From the Editor's Desk

I have now the honor and privilege of taking over as the editor from Prof. L. M. Patnaik, who pioneered the new facet of our journal with the previous editorial board. I would like to sincerely thank all the members who transformed the journal into the current mode. We now have a new and very enthusiastic editorial board as we step into our centenary year from May 27, 2008. The review mode with a guest editor introduced since 2007 has been a great success as we have received tremendous response from readers, interestingly enough from students. Several publishing houses have offered to host our journal and currently we are exploring the possibility of such a tie up. This will also ensure that we get into the web citation mode, which will certainly enhance the review mode operation of our journal. We have also planned the July–September issue to be dedicated to selected publications from IISc during the years 1907–1957, the first fifty years as a part of the centenary celebrations. We have requested several senior professors to assist us in this endeavor.

The present issue is guest edited by Professor Jayant Modak from the Chemical Engineering Department of our Institute. He has carefully selected the review articles to address aspects related to synthesis, modeling and optimization in biological sciences viewed as related to an extension of chemical engineering.

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Editorial

The revolution in basic biology at the molecular and cellular levels ushered in with the advances in recombinant DNA technology in 1970's have dramatically increased the information available on fundamental basis of living systems. The "omic" revolution has accelerated the pace at which quantitative data about functioning of the biological systems is being generated. The crucial challenge for the coming decades is how to integrate information from the genomic level to higher levels of system organization, for both fundamental scientific understanding and development of innovative biotechnologies. Engineering disciplines characterized by quantitative logic and problem solving skill are now finding biology more accessible. Thus, a new discipline of biological engineering is emerging, which combines the reductionist approach of biological science in viewing the system at its smallest level possible and constructionist approach of engineering in building new devices, approaches, and technologies from component concepts. Biological engineering encompasses a broad spectrum of the life sciences, including applications to health, agricultural, environmental, and ecological systems. This special issue is an attempt to capture a small slice of diverse research currently being carried out in this field. A unifying theme is that the contributors to this issue have their basic training in the field of chemical engineering. In some sense, the issue also highlights the extension of chemical engineering "synthesis, design, operation, modeling, control and optimization" approach to biological sciences.

The natural living systems are capable of performing innumerable tasks and in terms of its design, functioning and level of complexity are several orders of magnitude higher than the most complex man-made machine, the airplane. One of the attributes of living systems is the presence of large networks involved both in synthesis (metabolism) and regulation (signal). The reductionist approach of biological sciences has led to deeper qualitative understanding of these networks. However, quantification of these networks is still a distant dream. The article by Vinod and Venkatesh examines the issue of quantification of signaling networks both in terms of progress achieved and challenges ahead.

Infectious diseases are the leading cause of death worldwide. Among various sources of bacterial infections, the infections caused by aggregation of different bacteria to form "biofilm" are extremely difficult to control due to their inherent resistance to antimicrobial agents. The article by Prasanna and

Doble gives an overview of the mechanism of biofilm development and the reasons for its resistance to antimicrobial agents. The authors also discuss the possible preventive measures, in particular development of anti microbial small molecules.

The treatment of diseases traditionally follow "measurement, diagnosis and manipulation" approach. The article by Dixit amply demonstrates the power of mathematical and simulation tools in assisting the clinical treatment of the patient. The author focuses on chronic hepatitis C virus (HCV) infection which is a major cause of cirrhosis necessitating liver transplantation and often leading to death. The article also highlights the challenges ahead.

The scale at which biological information is generated today is posing interesting challenges to the engineers both in terms of the volume and the nature of the data to be handled. One such challenge is to analyze the events at nano or even sub-nano levels where traditional deterministic approach of continuum domain fails miserably. The article by Gadgil focuses on one such situation, namely, modeling biological reaction networks involving small number of molecules. The article discusses the need for discrete stochastic approach and presents the state-of-art information on analyzing biological reactions networks.

Drug discovery and development is a time consuming (few years to decade) and costly (millions of dollars) process. The last article in this issue by Das, Dhurjati and Wangikar, though not a review article in strict sense, addresses a challenging problem faced in the development of a drug molecule. The article demonstrates how a pharmacokinetic model and its analysis can be used for detecting a failure of the drug molecule at an early stage of development.

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