SYNOPSIS OF THESIS

The breathtaking discoveries of today's biology not only revolutionize our views about living things but also make a profound impact on science and engineering. Genetic engineering, which came into existence about 10-15 years ago, has made it possible to change in a purposeful way the machinery of inheritance to *design the living matter*. This recent upsurge of interest in biotechnology has aroused renewed consideration of the range of products of commercial value that might be produced from biological systems. The techniques by which such products are produced and isolated from organisms often is the major bottleneck in their application to modern industry. A major task of today's science is to expand and deepen basic research and make it's findings work in practical fields. With extensive utilization of experimental methods, simulation studies and system analysis may promote biology to the rank of an exact science. In the present thesis, an emphasis on some of these points has been made.

Affinity separations utilizing immobilized antibodies is a technique that is now being used for the purification of proteins for use as pharmaceuticals or in other applications where the purity of the product is an important consideration. The technique involves the immobilization of antibodies to inert supports in order to form biospecific adsorbents that can be used in purification processes. The biospecific adsorbents that have a high affinity for a single compound are ideally suited for the purification of proteins from a variety of biological sources.

Chapter one introduces the subject matter of the thesis. The literature on the various topics covered is reviewed in order to justify the work presented. Briefly, the problems associated with the purification of proteins on a large scale have been presented and highlights of the potential of affinity separations as industrial unit operations for this purpose are discussed. The reasons for using immobilized antibodies, their advantages and disadvantages are also discussed.

In chapter two, details of procedures by which polyclonal antibodies against a protein (Galactosyltransferase) are raised, purified and characterized are presented. These antibodies are then immobilized and used to study the process of deactivation of the adsorbed antibodies.

Chapter three presents an analysis of antibody deactivation. The effect of deactivation over a large number of cycles for various types of reactors has been studied in order to give clues for designing reactors using immobilized antibodies for large scale separations.

Chapter four presents a mathematical model for checking the feasibility of continuous affinity separations using a magnetically fluidized bed.

Chapter five presents the use of novel matrix for immobilization of a hydrophobic antigen rice prolamin and using it to estimate easily but accurately the content of prolamin in rice.

The processes by which antibodies and other different secretory proteins are made to cross the membrane barrier in cells are discussed in chapter six. Details of the signal that are recognized by the translocation apparatus are discussed.

Chapter seven presents detailed analysis of structural aspects of signal peptides. Based on this analysis, a mechanism has been postulated for the initiation of protein export across membranes.

Chapter eight comprises aspects of specific degradation of signal peptide inside the lipid bilayer of the membrane. A detailed analysis of differences existing between transmembrane sequences and signal peptides has helped to identify regions which may be playing a vital role in specificity of signal peptide peptidases.

Application of the above analysis to *Escherichia coli* has been undertaken in chapter nine. Regions in Protease IV, a signal peptide peptidase, have been identified by topological studies on the probable membrane spanning regions of this protein. A model for protein degradation in the membrane has been postulated.

Membranes are known to be fractal in nature. Each component of the membrane, namely the different types of lipids and proteins, constitute a part of the fractal shape. These components are mobile in shape leading to a time based evolution of the fractal shape, however, maintaining the

over all fractal dimension. The effects of *mobile shapes of fractals* on biological processes and its relevance to processes often encountered in other disciplines of science and engineering have been evaluated in chapter ten.

Chapter eleven finally concludes the thesis giving a concise summary of the results obtained and brings out the importance of the work. In the end, a brief discussion on further research that should be carried out is given.