T.E Sem VI (R) Biomedical Engg 22/12/2010
Digital Signal Processing for Biomedical Applications
(Library) 1

Con. 6624-10. **(REVISED COURSE)** **GT-7590**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume **suitable** data if **required**.

1. (a) Check whether the following system is linear, stable and time invariant or not. **6**
   (i) $y(n) = ne^{x(n)}$
   (ii) $y(n) = 4x(n+2) + 5$
   (iii) $y(n) = 8 \cos w_0 n \; x(n)$.
   (b) State and prove convolution property of Z-transform. **5**
   (c) Explain Parseval's energy relationship. **5**
   (d) Find the linear convolution of two sequences given by :– **4**

$$x(n) = [1, 2, 3, 4]$$
$$h(n) = [4, 1, 2, 1]$$

2. (a) Obtain cascade and parallel realization for the following IIR filter :– **10**

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z - 0\cdot25)(z^2 - z + 0\cdot2)}$$

   (b) A second order recursive system is described by :– **10**

$$y(n) = \frac{1}{4}u(n-1) - \frac{1}{8}y(n-2) + x(n) - x(n-1)$$

   (i) Find the unit sample response

   (ii) Find the response to input $x[n] = (1/2)^n u(n)$ with zero initial condition.

3. (a) Using DIF FFT, find DFT of following sequence :– **10**
   $x(n) = \{1, 2, 3, 4, 1, 2, 3, 4\}$
   (b) Using results in Q.3 (a) Find $X_2(k)$ if $x_2(n) = x(n-2)$. **5**
   (c) Using results in Q.3 (a), Find $X_3(k)$ if $x_3(n) = x^*(n)$. **5**

4. (a) Design a digital Butterworth low pass filter satisfying the following specifications using bilinear transformation (Assume T = 1s) **10**

$$0\cdot9 \le \left|H(e^{jw})\right| \le 1; \; 0 \le w \le \pi/2$$
$$\left|H(e^{jw})\right| \le 0\cdot2; \; 3\pi/4 \le w \le \pi$$

   (b) Determine the filter co-efficients h(n) for the desired frequency response of a low pass filter. **10**

$$H_d(e^{jw}) = \begin{cases} e^{-j2w}; & -\pi/4 \le w \le \pi/4 \\ 0 \quad ; & \pi/4 \le w \le \pi \end{cases}$$

Using Hamming Window.

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5. (a) The difference equation of the system is given by : **12**

$$y(n) = 3y(n-2) + 2y(n-1) + x(n)$$

and

$$x(n) = (1/2)^n\ u(n) \text{ with } y(-1) = y(-2) = 1.$$

Determine :

(i) Zero input response

(ii) Zero state response

(iii) Total response.

(b) Determine inverse Z-transform of $x(z) = \dfrac{1}{1 - \frac{3}{2} z^{-1} + 0 \cdot 5\, z^{-2}}$ for all possible ROC. **8**

6. (a) With the help of block diagram, explain TMS 320 (5x series of processors). **10**

(b) Derive the radix-2 DIF-FFT for a 8-point DFT. **10**

7. Write short notes on any **four** :– **20**

(a) Applications of DSP in biomedical field

(b) Energy and Power Signals

(c) Filtering of long data sequences

(d) Relationship between Z-transform and Fourier transform

(e) Adaptive noise cancellation.
