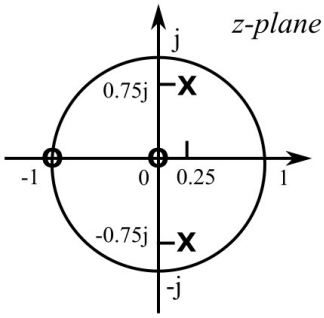
ELE314 Linear Systems and Signals Exam #3 Summer 2017 Name:

Open book/notes (10 questions, 10 points each)

1. ( ) The pole-zero plot of a digital filter shows two poles at 0.25 ± 0.75 *j* and two zeros at 0 and -1. What is its *H(z)*? (A) $\frac{z^2+1}{z^2+0.5z+0.625}$, (B) $\frac{z^2-0.5z+0.625}{z^2-z}$,



(C) $\frac{z^2+z}{z^2+0.5z+0.625}$, (D) $\frac{z^2+z}{z^2-0.5z+0.625}$, (E) none of the above.

2. ( ) For the above problem, what is the filter equation?

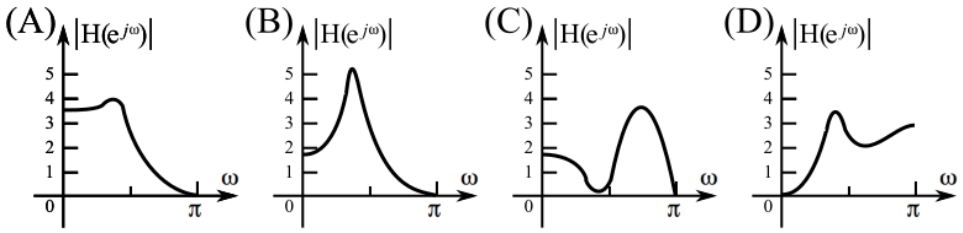
(A) $y[n]=x[n]+x[n-2]-0.5y[n-1]-0.625\,y[n-2]$,

(B) $y[n]=x[n]-0.5\,x[n-1]+0.625\,x[n-2]+y[n-1]$,

(C) $y[n]=x[n]+x[n-1]-0.5y[n-1]-0.625\,y[n-2]$,

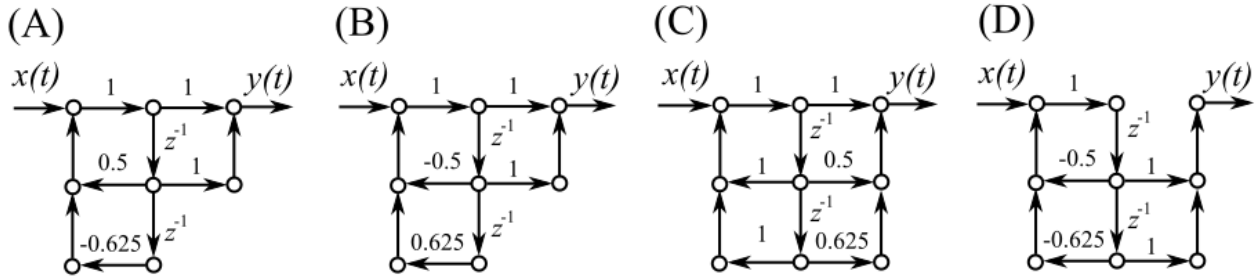
(D) $y[n]=x[n]+x[n-1]+0.5y[n-1]-0.625\,y[n-2]$, (E) none of the above.

3. ( ) For the above problem, what does its $|H(e^{i\omega})|$ look like?



(E) none of the above.

4. ( ) For the above problem, what is its Direct Form 2 realization?



(E) none of the above.

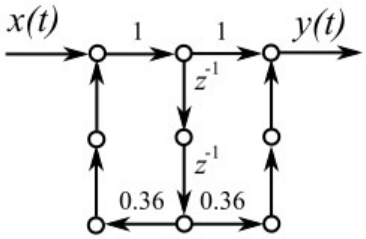
5. ( ) If $H(z)=\frac{\frac{\sqrt{2}}{2}z^{-1}}{1-\sqrt{(2)}z^{-1}+z^{-2}}$, what is $h[n]$? (Hint: Use the ZT Table.)

