**PREFACE**

Infectious diseases are caused by infectious agents discharged by infective in the environment. Infectious agents include viruses, bacteria, fungi, protozoa etc. Transmission of infectious agent can occur in various ways including physical contact, contaminated food, body fluids, objects, airborne inhalation, or through vectors as in case of malaria. Hence, it is important to pay adequate attention to the study and control of infectious diseases such as TB, cholera, H1N1, flu etc. The spread of an infectious disease mainly depends upon the susceptible and the infective populations, the reservoir population and the mode of transmission.

In view of the above, we have modelled the spread and method of control of infectious diseases in the thesis. The thesis consists of eight chapters.

The first chapter provides the introduction regarding the dynamics of infectious diseases including a brief literature survey relevant to modelling of infectious diseases, so that the work done in the thesis can be seen in its proper perspective.

In chapter two, we study effects of vaccination of susceptible human population and isolation of severely infected individuals on the spread of an infectious disease using an SIS mathematical model. It is shown that the endemic equilibrium is locally and nonlinearly asymptotically stable under certain conditions. The nonlinear stability is also illustrated by computer simulation using MAPLE software. These results imply that the spread of infectious disease decreases as the rate of vaccination of susceptible human population or isolation of severely infected population increases. It is further noted from the analysis that an infectious disease becomes more endemic due to immigration.

In third chapter, we have proposed a model on the effect of isolation of severely infected individuals on the spread of carrier dependent infectious diseases by
considering explicitly an equation for carrier population density, dependent upon human population density. Here we have assumed that the density of carrier population follows a generalized logistic model. We also assume that the growth rate of carrier population increases as human population density increases. Here again an SIS model is proposed and analyzed analytically as well as by computer simulation. It is shown that the endemic equilibrium is locally and nonlinear asymptotically stable under certain conditions. It is shown that the infection decreases with the increase of complete isolation of severely infected human population. It is also found that the disease becomes endemic due to immigration.

In fourth chapter, a four dimensional nonlinear mathematical model is proposed and analyzed to see the effect of the cumulative density of infrastructure, which depends on human population, on the spread of infectious disease. Here also the SIS model is proposed and analyzed analytically as well as by simulation. It is shown that the endemic equilibrium is locally and nonlinear asymptotically stable under certain conditions. These results imply that the spread of infectious disease increases as the cumulative density of infrastructure increases.

In chapter five, a model, same as in chapter four is proposed and analyzed to see the effect of general infrastructure of a city, where growth of infrastructure depends on human population density partially, on the spread of carrier dependent infectious diseases. The SIS model with immigration is proposed and analyzed analytically as well as by simulation. It is shown that the endemic equilibrium is locally and nonlinear asymptotically stable under certain conditions. These results imply that the spread of infectious disease increases as the cumulative density of infrastructure increases. It is also found that the disease becomes more endemic due to immigration.
In chapter six, a nonlinear mathematical model is considered to study the effect of cumulative density of ecological factors on the spread of infectious disease. Similar consideration as in chapter five have been made in the modeling process by including an equation which governs the cumulative density of ecological factors in place of the equation for infrastructure. The SIS model has been proposed and analyzed both analytically and by computer simulation. In each case, the condition for existence of endemic equilibrium is locally and nonlinearly asymptotically stable under certain conditions. It is shown that as the cumulative density of ecological factors increases, the spread of disease increases. It has also been shown that due to immigration the disease becomes more endemic.

In chapter seven, a nonlinear mathematical model is proposed and analyzed to study effects of cumulative density of ecological factors on the spread of malaria. Here also an SIS model has proposed and analyzed. The conditions for existence of endemic equilibrium point have been obtained and it has been shown that under certain condition, this equilibrium is locally and nonlinearly asymptotically stable. It has been shown that as the cumulative density of mosquito population increases, the spread of malaria increases. It has been also found that the disease becomes more endemic due to immigration.

Lastly, in chapter eight, a non-linear mathematical model has been proposed and analyzed to study the effects of introduction of an infectious agent in the environment to spread a disease in the population. It has been assumed that the rate of discharge of biological agent in the community is proportional to the number of susceptible people present in the community. The model has been analyzed by using stability theory of differential equation and by computer simulation. It has been shown that as the rate of
introduction of biological agent in the community increases, the number of infectives in the population increases. This model might be useful to control bioterrorism.