Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 27318

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Information Technology

IT 6502 — DIGITAL SIGNAL PROCESSING

(Regulations 2013)

Time : Three hours　　　　　　　　　　　　　　　　　　Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Test whether the system $y(n) = 0.5x(n) + 9$ is linear and time invariant.

2. Find whether the signal $x(n) = \cos\left(\frac{\pi}{3}n + \frac{\pi}{6}\right)$ is power signal or energy signal.

3. The first five DFT values for $N = 8$ is as follows :

   $X(K) = \{28, -4 + j\,9.656, -4 + 4j, -4 + j\,1.656, -4, \ldots\ldots\}$

   Compute the rest of the three DFT values.

4. Compute 4-point IDFT for $X(K) = \{2, 3 + j, -4, 3 - j\}$.

5. "IIR filter does not have linear phase". – Justify.

6. An IIR causal filter has the system function

   $y(n) = x(n) - 0.75\,y(n)$;
   $x(n) = 0.875\,\delta(n)$

   Assume 3 fractional bits in quantizer plus a sign bit. Show that the filter output enters into zero input limit cycle oscillation.

7. Write the frequency response of linear phase FIR filters when impulse response is anti symmetric and N is odd.

8. Write the necessary condition for a linear phase FIR filter.

9. Why is rounding preferred than truncation in realizing digital filter?

10. Consider the truncation of negative numbers represented in $(b_x + 1)$ bit, fixed point binary form including sign bit. Let $(b_x - b)$ bits be truncated. Obtain the range of truncation error for signed magnitude, 1's complement and 2's complement representation of the negative numbers.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Consider the DT system $y(n) = 10\,x(n)\cos(0.25\pi n + \theta)$ where θ is a constant. Check if the system is (1) linear (2) time invariant (3) causal (4) stable. (4)

(ii) Define energy and power of DT signals. (4)

(iii) Explain the basic signals in the study of DT signals and systems. (8)

Or

(b) Determine the Z-transform of

(i) $x(n) = \left(\frac{1}{2}\right)^n u(n)$. (8)

(ii) $x(n) = a^n u(n) + b^n u(-n-1)$. (8)

12. (a) (i) Compute DFT of $x(n) = \{1\ \ -3\ \ 5\ \ -6\}$. (4)

(ii) Prove the following DFT property. "Multiplication of two DFT and will result in circular convolution in time domain".

Assume $x_1(n) = [1, 2, 3, 4]$ and

$$x_2(n) = [2, -1, 1, -1]. \qquad (12)$$

Or

(b) Using decimation-in-time FFT algorithm compute DFT for $x(n) = [10000000]$. (16)

13. (a) (i) How is mapping achieved in bilinear transformation? (8)

(ii) Using impulse invariant method find

$H(Z)$ at $T = 1\,\text{sec}$

$$H(s) = \frac{2}{s^2 + 8s + 15}. \qquad (8)$$

Or

(b) Design digital IIR LP Butterworth filter to meet the following specifications :

Pass band gain = 0.89

Pass band edge frequency = 30 Hz

Stop band attenuation = 0.20

Stop band edge frequency = 75 Hz

Use bilinear transformation.

Assume sampling frequency 200Hz. (16)

14\. (a) Design FIR HP 11 tap filter for the frequency response

$$H\left(e^{jw}\right)=\begin{cases}1, \frac{-\pi}{4} \leq |w| \leq \pi \\ 0, |w| \leq \pi\end{cases}$$

Assume Hamming window. (16)

Or

(b) A LPF has the desired frequency response

$$H\left(e^{jw}\right)=\begin{cases}e^{-j3w}, 0 \leq w \leq \frac{\pi}{2} \\ 0, \quad \frac{\pi}{2} \leq w \leq \pi\end{cases}$$

Find filter coefficients for $N=7$ using type-I frequency sampling method. (16)

15\. (a) (i) Define zero input limit cycle oscillation and explain. (10)

(ii) A digital system is described by $y(n)=0.95\,y(n-1)+x(n)$. Find the dead band of the filter. Assume 5 bit sign magnitude representation (including sign bit). (6)

Or

(b) Compare fixed and floating point representations. What is an overflow? Why do they occur? (16)