STATEMENT

In this thesis, the author has made a theoretical study of some finite amplitude low frequency long wave-length modes in dispersive and dissipative media together with a critical examination of certain beam induced collective oscillations with an emphasis on heating the plasmas. The work presented can, therefore, be broadly divided into two parts. The first part (Chapter II - V) is devoted to studying the propagation of nonlinear ion acoustic waves in collisionless plasmas and nonlinear drift waves in collisional plasmas. The second part (Chapter VI - VII) consists of studying some collective interactions induced in a plasma either by an external electron beam or by a relative drift between the two species of the plasmas. A few introductory remarks and a brief summary of the results is presented in Chapter I.
Ion acoustic solitary wave result from an exact balance between nonlinearity and dispersion. When a relatively cold component of electrons is present in an otherwise hot plasma, the strength of dispersion for the system gets reduced. Hence, in such a system, the ion acoustic solitary wave has a larger amplitude for a given width compared to one in a plasma with single electron component. If the difference between the temperatures of the two components of electrons is sufficiently large the strength of dispersion is reduced to such an extent that a solitary solution is no longer possible (Chapter II). The strength of dispersion also changes from point to point if the plasma is inhomogeneous. Chapter V has been devoted to the study of propagation of an ion acoustic solitary wave in an inhomogeneous medium with both density and temperature inhomogeneity. For temperature gradient scalelengths much larger than the density gradient scalelengths, though the amplitude of the solitary wave is governed by the density gradients only, the velocity of the soliton increases as it propagates towards regions of increasing temperature.

Drift waves derive their importance from their causal relationship with enhanced particle losses observed in low-\(\beta\) plasmas. Moreover, the linear dispersion relation for the drift waves is similar to one for ion acoustic waves under certain circumstances. This motivated us to look for nonlinear steady state solutions for drift-waves.
in a collisional plasma. Chapter III and IV have been devoted to such studies. In general, it is found that, whenever the stabilizing ion viscosity effects are stronger than the destabilizing effects due to electron-ion collisions, there exists a stationary shock solution for the nonlinear drift waves.

Intense relativistic electron beams offer immense potentialities for heating a plasma to thermonuclear temperatures. Such a beam induces what is known as 'return current' as it enters a plasma. A new instability known as the 'return current instability' is supported by such induced currents. We have shown that, there exists a range of wavenumbers which is unstable only to return current instability and not to the usual electron-electron two stream instability. Moreover, an estimate has been made of the rate at which the return current looses energy as a result of decay of ion acoustic turbulence generated by such a current. This investigation is presented in Chapter VI.

In connection with the problem of plasma heating, the cross-field currents also play an important role, because of the anomalous resistivity they produce in a plasma. A number of electrostatic instabilities induced by such currents have been invoked as the basic mechanism for producing the observed anomalous resistivity. However, the plasma heating experiments with cross field currents often use a magnetic
mirror configuration for containing the plasma. The equilibrium distribution function for such a plasma is non-Maxwellian. In Chapter VII, we have studied the effects of loss-cone and temperature anisotropy in the electron distribution function on the cross-field current driven electrostatic instabilities. We have shown that non-Maxwellian plasmas can support fast growing waves even in regions of k-space which is stable to a Maxwellian plasma.
Lost on this planet
For an unknown cause
I was
happy
To have come to an End,
To be able to apprehend
The cause to live
To be with friends,
They need no name
No overtures, no claim,
They were always there
To share
My Utopia, my shame.
In return
My gesture is silent and mute
A feeling of deep gratitude.