

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S, FE) / S5 (PT) (S) Examination June 2024 (2019 Scheme)

**Course Code: ECT 303****Course Name: DIGITAL SIGNAL PROCESSING**

Max. Marks: 100

Duration: 3 Hours

PART A*(Answer all questions; each question carries 3 marks)*

Marks

- | | | |
|----|---|---|
| 1 | DFT of a real valued signal $X(k) = \{j, 1+j, A, 1-j, -1, B, -1-j, C\}$. Find the energy of the signal? | 3 |
| 2 | Determine the circular convolution of the following sequences, $x(n) = \{1, 2, 3, 1\}$ and $h(n) = \{4, 3, 2, 2\}$ | 3 |
| 3 | FFT algorithm is an in-place algorithm. Justify it? | 3 |
| 4 | Calculate the number of real multiplications and real additions involved in the calculation of 512- DFT using direct computation? | 3 |
| 5 | Given the specification pass band attenuation is 1 dB, stop band attenuation is 30 dB, pass band edge frequency 200 rad/sec and stop band edge frequency 600 rad/sec. Determine the order of the Butterworth Analog filter? | 3 |
| 6 | Describe the need for employing window technique for FIR filter design? | 3 |
| 7 | Why antialiasing filter is used in decimating systems? | 3 |
| 8 | Calculate the number of multiplications, additions and delay elements required in the direct form II realization of following system.
$y(n) = 3y(n-1) + 2y(n-2) + 4x(n) + 0.4x(n-1) + 0.8x(n-2)$ | 3 |
| 9 | Differentiate between Harvard and Von-Neumann architecture used in DSP processors? | 3 |
| 10 | Obtain the floating point arithmetic representation of numbers 6.5 and 1.5? | 3 |

PART B*(Answer one full question from each module, each question carries 14 marks)***Module -1**

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|----|--|---|
| 11 | a) Find the 4-DFT of the sequence $x(n) = 6 + \sin\left(\frac{2\pi n}{N}\right)$ | 5 |
| | b) Find the convolution of $x(n) = \{2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$ and $h(n) = \{3, 2, 1\}$ using overlap save method? | 9 |

- 12 a) Obtain the response of an LTI system with impulse response $h(n) = \{1, 1, 1\}$ 5
for an input $x(n) = \{1, 2, 3, 1\}$ using circular convolution?
- b) Given two sequences $x_1(n) = \{0, 1, 2, 3, 4\}$, $y(n) = \{1, 0, 0, 0, 0\}$; Determine a 9
sequence $x_2(n)$ so that $Y(k) = X_1(k) X_2(k)$

Module -2

- 13 a) Draw the flow diagram of 16 point radix – 2 DIT FFT algorithm 9
- b) Find the 4- IDFT of the sequence $X(k) = \{10, -2+2j, -2, -2-2j\}$ using radix 2 5
DIT FFT algorithm
- 14 a) Compute 8-DFT of the sequence $x(n) = \{0.5, 0.5, 0.5, 0.5, 0, 0, 0, 0\}$ using radix 8
2 DIT FFT algorithm
- b) Given $g(n) = \{1, -1, 1, -1\}$ and $h(n) = \{0, 2, 4, 6\}$ find the 4 point DFTs of 6
these 2 sequences using a single 4 point DFT?

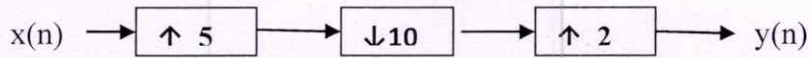
Module -3

- 15 a) Design an Analog Butterworth low pass filter that has 2 dB pass band 8
attenuation at a frequency of 20 rad/sec and at least 10 dB stop band attenuation
at 30 rad/sec.
- b) Apply bilinear transformation to $H(s) = \frac{2}{(s+1)(s+2)}$ with $T = 1$ sec and find 6
 $H(z)$?
- 16 a) Determine the filter coefficients of a linear phase FIR filter of length $N = 15$, 10
which has a symmetric impulse response and a frequency response that satisfies
the conditions, $H\left(\frac{2\pi k}{15}\right) = \begin{cases} 1, & k = 0, 1, 2, 3 \\ 0.4, & k = 4 \\ 0, & k = 5, 6, 7 \end{cases}$
- b) Explain the significance of linear phase FIR filter and comment on its impulse 4
response?

Module -4

- 17 a) Obtain the cascade and parallel structure of the system $y(n) = -\frac{1}{4}y(n-1) +$ 8
 $\frac{1}{8}y(n-2) + x(n) - 2x(n-1) + x(n-2)$
- b) Obtain the transposed direct form-II structure for the system 6
 $y(n) = 0.5y(n-1) - 0.25y(n-2) + x(n) + x(n-1)$
- 18 a) Realize the system function using minimum number of multipliers 6
 $H(z) = (1+z^{-1})(1+0.5z^{-1}+0.5z^{-2}+z^{-3})$

- b) For the given multi rate system develop an expression for output $y(n)$ as a function of input $x(n)$ 8

**Module -5**

- 19 a) Draw the architecture block diagram of TMS320C67XX and explain functions of each block? 10
- b) Differentiate between truncation and rounding? 4
- 20 a) Explain the effect of coefficient quantization in IIR and FIR filters? 8
- b) If quantization noise has uniform distribution with zero mean, find the quantization noise in ADC with step size Δ ? 6
