

- N.B.:** (1) Question No.1 is compulsory.
 (2) Solve any three questions from remaining questions.
 (3) In all four questions to be attempted.
 (4) Figures to the right indicate full marks.

1. (a) Sketch the frequency response and identify the following filters based on their pass band 20

$$(i) h[n] = \left\{ 1, -\frac{1}{2} \right\}$$

$$(ii) H[z] = \frac{z^{-1} - a}{1 - az^{-1}}$$

- (b) Justify DFT as a linear transformation.
 (c) Explain the frequency warping in Bilinear transformation.
 (d) What is multi rate DSP ? Where it is required ?

2. (a) An analog filter has transfer function 8

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

Determine the transfer function of digital filter using bilinear transformation. The digital filter should have specification $\omega_r = \frac{\pi}{2}$

- (b) Explain the effects of coefficient quantization in FIR filters. 8
 (c) The first five points of eight point DFT of real valued sequence are 4
 $\{ 0.25, 0.125 - j0.3018, 0, 0.125 - j0.0518, 0 \}$.
 Determine the remaining three points.

3. (a) $x[n] = \begin{cases} 1, & 0 \leq n \leq 3 \\ 0, & 4 \leq n \leq 7 \end{cases}$ 10

(i) Find DFT $X[k]$

(ii) Using the result obtained in (i) find the DFT of the following sequences.

$$x_1[n] = \begin{cases} 1, & n = 0 \\ 0, & 1 \leq n \leq 4 \\ 1, & 5 \leq n \leq 7 \end{cases} \quad \text{and} \quad x_2[n] = \begin{cases} 0, & 0 \leq n \leq 1 \\ 1, & 2 \leq n \leq 5 \\ 1, & 6 \leq n \leq 7 \end{cases}$$

(b) Implement a two stage decimator for the following specifications: Sampling rate of the input signal = 20,000 Hz 10

$$M = 100$$

Pass band = 0 to 40 Hz, Pass band ripple = 0.01,

Transition band = 40 to 50 Hz, Stop band ripple = 0.002

4. (a) By means of FFT-IFFT technique compute the linear convolution of $x[n] = \{2,1,2,1\}$ and $h[n] = \{1,2,3,4\}$ 8

(b) Consider the following specifications for a low pass filter 8

$$0.99 \leq |H(e^{j\omega})| \leq 1.01 \quad 0 \leq \omega \leq 0.3\pi \quad \text{and}$$

$$|H(e^{j\omega})| \leq 0.01 \quad 0.5\pi \leq |\omega| \leq \pi$$

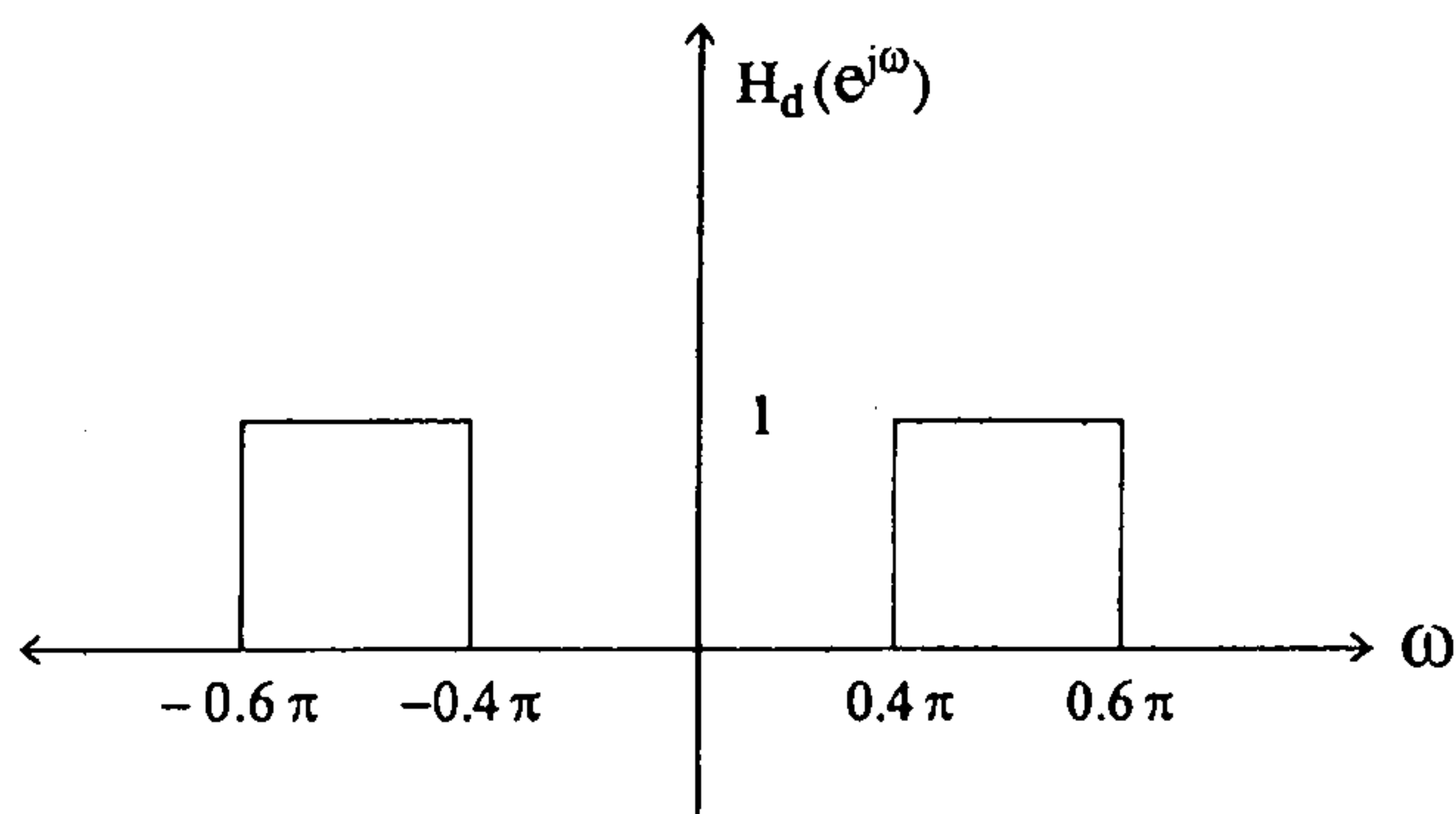
Design a linear phase FIR filter to meet these specifications using the window design method.

(c) Identify whether the following system is minimum phase, maximum phase, mixed phase. 4

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

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

5. (a) Design digital FIR filter for following specification. 10



Use hamming window and assume $M = 7$.

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- (b) Design digital low pass IIR Butterworth filter for the following specifications: 10

pass band ripple: \leq dB

pass band edge: 4 kHz

stop band attenuation: \geq 40dB

stop band edge : 6 kHz

Sample rate : 24 kHz

Use bilinear transformation

6. (a) Write a short note on 12

(i) Dual tone Multi-frequency Signal Detection.

(ii) Different methods for digital signal Synthesis.

- (b) The transfer function of digital causal system is given as follows : 8

$$H(z) = \frac{1 - z^{-1}}{1 - 0.2z^{-1} - 0.15z^{-2}}$$

Draw cascade form, parallel form realization.
