

# CBCS SCHEME

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15EE63

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019

## Digital Signal Processing

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

### Module-1

- 1 a. Find the 4-point DFT of the sequence,  $x(n) = 6 + \sin \frac{2\pi n}{4}$ ,  $0 \leq n \leq 3$ . (08 Marks)
- b. Given the sequence  $x(n) = \cos \frac{\pi n}{2}$  and  $h(n) = 2^n$ . Compute the 4-point circular convolution. (08 Marks)

OR

- 2 a. State and prove the following properties of DFT i) Periodicity and ii) Linearity. (06 Marks)
- b. Consider a FIR filter with impulse response  $h(n) = \{3, 2, 1, 1\}$  if the input is  $x(n) = \{1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$ . Find the output  $y(n)$ , use overlap-add method, assuming the length of block is 7. (10 Marks)

### Module-2

- 3 a. Why FFT is needed? What is the speed improvement factor in calculating 04-point DFT of a sequence using direct computation and FFT algorithm? (06 Marks)
- b. Compute the 8-point IDFT of the sequence  $\alpha(k) = \{0, 2 + 2j, -j4, 2 - 2j, 0, 2 + 2j, j4, 2 - 2j\}$  using the inverse radix-2 DIT algorithm. (10 Marks)

OR

- 4 a. What are the differences and similarities between DIT and DIF-FFT algorithm? (06 Marks)
- b. Using DIF FFT algorithm, compute the sequence  $x(n) = \{1, 2, -1, 2, 4, 2, -1, 2\}$ . (10 Marks)

### Module-3

- 5 a. Transform  $H(s) = \frac{s+a}{(s+a)^2 + b^2}$  into a digital filter using impulse invariance technique. (08 Marks)
- b. Show that the bilinear transformation maps.
- i) The  $j\Omega$  axis in s-plane on to the unit circle,  $|z|=1$ .
- ii) The left half s-plane,  $\text{Re}(s) < 0$  inside the unit circle,  $|z| < 1$ . (08 Marks)

OR

- 6 a. Mention the difference between Butterworth and Chebyshev filters. (04 Marks)
- b. Determine the  $H(z)$  for a lowest order Butterworth filter satisfying following constraints:
- $$\sqrt{0.5} \leq |H(e^{jw})| \leq 1 \quad 0 \leq |w| \leq \frac{\pi}{2}$$
- $$|H(e^{jw})| \leq 0.2 \quad \frac{3\pi}{4} \leq w \leq \pi, \quad \text{with } T = 1 \text{ sec. Apply impulse invariant transformation.}$$

(12 Marks)

Module-4

- 7 a. Obtain the cascade realization of system function,  $H(z) = 1 + \frac{5}{2}z^{-1} + 2z^{-2} + 2z^{-3}$ . (04 Marks)
- b. Design the digital filter using Chebyshev approximation and bilinear transformation to meet the following specifications:
- Passband ripple = 1dB for  $0 \leq \omega \leq 0.15\pi$
  - Stopband attenuation  $\geq 20$ dB for  $0.45\pi \leq \omega \leq \pi$  (12 Marks)

OR

- 8 a. Obtain the direct form-I, direct form - II, cascade and parallel form realization for the following system:  
 $y(n) = 0.75y(n-1) - 0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)$ . (12 Marks)
- b. Obtain the direct form-I structure for the given impulse response of a filter:  
 $h(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-3)]$ . (04 Marks)

Module-5

- 9 a. The frequency response of a linear phase FIR filter is given by,  
 $H(e^{j\omega}) = e^{j3\omega} [2 + 1.8 \cos 3\omega + 1.2 \cos 2\omega + 0.5 \cos \omega]$ . (12 Marks)  
 Find the impulse sequence of the filter.
- b. Mention the advantages and disadvantages of frequency sampling method. (04 Marks)

OR

- 10 a. Compare IIR filter and FIR filter. (08 Marks)
- b. Design an FIR filter (lowpass) using rectangular window with passband gain of 0dB, cut-off frequency of 200Hz, sampling frequency of 1kHz. Assume the length of the impulse response as 7. (08 Marks)

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