CHAPTER 7

CONCLUSION AND SCOPE FOR FUTURE WORK

The key driving factor for the study and realization of novel active filter circuits is their wide applications in different areas such as communication, control, consumer electronics, medical electronics, industrial electronics, etc. These circuits are mainly realized by current mode devices due to their low power consumption, higher bandwidth and better signal linearity.

In this thesis, some such novel active devices used for filter realization have been discussed. Several novel circuits including biquad, waveform generator and elliptical filter have been simulated using PSPICE and a representation of them are realized in the laboratory by employing commercially available integrated circuits such as LM741 (Op-Amp), LM13700 (Operational Transconductance Amplifier) and AD844 (Operational Trans-impedance Amplifier). There is good match between the theoretical, practical and simulation results for all circuits.

Chapter 1 of the thesis is devoted to introductory overview and development of the active devices. The performance of some newly proposed circuits using novel active elements have been discussed in subsequent chapters. The performance analysis of novel active circuit realizations in terms of cut off/centre frequency, bandwidth/quality factor, sensitivity to parameter variations, numbers of passive components and their spread are discussed in the following section. The scope for further work has been given in the Section 7.2.

7.1 PERFORMANCE ANALYSIS OF PROPOSED CIRCUITS

Chapter 2

To take the advantage of voltage mode and current mode behavior, transadmittance filter circuit is used. These filters have high input impedance and high output impedance.

In this chapter, two transconductance circuits of 1st and 2nd order are proposed by employing a single Op-Amp. Normally one filter circuit offers only one type of filter response. But both these circuits offer two filter responses simultaneously. First circuit offers low pass and high
pass response whereas second circuit offers band pass and high pass response. The parameter sensitivity of the cutoff frequency and the quality factor with respect to variation in passive components and open loop gain are low. These circuits offer low Q and thus can be used at input stage of broad band amplifier.

Subsequently a voltage controlled Square/ Triangular / Sinusoidal waveform generator is proposed using three OTAs. This circuit can also give square, triangular and sinusoidal waveforms simultaneously. The oscillation frequency is proportional to the control voltage over a decade of frequency range for the above circuit.

Later 7th order doubly terminated elliptical filter has been realized using OTA. Response of the circuit matches with passive LC circuit. It has many application such as video signal processing, biomedical signal processing etc. The circuit has less sensitivity to parameter variations and lower passive component spread.

Chapter 3

Application of single output amplifier devices are limited on account of associated noise and lower output swing. To overcome these limitations a Sallen-Key based filter is realized using FDDA. The proposed circuit offers high input impedance, low output impedance, higher voltage swing, high CMRR and less susceptibility to even order harmonics. The quality factor of the realized filters can be controlled by the gain of the amplifier. It can be used for low noise amplifier and filters. The proposed circuit cannot be used for very high frequency range due to limited gain-bandwidth product.

Chapter 4

The high input impedance and simultaneous multiple filter responses have always been attracting the analogue circuit designers. Two very similar types of filter circuits have been proposed, both realizes two filter responses simultaneously by employing two Four Terminal Floating Nullor (FTFN), two resistors and two capacitors. The first filter realizes highpass and bandpass responses, whereas second circuit realizes bandpass and lowpass filter responses. The proposed filter circuit offers linear phase response which is required for video signal processing. Commercially discrete FTFN is not available; it can be realized by using 2 ICs of AD844.
Chapter 5

Current Conveyors are widely used for the realization of filters, oscillators impedance convertors, impedance invertors and gyrators.

Two multifunctional filter circuits, employing current conveyors, have been proposed in this chapter. The first multifunctional filter circuit realizes low-pass, high-pass, band-pass filter with minimum number of active and passive components, as compared to the existing circuits made with the current conveyor and reported in the literature. All the capacitors in this circuit are connected to the ground. This makes implementation of the circuit in the monolithic form easier. The proposed circuit offers low sensitivity to active and passive components and orthogonality between the cutoff/central frequency and the quality factor as well.

The second proposed circuit enhances the features of the above circuit. It has on-chip tunability while retaining other advantages of the first circuit, that is, low sensitivity and the orthogonality between the cutoff/central frequency and the quality factor. The second circuit employs two current conveyors, one OTA and five passive components. This circuit is ideal for monolithic integration as one terminal of all the capacitors is grounded.

Chapter -6

The limitation of less number of high impedance input terminals of current conveyor is removed by Differential Difference Current Conveyor (DDCC) and Dual-X Differential Difference Current Conveyor (DX-DDCC).

A second order shelving equalizer is realized using one DDCC and two resistances and two capacitances. With a matching constraint this circuit can act as notch filter.

A universal filter using newly developed active device DX-DDCC is presented. The proposed universal filter employs minimum number of passive components, that is, only two capacitors. Grounded capacitor and absence of resistance makes this circuit very suitable for integrated circuits realization. This circuit also provides an on-chip tunability. It also offers orthogonality between the cutoff and quality factor with low sensitivity to parameter variations.
7.2 SCOPE FOR FURTHER WORK

Further work can be done in the following areas:

(i) Study of the effects of stray capacitors and temperature dependence of the devices

(ii) Some other topologies such as Multi Feedback, Tow-Thomas can be studied for the realization of high Q filters using the proposed active devices.

(iii) Design various tunable multifunction filters and oscillator circuits using Current Difference Transconductance Amplifier (CDTA), a newly developed versatile current mode device.