FINAL EXAM **K58DA**

DIGITAL SIGNAL PROCESSING

(90 minutes)

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Prob. 1 (15%)

A digital filter is designed using direct substitution to approximate an analog filter with poles at s $= -10$ and $s = -5 \pm j8$ and a zero at $s = 0$. If the sampling rate is 20 Hz, where are the digital filter's poles and zeros in the z plane? (Numerical locations.)

Prob. 2 (15%)

A first-order lowpass analog Butterworth filter with a corner frequency of 200 Hz is approximated by a digital filter using the bilinear technique. The sampling rate is 2000 samples/second. Where are the poles and zeros of the digital filter in the z plane?

Prob. 3 (15%)

Of the three window types, Rectangular, von Hann and Blackman, if they are all used to design the same type of digital FIR filter with the same number of samples in the impulse response
(a) Which one yields the narrowest transition from passband to stopband?
(b) Which one yields the greatest stopband attenuation?

Prob. 4 (30%)

Describe the digital filter implementation of the transfer function

$$H(z) = \frac{16z^2(z+1)}{(4z^2 - 2z + 1)(4z + 3)}$$

using:
(a) (20%) A cascade realization (Each section of the decomposed transfer function is implemented using the Type 1canonic direct-form structure)
(b) (10%) A parallel realization (Each section of the decomposed transfer function is implemented using the Type 1 canonic direct-form structure)

Prob. 5 (35%)

We want to design a Low Pass FIR Filter with the following characteristics:
Passband 10kHz,
Stopband 11kHz, with attenuation of 50dB,
Sampling frequency 44kHz
Determine the causal impulse response h(n) , and an expression for the phase within the passband.

Note: Students allowed to use printed books