

## **ABSTRACT**

Over past few years, experimental findings have shown that there exists self-sustained background activity in the cortex of the brain even if the brain is not involved in any kind of task. The role of this activity is not understood till date and has become one of the interesting questions in the field of computational neuroscience. Such activity has been predicted to be a result of competition between excitatory and inhibitory synaptic inputs. In this thesis, we have studied the properties of a homogeneous network of excitatory and inhibitory leaky integrate-and-fire neurons. It was shown in a computational study that such activity can only arise in inhibition dominated regime. We have studied the mean population activity as a function of network parameters such as network size, sparsity, the strength of excitation, the relative strength of inhibition to excitation, refractory period, membrane time constant and synaptic time constant. We confirmed the existence of two types of asynchronous network states as reported in a recent paper. We also found splitting of the coefficient of variation distribution at the transition point that showed that beyond the transition point the neural population splits in two. The input-output characteristics of the network were studied in response to various types of input pulses. We observed that before the transition point the network efficiently transmits the signal and beyond the transition point it transforms the input which was also reported in a study.