

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Regular and Supplementary  
Examination Dec 2022 (2019 Scheme)

Course Code: ECT 303

Course Name: DIGITAL SIGNAL PROCESSING

Max. Marks: 100 | Duration: 3 Hours

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PART A

*(Answer all questions; each question carries 3 marks) (p. 1)*

1. Compute the DFT of the sequence

$$x[n] = \left(\frac{1}{2}\right)^n \left[ \sum_{k=0}^3 (\delta(n-k)) \right]. \quad (\text{p. 1})$$

2. Explain Digital signal processing system with a block diagram. (p. 1)
3. Discuss the need for FFT. Justify your answer in terms of computational complexity, memory requirement etc. (p. 1)
4. Find the DFT of the sequence using DIT FFT algorithm  $x[n] = \{1, -1, 0, 1\}$ . (p. 1)
5. Compare FIR and IIR filters. (p. 1)
6. Analog transfer function of a digital filter is given by

$$H(s) = \frac{1}{s+3}$$

Comment on the stability of the filter. Obtain the digital transfer function of the same using impulse invariance method, where sampling time is T. (p. 1)

7. What is Multirate signal processing? Obtain interpolated and decimated versions for the sequence  $x[n] = \{1, 2, 3, 4, 5, 6, 7, 8\}$  by a factor 2. (p. 1)

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8. Obtain the direct form structure for the FIR filter with transfer

function  $H(z) = 1$

$$+ 2z^{-1} + 3z^{-2} + 4z^{-3} + 5z^{-4} + 6z^{-6} + 7z^{-7}. \quad (\text{p. 1})$$

9. What is meant by pipelining? Give its significance in DSP processors. (p. 1)

10. The effect of ADC quantization noise plays a very important role in DSP processors. Justify. (p. 1)

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**PART B**

*(Answer one full question from each module, each question carries 14 marks)* (p. 1)

**Module - 1**

11. a) State the following properties of DFT: (i) Linearity (ii) Time Reversal (iii) Parseval's theorem. (6 marks) (p. 1)

b) Illustrate the concept of circular convolution property of a DFT sequence for the discrete time sequences  $x[n] = \{1, 2, 1, 2\}$ ,  $h[n] = \{2, 4, 6, 8\}$ . (8 marks) (p. 1)

**OR**

12. a) What is the significance of zero padding? If number of zeros are padded on (i) Left of the signal (ii) Right of the signal, comment on its effect on the spectrum. (6 marks) (p. 2)

b) Find the linear convolution sum of the sequence  $x[n] = \{1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1\}$  and  $h[n] = \{1, 2\}$  using overlap add method. (8 marks) (p. 2)

**Module - 2**

13. a) Write down the principle of in-place computation in FFT. (4 marks) (p. 2)

b) Compute the IDFT of the sequence  $X[k] = \{1, -1, 1, -1, 1, -1, 1, -1\}$  using DIT algorithm. (10 marks) (p. 2)

OR

14. a) Explain the principle of DIF FFT algorithm and obtain the final flow graph for the same. (10 marks) (p. 2)

b) Find the 4-point DFT of sequences  $x[n] = \{1, 2, 0, 1\}$  and  $y[n] = \{2, 2, 1, 1\}$  by computing the 4-point DFT only once. (4 marks) (p. 2)

Module - 3

15. a) Design a Butterworth filter using bilinear transformation. Specifications of desired LPF are:

$$0.707 \leq |H(\omega)| \leq 1; 0 \leq \omega \leq \frac{\pi}{2} \text{ and } |H(\omega)| \leq 0.2; \frac{3\pi}{4} \leq \omega \leq \pi.$$

Given that  $T = 1$  sec. (10 marks) (p. 2)

b) Explain Gibbs Phenomenon. (4 marks) (p. 2)

OR

16. a) For the desired frequency response

$$H_d(\omega) = e^{-j3\omega}, -\frac{3\pi}{4} \leq \omega \leq \frac{3\pi}{4} \text{ and } 0 \text{ otherwise,}$$

determine for  $N = 7$  using rectangular window. (8 marks) (p. 2)

b) Explain the principle of frequency sampling technique for FIR filter design. (6 marks) (p. 2)

Module - 4

17. a) Obtain direct form I, direct form II and parallel form structure for the system

$$y(n) = \frac{1}{2} y(n-1) + \frac{1}{4} y(n-2) + x(n) + x(n-1). \quad (10$$

marks) (p. 2)

b) Write a short note on anti-aliasing filter and anti-imaging filter. (4 marks) (p. 2)

**OR**

18. a) Obtain the cascade form realisation using direct form II for

$$H(z) = \frac{2 + z^{-1} + z^{-2}}{(1 + \frac{1}{2} z^{-1})(1 - \frac{1}{4} z^{-1})(1 + \frac{1}{8} z^{-1})}$$

(7 marks) (p. 3)

b) Write down the principle of linear phase in FIR filter with a structure. (7 marks) (p. 3)

**Module - 5**

19. a) With a detailed block diagram, explain the architecture of typical DSP processor family TMS320C67XX. (10 marks) (p. 3)

b) Write a short note on truncation and rounding with examples. (4 marks) (p. 3)

**OR**

20. a) What are the various data formats in DSP processors? Explain with suitable examples. (8 marks) (p. 3)

b) MAC is the heart of DSP processor. Justify. (6 marks) (p. 3)