ECE 627

Spring 2011

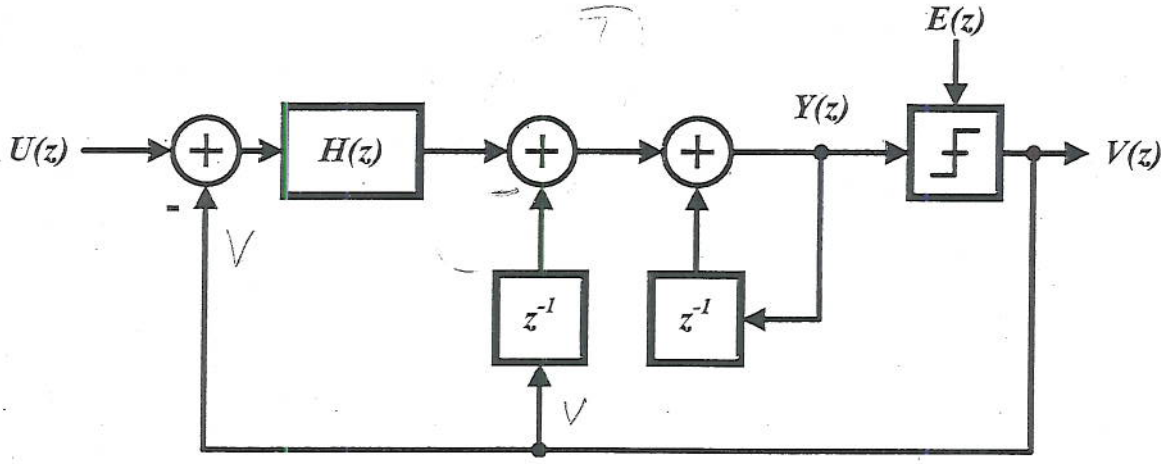
Final Examination

June 9, 2011, 6-7:50pm

1.

a. Analyze the ADC shown. Find the STF and NTF.

b. Find the STF and NTF if *H(z)* is a delaying integrator.



a. $Y = z^{-1}Y - z^{-1}V + H(U - V) = V - E$

$(1-z^{-1})(V-E) = (-z^{-1} - H)V + HU$

$[1+H]V = HU + [1-z^{-1}]E$

$STF = \frac{H}{1+H}$ $NTF = \frac{1-z^{-1}}{1+H}$

b. $1+H = 1 + \frac{z^{-1}}{1-z^{-1}} = \frac{1}{1-z^{-1}}$

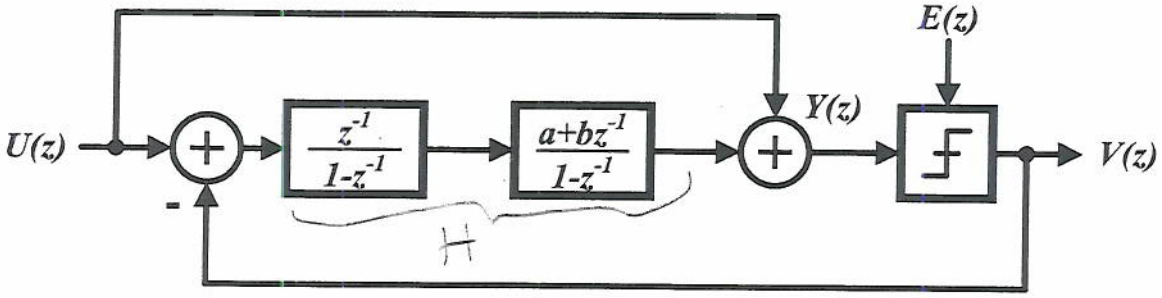
$STF = z^{-1}$

$NTF = (1-z^{-1})2$

2.

a. What should be the values of *a* and *b* to obtain $NTF = (1 - z^{-1})^2$ in the circuit shown?

b. What is the STF?



a. $H = z^{-1}\frac{a+bz^{-1}}{(1-z^{-1})^2}$

$V = E + U + H(U-V)$

$(H+1)V = (H+1)U + E$

$STF = 1, \quad NTF = \frac{1}{H+1} \overset{!}{=} (1-z^{-1})^2$

$H \overset{!}{=} \frac{1}{(1-z^{-1})^2} - 1 = \frac{1-(1-z^{-1})^2}{(1-z^{-1})^2} = \frac{2z^{-1}-z^{-2}}{(1-z^{-1})^2}$

$a \cdot z^{-1} + bz^{-2} \overset{!}{=} 2z^{-1} - z^{-2}$

$a = 2, \quad b = -1$

b. $STF = 1$

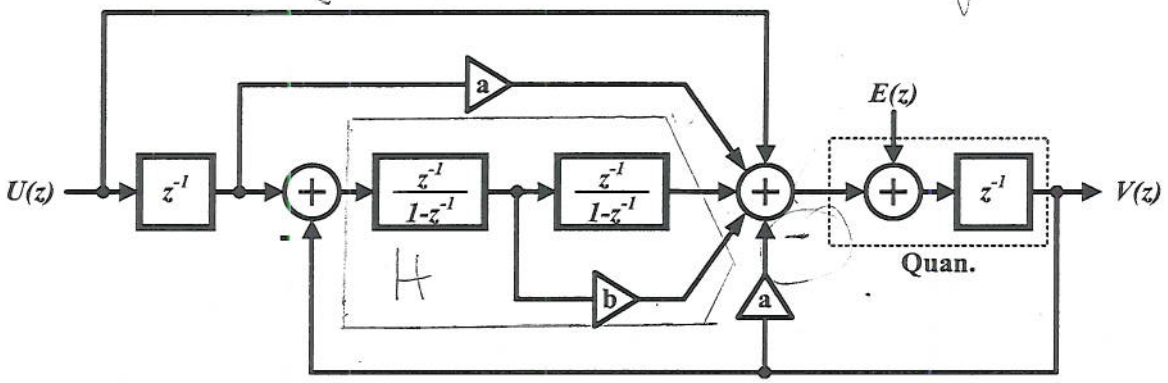
$$NTF \triangleq z^{-1}(1-z^{-1})^2$$

3.

a. Repeat the calculations of Problem 2 for the circuit shown below.

b. What advantage does this circuit have over the circuit of Problem 2?

Delay in quantizer, integrators



$$V = z^{-1}\left[E + (1+az^{-1})U - aV + H(z^{-1}U - V)\right]$$

$$H = bI + I^2, \quad I = \frac{z^{-1}}{1-z^{-1}}$$

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

$$NTF = 1, \quad NTF = z^{-1} / [1 + az^{-1} + z^{-1}(bI + I^2)]$$

$$1 + az^{-1} + \frac{bz^{-2}}{1-z^{-1}} + \frac{z^{-3}}{(1-z^{-1})^2} \triangleq z^{-1} / [z^{-1}(1-z^{-1})^2]$$

$$(1+az^{-1})(1-z^{-1})^2 + bz^{-2}(1-z^{-1}) + z^{-3} \triangleq 1$$

z^{-1}: $a - 2 \triangleq 0 \rightarrow a = 2$

z^{-2}: $1 - 2a + b \triangleq 0, \quad b = 3$

z^{-3}: $a - b + 1 \triangleq 0$, ✓

$STF = z^{-1}$