(A) $h[n]=\sin(\frac{\pi n}{2})$, (B) $h[n]=\sin(\frac{\pi n}{4})$, (C) $h[n]=\cos(\frac{\pi n}{2})$,

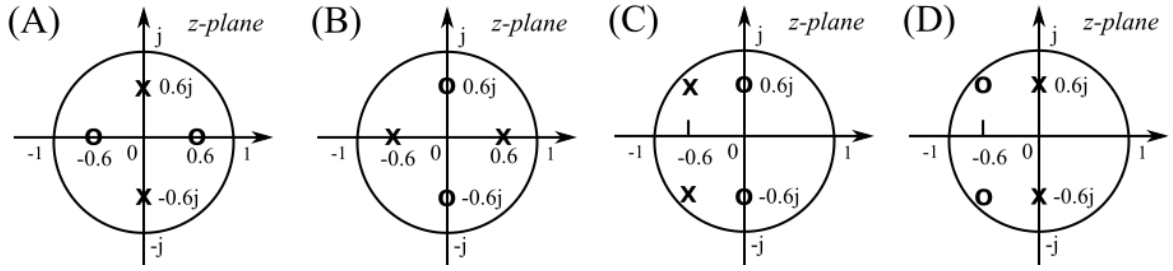
(D) $h[n]=\cos(\frac{\pi n}{4})$, (E) none of the above.

6. ( ) The Direct form 2 realization of a filter is shown below. What is its filter equation?

(A) $y[n]=x[n]+0.36x[n-2]+0.36\,y[n-2]$,
(B) $y[n]=x[n]-0.36\,x[n-2]-0.36\,y[n-2]$,
(C) $y[n]=x[n]+0.36x[n-1]+0.36\,y[n-1]$,
(D) $y[n]=x[n]-0.36x[n-1]-0.36\,y[n-1]$,
(E) none of the above.

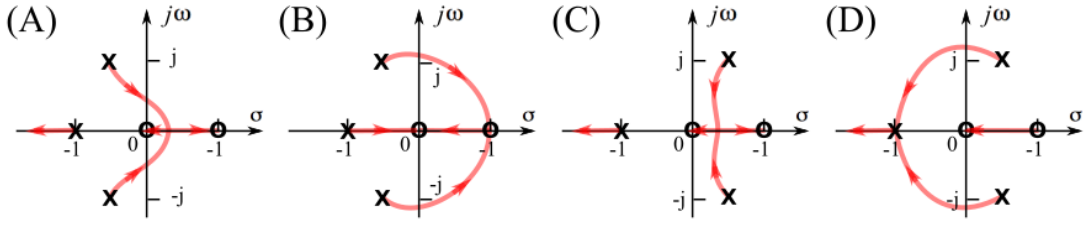


7. ( ) For the above problem, what is the pole-zero plot?



(E) none of the above.

8. ( ) The loop gain of a feedback control system is $G(s)H(s)=\dfrac{s(s-1)}{(s^2+s+1.25)(s+1)}$. What is its root locus for negative feedback?



(E) none of the above.

9. ( ) A state-space representation is developed for the 2nd-order differential equation $\ddot{y}(t)+2\dot{y}+5y = 2x$ by choosing the state variables: $s_1=y$; $s_2=\dot{y}$. The state equation in matrix form is $\dot{\underline{s}}=A\underline{s}+\underline{b}x$. What is the plant matrix *A*? (A) $\begin{bmatrix} 0 & 1 \\ -2 & -5 \end{bmatrix}$, (B) $\begin{bmatrix} 0 & 1 \\ 2 & 5 \end{bmatrix}$, (C) $\begin{bmatrix} 0 & 1 \\ -5 & -2 \end{bmatrix}$, (D) $\begin{bmatrix} 0 & 1 \\ 5 & 2 \end{bmatrix}$, (E) none of the above.

10. ( ) For the above problem, what is the input vector $\underline{b}$? (A) $\begin{bmatrix} 0 \\ 2 \end{bmatrix}$, (B) $\begin{bmatrix} 0 \\ -2 \end{bmatrix}$, (C) $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$, (D) $\begin{bmatrix} 0 \\ -1 \end{bmatrix}$, (E) none of the above.