Exercises Week 13

(2) a) $H(z) = 7 + 3z^{-1} + 1z^{-2} + 7z^{-3} + 3z^{-4} + 1z^{-5}$ No!

IIR

b) $H(z) = \frac{1 + 2z^{-1} + z^{-2}}{1 - 2z^{-1} + z^{-2}}$ is not FIR => No!

c). $H(z) = 1 + 2z^{-1} + 1z^{-2}$

$H(z) = 1 + 2z^{-1} - 1z^{-2}$ → Negative Symmetry => middle should be 0 (is 2) } ≠ Not ok!

d) $1 - 2z^{-1} + 1 \cdot z^{-2}$

1 -2 1 ok! positive symmetry

e) $1 - 2z^{-1} - 2z^{-2} + z^{-3}$ 1 -2 -2 1 ok! positive symmetry

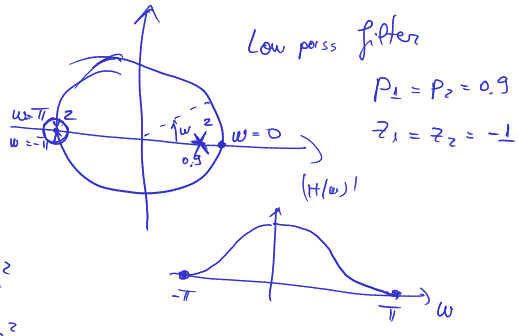
f) $1 + 2z^{-1} + 7z^{-2} - 2z^{-3} - 1z^{-4}$

should have been 0!! => Not ok!

g). $1 - z^{-1}$ 1 -1 ok, neg. sym => Linear-phase

h) $1 - z^{-2} = 1 + 0 \cdot z^{-1} - z^{-2}$ => 1 0 -1 => Neg. symmetry => Linear-phase

(1) a) $H(z) = \frac{b_0 + b_1 z^{-1} + b_2 z^{-2}}{1 + a_1 z^{-1} + a_2 z^{-2}}$



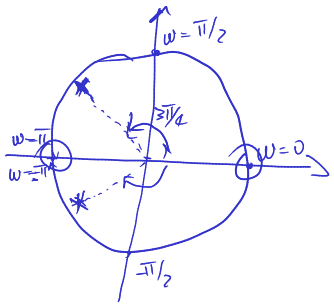
$= \frac{(z+1)(z+1)}{(z-0.9)(z-0.9)} = \frac{z^2 + 2z + 1}{z^2 - 1.8z + 0.81}$ $\div z^2$

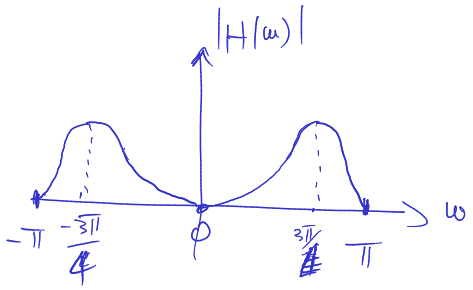
$= \frac{b_0 + b_1 z^{-1} + b_2 z^{-2}}{1 + a_1 z^{-1} + a_2 z^{-2}}$ ($a_1 = -1.8$, $a_2 = 0.81$)

$y[n] = -a_1 y[n-1] - a_2 y[n-2] + b_0 x[n] + b_1 x[n-1] + b_2 x[n-2]$

$y[n] = 1.8\, y[n-1] - 0.81\, y[n-2] + x[n] + 2x[n-1] + x[n-2]$

b).





$c = |c| \cdot e^{j \angle c}$

$z_1 = 1$

$z_2 = -1$

$p_1 = 0.8 \cdot e^{j 3\pi/4} = 0.8 \left(\cos 3\pi/4 + j \sin 3\pi/4\right) = -0.56 + 0.56j$ ($\cos 3\pi/4 = -\sqrt{2}/2$, $\sin 3\pi/4 = \sqrt{2}/2$)

$p_2 = 0.8 \cdot e^{-j 3\pi/4} = 0.8 \left(\cos(3\pi/4) - j \sin(3\pi/4)\right) = -0.56 - 0.56j$

$$H(z) = \frac{(z-1)(z+1)}{(z+0.56-0.56j)(z+0.56+0.56j)} = \frac{z^2-1}{z^2+0.56z+0.56jz+0.56}$$

$a - b \quad a \quad b$

$z^2 + 1.12z + 0.62$

$a^2 - b^2 = (z+0.56)^2 - (0.56j)^2$

$= z^2 + 1.12z + 0.31 + 0.31$

$$= \frac{1 - z^{-2}}{1 + 1.12z^{-1} + 0.62z^{-2}} \Rightarrow y[n] = -1.12\, y[n-1] - 0.62\, y[n+2] + x[n] - x[n-2]$$