Hitendra Sahu / Prof. P. C. Pandey (Supervisor), “Sensing of impedance cardiogram using synchronous demodulation”, *M. Tech. dissertation*, Biomedical Engineering Group, Department of Biosciences and Bioengineering, Indian Institute of Technology Bombay, June 2013.

ABSTRACT

Impedance cardiography is a noninvasive technique that measures variation in the thoracic impedance and relates it to the volumetric changes in the thorax during the cardiac cycle and can be used to estimate hemodynamic parameters like stroke volume and cardiac output. An impedance cardiograph consists of an alternating current source of high frequency and low amplitude, an amplifier to sense the resulting amplitude modulated voltage, a demodulator to detect the impedance signal, a baseline correction circuit, and an ECG extractor for reference purpose. Project objective is to develop a system for sensing the basal value and time-varying component of the impedance waveform, with settable excitation frequency and with very low noise and demodulation related distortions. In the present design, a microcontroller and an impedance converter chip are used for stable sinusoidal source with programmable frequency control and a digital synchronous demodulation. For current excitation, a voltage-to-current converter with balanced outputs is designed using two operational transconductance amplifiers. The sensed voltage is added with a sinusoidal voltage obtained from the excitation source and with digitally controlled amplitude and polarity to increase its modulation index before digital synchronous demodulation and for baseline correction of the sensed impedance signal. Two digital potentiometers have been used to provide independent control over current excitation and baseline correction. Synchronous digital demodulation in the impedance converter chip gives real and imaginary part of the impedance. An isolated RS232 interface along with a PC-based graphical user interface is provided to set the parameters and to acquire the sensed impedance signal.