The region of ionosphere and magnetosphere is heavily populated with a variety of whistler-mode waves such as whistlers, VLF/ELF emissions etc. and cold as well as hot (energetic) particles including those trapped in the earth's Van Allen radiation belts. Whistlers are originated from the dispersion of impulse radiations from lightning strokes while VLF/ELF emissions are believed to be generated from wave-particle interactions occurring within the region of ionosphere and magnetosphere itself. These waves travel through the ionosphere and magnetosphere from one hemisphere to the other almost along the geomagnetic field lines and interact with the energetic particles most probably in the equatorial region to produce other types of electromagnetic waves and cause pitch angle scattering and precipitation of energetic particles in the lower ionosphere. Unfortunately, these phenomena have not been used for the exploration of the low latitude ionosphere and magnetosphere so far because a proper and systematic study of these phenomena has not been made at low latitudes. Even a few problems related with the higher latitude phenomena have not been convincingly resolved. In this thesis, a theoretical study of these phenomena is made and the results are presented in five chapters. The first chapter, as usual, is of introductory nature and devoted to the critical survey of available literature on whistler-mode waves, energetic particle zones and wave-particle interaction and
precipitation phenomena at high, middle and low latitudes.

In chapter II, quiet-time and storm-time low latitude ELF magnetic field intensities are calculated under cyclotron resonance mechanism as a function of pitch angle, employing a realistic ionospheric model and using suitable plasma parameters. The results show that the intensity first increases with increasing pitch angle, attains a maximum value at a particular value of pitch angle and then decreases with increasing pitch angle further, approaching a zero value at 90°. The calculated intensities are found to be quite consistent with the observed intensities thereby showing that the cyclotron resonance instability mechanism is equally effective in the generation of both quiet-time and storm-time ELF emissions observed in the ground stations and aboard satellites at low latitudes.

In chapter III, a study of generation mechanism of higher latitude ELF emissions is made. The chapter is conveniently divided into two parts. In part I, detailed intensity calculations for ELF hiss emissions observed by geostationary satellite GEOS-2 in a detached plasma region of the magnetosphere are carried out. The results show that these detached plasma (DP) hiss emissions are generated under quasi-linear electron cyclotron resonance instability mechanism at $L = 6.6$ in the magnetospheric equatorial plane by energetic electrons of energy ~ 2 - 15 keV and are propagated down to the ionosphere in the ducted mode of propagation.
In part II, generation mechanism of plasmaspheric ELF hiss emissions observed aboard GEOS-1 satellite near the plasmapause in the equatorial region both at small and large wave normal angles is investigated by calculating their magnetic field intensities in both the Cerenkov and cyclotron resonance instability mechanisms. The results show that the intensities calculated in Cerenkov instability mechanism are 4 to 5 orders of magnitude lower than the observed intensities and therefore rule out the possibility of the generation of oblique wave normals in this mechanism. In contrast to this, the intensities calculated in cyclotron resonance instability mechanism are in good agreement with the observed intensities thereby showing that the plasmaspheric ELF hiss emissions observed aboard GEOS-1 satellite are originally generated by electron cyclotron resonance instability mechanism in the equatorial region near the inner edge of the plasmapause.

In chapter IV, a study on pitch angle diffusion measurement of resonant electrons is made. Following linear theory and adopting the well known Fokker-Planck expression for diffusion coefficient, expressions for limiting magnetic field intensity of wide-band whistler mode waves and diffusion parameter are derived. The diffusion parameter is theoretically shown to be equal to the ratio of the experimentally observed magnetic field intensity to the limiting intensity thereby justifying the
magnetic field intensity criterion of diffusion measurement assumed in this chapter. The results show that the strong diffusion is unlikely to occur at \( L \leq 4 \), while the results at \( 4.5 \leq L \leq 8 \) both inside and outside the plasmasphere favour strong diffusion without ruling out, however, the possibility of occasional occurrence of weak diffusion. The diffusion strength is found to increase with the increasing \( L \) values and the region of transition from weak to strong diffusion is found to lie at \( L \approx 4.5 \pm 0.25 \) which may shift towards lower \( L \) values during geomagnetically disturbed periods.

Chapter V, the last chapter, deals with a theoretical study of precipitation of low energy (eV and keV) electrons near the lower edge of inner radiation belt in terms of off-equatorial Landau resonance interaction between the energetic electrons and plasmaspheric ELF hiss of natural origin. The results show that off-equatorial Landau resonance acts on much lower energies than the first-order equatorial cyclotron resonance and satisfactorily explains the loss of low energy electrons from the inner radiation belt towards lower \( L \)-values. The results also indicate that the maximum energy and flux of precipitating electrons in this region by Landau resonance are \( \sim 200 \) keV and \( 10^{-3} \) times the trapped flux respectively which are consistent with the precipitating energetic electron spectrum in the SAMA region for keV electrons.