Vikas Marla / Prof. P. C. Pandey (Supervisor), "A Bioimpedance simulator," *M.Tech. Dissertation*, Department of Electrical Engineering, Indian Institute of Technology Bombay, July 2018.

## ABSTRACT

Impedance cardiography is a non-invasive technique involving measurement of the impedance of the thorax region for assessing the stroke volume and some other cardiovascular parameters which may be useful in diagnosis of cardiac disorders. A bioimpedance simulator is required to assess the impedance cardiograph instruments and also other bioimpedance measuring instruments. A bioimpedance simulator is developed to provide continuous time-varying impedance with adjustable basal impedance to imitate the thorax impedance. It consists of four blocks: a time varying impedance circuit and basal impedance circuit connected in parallel, controller circuit, wireless serial interface, and power circuit. A precision linear floating voltage-controlled resistor (VCR) is realized using a circuit with a matched pair of MOSFET devices, with independent substrates. The linear range of operation of MOSFET is extended by source drain (SD) bootstrapping of both gate and substrate terminals, and precise operation is achieved by self-tracking arrangement using an op amp. The time-varying impedance is simulated using the VCR. The adjustable basal impedance is simulated using resistor network and an analog multiplexer. The controller circuit is realized using a microcontroller with on-chip DAC and is serially connected to a Bluetooth module. The control waveforms to vary the resistance of the VCR are provided by the DAC of the microcontroller, and the controls to analog multiplexer to set the basal impedance are provided by IO port pins of the microcontroller. The parameters for the amplitude, frequency, waveforms of time-varying impedance, and basal impedance are set wirelessly through the Bluetooth module.