Introduction

It is commonly accepted that differential equations are useful in describing and solving many real life problems. A numerical analysis of the system of six coupled nonlinear Ordinary Differential Equations (ODEs) which are aroused in the reduction of stratified Boussinesq Equation has been undertaken. This chapter aims to introduce the several classes of differential equations, which occur rather frequently in the study of stratified Boussinesq equations. It may be noted that the Boussinesq approximation in literature is also referred to as Oberbeck-Boussinesq approximation for which, a reference can be made to an interesting article
by Rajagopal et. al. [31] providing a rigorous mathematical justification as perturbances of the Navier-Stokes equations. In their study of instability in stratified fluid with large Richardson number, Majda and Shefter [27] analyzed certain systems of ODEs reduction of governing Stratified Boussinesq Equations.

In chapter 2, the historical background, definitions and some relations that were of great concern to the study of Stratified Boussinesq Equations have been discussed. This chapter has been made self contained through defining the elementary concepts such as reduction of system of coupled nonlinear ODEs.

In chapter 3, the initial surface satisfying four first integrals have been evaluated. The C-program is given for evaluating the initial surface. Also, the numerical solutions of coupled system of nonlinear ODEs by Modified Euler Method (MEM) [12, 25] is obtained. The accuracy of the solution and the error in $\theta$ and $\phi$ is calculated. The convergence of MEM [4] is also considered. C-programming is used for calculations and MATLAB R2010a is used for plotting the graphs.

In chapter 4, the numerical solution of system of coupled nonlinear ODEs by Runge-Kutta(RK) fourth order method [11, 12] is obtained. Also the exact solutions and numerical solutions are compared. The error in results obtained by Runge-Kutta fourth order method for $\phi$ and $10^{-14}$ for $\theta$ is found. The convergence of Runge-Kutta fourth order method [4] is also considered. C-programming is used for calculations and MATLAB R2010a is used for plotting the graphs.
In chapter 5, the Adomian Decomposition Method (ADM) [3] is used for obtaining the solution of system of six coupled nonlinear ODEs. This method is implemented using the software MATHEMATICA 9. The error in numerical solution is calculated. The convergence of ADM [1, 2, 22] is also considered. ADM is a hybrid method which gives solution in the form of series. Using the initial conditions, the results with refinement of interval are calculated.

In chapter 6, the results obtained by MEM, RK fourth order method and ADM are compared. The accuracy of solutions obtained by all methods is observed, in addition to this, the critical interval for the value of transition of solutions from one manifold to another manifold have been investigated.

In chapter 7, we have concluded and summarized all the results which are investigated during this study of numerical solution of system of six coupled nonlinear ODEs.