    In this thesis, we investigated a nonlinear mathematical model for the purpose of describing the dynamic behavior of beta cell kinetics and a glucose-insulin feedback system. We applied the singular perturbation method to our model, whereby explicit conditions were derived which identify different dynamic behaviors and showed the existence of limit cycles which agrees with oscillatory behavior frequently observed in clinical data. We then extended the model to incorporate the periodic intake of glucose. Numerical investigation was carried out to identify the ranges of parametric values for which chaotic behavior could be expected in our model system.