PROBLEM:

Suppose that two filters are cascaded. The system functions are

$$H_1(z) = \frac{3}{1 - \frac{1}{2}z^{-1}} \qquad \text{and} \qquad H_2(z) = 2 + z^{-1} - z^{-2}$$

(a) Determine the poles and zeros of $H_1(z)$. If necessary, include poles and zeros at $z = 0$ and at $z = \infty$, and indicate repeated poles or zeros.

POLES =
ZEROS =

(b) Determine the poles and zeros of $H_2(z)$

POLES =
ZEROS =

(c) The cascaded system can be combined into one overall system and then described by a single difference equation of the form:

$$y[n] = \alpha y[n-1] + \beta x[n] + \gamma x[n-1]$$

Determine the numerical values of α, β and γ.

$\alpha =$	$\beta =$	$\gamma =$

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION

Suppose that two filters are cascaded. The system functions are

$$H_1(z) = \frac{3}{1 - \frac{1}{2}z^{-1}} \qquad \text{and} \qquad H_2(z) = 2 + z^{-1} - z^{-2}$$

(a) Determine the poles and zeros[4] of $H_1(z)$

POLES =	$1/2$
ZEROS =	0

$$H_1(z) = \frac{3z}{z - 1/2}$$

(b) Determine the poles and zeros of $H_2(z)$

POLES =	$0, 0$
ZEROS =	$-1, 1/2$

$$H_2(z) = \frac{2z^2 + z - 1}{z^2}$$

$$= \frac{(2z-1)(z+1)}{z^2}$$

(c) The cascaded system can be combined into one overall system and then described by a single difference equation of the form:

$$y[n] = \alpha y[n-1] + \beta x[n] + \gamma x[n-1]$$

Determine the numerical values of α, β and γ.

$\alpha = 0$	$\beta = 6$	$\gamma = 6$

Cascade: $H_{ov}(z) = H_1(z)\, H_2(z)$

$$= \frac{3z}{z - 1/2} \cdot \frac{(2z-1)(z+1)}{z^2}$$

$$= \frac{6(z+1)}{z} = \underset{\substack{\uparrow \\ b_0}}{6} + \underset{\substack{\uparrow \\ b_1}}{6}z^{-1}$$

[4]If necessary, include poles and zeros at $z = 0$ and at $z = \infty$, and indicate repeated poles or zeros.

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