

Reg No.: _____

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

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) If $x(n) = \{2, 3, 4, 5, 6, 4, 3, 2, 1\}$, $h(n) = \{2, 3, 4, 5\}$. Find $x(n)*h(n)$ using overlap save method. (7)
- b) Find the 8 point DFT of the sequence $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$ using DITFFT radix 2 algorithm. (8)
- 2 a) State and prove any three properties of DFT. (7)
- b) Find the 8-point DFT of the real sequence $x(n) = \{1, 2, 2, 2, 1, 0, 0, 0\}$ using decimation in frequency FFT algorithm. (8)
- 3 a) Find the circular convolution of $x_1(n) = \{1, 2, 3, 4\}$ and $x_2(n) = \{2, 1, 2\}$. (5)
- b) The first eight points of the 14-point DFT of a real valued sequence are $[12, -1+3j, 3+j4, 1-j5, -2+j2, 6+j3, -2-j3, 10]$
 - i) Determine the remaining points.
 - ii) Evaluate $x[0]$ without computing the IDFT of $X(k)$.
- c) Find the 8-point DFT of the sequence $\{2, 0, 2, 0, 2, 0, 2, 0\}$ using 4-point DFTs. (5)

PART B

Answer any two full questions, each carries 15 marks

- 4 a) Find the response of the signal $x(n) = 2\cos(\pi/2)n$ when applied to an FIR filter with impulse response $h(n) = \{1, 3, 1\}$. (5)
- b) A second order linear phase FIR filter has a zero at $z = 1/2$. Obtain the magnitude and phase response of the filter. (5)
- c) An all pole analog filter have transfer function $H(s) = 1/(s^2+5s+6)$. Find $H(z)$ by impulse invariance method. Assume $T=1$ sec. (5)
- 5 a) Design an ideal FIR high pass filter with frequency response (7)

$$H_d(\omega) = 1 \text{ for } \frac{\pi}{4} \leq |\omega| \leq \pi$$

$$0 \text{ for } |\omega| \leq \frac{\pi}{4}$$

Find the value of $h(n)$ for $N=11$.

- b) Design a digital Butterworth filter satisfying the following constraints (8)

$$0.707 \leq |H(e^{j\omega})| \leq 1 \text{ for } 0 \leq \omega \leq \frac{\pi}{2} \quad \text{and}$$

$$|H(e^{j\omega})| \leq 0.2 \text{ for } \frac{3\pi}{4} \leq \omega \leq \pi$$

using bilinear transformation, (Assume $T=1$ sec)

- 6 a) A low pass filter has the desired frequency response: (8)

$$H_d(\omega) = e^{-j3\omega} \quad \text{for } 0 < \omega < \frac{\pi}{2}$$

$$= 0 \quad \text{for } \frac{\pi}{2} < \omega < \pi$$

Determine $h(n)$ based on frequency sampling technique.

- b) For the given specification, design an analog Butterworth filter (7)

$$0.9 \leq |H(j\Omega)| \leq 1 \quad \text{for } 0 \leq \Omega \leq 0.2\pi \quad \text{and}$$

$$|H(j\Omega)| \leq 0.2 \quad \text{for } 0.4\pi \leq \Omega \leq \pi$$

PART C

Answer any two full questions, each carries 20 marks

- 7 a) Draw the direct form-I and direct form-II structures for a system described by the difference equation $y(n) = x(n) + \frac{1}{2}x(n-1) + 3y(n-1) - 2y(n-2)$. (10)

- b) Write short notes on any two finite word length effects in DSP systems with examples. (10)

- 8 a) Draw and explain the internal architecture of TMS320C67XX digital signal processor. (10)

- b) Consider a signal $x(n) = (\frac{1}{2})^n u(n)$. Obtain the signals with: (5)

i) Decimation factor 3 ii) Interpolation factor 3

- c) The signal $x(n) = (\frac{1}{2})^n u(n)$ is applied to a decimator that decimates the input signal by a factor of 2. Find the spectrum of the output and plot it. (5)

- 9 a) Draw the cascade form structure for a discrete time sequence described (5)

$$\text{by: } \frac{1 + \frac{1}{2}z^{-1}}{1 - \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}}$$

- b) Realise a FIR system with function $H(z) = 1 + \frac{3}{4}z^{-1} + \frac{17}{8}z^{-2} + \frac{3}{4}z^{-3} + z^{-4}$. (5)

- c) Write short notes on finite word length effect in IIR digital filters. (10)
