**Mid-Term Test#2**

**Analog/IC Filter Design (ELEC 6081)**

Electrical and Computer Engineering Department

Concordia University

April 1, 2009

Instructor: Dr. R. Raut Time: 60 minutes

**Q.1 :**



Figure 1:

The figure above shows a second order switched capacitor filter using parasitic insensitive switched capacitor integrators. Find an expression for the Z-domain transfer function . *You can assume that the sample-and-hold property holds for the signals Vi , and V1* i.e.,  etc.,.

**Q.2:** The schematic below represents a normalized low-pass CHEB filter of order 3 with equal terminating resistances.



Figure 2(a):

Produce an active RC design for the above ladder filter with terminations, and a pass-band edge frequency of 1000 radians. Use *operational simulation* technique, according to the leap-frog interconnection as shown below (Fig.2(b)).



Figure 2(b):

In the above T1, T3 are the voltage transfer functions (VTF) associated with the series R,L segments and –T2 is the VTF associated with the shunt capacitance segment of the ladder filter.

Show your schematic and the designed element values clearly.

**Q.3:** Design, using OP-AMP or OTA, a second order notch filter which corresponds to a frequency normalized transfer function . The stop-band frequencies of the notch filter are: , and respectively. *Note that the pole frequency of the filter is same as the (geometric) center frequency .*

Show the components of your designed circuit, and the schematic clearly.