GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL of ELECTRICAL and COMPUTER ENGINEERING

EE 4078 FALL 1997
Problem Set #7

Assigned: 21 Nov 1997
Due Date: 26 Nov 1997 (WEDNESDAY)

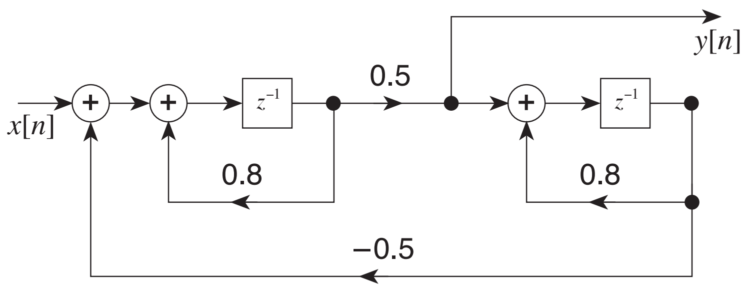
Important Date: Quiz #3 will be on Monday, 1-Dec-1997. It will concentrate on Chapters 4, 5 and 6, so it will only cover *only* the z-transform. Two z-transform tables will be attached to the quiz.

Reading: Chapter 4, sections 4.0–4.4 and 4.6–4.7
Chapter 5, sections 5.0–5.3; Chapter 6, sections 6.0–6.5

Turn in *only* the starred problems; some of them will be graded.

PROBLEM 7.1*:

Consider the causal, LTI system that is defined by the network below.



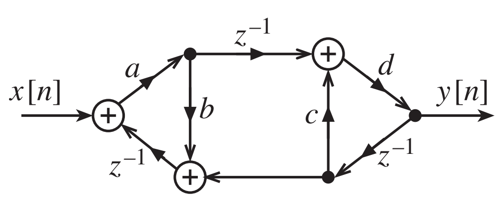
(a) Determine the difference equations *corresponding to this structure* that will enable the output samples to be computed recursively from the input sequence. State explicitly the *order* in which the computations must be done and the *names* of all intermediate signals used.

(b) Determine the system function, $H(z) = Y(z)/X(z)$, of this LTI system.

(c) Then find the (complex) poles — give the radius and angle for each.

PROBLEM 7.2*:

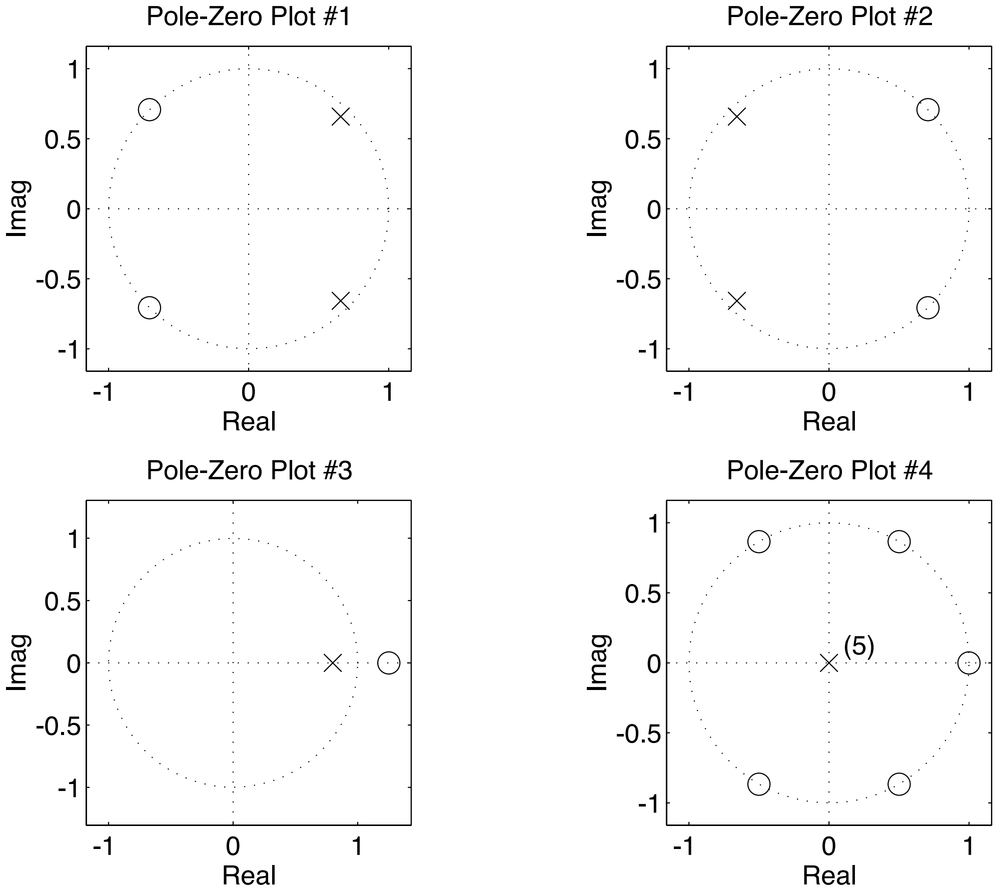
Consider the causal, LTI system that is defined by the signal flow graph below:



(a) The signal flow graph represents a computation that involves several difference equations. Determine all the difference equations *defined by the flow graph,* and state the order in which they must be computed. Do not try to find the overall difference equation of the system.

