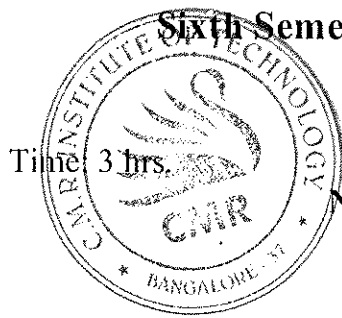


--	--	--	--	--	--	--	--	--	--



Time: 3 hrs.

Sixth Semester B.E. Degree Examination, June/July 2016

**Digital Signal Processing**

Max. Marks:100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

**PART – A**

- 1 a. Compute the  $N$  – point DFT of  $x[n] = a^n$  for  $0 \leq n \leq N-1$ . Also find the DFT of the sequence  $x[n] = 0.5^n u[n]$ ;  $0 \leq n \leq 3$ . (07 Marks)
- b. Find the DFT of a sequence  $x[n] = \begin{cases} 1 & \text{for } 0 \leq n \leq 3 \\ 0 & \text{otherwise} \end{cases}$   
For  $N = 8$ . Plot magnitude of the DFT  $x(k)$ . (10 Marks)
- c. If  $x[n] \xrightarrow{\text{DFT}} x(k)$  then prove that  $\text{DFT} \{x(k)\} = N x(-\ell)$  (03 Marks)
- 2 a. The first values of an 8 point DFT of a real value sequence is  $\{28, -4.966j, 4+4j, -4+1.66j, -4\}$ . Find the remaining values of the DFT. (04 Marks)
- b. Obtain the circular convolution of  $x_1[n] = [1, 2, 3, 4]$  with  $[1, 1, 2, 2]$ . (06 Marks)
- c. A long sequence  $x[n]$  is filtered through a filter with impulse response  $h(n)$  to yield the output  $y[n]$ . if  $x[n] = \{1, 4, 3, 0, 7, 4, -7, -7, -1, 3, 4, 3\}$ ,  $h(n) = \{1, 2\}$  compute  $y[n]$  using overlap add technique. Use only a 5 point circular convolution. (10 Marks)
- 3 a. Prove the symmetry and periodicity property of a twiddle factor. (04 Marks)
- b. Develop an 8 point DIT – FFT algorithm. Draw the signal flow Graph. Determine the DFT of the sequence  $x[n] = \{1, 1, 1, 1, 0, 0, 0, 0\}$  using signal flow graph. Show all the intermediate results on the signal flow graph. (12 Marks)
- c. What is FFT algorithm? State their advantages over the direct computation of DFT. (04 Marks)
- 4 a. Find 4 point circular convolution of  $x[n]$  and  $h[n]$  using radix 2 DIF FFT algorithm  $x[n] = [1, 1, 1, 1]$  and  $h[n] = [1, 0, 1, 0]$ . (08 Marks)
- b. Calculate the IDFT of  $x(k) = \{0, 2.828 - j2.828, 0, 0, 0, 0, 0, 2.82 + j 2.82\}$  using inverse radix 2 DIT FFT algorithm. (12 Marks)

**PART – B**

- 5 a. The transfer function of an analog filter is given as  $H_a(s) = \frac{1}{(s+1)(s+2)}$ : obtain  $H(z)$  using impulse invariant method. Take sampling frequency of 5 samples/sec. (05 Marks)
- b. Obtain  $H(z)$  using impulse invariance method for following analog filter  $H_a(s) = \frac{1}{(s+0.5)(s^2+0.5s+2)}$ . Assume  $T = 1$  sec. (10 Marks)
- c. Convert the analog filter into a digital filter whose system function is  $H(s) = \frac{2}{(s+1)(s+3)}$  using bilinear transformation, with  $T = 0.1$  sec. (05 Marks)

- 6 a. Design a Digital Butterworth filter using the bilinear transformation for the following specifications:

$$0.8 \leq |H(e^{j\omega})| \leq 1 \quad \text{for } 0 \leq \omega \leq 0.2\pi$$

$$|H(e^{j\omega})| \leq 0.2 \quad \text{for } 0.6\pi \leq \omega \leq \pi$$

(12 Marks)

- b. Determine the order of a Chebyshev digital low pass filter to meet the following specifications: In the passband extending from 0 to  $0.25\pi$  a ripple of not more than 2dB is allowed. In the stop band extending from  $0.4\pi$  to  $\pi$ , attenuation can be more than 40dB. Use bilinear transformation method. (08 Marks)

- 7 a. The frequency response of a filter is given by  $H(e^{j\omega}) = j\omega; -\pi \leq \omega \leq \pi$ . Design the FIR filter, using a rectangular window function. Take  $N = 7$ . (12 Marks)

- b. The desired frequency response of the low pass FIR filter is given by

$$H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j3\omega}; & |\omega| < 3\pi/4 \\ 0 & ; 3\pi/4 < |\omega| < \pi \end{cases}$$

Determine the frequency response of the FIR filter if the hamming window is used with  $N = 7$ . (08 Marks)

- 8 a. A FIR filter is given by  $y[n] = x[n] + \frac{2}{5}x[n-1] + \frac{3}{4}x[n-2] + \frac{1}{3}x[n-3]$ . Draw the direct and linear form realization. (10 Marks)
- b. Obtain the direct form II and cascade realization of the following function.

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z - 0.25)(z^2 - z + 0.5)}$$

(10 Marks)

\* \* \* \* \*