

Time: 3 Hours

Marks: 80

- N.B: (1) Questions No.1 is compulsory.
 (2) Attempt any three questions out of remaining five questions.
 (3) Assume suitable data if required.
 (4) Figures to the right indicate full marks.

Q 1. Solve any four

- a) Determine the zeros of the following systems and indicate whether the system is minimum, maximum or mixed phase.

$$1) H_1(z) = 6+z^{-1}+6z^{-2}$$

$$2) H_2(z) = 1-z^{-1}-6z^{-2}$$

5

- b) Define group delay and phase delay.

5

- c) Compare FIR and IIR filters

5

- d) What is frequency warping in bilinear transformation.

5

- Q2 a) Compute DFT of sequence $x(n) = \{ 2, 1, 2, 1, 1, 2, 1, 2 \}$ using DIT-FFT algorithm. 10

- b) A low pass filter is to be designed with following desired frequency response.

$$H_d(e^{j\omega}) = e^{-j2\omega} \quad \begin{matrix} -\frac{\pi}{4} < \omega < \frac{\pi}{4} \\ = 0 & \frac{\pi}{4} < \omega < \pi \end{matrix}$$

Determine the filter coefficients $h_d(n)$ if the window function is defined as

$$w(n) = \begin{cases} 1 & 0 \leq n \leq 4 \\ = 0 & \text{otherwise} \end{cases}$$

- Also determine the frequency response $H(e^{j\omega})$ of the designed filter. 10

- Q 3 a) The transfer function for discrete time system is given as

$$H(z) = \frac{1 + \frac{1}{2}Z^{-1}}{1 - \frac{3}{4}Z^{-1} + \frac{1}{8}Z^{-2}}$$

- i) Draw Direct Form I and Form II realization

- ii) Draw cascaded and parallel form realization

10

- b) Explain subband coding of speech signal as an application of multirate signal processing. 10

Q4 a) Develop composite radix DITFFT flow graph for $N=6=2 \times 3$. 10

b) Design a digital Butterworth filter that satisfies following constraints using bilinear transformation method. Assume $T_s=1s$.

$$0.9 \leq |H(e^{jw})| \leq 1 \quad 0 \leq w \leq \frac{\pi}{2}$$

$$|H(e^{jw})| \leq 0.2 \quad \frac{3\pi}{4} \leq w \leq \pi$$

Q 5 a) Show the mapping from S plane to Z plane using impulse invariant method. Explain its limitations. Using this method determine $H(z)$ if

$$H(s) = \frac{10}{(s+5)(s+2)} \quad \text{if } T_s=0.2s. \quad 10$$

b) If $x(n) = \{1, 2, 3, \dots\}$ and $h(n) = \{1, 0\}$

- 1) Find linear convolution using circular convolution
- 2) Find circular convolution using DFT-IDFT.

10

Q6 Write short notes on following,

a. Musical Sound Processing.

07

b. Dual tone multi frequency signal detection.

06

c. Subband Coding of Speech signals.

07