Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

(A Constituent Institute of Manipal University)
Manipal – 576 104

V SEMESTER B.Tech (BME) DEGREE MAKEUP EXAMINATIONS, DEC/JAN 2015 -16
SUBJECT: BIOMEDICAL DIGITAL SIGNAL PROCESSING (BME 309)
(REVISED CREDIT SYSTEM)
Wednesday, January 06, 2016: 2.00p.m. - 5.00p.m.

TIME: 3 HOURS **MAX. MARKS: 100**

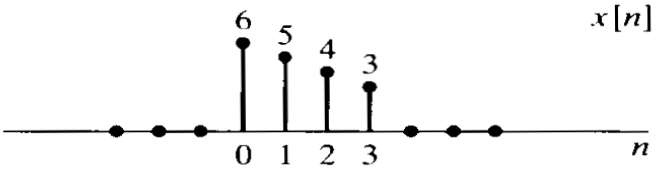
Instruction to Candidates:
Answer any FIVE full questions.

1. A. Calculate the 8-point DFT of the sequence $x[n] = \{1,2,3,4,4,3,2,1\}$, using DIT-FFT radix-2 algorithm. (08)

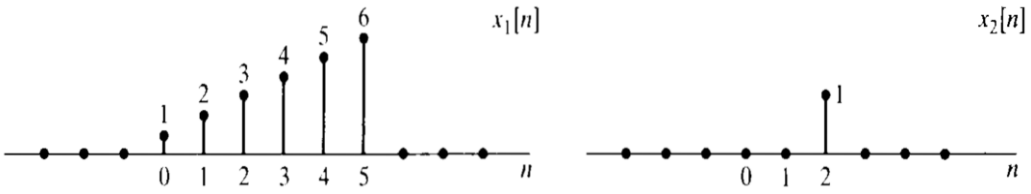
   B. List the characteristics of FIR filters. (04)

   C. (a) Figure shows a finite length sequence $x[n]$. Sketch the following sequences in the range $0 \leq n \leq 3$. (08)

   (i) $x\big((n-3)\big)_4$ (ii) $x\big((n+2)\big)_4$ (iii) $x\big((-n)\big)_4$



   (b) Figure shows two finite length sequences $x_1[n]$ & $x_2[n]$. Sketch their 6-point circular convolution.



2. A. Define a Chebyshev polynomial and mention its important properties. (04)

   B. A Causal system produces an output sequence $y(n) = \delta(n) + \frac{2}{5}\delta(n-1)$ for the input $x(n) = \delta(n) - \frac{7}{10}\delta(n-1) + \frac{1}{10}\delta(n-2)$. Determine the impulse response and the difference equation representation of the system. (06)

C. Determine the impulse response associated with a linear-phase FIR low pass filter which will meet the following specifications: (10)

Pass band edge frequency: 1.5kHz Stop band edge frequency: 2kHz

Minimum stop band attenuation: 50dB Sampling frequency: 8kHz

3. A. Assume that a complex multiplication takes 1μs and that the amount of time to compute a DFT is determined by the amount of time it takes to perform all of the multiplications. (04)

(i) Find the time taken to compute a 1024-point DFT directly.

(ii) What is the computation time if an FFT is used?

(iii) Repeat parts (i) and (ii) for a 4096-point DFT.

B. (a) Find the DFT $X[k]$ of the sequence, $x[n] = \{0, 1, 2, 3\}$ using the Matrix method. (08)
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(b) Find the IDFT $x[n]$ from $X[k]$ obtained in part (a) using the Matrix method.

C. Consider two LSI systems with impulse responses $h_1[n] = \delta[n-2]$ and (08)

$h_2[n] = \delta[n-3]$ respectively. Calculate the overall impulse response $h[n]$, if the systems are connected in (i) cascade (ii) parallel.

4. A. What is the necessary and sufficient condition for a discrete-time filter to have linear- phase? An FIR filter is specified by the following impulse response: (06)

$h(n) = -\frac{1}{3}\delta(n) + \frac{1}{2}\delta(n-1) - \frac{1}{3}\delta(n-2)$. Is this a linear-phase filter?

B. Determine the frequency response associated with a linear-phase FIR band pass filter having cutoff frequencies of w_{c1} =1 radians and w_{c2}= 2 radians. Use Hanning window of length 5. (10)

C. A continuous-time signal $x(t)$ is obtained at the output of an ideal lowpass filter with cutoff frequency $w_c = 1000\pi\ rad/sec$. If impulse–train sampling is performed on $x(t)$, which of the following sampling periods would guarantee perfect recovery of $x(t)$ from its sampled version using an appropriate lowpass filter? (04)

(i) T = $0.5\text{x}10^{-3}$ Sec (ii) T = $2\text{x}10^{-3}$ Sec (iii) T = 10^{-4} Sec

5. A. Perform the convolution of the following two sequences using the Z-transform. (04)

$x(n) = \delta(n) - 2\delta(n-2)$ $h(n) = 2\delta(n) - 2\delta(n-1) + 3\delta(n-2) + \delta(n-3)$

B. Determine the periodic sequence $y[n]$ obtained by a periodic convolution of the pair of periodic sequences of period 5, one period of which is given below: (08)

$x[n] = \{1,2,-2,-1,3\}$, $h[n] = \{2,0,1,3,-4\}$, $0 \le n \le 4$

C. Determine the transfer function associated with an analog low pass Butterworth filter that will have a -1dB cutoff frequency at 75Hz and have greater than 20dB of attenuation for all frequencies greater than 150Hz. (08)

6. A. Find the Z-transform of the following using the properties of Z-transform. (04)

(i) $x(n) = n\,u(n)$ (ii) $x(n) = \left(\frac{1}{2}\right)^n u(-n)$

B. A analog Chebyshev low pass filter is to be designed to meet the following specifications: (10)

Pass band ripple: ≤ 3dB Pass band edge:100 rad/sec

Stop band attenuation: ≥ 25dB Stop band edge: 250 rad/sec

Obtain the Transfer function & Frequency response of the filter.

C. Consider a FIR filter with impulse response $h(n) = \{3, 2, \underset{\uparrow}{1}, 1\}$. If the input to the filter is $x(n) = \{\underset{\uparrow}{1}, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1\}$, find the output using Overlap-add method of convolution. (06)

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