(b) Determine the input-output transfer function $H(z)$ for this structure (this may not be easy).

PROBLEM 7.3:



For each of the pole-zero plots (#1, #2, #3 and #4), determine which one of the following systems (specified by either an $H(z)$ or a difference equation) matches the pole-zero plot.

S_1 : $\quad y[n] = -0.96y[n-2] + x[n] + \sqrt{2}x[n-1] + x[n-2]$

S_2 : $\quad y[n] = 0.8y[n-1] + 0.8x[n] - x[n-1]$

S_3 : $\quad H(z) = \dfrac{1 - z^{-1}}{1 + 0.8z^{-1}}$

S_4 : $\quad H(z) = \dfrac{1}{1 + 1.3152z^{-1} + 0.8649z^{-2}}$

S_5 : $\quad y[n] = -1.3152y[n-1] - 0.8649y[n-2] + x[n] - \sqrt{2}x[n-1] + x[n-2]$

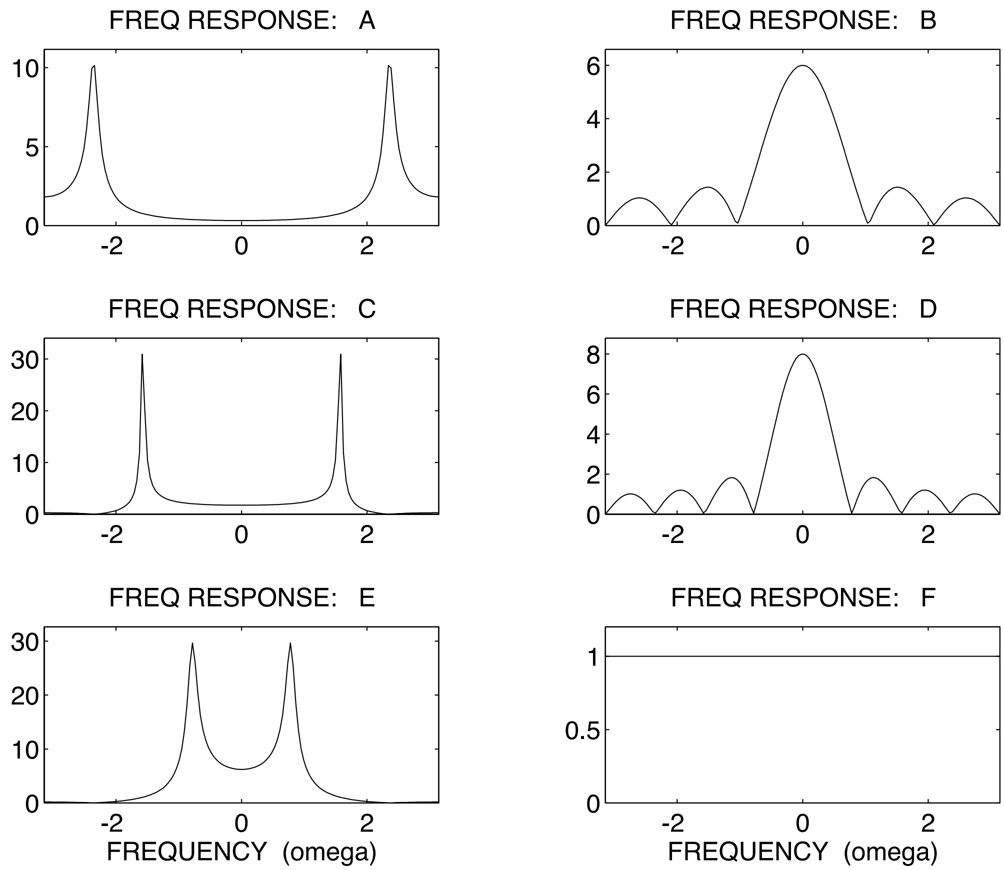
S_6 : $\quad H(z) = \dfrac{1 + \sqrt{2}z^{-1} + z^{-2}}{1 - 1.3152z^{-1} + 0.8649z^{-2}}$

S_7 : $\quad y[n] = \displaystyle\sum_{k=0}^{7} x[n-k]$

S_8 : $\quad y[n] = x[n] + x[n-1] + x[n-2] + x[n-3] + x[n-4] + x[n-5]$

S_9 : $\quad H(z) = 1 - z^{-1} + z^{-2} - z^{-3} + z^{-4} - z^{-5}$

PROBLEM 7.4:



For each of the frequency response plots (A, B, C, D, E, F), determine which one of the following systems (specified by either an $H(z)$ or a difference equation) matches the frequency response.

