PREFACE

LIDAR is an acronym for light detection and ranging. It is the optical counterpart part of the familiar radar technique for remote sensing, which uses laser light and can be thought of as Laser Radar. A lidar system transmits a pulse of light into the atmosphere and analyzes the backscatter signal intensity as a function of time. Because the laser pulse travels at the speed of light, it is possible to convert time into range and consider the lidar signal to be backscattered intensity as a function of range. Lidar is one of the active remote sensing techniques of the environment. It has proven to be an essential tool to monitor the structure, composition and dynamics of the earth's atmosphere. Lidar has largely contributed to our knowledge of the Earth's atmosphere during the past decades. High spatial and temporal resolution of the measurements, the possibility of observing the atmosphere at ambient conditions, and the potential of covering the height range from the ground to more than 100 km altitude make up the attractiveness of lidar instruments. It is particularly useful for the investigation of highly variable atmospheric parameters. Simple elastic backscatter lidars have been used to investigate turbulent processes and the diurnal cycle of the planetary boundary layer. Polarization Lidar systems are used to distinguish water droplets from ice crystals in clouds. Rayleigh scatter lidars provide middle atmosphere temperatures and present long-term variability in the thermal structure. Resonance lidars probe the mesospheric region and
provide the winds driven metal layer densities. Raman lidars work on the principle of Raman Effect and provides an approach to the range resolved measurements of atmospheric trace species.

The thesis entitled "Development of LIDAR techniques for environmental remote sensing and mathematical analysis of atmospheric data" presents the realization of several lidar techniques and methods of analysis involved in the retrieval of environmental parameters such as (i) atmospheric boundary layer (ABL) height, (ii) Scattering and depolarization properties of high altitude clouds, (iii) altitude profiles of aerosol backscatter and extinction in the troposphere and stratosphere, (v) profiles of temperature in the lower and middle atmosphere, (vi) vertical profiles of mesospheric sodium density, and (iv) water vapor mixing ratio profiles in the lower atmosphere from the intensity profiles of lidar data using different lidar techniques. The thesis is organized in to six chapters. The first chapter provides a brief introduction to the atmosphere and basics of laser remote sensing applicable to the atmosphere.

Chapter two, three and four discuss the elastic backscatter lidar technique, namely Mie and Rayleigh scattering technique applied to the lower and middle atmosphere. Chapter five presents the resonance lidar technique applied to the upper atmosphere. The last chapter discusses the application of inelastic or Raman scattering technique to derive the molecular species concentration and their application to the atmosphere.