EEL 731 MAJOR EXAMINATION/SCDR

07-05-07/10:30-12:30/IILT1/Full marks = 100

Q. 1 Realize the transfer function

$$H_5(z) = 1 + a_1 z^{-1} + a_2 z^{-2} + a_2 z^{3} + a_1 z^{-4} + z^{-5}$$

by an FIR lattice structure. [15 marks]

Q. 2 Realize the transfer function

$$H_4(z) = (z^{-1} + z^{-2}) / [1 + (1/2) z^{-1}]^4$$

by a canonical IIR lattice structure. [25 marks]

Q. 3 Determine the conditions for the polynomial

$$D_4(z) = 1 + a_2 z^{-2} + a_4 z^{-4}$$

to qualify for the denominator of a stable transfer function. [10 marks]

Q. 4 The system having the transfer function

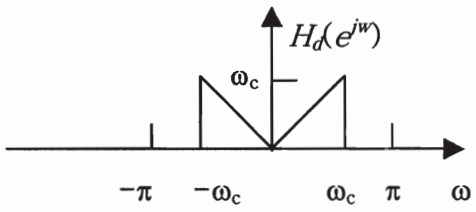
$$H(z) = N(z) / (1 - 3z^{-1} + 1.5z^{-2})$$

has the following impulse response :

$$h(n) = \{3.2, 5.6, 7.0, 12.6, 27.3, \ldots\ldots\}.$$

Find $N(z)$. [10 marks]

Q. 5 Determine an expression for the impulse response $h_d(n)$ of the zero-phase transfer function $H_d(e^{jw})$ sketched below. Find $h_d(0)$ and show that $h_d(n) = h_d(-n)$. How would you approximate this transfer function by a realizable FIR filter of odd length N, using the simplest possible window ? [20 marks]



Q. 6 Consider the transfer function

$$H(z) = (1/2)[1 + A(z)] = N(z) / D(z)$$

(a) If $A(z)$ is an all-pass filter of the N-th order, what can you say about the properties of $N(z)$?

(b) If $N = 1$, what type of filter will $H(z)$ be ?

(c) If $N = 2$, what type of filter will $H(z)$ be ?

(d) If $A(z)$ is a cascade of two different second order all-pass filters, each of the form

$$A_i(z) = [a_i - b_i(1 + a_i) z^{-1} + z^{-2}] / [1 - b_i(1 + a_i) z^{-1} + a_i z^{-2}], i = 1,2$$

what type of filter will $H(z)$ be ?

(e) Realize $A_1(z)$ in part (d) by a lattice structure. [20 marks]