S_1 : $\quad y[n] = -0.96y[n-2] + x[n] + \sqrt{2}x[n-1] + x[n-2]$

S_2 : $\quad y[n] = 0.8y[n-1] + 0.8x[n] - x[n-1]$

S_3 : $\quad H(z) = \dfrac{1 - z^{-1}}{1 + 0.8z^{-1}}$

S_4 : $\quad H(z) = \dfrac{1}{1 + 1.3152z^{-1} + 0.8649z^{-2}}$

S_5 : $\quad y[n] = -1.3152y[n-1] - 0.8649y[n-2] + x[n] - \sqrt{2}x[n-1] + x[n-2]$

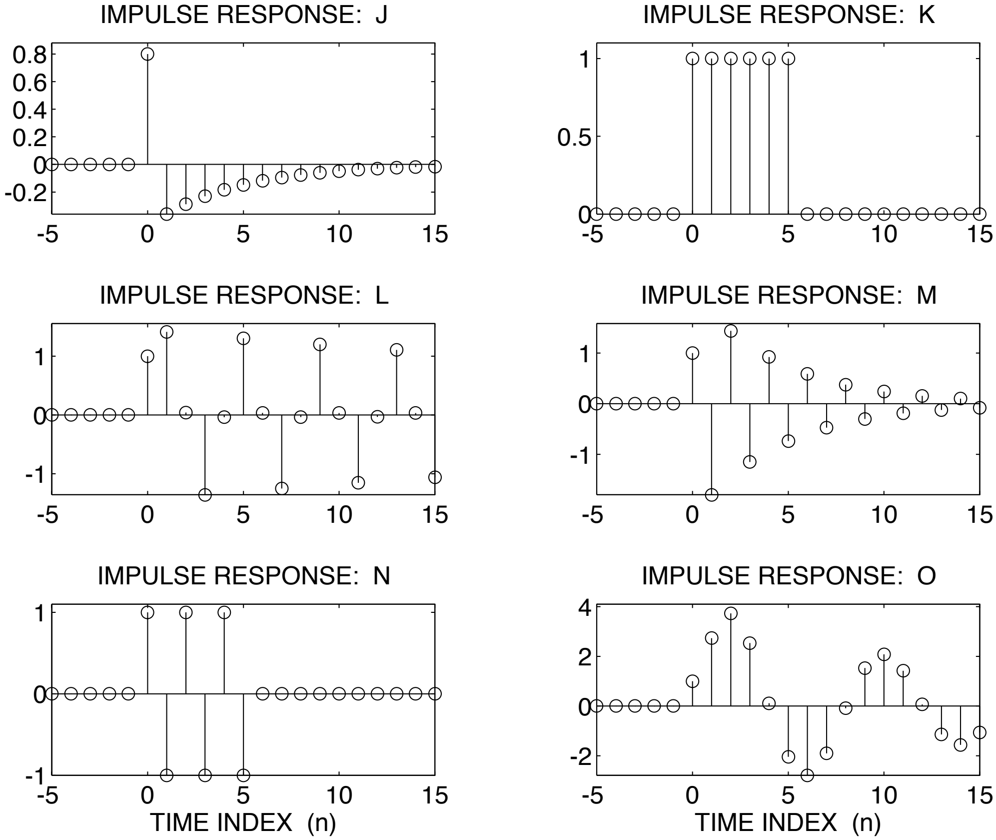
S_6 : $\quad H(z) = \dfrac{1 + \sqrt{2}z^{-1} + z^{-2}}{1 - 1.3152z^{-1} + 0.8649z^{-2}}$

S_7 : $\quad y[n] = \displaystyle\sum_{k=0}^{7} x[n-k]$

S_8 : $\quad y[n] = x[n] + x[n-1] + x[n-2] + x[n-3] + x[n-4] + x[n-5]$

S_9 : $\quad H(z) = 1 - z^{-1} + z^{-2} - z^{-3} + z^{-4} - z^{-5}$

PROBLEM 7.5:



For each of the impulse-response plots (J, K, L, M, N, O), determine which one of the following systems (specified by either an $H(z)$ or a difference equation) matches the impulse response.

S_1 : $y[n] = -0.96y[n-2] + x[n] + \sqrt{2}x[n-1] + x[n-2]$

S_2 : $y[n] = 0.8y[n-1] + 0.8x[n] - x[n-1]$

S_3 : $H(z) = \dfrac{1 - z^{-1}}{1 + 0.8z^{-1}}$

S_4 : $H(z) = \dfrac{1}{1 + 1.3152z^{-1} + 0.8649z^{-2}}$

S_5 : $y[n] = -1.3152y[n-1] - 0.8649y[n-2] + x[n] - \sqrt{2}x[n-1] + x[n-2]$

S_6 : $H(z) = \dfrac{1 + \sqrt{2}z^{-1} + z^{-2}}{1 - 1.3152z^{-1} + 0.8649z^{-2}}$

S_7 : $y[n] = \displaystyle\sum_{k=0}^{7} x[n-k]$

S_8 : $y[n] = x[n] + x[n-1] + x[n-2] + x[n-3] + x[n-4] + x[n-5]$

S_9 : $H(z) = 1 - z^{-1} + z^{-2} - z^{-3} + z^{-4} - z^{-5}$