ABSTRACT

In this thesis we discuss non-linear effects in multi-component plasmas. By multi-component we mean electron-ion, electron-positron-ion, and dust-electron-ion etc. type plasmas. Different types of solitary waves and soliton, are the main focus in this work. A soliton is a solitary wave with constant profile that preserves its shape during collisions. First of all we consider magnetosonic soliton propagating obliquely at an angle 9 to an external magnetic field in Electron-Positron-Ion plasma, using the effective one fluid MHD model. Two separates modes (fast and slow) for the waves are discussed in the linear approximation and the Kadomstev-Petviashvilli (KP) equation is derived by using the reductive perturbation scheme for these modes in the nonlinear regime. The KP equation is the two dimensional analogy of the KdV equation and it admits solitary wave solution. We also obtain a nonlinear dispersion relation that relates the nonlinear wave number with different parameters. It is observed that for both the modes the angle 9, positron concentration, ion temperature, and plasma 13-value affect the propagation properties of solitary waves and are from those of the simple Electron-Ion plasmas. Like wise current density, electric field and magnetic field for these solitons are investigated, for their dependence on the above- mentioned parameters.

Ion Acoustic wave (lAW) is a low frequency electrostatic wave, which is supported by the ion inertia in plasma physics. The lighter particles (e.g. electrons or positrons) play the role of restoring force to this wave. Due to the compressions and rarefaction of ion number density these low frequency waves propagate in plasma. In the third chapter we investigate the linear and nonlinear properties of the JAW, propagating obliquely to an external magnetic field in weakly relativistic, rotating magneto Electron-Positron-Jon plasrnas. The Zakharov-Kuznetsov equation is derived by employing again the reductive perturbation technique for this wave in the small amplitude nonlinear regime. This equation admits solitary wave solution. The amplitude and width of this solitary wave have been discussed with effects of obliqueness, relativity, ion temperature, positron concentration, magnetic field and rotation of the plasma and observed that for JAW these parameters affect the propagation properties of solitary waves and behave differently from the simple Electron-Ion plasmas.

Most often, the velocity distribution function of particles in space plasmas has a non-Maxwellian superthermal tail. The distribution function decreases generally as a power law of the velocity instead of an exponential decrease associated with a Maxwellian distribution. A useful distribution to model plasma containing suprathermal and superthermal particles is the generalized Lorentzian, or kappa, distribution function. The kappa distribution indeed possesses the desired property that particles with velocities greater than the thermal velocity obey a power law distribution. Another Non-maxweliain distribution named (rq) distribution, which is a generalized version of the Lorentzian (kappa) distribution, and gives better fits to real space plasma, has been introduced. In the third problem (4th chapter) we discuss the basic properties of generalized (r,q) distribution function and then using this distribution, we consider particle (electron) trapping in wave electrostatic potential well. The effect of particle trapping on the linear and nonlinear evolution of an ion acoustic wave in electron-ion plasmas has been discussed. The spectral indices q and r represent the high-energy tails, flatness or pointedness on top of the distribution function respectively. The generalized KdV

equations with associated solitary wave solutions for different ranges of parameter r are derived by employing a perturbation technique. It is shown that spectral indices r and q affect the trapping of electrons and subsequently the dynamics of ion acoustic solitary wave significantly.

Dusty plasmas (plasmas containing charged dust grains of micron to sub- micron Size) occur in a wide variety of space and laboratory environments. Dust- acoustic wave on a very slow time scale of dust dynamics emerges as a result of the balance between dust grain inertia and plasma pressure. In the fifth chapter we examine the characteristics of obliquely propagating Dust Acoustic Waves (DAW) in positively charged, rotating and magnetized dusty plasma, apply the results to the day side tropical mesosphere by incorporating adiabatic dust charge fluctuation. The nonlinear evolution equation here is the Korteweg-de Vries (KdV) equation that is derived by employing the reductive perturbation technique. This KdV equation may support nonlinear DAWs on a very slow time scale. The meteoritic dust in mesospheric plasma on day side is charged positively due to plasma currents and photo and thermionic emissions. The sum of Lorentz force frequency and rotational frequency give the effective gyro-frequency. The dynamics of DAW with effect of electronic, ionic, thermionic and photoelectric currents along with obliqueness and effective gyro frequency are studied. It is observed that obliqueness 8 and effective gyrofrequency modif5’ the width, in inverse proportion. Also the amplitude of dust acoustic soliton modifies directly and width modifies inversely with positively dust charge variation for this model.