

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: EC301

Course Name: DIGITAL SIGNAL PROCESSING

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

Marks

- | | | |
|---|--|------|
| 1 | a) Explain, how DFT and IDFT can be expressed as Linear Transformation | (3) |
| | b) Derive the relationship of DFT to Z-transform | (3) |
| | c) Find the circular convolution of $x[n] = \{1, 2, -1, 3, 4\}$ and $h[n] = \{2, -1, 4, 1, 3\}$ | (5) |
| | d) Explain overlap add method for filtering of long data sequences. | (4) |
| 2 | a) Show that, if $x[n]$ is a real and even sequence, then its DFT $X[k]$ is also real and even | (3) |
| | b) Find linear convolution of $x[n] = \{2, 3, -1\}$ and $h[n] = \{1, -1, 2\}$, using circular convolution. | (5) |
| | c) Find the number of complex multiplications involved in the calculation of a 1024 point DFT using (i) direct computation(ii) radix-2 FFT algorithm | (3) |
| | d) Explain, how N point DFTs of two real-valued sequences can be found by computing a single N point DFT. | (4) |
| 3 | a) Find 8 point DFT of $x[n] = \{2, 1, -1, 3, 5, 2, 4, 1\}$ using radix-2 decimation in time FFT algorithm | (11) |
| | b) Explain, how a 2N point DFT of a 2N point real-valued sequence can be found by computing a single N point DFT. | (4) |

PART B

Answer any two full questions, each carries 15 marks.

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|---|---|------|
| 4 | a) Prove that, if z_1 is a zero of a linear phase FIR filter, then $1/z_1$ is also a zero. | (5) |
| | b) Design a linear phase FIR low pass filter having length $M = 15$ and cut-off frequency $\omega_c = \pi/6$. Use Hamming window. | (10) |
| 5 | a) Explain the design of linear phase FIR filters by the frequency sampling method. | (9) |
| | b) Explain the frequency transformations in the analog domain | (6) |
| 6 | Design a digital Butterworth low pass filter with $\omega_p = \pi/6$, $\omega_s = \pi/4$, minimum pass band gain = -2dB and minimum stop band attenuation = 8dB. Use bilinear | (15) |

transformation. (Take $T = 1$)

PART C

Answer any two full questions, each carries 20 marks.

- 7 a) Find the lattice structure implementation of FIR filter $h[n] = \{1, 0.5, 0.75, -0.6\}$ (6)
 b) Draw the direct form II structure and transposed direct form II structure of (5)

$$H(z) = \frac{1+0.5z^{-1}-0.75z^{-2}}{1+0.6z^{-1}+0.4z^{-2}-0.2z^{-3}}$$

 c) Draw the block diagram of TMS320C67XX and briefly explain the function of (9)
 each block.
- 8 a) Draw the direct form realization of linear phase FIR filter (5)
 $h[n] = \{1, 0.5, 0.25, -0.5, 0.8, -0.5, 0.25, 0.5, 1\}$ using minimum multipliers.
 b) Draw the signal flow graphs of direct form II and cascade form structures (5)
 of
$$H(z) = \frac{(0.8+0.2z^{-1}+0.6z^{-2})(1-0.6z^{-1})}{(1-0.6z^{-1}+0.8z^{-2})(1+0.8z^{-1}-0.7z^{-2})}$$

 c) Explain the effects of coefficient quantization in IIR and FIR filters. (10)
- 9 a) Give the output of decimation by M system in time domain. Explain output (10)
 frequency spectrum. What is the importance of low pass filtering prior to down-
 sampling?
 b) How does a floating-point number represented in a processor? Explain the (5)
 operations of addition and multiplication of two floating point numbers with
 examples.
 c) Derive the variance of quantization noise in ADC with step size Δ . (Assume (5)
 quantization noise has uniform distributed pdf with zero mean)
