10/11/17 - FN

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

Question Paper Code : 50765

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017
Fifth/Sixth Semester
Information Technology
IT 6502 – DIGITAL SIGNAL PROCESSING
(Common to Computer Science and Engineering/Mechatronics Engineering)
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Find the equivalent digital frequency 'w' given the analog frequency $\Omega = 20\pi$ rad/sec and sampling frequency $F_s = 30$ Hz.
2. Given $X(Z) = Z^2 + 2Z + 1 - 2Z^{-2}$. Find the equivalent time domain signal x(n).
3. Given x(n) = {1, 2, 3, 4} and h(n) = {2, 1, 3}. Circularly convolve x(n) and h(n).
4. State the need for using FFT algorithms for computing Discrete Fourier Transform (DFT).
5. Find the equivalent digital filter H(z) given the analog filter $H(S) = \frac{A}{S+a}$ using impulse invariant transformation.
6. What is the transfer function H(S) for a normalised Butterworth filter of order 3 ?
7. What are the various windows used for designing FIR filters ?
8. Given the impulse response of an FIR filter, h(n) = {1, 2, 3, 1, 3, 2, 1}. Is it a linear phase FIR filter ? Justify your answer.
9. Distinguish between truncation and rounding of binary digits using relevant examples.
10. What is meant by signal scaling ?

PART – B (5×13=65 Marks)

11. a) A discrete time system is represented by the following difference equation $y(n) = 3y^2(n-1) - nx(n) + 4x(n-1) - 2x(n+1)$ for $n \geq 0$. Determine whether the system is memoryless, causal, linear and shift invariant. Justify your answers.

(OR)

b) A causal system is represented by the following difference equation

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

i) Find the system function H(Z) and its Corresponding Region of Convergence (ROC).

ii) Find the unit sample response h(n) of the system.

12. a) Given $x(n) = \{1, 2, -1, 2, 2, -1, 2, 1\}$. Compute 8-point DFT using Decimation-in-time algorithm.

(OR)

b) Given $x(n) = \{1, 2, 3, 4\} = h(n)$. Circularly convolve x(n) and h(n) using DFT and IDFT computations.

13. a) Explain with necessary equations the approximation of derivatives method for converting an analog filter into a digital filter.

(OR)

b) Using bilinear transformation design a low pass filter monotonic in passband with –3.01 dB cutoff frequency of 0.4 π rad and magnitude down atleast by 15 dB at 0.75π rad.

14. a) Design an FIR filter with N = 7 using Hanning window, given

$$H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega}, & -\frac{\pi}{4} \leq \omega \leq \frac{\pi}{4} \\ 0, & \frac{\pi}{4} < |\omega| \leq \pi \end{cases}$$

(OR)

b) Given $H(Z) = 0.5 + 0.25Z^{-1} + 0.75Z^{-2} + Z^{-3} + 0.75Z^{-4} + 0.25Z^{-5} + 0.5Z^{-6}$. Draw the linear phase realization and direct form realization and compare both the structures.

15. a) Explain in detail the input quantization error and coefficient quantization error and its effect on digital filter design, with an example.

(OR)

b) Explain the characteristics of limit cycle oscillation with respect to the system described by the difference equation $y(n) = 0.95\,y(n-1) + x(n)$. Determine the deadband of the system when $x(n) = 0.875$ for $n = 0$ and $y(-1) = 0$. Assume 4-bit sign magnitude representation (excluding sign bit).

PART – C (1×15=15 Marks)

16. a) A system with input x(n) and output y(n) is characterized by the following equation $y(n) = x(n+1) + x(n-1)$.

i) Find the impulse response of the system.

ii) Is the system causal ? Justify.

iii) Is this an FIR or IIR filter ?

iv) Find the frequency response of the system.

v) Is this system BIBO stable ? Justify.

(OR)

b) The impulse response of a discrete time system LTI system is given by

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

i) Is this a causal system ? Justify.

ii) Is this an FIR of IIR filter ?

iii) Find the frequency response $H(e^{j\omega})$ of the system ?

iv) Give a difference equation realization of the system.