a) B, C, D, E

An IIR system will have form

\[ H(z) = \frac{F(z)}{G(z)} \]

(b) A, F

The poles of an FIR system must be at \( p = 0 \).

(c) A, B, C, E, F

Because the systems are causal, the poles of stable system must
be inside the unit circle.

(d) E

All zeros and poles are inside unit circle.

(e) A, F

All poles should be \( p = 0 \), and zero comes in conjugate reciprocal
pairs.

(f) C

All-pass system.

(g) E

All poles and zeros should be inside unit circle.

(h) F

The length of A is 11. The length of F is 7. The length of others
is infinite.

(i) E

Minimum-phase system
2. (a) \[ h[n] = 2g[n] + 3g[n-1] + 2g[n-2] \]
\[ H(e^{j\omega}) = 2 + e^{-j\omega} + 2e^{-2j\omega} \]
\[ = e^{-j\omega}(2e^{j\omega} + 1 + 2e^{-j\omega}) \]
\[ = e^{-j\omega}(4\cos\omega + 1) \]

Because \( 4\cos\omega + 1 \) can be negative or positive, it's generalized linear phase. 
\( \alpha = 1, \beta = 0, \ A(e^{j\omega}) = 4\cos\omega + 1 \)

(b) \[ h[n] = g[n] + 2g[n-1] + 3g[n-2] \]
\[ H(e^{j\omega}) = 1 + 2e^{-j\omega} + 3e^{-2j\omega} \]

Because the impulse response is not symmetric or anti-symmetric, it's not generalized linear phase system.

(c) \[ h[n] = g[n] + 3g[n-1] + 3g[n-2] \]
\[ H(e^{j\omega}) = 1 + 3e^{-j\omega} + e^{-2j\omega} \]
\[ = e^{-j\omega}(e^{-j\omega} + 3 + e^{-j\omega}) \]
\[ = e^{-j\omega}(2\cos\omega + 3) \]

Because \( 2\cos\omega + 3 \) is always greater than 0, it's linear phase system.
\( \alpha = 1, \beta = 0, \ A(e^{j\omega}) = 2\cos\omega + 3 \)

(d) \[ h[n] = g[n] + 3g[n-1] \]
\[ H(e^{j\omega}) = 1 + e^{-j\omega} = e^{-j\omega/2}(e^{j\omega/2} + e^{-j\omega/2}) \]
\[ = 2\cos \frac{\omega}{2} \cdot e^{-j\omega/2} \]

Because \( \cos \frac{\omega}{2} \) can be negative or positive, it is generalized linear phase system.
\( \alpha = \frac{1}{2}, \beta = 0, \ A(e^{j\omega}) = 2\cos \frac{\omega}{2} \)
(e) \( h[n] = \delta[n] - \delta[n-2] \)

\[ H(e^{j\omega}) = 1 - e^{-2j\omega} \]

\[ = e^{-j\omega} (e^{j\omega} - e^{-j\omega}) \]

\[ = 2j \sin \omega \ e^{-j\omega} \]

\[ = 2 \sin \omega \ e^{-j\omega + \frac{j\pi}{2}} \]

Because \( 2 \sin \omega \) can be negative or positive, it is generalized linear phase system.

\[ \alpha = 1, \quad \beta = \frac{\pi}{2}, \quad A(e^{j\omega}) = 2 \sin \omega . \]

3. (a) \( H(e^{j\omega}) = H_1(e^{j\omega}) \ H_2(e^{j\omega}) = A_1(e^{j\omega}) \ e^{-j\omega \ \frac{M_1}{2}} \cdot \ j \ A_2(e^{j\omega}) \ e^{-j\omega \ \frac{M_2}{2}} \)

\[ = A_1(e^{j\omega}) \ A_2(e^{j\omega}) \ e^{-j\omega \ (M_1+M_2) + \frac{j\pi}{2}} \]

(b) \( L = M_1 + M_2 \)

(c) \( \text{grd} ( H(e^{j\omega}) ) = \frac{d}{d\omega} \frac{A(e^{j\omega}) \ e^{-j\omega \ \frac{M_1+M_2}{2} + \frac{j\pi}{2}}}{d\omega} = \frac{M_1 + M_2}{2} \)

(d) \( M_1 \) is an even integer, \( M_2 \) is an odd number. That means \( M_1 + M_2 \) is an odd number. and \( \beta = \frac{\pi}{2} \), that means it's anti-symmetric

Hence, it's type IV.

4. First, the length is 8. That means exist 7 zeros. There is a zero at \( z=-2 \), there must be another zero at \( z=-\frac{1}{2} \). For the zero \( z=0.8 \ e^{j\frac{\pi}{4}} \), due to the property of FIR, other zeros are \( z=1.25 \ e^{j\frac{\pi}{4}}, \ z=0.8 \ e^{-j\frac{\pi}{4}}, \ z=1.25 \ e^{-j\frac{\pi}{4}} \)

From \( h[n] = -h[-n] \) and length = 8. We know it's type IV. For type IV, there is a zero \( z=1 \). Hence

\[ H(z) = (1-z^{-1})(1+\frac{1}{2} z^{-1})(1-0.8 \ e^{j\frac{\pi}{4}})(1-0.8 \ e^{-j\frac{\pi}{4}})(1-1.25 \ e^{j\frac{\pi}{4}})(1-1.25 \ e^{-j\frac{\pi}{4}}) \]