English SUMMARY

In this thesis we study some nonlinear models in plasma physics and its applications. We obtained exact solutions for some important equations which describe physical models and we obtained related physical quantities. This thesis consists of an introduction, five chapters, 54 figures and a list of references at the end of each chapter, together with english and arabic summary. This thesis is organized as follow:

Introduction.

In this introduction we give quick hint for the importance of Magnetohydrodynamics (MHD) and plasma and its applications.

Chapter 1.

Which considered as a background for the material used in this thesis it cover the fundamental concepts of known results concerning our objects to make this thesis somewhat self contained.

Chapter 2.

We have investigated isothermal magneto-static (MS) atmospheric Models. The equations of magnetohydrostatic equilibria for a plasma in a gravitational field are investigated analytically. For equilibria with one ignorable spatial coordinate, the equations reduce to a single nonlinear elliptic equation for the magnetic potential A, known as the Grad-Shafranov equation. Specifying the arbitrary functions in the latter equation, one gets the nonlinear elliptic equation. Analytical nonlinear periodic solutions of the elliptic equation are obtained for the case of a nonlinear isothermal

atmosphere in a uniform gravitational field. In this chapter we obtained several classes of exact traveling wave solutions of some nonlinear equations using the generalized tanh and Jacobi elliptic function methods, also Bäcklund transformations (BTs) are used to generate new classes of solutions. The final results are used to investigate some models in solar physics.

Note: The results in this chapter obtained using generalized tanh method are published in International Association of Geomagnetism and Aeronomy[1]. The results in this chapter obtained using Bäcklund transformations are published in International Congress on Computational and Applied Mathematics[2] and then submitted to Journal of Computational and Applied Mathematics[3].

Chapter 3.

In this chapter we find exact solutions of two-dimensional force-free magnetic fields (FFMFs), the FFMF is a type of field which arises as a special case from the MS equation in plasmas. This special case arises when the plasma pressure is so small, relative to the magnetic pressure, that the plasma pressure may be ignored, and so only the magnetic pressure is considered. The name "force-free" comes from being able to neglect the force from the plasma. We find exact solution of two-dimensional FFMF described by Liouville, sine, double sine, sinh-poission and power force-free magnetic equations. By finding the exact solutions of these equations by using the generalized tanh, Jacobi elliptic function and G'/G-expansion methods. In all those cases the ratio of the current density and the magnetic field is not constant as happens e.g. in the solar atmosphere.

Note: The results in this chapter obtained using generalized tanh method are published in Physics of Plasmas[4]. The results in this chapter obtained using

Jacobi elliptic function method submitted to Plasma Physics and Controlled Fusion[5].

Chapter 4.

We discussed the derivation of Sagdeev potential, as a results of which, could be analyzed to predict the existence of various features of localized solitons in various configurations of plasmas. The advantages of the method in finding the solitary waves or double layers stemming from the nonlinear waves was found useful in investigating the large and small amplitude wave propagation. The study advances to describe the spiky and explosive solitary waves along with the possible existence of double layers causeway from the interaction of trapped electrons which are to be expected as common features in space plasmas. Moreover we find exact wave solution of the Korteweg-de Vries (KdV) equation, the KdV equation derived with mixed nonlinearity, the equation in general form and generalized Schamel equation by using generalized tanh and Jacobi elliptic function methods.

Chapter 5.

we discussed the nonlinear development of ion-acoustic waves in a magnetized plasma under the restrictions of small wave amplitude, weak dispersion, and strong magnetic fields is described by the Zakharov–Kuznetsov (ZK) equation. Kadomtsev-Petviashvili (KP) equation is derived for unmagnetized hot dust plasmas. It suggests that the nonlinear dust acoustic solitary waves in a hot dusty plasma are stable even there are some higher order transverse perturbations. Moreover we find exact wave solution of the ZK, generalized ZK, generalized form of modified ZK, KP, potential KP and Gardner Kadomtsov –Petviashivilli (GKP) equations by using generalized tanh and Jacobi elliptic function methods.