

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R,S) (FT/WP/PT) Examination November 2025 (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

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|----|--|---|
| 1 | The first five points of 8-DFT of a real valued signal
$X(K) = \{1, 1+j, -1+j, 1-j, -1\}$. Find the energy of the signal? | 3 |
| 2 | Obtain the response of an LTI system with impulse response $h(n) = \{-1, -2\}$ for an input $x(n) = \{1, 2, 3\}$ using circular convolution? | 3 |
| 3 | Calculate the number of real multiplications and real additions involved in the calculation of 1024 point DFT using direct computation algorithm? | 3 |
| 4 | FFT algorithm is an in-place algorithm. Justify it? | 3 |
| 5 | If $H(z)$ has a zero at $z = 2e^{j\pi/4}$ determine the other zeros of lowest degree linear phase FIR filter $H(z)$? | 3 |
| 6 | Describe warping effect in bilinear transformation method and how can we eliminate it? | 3 |
| 7 | Calculate the number of multiplications, additions and delay elements required in the direct form II realization of following system.
$y(n) = 0.5y(n-1) - 0.25y(n-2) + x(n) + x(n-1)$ | 3 |
| 8 | Explain the significance of lowpass filtering prior to sampling? | 3 |
| 9 | Differentiate between truncation and rounding? | 3 |
| 10 | Give any three applications of DSP Processor. | 3 |

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

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| 11 | a) Calculate the output $y(n)$ of a filter whose impulse response is $h(n) = \{1, 2\}$ and input signal $x(n) = \{1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1\}$ using overlap save method | 8 |
|----|--|---|

- b) Given two sequences $x_1(n) = \{1, -1, -2, 3, -1\}$, $x_2(n) = \{1, 2, 3\}$; Determine a sequence $y(n)$ so that $Y(k) = X_1(k) X_2(k)$ 6
- 12 a) Perform the circular convolution of following sequences $x(n) = \{1, 1, 1, 2\}$ 8
 $y(n) = \{1, 2, 3, 2\}$ using DFT and IDFT method.
- b) Obtain the convolution of $x(n) = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ and $h(n) = \{2, 4, 6\}$ 6
 using overlap add method?

Module -2

- 13 a) Obtain the 8- DFT of the sequence $\{1, 2, 3, 5, 6, 7\}$ using radix-2 DIT algorithm 8
- b) Given $g(n) = \{1, 2, 1, 2\}$ and $h(n) = \{1, 2, 2, 1\}$ find the 4 point DFTs of these 6
 2 sequences using a single 4 point DFT?
- 14 a) Obtain the DFT of the sequence $\{1, 2, 3, 4, 4, 3, 2, 1\}$ using radix-2 DIF 8
 algorithm
- b) Draw the flow diagram of 8 point radix – 2 DIT FFT algorithm 6

Module -3

- 15 a) Design an ideal highpass filter with desired frequency response 9
 $H(e^{j\omega}) = 1$ for $0.25\pi \leq |\omega| \leq \pi$ and $H(e^{j\omega}) = 0$ for $|\omega| \leq 0.25\pi$.
 Find $h(n)$ for $N = 11$. (use Hamming window)
- b) Show that the zeros of linear phase FIR filter exists as reciprocals? 5
- 16 a) Design an analog Butterworth filter that has -1dB pass band attenuation at 200 9
 Hz and at least -15dB stop band attenuation at 540 Hz. Sampling frequency =
 2000 Hz. Find the cut off frequency by matching pass band criterion. Use
 prewarping analog frequencies for the design.
- b) Apply impulse invariance transformation to $H(s) = \frac{2}{(s+1)(s+2)}$ with $T = 1$ sec 5
 and find $H(z)$?

Module -4

- 17 a) Realize the system given by difference equation $y(n) = -\frac{1}{4}y(n-1) + \frac{1}{8}y(n-2)$ 9
 $+ x(n) - 2x(n-1) + x(n-2)$ in cascade form and parallel form?
- b) Obtain the direct form-II structure for the system $y(n) = 2y(n-1) + 3y(n-2) +$ 5
 $x(n) + 2x(n-1) + 3x(n-2)$
- 18 a) Explain the steps through which we obtained direct form-II realization of 9
 recursive LTI system described by difference equation.

$$y(n) = -\sum_{k=1}^N a_k y(n-k) + \sum_{k=0}^M b_k x(n-k)$$

- b) Realize the system function using minimum number of multipliers 5

$$H(z) = \frac{1}{2} + \frac{1}{3}z^{-1} + z^{-2} + \frac{1}{4}z^{-3} + z^{-4} + \frac{1}{3}z^{-5} + \frac{1}{2}z^{-6}$$

Module -5

- 19 a) Draw the architecture block diagram of TMS320C67XX processor 8
- b) If quantization noise has uniform distribution with zero mean, find the quantization noise in ADC with step size Δ ? 6
- 20 a) Describe the possible errors arise in dsp algorithms due to the storage of filter coefficients in finite length registers? 8
- b) Draw the block diagram of interpolator; Explain the purpose of anti-imaging filter in interpolator? 6
