**ECE 464/564: Digital Signal Processing - Winter 2018**
**Homework 6**
**Due: Mar 1, 2018 (Thursday)**

1. Let x[n] and y[n] be sequences related by the following difference equation:

$$y[n] - \frac{1}{4}y[n-2] = x[n-2] - \frac{1}{4}x[n].$$

   a) Draw the direct form I implementation for the system
   b) Draw the direct form II implementation for the system
   c) Write the system transfer function of the system

2. Consider the signal flow graph shown in the figure:

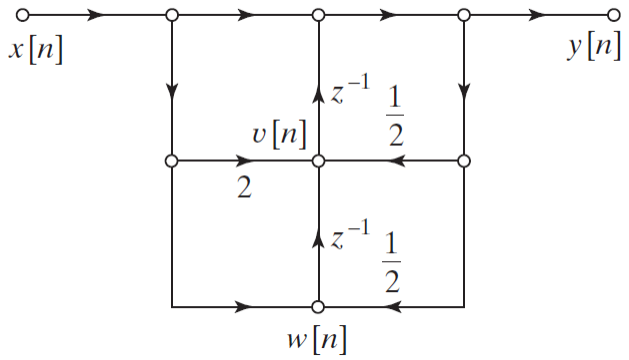


**Fig. 1.** Signal flow graph (for Prob. 2)

   a) Using the node variables indicated, write the set of difference equations represented by this flow graph
   b) Draw the flow graph of an equivalent system that is the cascade of two 1st order systems
   c) Is the system stable?

3. Consider a causal LTI system whose system function is:

$$H(z) = \frac{1 - \frac{3}{10}z^{-1} + \frac{1}{3}z^{-2}}{\left(1 - \frac{4}{5}z^{-1} + \frac{2}{3}z^{-2}\right)\left(1 + \frac{1}{5}z^{-1}\right)} = \frac{\frac{1}{2}}{1 - \frac{4}{5}z^{-1} + \frac{2}{3}z^{-2}} + \frac{\frac{1}{2}}{1 + \frac{1}{5}z^{-1}}$$

   a. Draw the signal flow graphs for implementations of the system in each of the following forms:
      1. Direct Form I
      2. Direct Form II
      3. Cascade form using 1st and 2nd order direct form II sections
      4. Parallel form using 1st and 2nd order direct form I sections

5. Transposed direct form II

b. Write the difference equations for the flow graph of part 5. in (a) and show that this system has the correct system function.

4. The flow graph shown in the figure below is non-computable. i.e, it is not possible to compute the output using the difference equations represented by the flow graph because it contains a closed loop having no delay elements.

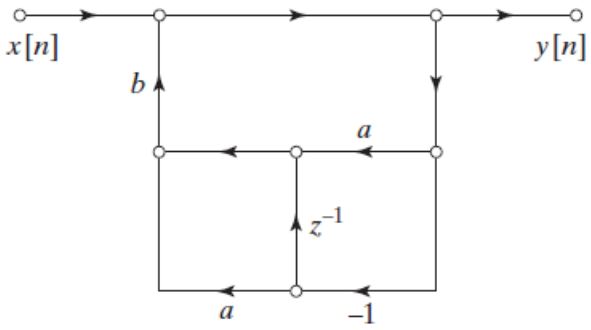


**Fig. 2.** Signal flow graph (for Prob. 4)

a) Write the difference equation for the system and from that find the system function of the flow graph.
b) From the system function, obtain a flow graph that is computable.

5. For the LTI system described by the flow graph in the figure below determine the difference equation relating the input x[n] to the output y[n].

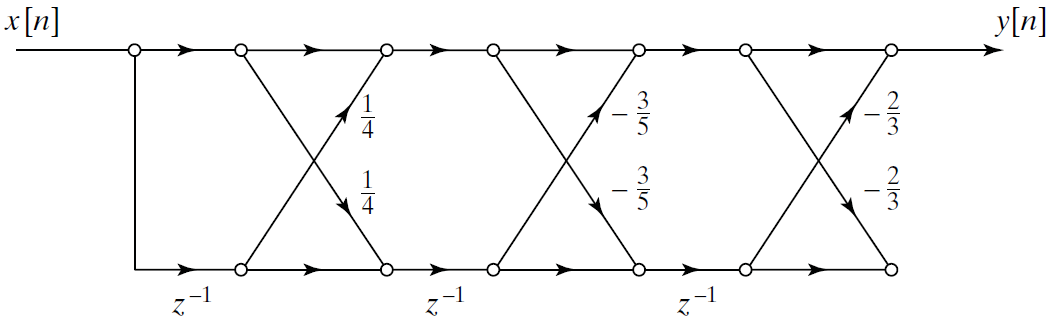


**Fig. 3.** Signal flow graph (for Prob. 5)