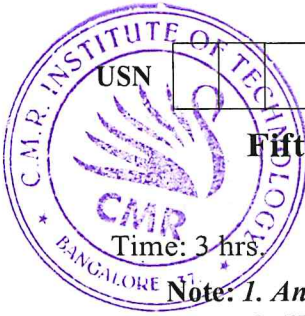


# CBCS SCHEME

15EC52



## Fifth Semester B.E. Degree Examination, Aug./Sept. 2020 Digital Signal Processing

Max. Marks: 80

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.  
2. Use of Normalized filters tables is permitted.

### Module-1

- 1 a. Compute the circular convolution of the following sequences using DFT and 1DFT method  
 $x(n) = \{1, 2, 3, 4\}$  and  $h(n) = \{4, 3, 2, 1\}$ . (08 Marks)
- b. Given  $x(n) = \{1, -2, -2, 5, 8, 2\}$ , evaluate the given expression  $\sum_{K=0}^5 e^{-j2\pi k/3} x(K)$  without computing DFT. (04 Marks)
- c. Obtain the relationship of DFT with z-transforms. (04 Marks)

OR

- 2 a. Explain frequency domain sampling and reconstruction of signals. (09 Marks)
- b. Consider the finite length sequence  $x(n) = \delta(x) + 2\delta(n - 5)$
- i) Find the 10 point DFT of  $x(n)$
- ii) Find the sequence that has a DFT  $y(k) = e^{j2k2\pi/10} x(k)$ . (07 Marks)

### Module-2

- 3 a. Evaluate the linear convolution of the following sequences using DFT and 1DFT method.  
 $x(n) = \{1, 2, 3\}$  and  $h(n) = \{1, 2, 2, 1\}$ . (08 Marks)
- b. A long sequence  $x(n)$  is filtered through a filter with impulse response  $h(n)$  to yield the output  $y(n)$ . If  $x(n) = \{1, 1, 1, 1, 1, 3, 1, 1, 4, 2, 1, 1, 3, 1\}$  and  $h(n) = \{1, -1\}$ . Compute  $y(n)$  using overlap save technique. Use only a 5-point circular convolution. (08 Marks)

OR

- 4 a. State and prove the following properties of DFT i) Parseval's theorem (06 Marks)  
ii) Time shifting property. (04 Marks)
- b. Determine the response of an LTI system with  $h(n) = \{1, -1, 2\}$  for an input  $x(n) = \{1, 0, 1, -2, 1, 2, 3, -1, 0, 2\}$  use overlap add method with block length  $L = 4$ . (06 Marks)

### Module-3

- 5 a. Find the DFT of the sequence using decimation in time FFT algorithm and draw the flow graph indicating the intermediate values in the flow graph.  
 $x(n) = \{1, -1, -1, -1, 1, 1, 1, -1\}$ . (08 Marks)
- b. Derive the computational arrangement of 8-point DFT using radix - 2 DIF-FFT algorithm. (08 Marks)

OR

- 6 a. What is Goertzel algorithm? Obtain direct form-II realization of second order goertzel filter. (08 Marks)
- b. Find the 1DFT of the sequence using DIF-FFT algorithm :  
 $X(k) = \{0, 2\sqrt{2}(1-j), 0, 0, 0, 0, 2\sqrt{2}(1+j)\}$ . (08 Marks)

**Module-4**

- 7 a. Draw the block diagrams of direct form – I and direct form – II realizations for a digital IIR filter described by the system function :

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z - 1/4)(z^2 - z + 1/2)} \quad (08 \text{ Marks})$$

- b. Show that the bilinear transformation maps the s-plane to z-plane efficiently in the transformation of analog to digital filter. (08 Marks)

**OR**

- 8 a. Design a two pass Butterworth analog filter to meet the following specifications :

- i) Attenuation of –1db at 20rad/sec  
ii) Attenuation is greater than 20db beyond 40rad/sec. (09 Marks)

- b. The transfer function of analog filter is  $H(s) = \frac{2}{(s+1)(s+2)}$ . Find  $H(z)$  using impulse invariance method. Show  $H(z)$  when  $T_s = 1$ sec. (07 Marks)

**Module-5**

- 9 a. A low pass filter is to be designed with the following desired frequency response

$$H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j2\omega}; & |\omega| < \pi/4 \\ 0; & \pi/4 < |\omega| < \pi \end{cases}$$

Determine the filter coefficients  $h_d(n)$  and  $h(n)$  if  $\omega(n)$  is a rectangular window defined as follows :

$$\omega_R(n) = \begin{cases} 1; & 0 \leq n \leq 4 \\ 0; & \text{otherwise} \end{cases} \quad (08 \text{ Marks})$$

- b. Realize the direct form the linear phase FIR filters for the following impulse response

$$h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4). \quad (08 \text{ Marks})$$

**OR**

- 10 a. The frequency response of an FIR filter is given by :

$$H(\omega) = e^{-j3\omega}(1 + 1.8\cos 3\omega + 1.2\cos 2\omega + 0.5\cos \omega).$$

Determine the coefficients of the impulse response  $h(n)$  of the FIR filter. (06 Marks)

- b. Obtain the coefficients of FIR filter to meet the specification given below using the window method :

- i) Pass band edge frequency  $f_p = 1.5$ KHz  
ii) Stop band edge frequency  $f_s = 2$ KHz  
iii) Minimum stop band attenuation = 50db (Hamming)  
iv) Sampling frequency  $F_s = 8$ KHz. (10 Marks)

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