Abstract: The design and development of wearable biosensor systems for health and wellness monitoring has garnered lots of attention in the scientific community and the industry during the past decade. When it comes to health and wellness monitoring, accurate measurements, analysis and estimations would be vital. One major challenge in achieving a high performance wearable health monitoring system is motion and noise artifacts. This consideration was the basis for this dissertation. This study presents different algorithms and signal processing techniques to address motion and noise artifact detection and vital signal reconstruction from electrocardiogram/photoplethysmogram recordings. Five vital signals including ECG, PPG, Heart Rate, HRV and SpO2 are in the scope of the present dissertation. Accurate estimation of Heart Rates and Oxygen Saturation from photoplethysmogram (PPG) and Heart Rate from electrocardiogram (ECG) signals during daily physical activity is a very challenging problem. On the other hand motion and noise artifact in PPG and ECG recordings introduce challenges in early detection of heart failure diseases including Atrial Fibrillation and congestive heart failure. We address the problem of motion and noise artifact in three categories (1) “Motion and Noise Corrupted Data Removal, and (2) “MA Corrupted Signal Usability Index Measurement” and (3) “Motion and Noise Corrupted Data Reconstruction”. Nine novel signal processing techniques (TDV, RepMA, RAFMA, IMAR, DyParaM, TifMA, OxiMA, SpaMa and SegMA) are introduced in this study to cope with the motion and noise artifact in PPG and ECG based wearable sensors. Out of nine methods, three methods belong to the first category, one from the second and four vital signal reconstruction techniques for the third problem. It will be shown that the proposed techniques are able to meet major aims of this study and to address the problem of motion and noise artifacts corresponding to each of the three scenarios. The results show that the algorithms presented in this study have potential for PPG or ECG based HR or SpO2 monitoring in wearable devices for fitness tracking and health monitoring during daily physical activities.