MIDTERM EXAMINATION 2001
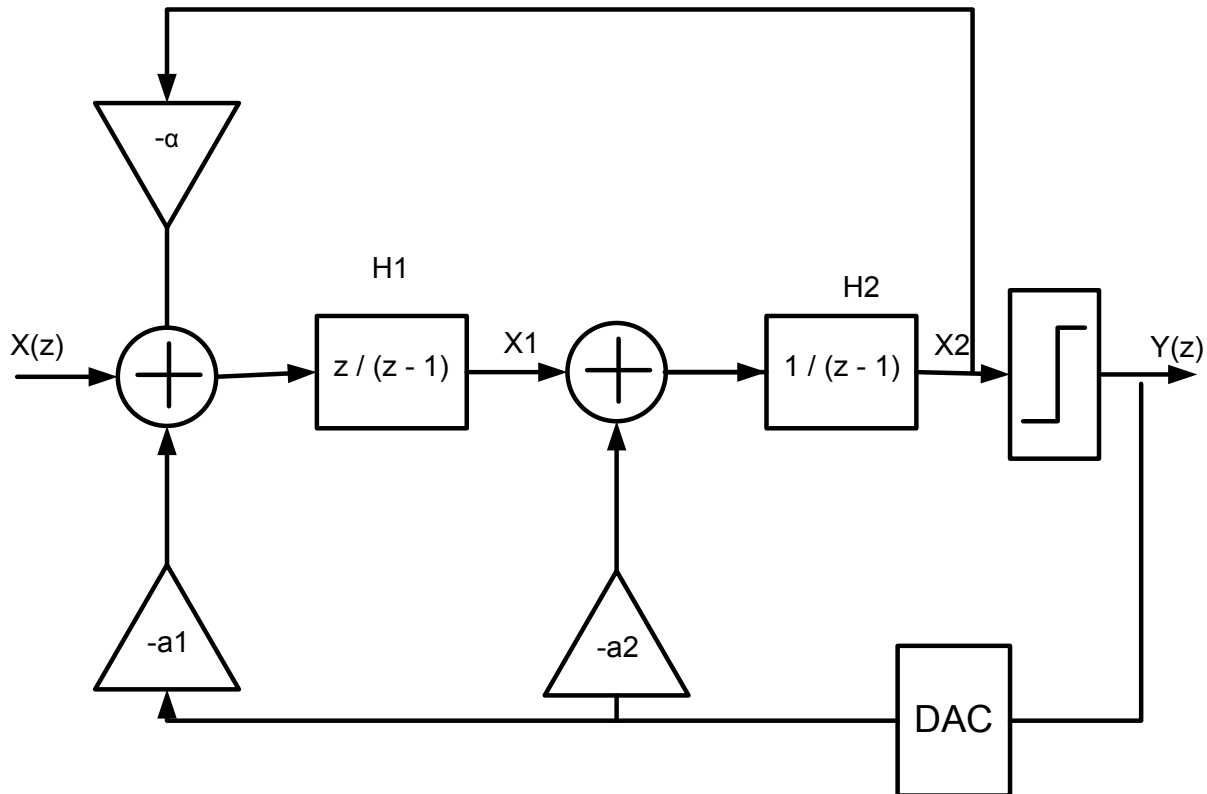
1. For the delta-sigma modulator shown below

    a) Find the STF and NTF
    b) Choose a1, a2 and alpha such that the input signal appears undistorted in the output, and the NTF becomes $1 - 1.95z^{-1} + z^{-2}$
   c) Find the zeros and poles of the NTF given above

$$Y(z) = z^{-1} X + [\ 1- (2- \alpha)\ z^{-1} + z^{-2}]\ E\ /\ 1- (\ 2 - a1 - a2 - \alpha)\ z^{-1} + (1-a2)\ z^{-2}$$

and if $a1 + \alpha = 1$ along with $a2 = 1$, then one can achieve the FIR structure for the noise transfer function (NTF). The output is given by $Y(z) = z^{-1} X(z) + [\ 1- (2- \alpha)\ z^{-1} + z^{-2}]\ E\ (z)$ with a zero in the NTF in the signal band of interest which helps to decrease the in band noise from -43.129dB (in case $\alpha=0$) to
-46.6675dB (for $\alpha = 0.05118$) for OSR of 8 (the reduction in input magnitude due to stability reason also has to be subtracted) with an assumption that quantization noise uniform.

1. Find the NTF and STF of the ADC shown below
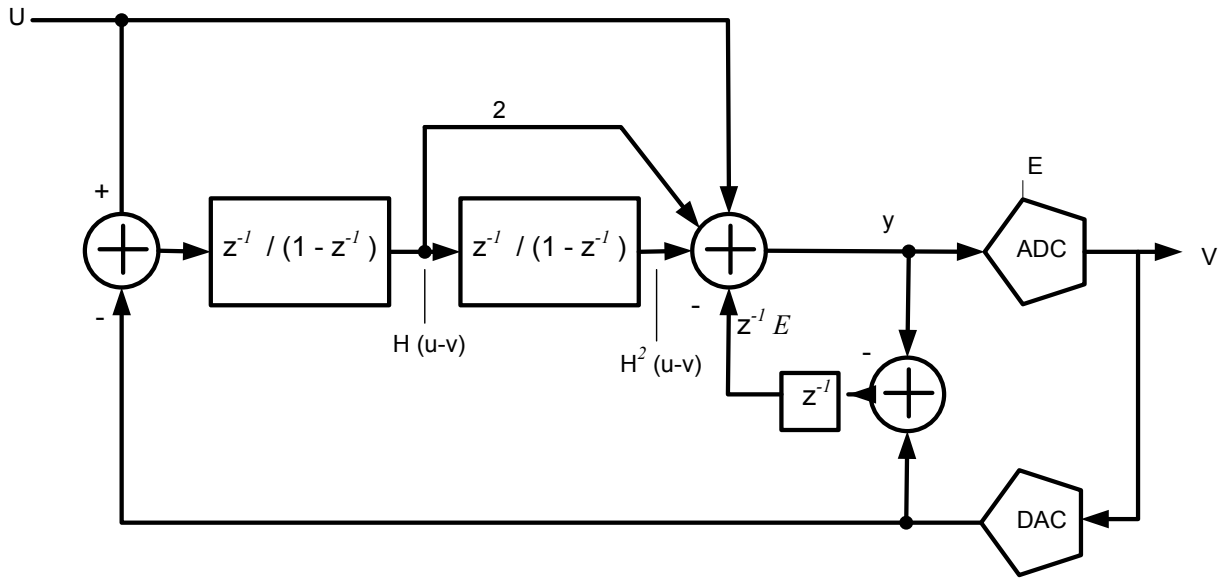
$$Y = U + 2\,H\,(U\text{-}V) + H^2\,(U\text{-}V) - z^{-1}E = V - E$$

$$V = E + (H+1)^2\,U - [\,(H+1)^2 - 1\,]\,V - z^{-1}E$$

$$(H+1)^2\,V = (H+1)^2\,U + (1 - z^{-1})\,E$$

$$(H+1)^{-2} = (1 - z^{-1})^2$$

$$V = U + (1 - z^{-1})^3\,E$$

$$\text{NTF} = (1 - z^{-1})^3$$

$$\text{STF} = 1$$