

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Seventh Semester B.Tech Degree Examination (Regular and Supplementary), December 2020

**Course Code: EE407****Course Name: DIGITAL SIGNAL PROCESSING**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each carries 5 marks.*

Marks

- 1 State and prove complex conjugate property of Discrete Fourier Transform (DFT). (5)
- 2 Draw the cascade structure of the FIR filter represented by the system function  $H(z) = (1 + 2z^{-1})\left(1 + \frac{1}{2}z^{-1} + z^{-2}\right)$  (5)  
Can you realize this system using minimum number of multipliers?
- 3 Convert the analog filter with system function  $H(s) = \frac{s + 0.1}{(s + 0.1)^2 + 9}$  into a digital filter by means of the impulse invariance method. Sampling time  $T=1\text{sec}$ . (5)
- 4 What is the advantage of windowing technique in FIR filter design? What are the desirable characteristics of a window used to truncate the infinite impulse response? (5)
- 5 What are the common methods of quantization? Explain. (5)
- 6 With suitable example explain floating point number representation (5)
- 7 What are the functions of Auxiliary Register Arithmetic Unit (ARAU) of TMS320C24x DSP Controller? (5)
- 8 With diagram explain the multiplication operation in TMS320C24x DSP Controller. (5)

**PART B***Answer any two full questions, each carries 10 marks.*

- 9 a) Find the 8 point DFT of the sequence  $x(n)=\{5,4,3,2,2,3,4,5\}$  using Decimation in Time FFT algorithm. (10)
- 10 a) Explain circular time shift property of DFT. Let  $x(n)=\{1,2,3,4,5\}$ . The five point DFT of  $x(n)$  is denoted as  $X(k)$ . If  $Y(k) = e^{-\frac{j6k\pi}{5}}X(k)$ , find  $y(n)$ . (5)  
b) With the help of diagram and equations explain the single stage all pole lattice IIR filter structure. (5)
- 11 a) Draw the FIR linear phase realization using minimum number of multipliers of the system function  $H(z) = (1 + \frac{1}{2}z^{-1} + z^{-2})(1 + \frac{1}{4}z^{-1} + z^{-2})$  (4)

- b) Determine and draw the parallel form realization of the IIR filter structure represented by the difference equation  $y(n) = -0.1y(n-1) + 0.72y(n-2) + 0.7x(n) - 0.252x(n-2)$  (6)

**PART C**

*Answer any two full questions, each carries 10 marks.*

- 12 Design a digital Butterworth filter satisfying the constraints (10)
- $$0.707 \leq |H(e^{j\omega})| \leq 1 \quad \text{for } 0 \leq \omega \leq \pi/2$$
- $$|H(e^{j\omega})| \leq 0.2 \quad \text{for } 3\pi/4 \leq \omega \leq \pi$$
- with  $T=1s$  using Bilinear transformation
- 13 a) A digital low pass filter is required to meet the following specifications: Pass band ripple  $\leq 1dB$ , Pass band edge frequency:  $4kHz$ , Stop band attenuation  $\geq 40dB$ , Stop band edge frequency:  $6kHz$  and Sampling frequency:  $24kHz$ . Determine the order of a Chebyshev filter to meet the specifications in the digital implementation using bilinear transformation. (5)
- b) With equations explain how impulse response of an FIR filter is obtained using frequency sampling method. (5)
- 14 a) Design an FIR high pass filter using hanning window with a cut off frequency of  $1.2 \text{ rad/sec}$  and length  $N=7$ . (10)

**PART D**

*Answer any two full questions, each carries 10 marks.*

- 15 a) Consider the cascaded realisation of the following first order sections.  $H_1(z) = \frac{1}{1-0.9z^{-1}}$  (8)
- $$\frac{1}{1-0.9z^{-1}} H_2(z) = \frac{1}{1-0.8z^{-1}}$$
- Obtain the product quantisation model of the system and determine overall output noise power.
- b) Which are the methods used to prevent overflow? (2)
- 16 a) Explain limit cycle oscillations in digital filters. (5)
- b) Explain the IO and Memory instructions in TMS320C24x DSP controller. (5)
- 17 a) Explain the central processing unit of TMS320C24x. (5)
- b) Explain the three basic memory addressing modes used by the TMS320C24x instruction set. (5)

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