Biomedical Wireless Sensor Networks (BWSN) consists of wearable wireless sensor nodes mounted on the human body to monitor the health status. These nodes are mobile in nature and are dynamically reconfigurable with no fixed infrastructure. This network can have a layered architecture or cluster based architecture. The BWSN is developed with cluster based architecture, in which the information from a cluster is collected by the cluster head and is send to the destination remote monitoring station through multiple hops. The sensor node in the human body is also called a aggregation sensor node or unit which is connected with various sensors such as EEG sensor, ECG sensor, blood pressure sensor and motion sensor. The aggregation sensor unit collects all the information from the sensors and processes it. When any of these physiological parameters is not in the normal range, then this information has to be sent to the remote monitoring station. All the nodes in the BWSN are operated on battery power. Thus each node should consume less energy to maximize the lifetime of the network. Hence the packet has to be communicated through an optimized path from the aggregation sensor node to the destination monitoring station.

The thesis explores three cluster based routing protocols used in Wireless Sensor Network (WSN) applications such as Low Energy Adaptive Clustering Hierarchy (LEACH), LEACH-C and LEACH-M. A detailed study on these protocols is made and compared its features. In order to further improve the performance of routing protocol LEACH, optimization techniques are added. The optimization techniques find optimized path in BWSN to route the packet from the aggregation sensor node to the destination monitoring station. First the system was designed with a GA-based
optimization approach and the results are compared with LEACH, LEACH-C and LEACH-M. For evaluation, metrics like packet delivery ratio, end-to-end delay, and routing power consumption are analyzed. From the analysis it is observed that the GA-based LEACH protocol is better than the other protocols LEACH, LEACH-C and LEACH-M. Again the system was designed with PSO-based LEACH protocol and its performance is compared with LEACH, LEACH-C and LEACH-M. Simulation analysis shows that the PSO-based LEACH method is better than the other protocols LEACH, LEACH-C and LEACH-M.

Finally the system was designed with Extended Q-Learning (EQ-L) algorithm which uses less computation than the normal Q-Learning algorithm. The performance of EQ-L algorithm is compared with both GA-based LEACH protocol and PSO-based LEACH protocol. Results shows that the EQ-L based technique needs less end-to-end delay, and less routing power consumption to route the packets from the aggregation node to the destination monitoring station. Analysis has been made with the metrics namely, packet delivery ratio, end-to-end delay and routing power consumption with varying the node mobility. The scenario was simulated with various mobility models such as Random Walk mobility model, Random Waypoint mobility model, Random Direction mobility model, City Selection mobility model, Freeway mobility model and Manhattan mobility model respectively. For all the approaches the random walk mobility model gives better performance than the other mobility models. The maximum average packet delivery ratio is about 96 percent for 0 m/s mobility and the minimum average packet delivery ratio is about 73 percent for 2 m/s mobility. Also the average routing power consumption of EQ-L based approach is 3 to 4 percent less than the GA-based LEACH and PSO-based LEACH.