1. Draw the signal flow graph for the direct form I and direct form II implementation of the LTI system with system function.

\[ H(z) = \frac{1 - \frac{1}{2}z^{-2}}{1 - \frac{1}{4}z^{-1} - \frac{1}{8}z^{-2}} \]

2. An LTI system is realized by the flow graph shown in Figure 1.

![Flow graph](image)

(a) Write the difference equation relating \( x[n] \) and \( y[n] \) for this flow graph.

(b) What is the system function of the system?

(c) Draw the flow graph of an equivalent system that is the cascade of two 1st order systems.

(d) Is the system stable?

3. For the LTI system described by the flow graph in Figure 2, determine the difference equation relating the input \( x[n] \) to the output \( y[n] \).

![Flow graph](image)

4. Consider a causal LTI system whose system function is

\[ H(z) = \frac{1 - \frac{3}{10}z^{-1} + \frac{1}{3}z^{-2}}{1 - \frac{4}{5}z^{-1} + \frac{2}{3}z^{-2}} \]

\[ = \frac{1}{2} \left( \frac{1}{1 - \frac{4}{5}z^{-1} + \frac{2}{3}z^{-2}} \right) + \frac{1}{2} \left( \frac{1}{1 + \frac{1}{5}z^{-1}} \right) \]
(a) Draw the signal flow graphs for implementations of the system in each of the following forms:

i. Direct form I

ii. Direct form II

iii. Cascade form using 1st and 2nd order direct form II sections

iv. Parallel form using 1st and 2nd order direct form I section

v. Transposed direct form II.

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

5. For the LTI system described by the graph in the Figure 3 determine the difference equation relating the input $x[n]$ to the output $y[n]$. 

![Figure 3](image.png)