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Name.........................

Reg. No.....................

SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE [REGULAR/ SUPPLEMENTARY] EXAMINATION, NOVEMBER 2013

EE 09 703—DIGITAL SIGNAL PROCESSING

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *question.*

1. What are the advantages of FFT algorithm over direct computation of DFT ?
2. A sequence $x(n)$ has DFT given by $X(k) = [1, 5]$. What is the DFT of $x[(n-1) \text{ modulo } 2]$?
3. Draw direct form I structure for the second order system function $H(z) = \dfrac{b_0 + b_1 z^{-1} + b_2 z^{-2}}{1 + a_1 z^{-1} + a_2 z^{-2}}$.
4. Define Hanning and Blackmann window functions.
5. What is the error that arises due to truncation in floating point numbers ?

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. Obtain circular convolution of the two sequences $x(n) \{1, 2, 1\}$ and $h(n) = \{1, -2, 2\}$ using matrix method. Compare the result with that obtained using linear convolution and comment on your results.
7. Distinguish between decimation in time (DIT) and decimation in frequency (DIF) FFT.
8. Obtain the cascade realization of : $H(z) = \dfrac{\left(1 - z^{-1}\right)}{\left(1 - 0.2 z^{-1} - 0.15 z^{-2}\right)}$.
9. Compare IIR and FIR filters.
10. What is meant by prewarping ? Why is it employed ?
11. What is meant by rounding ? Discuss its effect on all types of number representations.

(4 × 5 = 20 marks)

Turn over

Part C

12. (a) Find the DFT of the following sequence $x(n)=\{1,-1,-1,-1,1,1,1,-1\}$ using DIT - FFT algorithm.

(10 marks)

Or

(b) Find the DFT of the following sequence $x(n)=\{0,1,2,3,4,5,6,7\}$ using DIF - FFT algorithm.

(10 marks)

13. (a) (i) Consider an FIR lattice filter with coefficients $k_1=\frac{1}{2}; k_2=\frac{1}{3}; k_3=\frac{1}{4}$. Determine the FIR filter coefficients for the direct form structure.

(5 marks)

(ii) Determine the state - space model for the system described by $y(n)=y(n-1)+0.11\,y(n-2)+x(n)$ and sketch type 1 state - space realization.

(5 marks)

Or

(b) Obtain cascad and parallel realizations for the system described by the system function :

$$H_{(z)}=\frac{10\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{2}{3}z^{-1}\right)\left(1+2z^{-1}\right)}{\left(1-\frac{3}{4}z^{-1}\right)\left(1-\frac{1}{8}z^{-1}\right)\left[1-\left(\frac{1}{2}+\frac{j}{2}\right)z^{-1}\right]\left[1-\left(\frac{1}{2}-\frac{j}{2}\right)z^{-1}\right]}$$

(10 marks)

14. (a) Describe the process of multiplying the impulse of an ideal IIR filter by window function. How is the selection of window made and hence give the design steps for obtaining the FIR filters.

(10 marks)

Or

(b) Design a Butterworth filter using the impulse invariance method for the following specifications.

$$0.8\le\left|H\left(e^{jw}\right)\le 1\right| \qquad 0\le w\le 0.2\,\pi$$

$$\left|H\left(e^{jw}\right)\le 0.2\right| \qquad 0.6\,\pi\le w\le\pi$$

(10 marks)

15. (a) The input to the system $y(n) = 0.999\, y(n-1) + x(n)$ is applied to an ADC. Find the quantization noise power at the output of the digital filter of the input is quantized to :

    (i) 8 bits.

    (ii) 16 bits.

(10 marks)

Or

(b) What are limit cycle oscillations ? Using suitable examples, explain how they are generated ?

(10 marks)

[4 × 10 = 40 marks]