

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.

- 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 each block. (9)
- 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 frequency spectrum. What is the importance of low pass filtering prior to down-sampling? (10)
 b) How does a floating-point number represented in a processor? Explain the operations of addition and multiplication of two floating point numbers with examples. (5)
 c) Derive the variance of quantization noise in ADC with step size Δ . (Assume quantization noise has uniform distributed pdf with zero mean) (5)
