Clustering is an essential subject in unsupervised learning. It is a common technique used in many fields, including machine learning, statistics, bioinformatics, and computer graphics. Classifying samples into homogeneous groups is based on different criterions. In this thesis, we focus on the clusters that are characterized by the different parameters (i.e., means and covariances), and we study the clustering method for the high dimensional mixture data. According to this setting, we propose two new methods, Covariance clustering method and Two-step method. Also, we investigate and develop the Mean clustering method from both theoretical and practical aspects by random matrix theory.