Printed Pages—4 **EEC602**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2488	**Roll No.**										

B. Tech.

(SEM. VI) THEORY EXAMINATION 2011-12

DIGITAL SIGNAL PROCESSING

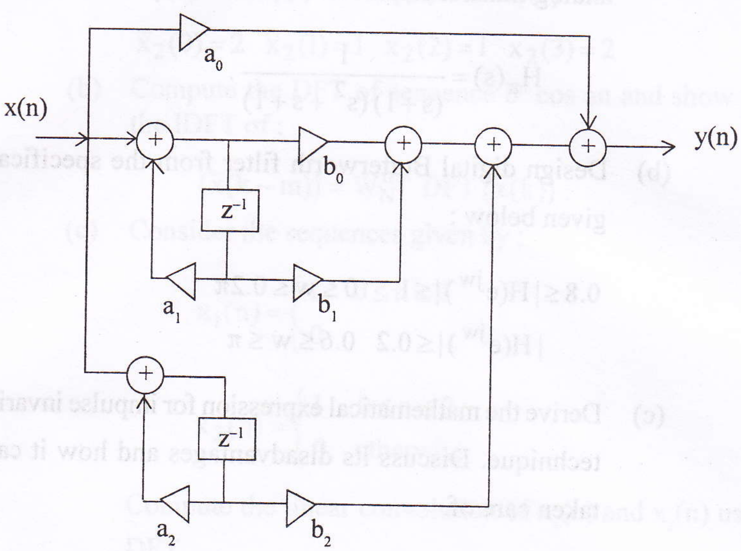
Time : 3 Hours *Total Marks : 100*

Note : Attempt ***all*** questions. All questions carry equal marks.

1. Attempt any ***two*** parts of the following : **(10×2=20)**

(a) What do you mean by canonical form of realization ?

Determine the system function $H(z)=\frac{Y(z)}{X(z)}$ for the following system shown in figure 1 :



(b) Find the ladder structure realization of the system function :

$$H(z)=\frac{2z^{-2}+3z^{-1}+1}{z^{-2}+z^{-1}+1}.$$

(c) System function $H(z)=\frac{Y(z)}{X(z)}$ for a linear shift invariant system is given by $\frac{2}{z^{-3}+4z^{-2}+z^{-1}+2}$.

Find the two part realization of the system.

2. Attempt any *two* parts of the following : **(10×2=20)**

(a) Explain frequency working effect. How this problem is overcome in Bilinear transform method of IIR filter design ?

Apply Bilinear transformation technique to transform the analog transfer function :

$$H_a(s)=\frac{1}{(s+1)(s^2+s+1)}.$$

(b) Design digital Butterworth filter from the specification given below :

$$0.8\le|H(e^{jw})|\le 1 \qquad 0\le w\le 0.2\pi$$
$$|H(e^{jw})|\le 0.2 \qquad 0.6\le w\le \pi$$

(c) Derive the mathematical expression for impulse invariance technique. Discuss its disadvantages and how it can be taken care of.

3. Attempt any *two* parts of the following : **(10×2=20)**

(a) Compare FIR and IIR filter. Show that for a linear phase FIR filter, the impulse response is given by :

$$h(n) = h(N-1-n)$$

or $$h(n) = -h(N-1-n)$$

and hence classify the FIR filters.

(b) Explain Gibb's phenomenon. Find the response of rectangular window and explain it.

(c) Determine the frequency response of symmetric Hann window given by :

$$w(n) = \begin{cases} \frac{1}{2}\left(1+\cos\frac{n\pi}{M}\right) & -m \le n \le M \\ 0 & \text{otherwise.} \end{cases}$$

4. Attempt any *two* parts of the following : **(10×2=20)**

(a) Find circular convolution of sequences $\tilde{x}_1(n)$ and $\tilde{x}_2(n)$ of length N = 4 given by :

$$\tilde{x}_1(0)=1 \;\; \tilde{x}_1(1)=2 \;\; \tilde{x}_1(2)=2 \;\; \tilde{x}_1(3)=1$$

$$\tilde{x}_2(0)=2 \;\; \tilde{x}_2(1)=1 \;\; x_2(2)=1 \;\; x_2(3)=2$$

(b) Compute the DFT of sequence $b^n \cos an$ and show that the IDFT of :

$$\{\tilde{x}(k-m)\} = W_N^{mn} \text{ DFT } \{\tilde{x}(k)\}.$$

(c) Consider the sequences given by :

$$x_1(n) = \begin{cases} 1 & 0 \le n \le 2 \\ 0 & \end{cases}$$

$$x_2(n) = \begin{cases} 1 & 0 \le n \le 2 \\ 0 & \text{otherwise} \end{cases}$$

Compute the linear convolution of $x_1(n)$ and $x_2(n)$ using DFT.

5. Attempt any *two* parts of the following : (10×2=20)

(a) What do you mean by FFT ? Differentiate between DIT and DIF FFT algorithm. State and prove the symmetry and periodicity properties of complex exponential sequence W_M^K. Explain how these properties are used in FFT algorithms.

(b) Show that the output data is in bit reversed order for the decimation-in frequency algorithm for N = 8.

(c) Develop a DIT FFT algorithm using 4 point DFTs for the case $N = 4^v$. Compare the number of multiplications with the algorithm using 2-point PFTS with $N = 2^{2v}$.