Reg. No. :

Question Paper Code: R4B02

B.E./B.Tech. DEGREE EXAMINATION, NOV 2025

Fourth Semester

Biomedical Engineering

R21UBM402 - PRINCIPLES OF DIGITAL SIGNAL PROCESSING

(Regulations R2021)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. What is the purpose of zero padding in convolution theorem and how does it affect the output size? CO1- U

2. The Number of complex addition and multiplication in radix -2 FFT are --------- ---- and ------------ CO2-App

3. Determine the order of the butter worth analog filter for the given specification CO2-App

    $\alpha p = 5$, $\alpha s = 20$, $\Omega p = 1000$ rad/sec and $\Omega s = 500$ rad/sec

4. What is prewarping? Why is it employed? CO1- U

5. Realize the FIR filter using cascade form. $H(z) = (1+2z^{-1}-z^{-2})(1+z^{-1}-z^{-2})$ CO2-App

6. Write the procedure for FIR filter design by frequency sampling method. CO1- U

7. Convert $(-0.125)_{10}$ to one's complement format of binary and verify the result by converting the binary to decimal. CO2-App

8. Compare fixed point and floating-point number representation. CO1- U

9. What is the total memory space in TMS320C5x processors and how is it divided between program, data and IO? CO1- U

10. How is fast computation achieved in DSPs? CO1- U

PART – B (5 x 16= 80 Marks)

11. (a) Analyze the steps involved in computing the eight-point DFT of CO2- App   (16)
        the sequence x(n)= {-1,1, -1,1,0,0,0,0} using the Decimation-In-
        Frequency (DIF) FFT algorithm and explain how the butterfly
        operations are performed.

Or

(b) Analyze and compute the 8-point DFT of the discrete-time signal $x(n) = \{-1, 2, 2, 2, -1, 0, 0, 0\}$ using the Radix-2 Decimation-In-Time (DIT) FFT algorithm   CO2- App   (16)

12. (a) Design a Butter worth digital IIR lowpass filter using bilinear transformation by taking T=0.1 sec, to satisfy the following specification.   CO2- App   (16)

$$0.6 \leq \ |H(ej\omega)| \ \leq 1.0; \text{ for } 0 \leq \omega \leq 0.35\pi$$
$$|H(ej\omega)| \ \leq 0.1; \text{ for } 0.75\pi \leq \omega \leq \pi$$

Or

(b) Design a Chebyshev digital IIR lowpass filter using impulse invariant transformation by taking T= 1 sec, to satisfy the following specification.   CO2- App   (16)

$$0.87 \leq \ |H(ej\omega)| \ \leq 1.0; \text{ for } 0 \leq \omega \leq 0.25\pi$$
$$|H(ej\omega)| \ \leq 0.35; \text{ for } 0.375\pi \leq \omega \leq \pi$$

13. (a) Design an Ideal HPF with frequency response   CO2- App   (16)
Hd(ejw) = 1, for $\pi/4 \leq |\omega| \leq \pi$
= 0, for $|\omega| \leq \pi/4$
   Using a Hamming window for N=11 samples.

Or

(b) Design a band pass filter using frequency sampling method for the specifications,   CO2- App   (16)
Sampling frequency F= 8000Hz
Cutoff frequency fc1 =1000 Hz
                fc2=3000 Hz
Determine the filter coefficients for N=7. If N=5 what will be the filter coefficients?

14. (a) 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 dead band of the system when x(n)=0.875 for n=0, 0 for n≠0   CO5- App   (16)

Or

(b) Evaluate the effects of quantization on the stability and performance of the digital system characterized by the difference equation: y(n)=0.95y(n-1)+x(n).   CO5- App   (16)
Given the initial condition x(n)=0 and y(-1)=13.Analyze the dead band of the system due to finite word-length effects.

15. (a) Develop an optimized assembly language program for the   CO4- App (16)
TMS320C5x DSP processor to efficiently multiply two unsigned
32-bit numbers stored in memory. Utilize processor-specific
instructions, addressing modes, and register optimization
techniques to perform the multiplication and store the resulting
64-bit product in memory

Or

(b) Analyze the process of performing 64-bit subtraction using the   CO4- App (16)
TMS320C54x DSP processor. Develop an assembly language
program that efficiently subtracts two 64-bit numbers stored in
memory. Examine the role of processor-specific instructions,
addressing modes, and register utilization in optimizing the
computation

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