Abstract of the Thesis

The aim of this thesis is to explore both theoretically and experimentally different applications of the fractional-order analog circuits using in-house developed PMMA coated fractional capacitors. Certain aspects such as realizations and performance studies of fractional-order filters, and fractional-order phase-locked loop have been taken up for investigation. The noise model of a fractional capacitor has also been developed.

The design, realization and performance studies of continuous- time fractional-order Kerwin-Huelsman-Newcomb (KHN) biquad filters is first studied in this thesis. The frequency responses of the filters, obtained experimentally, have been compared with simulated results. It has been observed that fractional-order filters can give better performance in certain aspects compared to integer order filters. Further, a generalized approach to design a high `Q' fractional-order bandpass filter using fractional inductor and fractional capacitor (FC) is also explored. It has been carried out by realizing a fractional inductor of order more than one using a General Impedance Converter (GIC). Sharper cut-off characteristics compared to an integer order bandpass filter can be achieved using a fractional-order R-L_{α}-C_{β} bandpass filter. The performance of fractional-order band pass filter has been studied and compared with an integer-order one through both simulation and experimentation.

An analog fractional-order Phase-Locked Loop (FPLL) configuration has been proposed using a fractional-order loop filter. The expressions for bandwidth, capture range and lock range of the FPLL have been derived analytically and then compared with the experimental observations using LM565 IC. It has been observed that bandwidth and capture range can be extended by using FPLL. Finally, the noise model of a fractional capacitor has been proposed and using this model, the noise performance of fractionalorder filter circuits have been studied.