

1. State whether each of the following statement is **true** or **false**. Justify your answer in 20 4 or 5 sentences.

- (a) Linear phase filters are always IIR.
- (b) For a causal system $|h(n)|$ tends to zero, as n tends to infinity, the system is stable.
- (c) A stable filter is always causal.
- (d) A stable, causal FIR filter has its poles lying any where inside the unit circle in the z -plane.
- (e) IIR filter have always recursive realization.

2. (a) (i) A certain DT system is stable and has transfer function as given below, find the impulse response of system if— 5

$$H(z) = \frac{z^3}{(z - 0.2)(z - 0.5)(z - 2)}$$

(ii) If $H(z) = \frac{1 - 0.2z^{-1}}{1 - 0.707z^{-1}} - \frac{1}{1 + 2z^{-1}}$ 5

If this filter is known to be unstable, find all possible impulse response of filter.

(b) Using partial fraction Expansion method, find inverse z -transform of the following expression— 10

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

for the following Roc.

- (i) $|z| > 3$
- (ii) $2 < |z| < 3$
- (iii) $|z| < 2$

3.

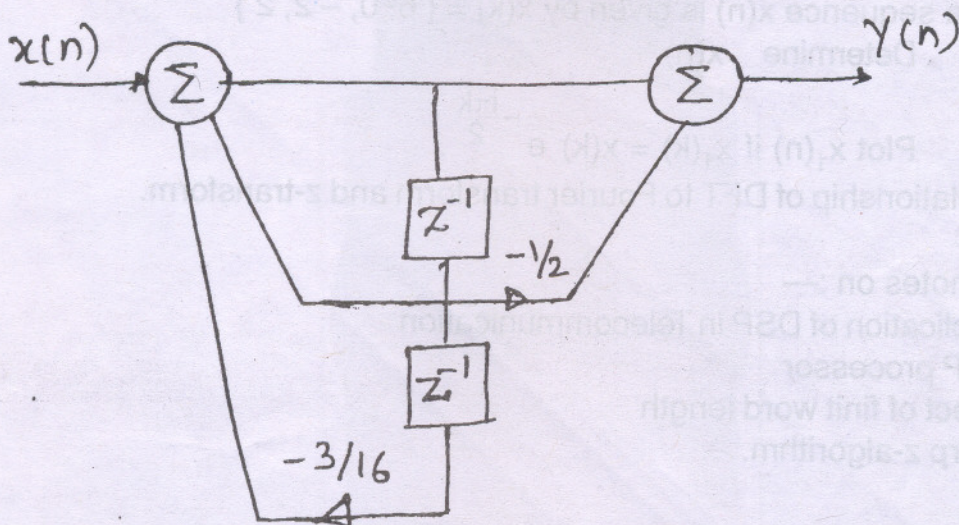


Figure shows the direct Form-II realization of IIR filter.

- (a) Find the transfer function of the filter. 3
- (b) Find the corresponding difference equation. 2
- (c) Realise the filter using cascade form. 3
- (d) Realise the filter using parallel form. 3
- (e) Find the impulse response function of filter. 3
- (f) Show pole zero pattern of filter. 3
- (g) State whether the filter is stable or not. Justify the same. 3

4. (a) An ideal low pass filter has the response—

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$$H(e^{jw}) = 2e^{-jw\alpha} \quad |w| < w_c$$

$$= 0 \quad w_c < |w| < \pi$$

Find $h(n)$, for a transition width $< \pi/32$, calculate the window length and the values of α for (i) rectangular window (ii) Hamming window.

- (b) Design a digital Butterworth filter satisfies the following constraint using bilinear transformation. Assume $T = 1$ s

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

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

5. (a) Using DIF-FFT find DFT of the following sequence—

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$$x(n) = \{1, 3, -2, 4, 1, 4, -2, 3\}$$

- (b) Find the initial and final values of $x(n)$ for the following causal system—

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$$(i) X(z) = \frac{2z^2 + 1}{z^2 - 0.5z - 0.5}$$

$$(ii) X(z) = \frac{z}{z^2 + z - 1}$$

- (c) Determine the convolution of following pair of signal by z-transform—

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$$x_1(n) = \left(\frac{1}{4}\right)^n u(n-1), \quad x_2(n) = \left[1 + \left(\frac{1}{2}\right)^n\right] u(n)$$

6. (a) A four point sequence $x(n)$ has DFT $X(K) = \{6, 2, 1, 2\}$. Sequence $p(n)$ is related to $x(n)$ has DFT $P(K) = \{6 - 2, 1, -2\}$. What is the relation between $x[n]$ and $p[n]$? Prove your answer.

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- (b) Find circular convolution of the following sequences using DFT/IDFT any—

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$$x_1(n) = \{1, 2, 3, 1\}$$

$$x_2(n) = \{4, 3, 2, 2\}$$

- (c) DFT of a sequence $x(n)$ is given by $x(k) = \{6, 0, -2, 2\}$

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- (i) Determine $x(n)$

- (ii) Plot $x_1(n)$ if $x_1(k) = x(k) e^{-\frac{j\pi k}{2}}$

- (d) Write relationship of DFT to Fourier transform and z-transform.

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7. Write short notes on :—

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- Application of DSP in Telecommunication
- DSP processor
- Effect of finit word length
- Chirp z-algorithm.