Reg. No. :

Question Paper Code : 90190

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Fifth Semester

Medical Electronics

EC 8553 – DISCRETE-TIME SIGNAL PROCESSING

(Common to Biomedical Engineering/Computer and Communication Engineering/ Electronics and Communication Engineering/Electronics and Telecommunication Engineering)

(Regulations 2017)

Time : Three Hours　　　　Maximum : 100 Marks

Answer ALL questions

PART – A　　　　**(10×2 = 20 Marks)**

1. Determine the IDFT of Y(K) = {1, 0, 1, 0}.

2. Draw the 4-point radix 2 DIT-FFT and 4-point radix 2 DIF-FFT butterfly structures for FFT.

3. Summarize the procedure to design digital filters from analog filters. Recall in this context what is meant by backward difference.

4. What is bilinear transformation ? List the properties of bilinear transformation.

5. Obtain the direct form realization of the filter $H(Z)=\frac{1}{2}+\frac{1}{4}z^{-1}+\frac{1}{4}z^{-2}+\frac{1}{2}z^{-3}$ with minimum number of multipliers.

6. How to design an FIR filter using frequency sampling method ? For what type of filters frequency sampling method is suitable ?

7. Define input quantization error and product quantization error.

8. Interpret how the digital filter is affected by quantization of filter coefficients ?

9. Distinguish between fixed point and floating point arithmetic.

10. List the applications of Digital Signal Processing.

(5×13 = 65 Marks)

PART – B

11. a) i) Compute the DFT of the sequence $x(n) = \{0, 1, 2, 1\}$. Sketch the magnitude and phase spectrum. (7)

ii) For the given $x_1(n)$, $x_2(n)$ and N, compute the circular convolution of $x_1(n)$ and $x_2(n)$. (6)

1) $x_1(n) = \delta(n) + \delta(n-1) + \delta(n-2)$, $N = 3$

$x_2(n) = 2\delta(n) - \delta(n-1) + 2\delta(n-2)$

2) $x_1(n) = \delta(n) + \delta(n-1) + \delta(n-2) - \delta(n-3)$, $N = 5$

$x_2(n) = \delta(n) - \delta(n-2) + \delta(n-4)$.

(OR)

b) i) Perform Linear convolution of the following sequences by overlap-add method. (7)

$x(n) = \{1, -2, 3, 2, -3, 4, 3, -4\}$ and $h(n) = \{1, 2, -1\}$.

ii) Compute the 8 point DFT of the sequence $x(n) = \{1, 1, 1, 1, 1, 1, 1, 0\}$ using DIT, FFT algorithm. (6)

12. a) For the given specifications $0.9 \le |H(j\Omega)| \le 1$, for $0 \le \Omega \le 0.2\pi$

$|H(j\Omega)| \le 0.2$, for $0.4\pi \le \Omega \le \pi$

Plot the magnitude response and design an analog Butterworth filter. (13)

(OR)

b) i) For the analog transfer function $H_a(s) = \frac{2}{(s+1)(s+3)}$. Determine H(z), if T = 1s, using Impulse invariant method. (7)

ii) Realize the system with difference equation

$y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) + \frac{1}{3}x(n)$ In cascade form. (6)

13. a) Discuss on the frequency response of linear phase FIR filter when the impulse response is symmetrical and N is odd. (13)

(OR)

b) List the steps in the design of FIR filter using windows. Point out the characteristics of the following window functions. (13)

i) Rectangular Window

ii) Hanning Window

iii) Hamming Window.

14. a) i) A digital system is characterized by the difference equation $y(n) = 0.8y(n-1) + x(n)$. Determine the limit cycle behavior and the dead band of the system with $x(n) = 0$ and initial condition $y(-1) = 10$. Assume that the result $y(n)$ is rounded off to the nearest integer. (7)

ii) Given $H(Z) = \frac{0.5 + 0.4z^{-1}}{1 - 0.312z^{-1}}$ is the transfer function of a digital filter.

Find the scaling factor S_0 to avoid overflow in adder 1 of the digital filter shown in fig. 1. (6)

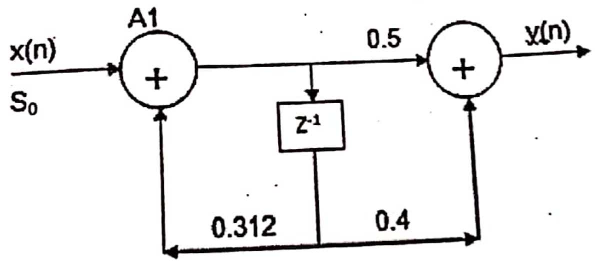

Fig. 1

(OR)

b) Discuss the effect of coefficient quantization on pole locations of the following IIR system, when it is realized in direct form – 1.

$H(Z) = \frac{1}{1 - 0.7z^{-1} + 0.12z^{-2}}$. Assume a word length of 4-bits through truncation. (13)