Printed Pages : 4 TEC – 602

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

PAPER ID : 3092 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. VI) EXAMINATION, 2007-08

DIGITAL SIGNAL PROCESSING

Time : 3 Hours] *[Total Marks : **100***

Note : *(1) Attempt **all** questions.*

*(2) All questions carry **equal** marks.*

1 Attempt any **four** parts of the following :

(a) What is frequency-domain sampling ? **5**
Prove that DFT of a finite length sequence is the same as samples of DTFT in one period.

(b) Find the four point DFT of **5**

$$x(n) = \cos\left(\frac{n\pi}{2}\right), \ 0 \le n \le 3.$$

(c) State and prove the "circular shifting" property of DFT. **5**

(d) Find the circular convolution of $x_1(n)$ and $x_2(n)$ for $x_1(n) = \{2, 1, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 4\}$. **5**

(e) Show that discrete fourier transform can be obtained by sampling Z transform on unit circle. **5**

(f) For the sequence $x(n)=\{0,1,2,3\}$ find, 5

(i) $x((n-2))_4$ and

(ii) $x((-n))_4$.

2 Attempt any **four** parts of the following :

(a) Find the DFT of the four point sequence $x(n)=\{0,1,2,3\}$ using decimation-in-time algorithm and corresponding signal flow graph. 5

(b) Find the inverse-DFT of the sequence $x(k)=\{6,-2+2j,-2,-2-2j\}$ using efficient computation algorithm.

(c) Draw the signal flow graph of an 8 point DFT computation using decimation-in-time algorithm and mention the corresponding expressions of signals at various nodes. 5

(d) Explain Goertzed algorithm for computing DFT of a finite length sequence. 5

(e) Explain in brief the chirp-z transform algorithm. 5

(f) Compare the number of multiplications and additions which are needed for direct computation of DFT with those needed for radix-2 FET algorithms. 5

3 Attempt any **two** parts of the following:

(a) Consider a causal LTI system whose system function is : 5

$$H(z)=\frac{\left(1+\frac{1}{5}z^{-1}\right)}{\left(1-\frac{1}{2}z^{-1}+\frac{1}{3}z^{-2}\right)\left(1+\frac{1}{4}z^{-1}\right)}$$

Draw the direct-form II structure of the system, and write the corresponding difference equations.

(b) Determine the lattice coefficients corresponding to the FIR filter with system function **10**

$$H(z) = 1 + \frac{13}{24}z^{-1} + \frac{5}{8}z^{-2} + \frac{1}{3}z^{-3}$$

and draw the lattice structure of the system and compare it with direct form structure.

(c) Discuss frequency sampling method for implementation of filters with mathematical expressions and signal flow graph. **10**

4 Attempt any **two** parts of the following :

(a) A causal FIR filter has impulse response $h(n)$ defined in such a way, **10**

$$h(n) = \begin{cases} h(M-n), & 0 \le n \le M \\ 0 & else \end{cases}$$

consider M as odd integer, find the frequency response and show that the filter has linear-phase.

(b) Design a low pass digital FIR filter having following specifications : **10**

$$0.99 \le \left|H\left(e^{jw}\right)\right| \le 1.01, 0 \le |w| \le 0.19\pi$$
$$\left|H\left(e^{jw}\right)\right| \le 0.01, 0.21\pi \le |w| \le \pi$$

use Hanning window. Assume $w_c = 0.2\pi$, express the impulse response $h_d(n)$.

(c) Explain the design steps of FIR filter having linear phase using frequency sampling method. **10**

5 Attempt any **four** parts of the following :

(a) An analog filter has the following system function : 5

$$H(s) = \frac{1}{(s+0.1)^2 + 9}$$

convert this filter into a digital filter using backward difference for derivative.

(b) Convert the analog filter having system function, 5

$$H(s) = \frac{s+0.1}{(s+0.1)^2 + 16}$$

into a digital IIR filter by means of bilinear transformation, assume $w_r = \pi/2$.

(c) Use impulse invariance method to design a digital filter from an analog prototype that has a system function- 5

$$H_a(s) = \frac{s+a}{(s+a)^2 + b^2}$$

(d) Design a digital butterworth filter using Bilinear transformation method if- 5

$$0.707 \le \left|H\left(e^{jw}\right)\right| \le 1,\ 0 \le |w| \le 0.5\pi$$

$$\left|H\left(e^{jw}\right)\right| \le 0.2,\ \frac{3\pi}{4} \le |w| \le \pi$$

(e) Describe the complete mapping with expressions and diagrams from s-plane into z-plane if bilinear transformation is used. 5

(f) Explain "frequency warping effect" and "prewarping" with respect to bilinear transformation. 5
