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MAS.160 / MAS.510 / MAS.511 Signals, Systems and Information for Media Technology  
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MAS160: Signals, Systems & Information for Media Technology

Problem Set 7

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**Problem 1:  $z$ -Transforms, Poles, and Zeros**

Determine the  $z$ -transforms of the following signals. Sketch the corresponding pole-zero patterns.

- (a)  $x[n] = \delta[n - 5]$
- (b)  $x[n] = nu[n]$
- (c)  $x[n] = \left(-\frac{1}{3}\right)^n u[n]$
- (d)  $x[n] = (a^n + a^{-n})u[n]$ ,  $a$  real
- (e)  $x[n] = (na^n \cos \omega_0 n)u[n]$ ,  $a$  real
- (f)  $x[n] = \left(\frac{1}{2}\right)^n (u[n - 1] - u[n - 10])$

**Problem 2:  $z$ -Transform Properties**

Given  $x[n]$  below, use the properties of the  $z$ -transform to derive the transform of the following signals.

$$x[n] \rightarrow X(z) = \frac{z^{-1}}{(1 - z^{-1})^2}$$

- (a)  $x[n - 3]$
- (b)  $x[n] * \delta[n - 3]$
- (c)  $x[n] - x[n - 1]$
- (d)  $x[n] * (\delta[n] - \delta[n - 1])$
- (e)  $5x[n - 1] + 4\left(-\frac{1}{3}\right)^n u[n]$

**Problem 3: Relating pole-zero plots to frequency- and impulse-response**

- (a) *DSP First* 8.16
- (b) *DSP First* 8.17

**Problem 4: *DSP First* Lab 10**

Items to be turned in:

- (a) Answers to questions from C.10.4.
- (b) Answers to questions from C.10.5.
- (c) Plots and answers to questions from C.10.6.