

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.

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

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

$$w(n) = 1 \quad 0 \leq n \leq 4$$

$$= 0 \quad \text{otherwise}$$

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 a 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 $T_s=1s$.

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

$$|H(e^{j\omega})| \leq 0.2 \quad \frac{3\pi}{4} \leq \omega \leq \pi \quad 10$$

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 $x(n) = \{1, 2, 3\}$ 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