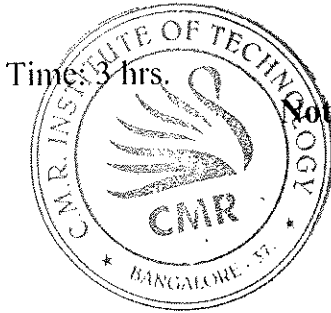


--	--	--	--	--	--	--	--	--	--

**Fifth Semester B.E. Degree Examination, June/July 2016**  
**Digital Signal Processing**

Time: 3 hrs.

Max. Marks: 100



- Note:** 1. Answer any FIVE full questions, selecting at least TWO questions from each part.  
 2. Use of prototype filter tables is not permitted.

**PART – A**

- 1 a. Find the N – point DFT of  $x(n) = a^n$  for  $0 < a < 1$ . (04 Marks)
- b. A discrete time LTI system has impulse response  $h(n) = 2\delta(n) - \delta(n - 1)$ . Determine the output of the system if the input  $x(n) = \{\delta(n) + 3\delta(n - 1) + 2\delta(n - 2) - \delta(n - 3) + \delta(n - 4)\}$  using circular convolution. (06 Marks)
- c. Determine 8 – point DFT of the signal  $x(n) = \{1, 1, 1, 1, 1, 1, 0, 0\}$ . Also sketch its magnitude and phase. (10 Marks)
- 2 a.  $g(n)$  and  $h(n)$  are the two sequences of length 6 with 6 – point DFT's  $G(k)$  and  $H(k)$  respectively. The sequence  $g(n) = \{4, 3, 1, 5, 2, 6\}$ . The DFT's are related by circular frequency shift as  $H(k) = G((k - 3))_6$ . Determine  $h(n)$  without computing DFT and IDFT. (07 Marks)
- b. Given  $x(n) = \{1, 2, 3, 4\}$  and  $h(n) = \{1, 2, 2\}$  compute i) circular convolution ii) linear convolution iii) linear convolution using circular convolution. (08 Marks)
- c. Prove Parseval's relation as applied to DFT. (05 Marks)
- 3 a. Explain with necessary diagrams and equations the concept of overlap – save method for linear filtering. (10 Marks)
- b. Write a note on Goertzel algorithm. (05 Marks)
- c. What is in-place computation? What is the total number of complex additions and multiplications required for  $N = 64$  point, if DFT is computed directly and if FFT is used? Also find the number of stages required and its memory requirement. (05 Marks)
- 4 a. First five points of the 8 – point DFT of a real valued sequence is given by  $x(0) = 0$ ,  $x(1) = 2 + 2j$ ,  $x(2) = -4j$ ,  $x(3) = 2 - 2j$ ,  $x(4) = 0$ . Determine the remaining points. Hence find the original sequence  $x(n)$  using DIT – FFT algorithm. (10 Marks)
- b. Find the 4 – pt circular convolution of  $x(n) = \{1, 1, 1, 1\}$  and  $h(n) = \{1, 0, 1, 0\}$  using radix 2 DIF – FFT algorithm. (10 Marks)

**PART – B**

- 5 a. Design an analog Chebyshev filter with the following specifications :  
 Passband ripple : 1 dB for  $0 \leq \Omega \leq 10$  rad/sec  
 Stopband attenuation : -60 dB for  $\Omega \geq 50$  rad/sec. (12 Marks)
- b. Derive the expressions of order and cutoff frequency of a analog butter worth filter. (08 Marks)
- 6 a. Realize the following difference equation using digital structures in all the forms :  
 $y(n) - \frac{3}{4}y(n - 1) + \frac{1}{8}y(n - 2) = x(n) + \frac{1}{3}x(n - 1)$ . (16 Marks)
- b. Realize the FIR filter whose transfer function is given by :  
 $H(z) = 1 + \frac{3}{4}z^{-1} + \frac{17}{8}z^{-2} + \frac{3}{4}z^{-3} + z^{-4}$  in direct form . (04 Marks)

- 7 a. Design a symmetric FIR low pass filter whose desired frequency response is given as :

$$H_u(\omega) = \begin{cases} e^{-j\omega\rho} & \text{for } |\omega| \leq \omega_c \\ 0 & \text{otherwise} \end{cases}$$

The length of the filter should be 7 and  $\omega_c = 1$  rad/sample. Use rectangular window.

(10 Marks)

- b. Design a normalized linear phase FIR filter having the phase delay of  $T = 4$  and at least 40 dB attenuation in the stopband. Also obtain the magnitude /frequency response of the filter.

(10 Marks)

- 8 a. Let  $H_a(S) = \frac{b}{(s+a)^2 + b^2}$  be a causal II order analog transfer function. Show that the causal

II order digital transfer  $H(z)$  obtained from  $H_a(s)$  through impulse invariance is given by :

$$H(z) = \frac{e^{-aT} \sin bTZ^{-1}}{1 - 2e^{-aT} \cos bTZ^{-1} + e^{-2aT} Z^{-2}} \quad (10 \text{ Marks})$$

- b. Design an IIR digital butterworth filter that when used in the analog to digital with digital to analog will satisfy the following equivalent specification.

- i) Lowpass filter with  $-1$  dB cutoff  $100 \pi$  rad/sec
- ii) Stopband attenuation of 35 dB at  $1000 \pi$  rad/sec
- iii) Monotonic in stopband and passband
- iv) Sampling rate of 2000 rad/sec
- v) Use bilinear transformation.

(10 Marks)

\* \* \* \* \*