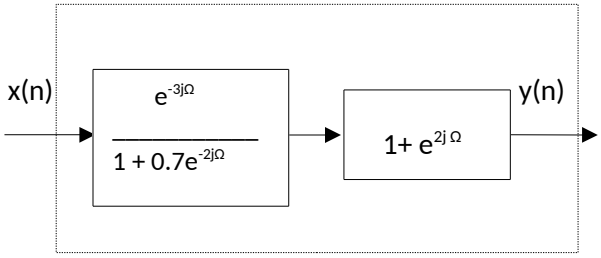
TEST 1 PART B

1. For the causal filter below (20pts)



a. Write the overall difference equation(show the equation clearly and define coefficients)
b. Give the transfer function of the system (show the equation clearly)
c. Compute with pencil and paper the impulse response in closed form
d. Use MATLAB to determine steady state response due to x(n)=u(n)
e. Write a MATLAB program to compute and plot the frequency response of the overall system. Give plots in dB and the program.

Exercise 2.

For the following causal filter: (15 pts)

$$y(n)=x(n)-x(n-2)+1.2y(n-1)-0.36y(n-2)$$

a) Determine the transfer function.
b) Find the poles and zeros.
c) Use the residue theorem for the inverse z-transform and calculate in closed form the transient and steady state response of the filter below due to the input $x(n)=u(n)$.

Exercise 3 - This small programming exercise is on a simple linear prediction of speech and its utility in estimating the frequency response of the mouth cavity (vocal tract). You need to use the file *cleanspeech* and apply frame by frame processing. Identify voiced (vowel) frames in speech (those that have strong periodicity).

Apply the function **lpc** in MATLAB first on a voiced (vowel) frame. The lpc will provide to you coefficients that you can use to form an *all-pole* transfer function. The order of this transfer function should be 10 (hence you need 10 lpc coefficients). The frame size that you use should be N=256.

For a randomly chosen strongly voiced frame, Use MATLAB and Provide

- A time domain plot and an FFT spectral plot (in dB)
- A plot of the *all pole* filter magnitude response in dB
- Provide a pole zero plot for the all pole filter
- Provide the frequency in HZ of the first peak of the all pole filter (ignore peaks at DC)

Determine three 256-point frames. One perfectly periodic, one that looks random (but not silence), and one mixed (somewhat periodic but not perfectly periodic)

- Apply the lpc function for N=256 on all three frams. For each frame, Provide the time domain, the FFT (in dB) and the all-pole frequency response in dB.

To get full credit, label your graphs carefully and provide 1-2 sentences to explain each result.

Do your own work. Info in your text book on speech processing should be helpful. You can also use resources from MathWorks.