR Filter   (b) FIR Filter

    (c) Butterworth Filter   (d) Chebyshev Filter

xiv) If x(n) = (1, 0, 0, 1) then the DFT value X(0) is –

    (a) 2   (b) 1 + j   (c) 0   (d) 1 – j

Group-B
(Short Answer Type Questions)
Answer any *three* of the following

$0 \le n \le 3$ 5x3=15

2. Find y(n) if x(n) = n+2 for

   h(n)=aⁿu(n) for all n   5

3. When a system is said to be BIBO stable?

   Find whether the system with impulse response $h(n)=2e^{-2|n|}$ is stable or not.   5

4. Find the DFT of a sequence x(n) = {1, 1, 0, 0}   5

5. What is wrapping effect? How can you remove this effect?   5

6. Find the causal signal x(n) which is having the Z transform as

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

Group – C
(Long Answer Type Questions)
Answer any *three* of the following

3x15=45

7. (a) Computer the response of the system –

   y(n)= 0.7 y(n–1) –0.12y(n–2)+x(n–1)+x(n–2) to input x(n)=nu(n).

Is the System is stable?

(b) What is ROC? State its properties.

(c) What is relation between z-transform and DTFT. 8+4+3

8. (a) Computer the 8-point DFT of the following sequence

$x(n) = \{½, ½, ½, ½, 0, 0, 0, 0\}$.

Use in-place radix-2 decimation in time FFT algorithm.

(b) What is a butterfly regarding FFT?

(c) What are the difference and similarities between DIT and DIF algorithms? 10+2+3

9. (a) Design the symmetric FIR lowpass filter using rectangular window for which desired frequency response is expressed as

$$H_d(\ ) = \begin{cases} \omega & e^{-j\omega t} \quad \text{for } |\omega| \le \omega_c \\ 0 & \text{elsewhere.} \end{cases}$$

Where the length of the filter 7 and $w_c = 1$.

(b) Determine H(z) using impulse invariant method at 5 Hz sampling frequency from –

$$H(z) = \frac{2}{(s+1)(s+2)}$$ 9+6

10. (a) Draw cascade structures for the system described by the difference equation –

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

(b) Design a digital Butterworth filter using the following specifications using bilinear transformation method –

$0.8 \le H(j\omega) \le 1 \quad \text{for } 0 < \omega < 0.2pi$

$H(j\omega) \le 0.2 \quad \text{for } 0.6pi < \omega < pi$ 5+10

11. Write short notes on (any three) – 3x5

(a) Energy and power signal

(b) IIR and FIR filter

(c) Overlap save method and overlap add method

(d) Casual & non-casual systems

(e) Utility of FFT over DFT

————X-X-X————