Preface

It is generally accepted that in the twenty-first century biology will occupy one of the leading places in science. Biology will make an important contribution not only to our fundamental knowledge but also to the development of medicine, ecology, generation of new living species. Many problems in biology which are of interdisciplinary complex character lie at the boundaries between different sciences. To solve such problems it is necessary to apply ideas and methods of other exact sciences and first of all physics, mathematics, chemistry, and physical chemistry. It is by close cooperation between biology and other exact sciences that the development of biophysics as an independent boundary science has become possible.

In this book the main ideas of modern biophysics are presented in the form accessible to wide circles of readers. Biophysics (biological physics) is a science about physical and physico-chemical mechanisms of interactions which lie in the basis of biological processes. Physical properties of biopolymers and kinetics of cell metabolic reactions are responsible for molecular characteristics of biological processes. A biomacromolecule as the main structure element in a cell is considered in biophysics as a peculiar molecular machine where energy is transformed and conversed from one type of energy into another. It is pertinent to recall what Bruce Alberts, a well known American biologist, said about a cell. He wrote that "the entire cell can be viewed as a factory that contains an elaborate network of interlocking assembly lines, each of which is composed of a set of large protein machines" (Cell, 1998, vol. 92, pp. 291-294).

The real understanding of how these protein machines operate demands the knowledge of not only atomic equilibrium structure but also our understanding of kinetic and energy characteristics of intermediate transformations. In the post-genome sequencing era the first priority is given to the mechanisms of intramolecular mobility of macromolecular complexes as the base of their activity. Such an approach corresponds to the biophysical concept of directed electron-conformational interactions when energy transformation and reaction product generation become a result of internal interaction between separate parts within the whole macromolecular complex. In other words, this

is the concept of a "physical machine" put forward in 1970-1980s by D.S.Chernavsky, L.A.Blumenfeld, and M.V.Volkelshtein.

In theoretical biophysics, generalized kinetic and physical models of interactions allow to describe different biological phenomena. However the analysis of such models clearly demonstrates that different biological processes can very often be similar with respect to their molecular mechanisms. For example, mechanisms of primary photobiological processes (photosynthesis, visual reception), enzyme catalysis in the enzyme active center, and ion transfer through membrane channels are governed by similar physical principles. It follows that educational programs on biology at universities should necessarily include ideas of physics, mathematics and physical chemistry, thus illustrating their efficiency in solving biological problems. Biophysics bears the main responsibility to show an important role of regular application of ideas from exact sciences in studying biological processes.

The great experience gained at Moscow State University has shown that this requirement is satisfied when teaching of biophysics is carried on within a logically combined independent general course on biophysics. Such a lecture course on biophysics is given both to biology and physics undergraduates as well as to bachelors of medicine and agriculture. It is useful for scientists working in other fields who want to study biological problems using methods of exact sciences.

In this book the main ideas and concepts of theoretical biophysics (kinetics and thermodynamics of biological processes, molecular biophysics) are presented in a concise and simple form. It makes the base for the biophysical analysis of some important processes (membrane processes, primary photobiological processes and enzyme reactions) analyzed in the book. The material is quite understandable and accessible to specialists of different profiles and background. It is useful for the subsequent profound studying of biophysics using special literature sources for the application of the biophysical approach in different fields of biology.