Inventory is any kind of resource having economic value and is maintained to fulfill the present and future needs of an organization. The inventory systems, under study, are described mathematically, from which operating rules for controlling the inventory systems can be developed. In this thesis, various inventory models under periodic review and continuous review are developed for single item in which the demand may be deterministic or stochastic. In the deterministic models, demand is considered as a constant or time dependent or stock dependent or stock and time dependent. A periodic review stochastic inventory model in which the demand depends on stock, time and selling price is developed. In some stochastic models the probability distribution of demand is considered to be unknown. Distribution free procedure is applied in such models. Permissible delay in payments is the backbone of any business. The delay in payment of the retailer is a kind of price discount since paying later indirectly reduces the purchase cost. This concept is proposed in most of the inventory models in this treatise. Good items, deteriorating items, differential items with or without shortages are considered in the proposed inventory models. In the developed models lead time, setup cost and yield variability are reduced through additional capital investments by which the significant savings can be achieved. The benefits are made known through numerical examples. Two stage supply chain systems are also developed and it is shown that the efficiency of a supply chain depends on active cooperation and close coordination between the vendor and the buyer. Algorithms are developed to optimize total inventory cost or profit. Each model is elucidated with numerical examples.