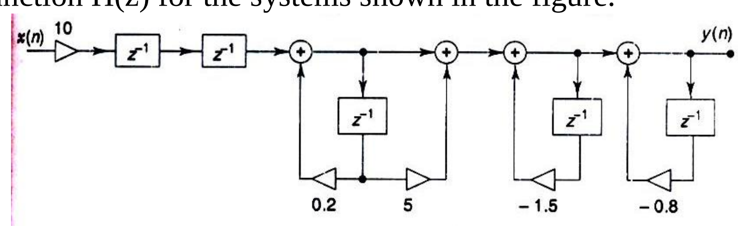
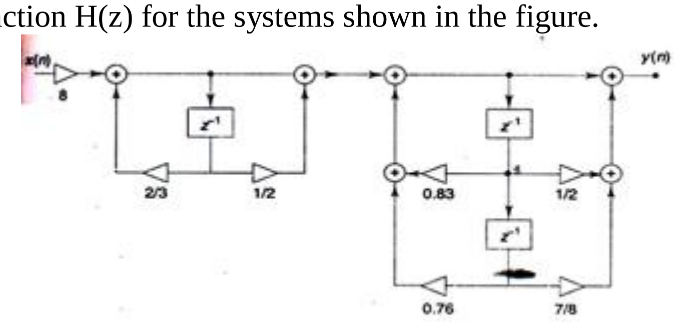
UNIT 1
ECE DEPARTMENT

Subject: DSP (EEC-602) **Branch: ECE 6th Semester**

1. Compare FIR and IIR filter.
2. Discuss the advantages of representing the digital system in block diagram form.
3. Define canonic and non-canonic structure.
4. Obtain direct form and cascade form realizations for the transfer function of an FIR system given by $\boldsymbol{H(z) = (1 - \frac{1}{4}z^{-1} + \frac{3}{8}z^{-2})(1 - \frac{1}{8}z^{-1} - \frac{1}{2}z^{-2})}$
5. Determine the direct forms-I realizations for a third order IIR transfer function.
$$\mathbf{H(z)} = \frac{\mathbf{2(1-z^{-1})(1+\sqrt{2}z^{-1}+z^{-2})}}{\mathbf{(1+0.5z^{-1}(1-0.9z^{-1}+0.81z^{-2}))}}$$
6. Determine the direct forms-II realizations for a third order IIR transfer function.
$$\mathbf{H(z)} = \frac{\mathbf{2(1-z^{-1})(1+\sqrt{2}z^{-1}+z^{-2})}}{\mathbf{(1+0.5z^{-1}(1-0.9z^{-1}+0.81z^{-2}))}}$$
7. Sketch the ladder structure for $\mathbf{H(z)} = \frac{\mathbf{2+8z^{-1}+6z^{-2}}}{\mathbf{1+8z^{-1}+12z^{-2}}}$ **.** Also check whether the system is stable.
8. Obtain the system function H(z) for the systems shown in the figure.



9. Sketch the ladder structure for $\boldsymbol{H(z)} = \frac{\mathbf{1-0.6z^{-1}+1.2z^{-2}}}{\mathbf{1+0.15z^{-1}-0.64z^{-2}}}$ **.** Also check whether the system is stable.
10. A system is represented by its transfer function H(z) given by $\boldsymbol{H(z) = 4 + \frac{3z}{(z-\frac{1}{2})} - \frac{1}{(z-\frac{1}{4})}}$. Does this H(z) represent an FIR or an IIR filter? Also realise the system function in direct form I and II.
11. Obtain the direct form-I and II structure for the system.
$$y(n) = b_o\, x(n) + b_1\, x(n-1) + b_2\, x(n-2) + b_3\, x(n-3) - a_1\, y(n-1) - a_2\, y(n-2) - a_3\, y(n-3).$$
12. Obtain the system function H(z) for the systems shown in the figure.



13. Obtain direct form and cascade form realizations for the transfer function of an FIR system given by $\boldsymbol{H(z) = (1 - \frac{1}{4}z^{-1} + \frac{3}{8}z^{-2})(1 - \frac{1}{8}z^{-1} - \frac{1}{2}z^{-2})}$
14. Obtain the cascade and parallel realization structures for the following signals.
$$\boldsymbol{H(z) = \frac{1}{(1-az^{-1})^2} + \frac{1}{(1-bz^{-1})^2}}$$

UNIT 2
ECE DEPARTMENT

Subject: DSP (EEC-602) **Branch: ECE 6th Semester**

1. Compare between impulse invariant method and bilinear transformation methods.
2. Convert the analog filter with the system function $\boldsymbol{H_a(s)} = \frac{(s+0.2)}{(s+0.2)^2+9}$ into a digital IIR filter using impulse invariant technique. Assume T = 1sec.
3. Derive the mathematical expression for bilinear transformation technique. Also discuss its advantages and disadvantages.
4. A digital filter with a 3dB bandwidth of 0.25π is to be designed from the analog filter whose system response is $H(s) = \frac{\Omega_c}{s+\Omega_c}$.
5. Design a digital Butterworth filter that satisfies the following constraint using bilinear transformation. Assume T = 1sec.

   $0.9 \le |H(e^{j\omega})| \le 1, \quad 0 \le \omega \le \pi/2$

   $|H(e^{j\omega})| \le 0.2, \quad 3\pi/4 \le \omega \le \pi$

6. Design a digital Chebyshev filter to satisfy the constraints using bilinear transformation. Assume T = 1sec.

   $0.707 \le |H(e^{j\omega})| \le 1, \quad 0 \le \omega \le 0.2\pi$

   $|H(e^{j\omega})| \le 0.1, \quad 0.5\pi \le \omega \le \pi$

UNIT 3

ECE DEPARTMENT

Subject: DSP (EEC-602) **Branch: ECE 6th Semester**

1. Design a low-pass digital FIR filter using Kaiser Window satisfying the specifications given below.
Passband cut-off frequency, f_p = 150Hz, Stopband cut-off frequency, f_s = 250 Hz., Passband ripple A_p = 0.1dB, Stopband Attenuation A_s = 40dB and Sampling frequency F = 1000 Hz.

2. A low-pass filter is to be designed with the following desired frequency response

$$\mathbf{H_d(e^{j\omega})} = \begin{cases} \mathbf{e^{-j2\omega}}, -\frac{\boldsymbol{\Pi}}{\mathbf{4}} \leq \boldsymbol{\omega} \leq \frac{\boldsymbol{\Pi}}{\mathbf{4}} \\ \mathbf{0},\ \frac{\boldsymbol{\Pi}}{\mathbf{4}} \mid \boldsymbol{\omega} \mid \boldsymbol{\Pi} \end{cases}$$

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

$$\boldsymbol{\omega}(\mathbf{n}) = \begin{cases} \mathbf{1}, \mathbf{0} \leq \mathbf{n} \leq \mathbf{4} \\ \mathbf{0}, \mathbf{otherwise} \end{cases}$$