

N.B. : (1) Question No. 1 is **compulsory**.

(2) Attempt any **four** out of remaining **six** questions.

(3) Assume **suitable** data wherever **necessary**.

1. Solve any **five** :-

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- Compare FIR and IIR filters.
- Compare Impulse invariance and Bilinear transformation method.
- Ideal filter characteristics are not realizable. Give reason.
- Write a short note on limit cycle.
- Explain the characteristics of different window functions.
- Sketch the locations of all zeros of linear phase FIR filter if some of the zeros are at $0.5 e^{j\pi/3}$ and 0.2 .

2. (a) The desired response of Low Pass filter is -

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$$H_d(e^{jw}) = e^{-j3w}, \quad -\frac{3\pi}{4} \leq w \leq \frac{3\pi}{4}$$

$$= 0, \quad \frac{3\pi}{4} < |w| \leq \pi$$

Obtain $H(w)$ for $M = 7$ using Hanning window.

(b) Justify : Ideal filter characteristics are not realizable.

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3. An IIR digital low-pass filter is required to meet the following specifications :

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Pass-band ripple : ≤ 0.5 dB

Pass-band edge : 1.2 KHz

Stop-band attenuation : ≥ 40 dB

Stop-band edge : 2.0 KHz

Sample rate : 8.0 KHz.

Determine the system function $H(z)$ of the lowest order Butterworth digital filter to meet the above specifications. Use Bilinear transformation.

4. A low pass digital filter has following specifications :

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$$0.8 \leq |H(e^{jw})| \leq 1 \text{ for } 0 \leq w \leq 0.2\pi$$

$$|H(e^{jw})| \leq 0.2 \text{ for } 0.6\pi \leq w \leq \pi$$

Determine the order of Chebyshev, Butterworth and Elliptic filter to meet the above specification.

Also draw the frequency response of the above filters.

5. (a) DT system has a transfer function –

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$$H(z) = \frac{1}{1 - 0.8z^{-1} + 0.12z^{-2}}$$

A four bit processor is used with MSB as a sign bit. What is the effect of quantization on poles if (i) Direct II form is used (ii) Cascade form is used for realization.

Which type of realization has lesser effect of quantization ?

- (b) Find Cascade and parallel realization of IIR digital function –

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$$H(z) = \frac{6z^2 + 15z + 12}{2z^2 + 5z + 2}$$

6. (a) The frequency response of a filter has a form –

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$$H(e^{jw}) = e^{-j3w} [1 + 0.4 \cos 3w + 0.2 \cos 2w + 0.2 \cos w]$$

Find the impulse response of the system.

- (b) Desired frequency response of digital filter is –

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$$\begin{aligned} H_d(e^{jw}) &= e^{-j3w} & 0 \leq w \leq \pi/2 \\ &= 0 & \pi/2 \leq w \leq 3\pi/2 \\ &= e^{-j3w} & 3\pi/2 \leq w \leq 2\pi \end{aligned}$$

Determine $h(n)$ for $M = 7$ using frequency sampling technique.

7. Write short notes on any **three** :-

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- Design procedure of Bessel filters
- Matched z-transform
- Frequency transformations in Digital Domain
- Advantages of elliptic approximation over Chebyshev and inverse Chebyshev approximations.