Problem 1: Consider the first-order causal and stable allpass transfer function given by

\[ A(z) = \frac{1 - dz}{z - d}. \]

Determine the expression for \((1 - |A(z)|^2)\), and show that

\[
(1 - |A(z)|^2) \begin{cases} < 0, & \text{for } |z|^2 < 1; \\ = 0, & \text{for } |z|^2 = 1; \\ > 0, & \text{for } |z|^2 > 1. \end{cases}
\]

Problem 2: Consider a linear-phase FIR transfer function with real coefficients given by \(H(z) = F_1(z)F_2(z)\). Determine the factor \(F_2(z)\) of lowest order for each of the following choices of \(F_1(z)\):

(a) \(F_1(z) = 2.1 - 3.5z^{-1} + 4.2z^{-2}\),

(b) \(F_1(z) = 1 - 5z^{-1} + \frac{25}{4}z^{-2} - 9z^{-3}\).

Problem 3: A third-order FIR filter has a transfer function given by

\[ G_1(z) = (2 + 3.4z^{-1} - 4z^{-2})(3 - 1.5z^{-1}) \]

(a) Determine the transfer functions of all other FIR filters whose magnitude responses are identical to that of \(G_1(z)\).

(b) Which one of these filters has a minimum-phase transfer function, and which one has a maximum-phase transfer function?