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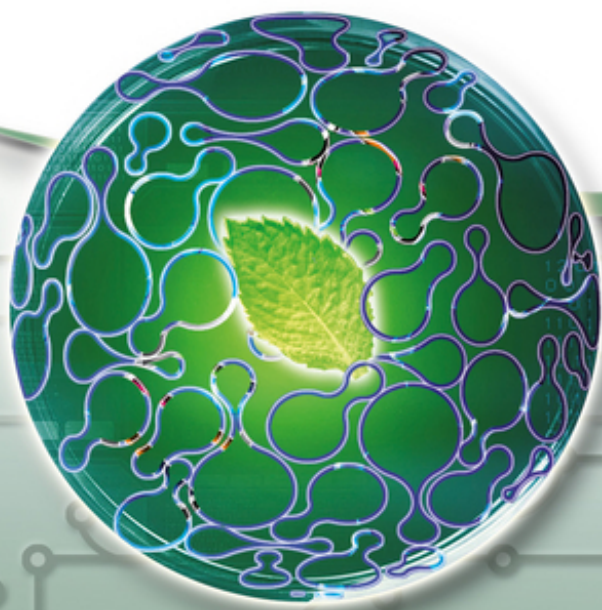
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1 Introduction

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1.1 Introduction

The European Federation of Biotechnology proposed a definition of biotechnology as “The integration of natural science and organisms, cells, parts thereof and molecular analogs for products and services.” The Concise Oxford English Dictionary states “biotechnology is the exploitation of biological processes for industrial and other purposes especially the genetic manipulation of microorganisms for the production of antibiotics, hormone, and so on” [1].

Biochemical engineering has developed as a branch of chemical engineering, and deals with the design and construction of unit processes that involve biological molecules or organisms. Biochemical engineering is often taught as a supplementary option to students of chemical engineering or biological engineering courses because of the overlap in the curriculum and similarities in problem-solving techniques used in both professions. Its contribution is widely found in the food, feed, pharmaceutical, and biotechnological industries, and in water treatment plants.

Biological engineering or bioengineering is the application of the concepts, principles, and methods of biology to solve real-world problems using engineering methodologies and also its traditional sensitivity to the cost advantage and practicality. In this context, while traditional engineering applies physical and mathematical sciences to analyze, design, and manufacture inanimate tools, structures, and processes, biological engineering primarily utilizes knowledge of molecular biology to study, investigate, and develop applications of living organisms. In summary, biological engineers principally focus on applying engineering principles and the knowledge of molecular biology to study and enhance biological systems for varied applications.

Referring to the above review and brief discussion, it is proposed to have a section titled “Applied Bioengineering” be included in the Wiley Biotechnology Series. This section will deal with recent progress in all subjects closely related to “engineering and technologies” in the field of biotechnology; widening the coverage beyond conventional biochemical engineering and bioprocess engineering

to include other biology-based engineering disciplines. The topics involved were selected specifically from the perspective of practical applications.

The volume “Applied Bioengineering” comprises five topics: enzyme technology, microbial process engineering, plant cell culture, animal cell culture, and environmental bioengineering. Each topic is figured in several chapters, though with more chapters pertaining to environmental bioengineering. This field has seen an increase in active research as mentioned below because of growing awareness and concern about conservation, remediation, and improvement of the environment.

The later part of this chapter provides a brief overview on the developments in bioengineering, referring to recent highly cited research.

1.2

Enzyme Technology

Recently, several attempts have been made to screen organic-solvent-tolerant enzymes from various microorganisms [2]. The ligninolytic oxidoreductases are being improved utilizing protein engineering by the application of different “omics” technologies. Enzymatic delignification will soon come into practical use in pulp mills [3]. Enzyme stabilization has been attempted using various approaches such as protein engineering, chemical modification, and immobilization [4].

Microbial glucose oxidase has garnered considerable interest because of its wide applications in chemical, pharmaceutical, food, beverage, clinical chemistry, biotechnology, and other industries. Novel applications of glucose oxidase in biosensors have further increased its demand [5]. Numerous oxidative biotransformation studies have demonstrated that enzymes have diverse characteristics and wide range of potential, and established applications [6]. Multienzymatic cascade reactions used in the asymmetric synthesis of chiral alcohols, amines, and amino acids, as well as for C–C bond formation, have been extensively studied [7].

1.3

Microbial Process Engineering

1.3.1

Bioreactor Development

Stirred-tank bioreactors are used in a large variety of bioprocesses because of their high rates of mass and heat transfer and excellent mixing. Theoretical predictions of the volumetric mass transfer coefficient have been recently proposed, and different criteria for bioreactor scale-up have been reported [8].