Biochemical Engineering
BSE222A (UG) & BSE612 (PG)

Instructor: Prof. Ashok Kumar

Department: Biological Sciences and Bioengineering

Units: 3-0-0-9

Prerequisite: Compulsory course for BSBE UG students. Can be taken as elective by UG students from other departments after consent of the instructor. No prerequisite for M.Tech and Ph.D students of BSBE. For post-graduate students from other departments – consent of the instructor.

Contact: LAB 15, BSBE, IIT Kanpur,
Email: ashokkum@iitk.ac.in; Tel:2594051(office); 2594052 (Lab)

Meeting venue and time: BSBE Seminar Room (SR)

Monday:	11:00 am to 12: 00 noon
Tuesday:	12:00 noon to 01: 00 pm
Friday:	12:00 noon to 01: 00 pm

Weightage:

Attendance	10%
Mid semester exam	35%
Quiz, assignment & presentations	15%
End semester exam	40%

Note: Evaluation for BSE222A and BSE612A are done separately.

Objective:

Biochemical engineering course aims at providing the fundamental understanding to the students for the efficient utilization of physical, chemical and biological processes to convert raw materials into useful products, at minimal cost, with minimal energy consumption, and with minimal impact on the environment. The course will focus to explain how a product is produced by using bioprocesses (upstream process) and how this product can be purified using different bioseparation technologies (downstream process). Some aspects of enzyme technology and environmental bioprocesses can also be explained. Some case studies of biochemical processes at industrial scale will be discussed. Students in groups will study some of the recent topics in the area from journal publications and will make presentations. The course aims to provide an understanding for the bioprocesses conducted at the laboratory scale level to industrial applications.

Course Content:

A. Introduction to biochemical engineering, bioprocesses, bioproducts and biochemical technology with specific examples – **Three lectures.**

B. Upstream process: Microbial, mammalian and plant systems for bioprocess technology. Sterilization. Stoichiometry and energetics of microbial metabolism. Transport phenomena – **Five lectures.**

C. Enzyme catalyzed reactions and processes. Cell and enzyme immobilization. Bioreactor design and applications. Instrumentation and control – **Six lectures.**

D. Downstream process: Bioseparations, characteristics of biological materials, pretreatment methods, separation of cell biomass, adsorption, filtration, centrifugation, precipitation and extraction – **Four lectures.**

E. Liquid chromatography- principles, plate and rate theory, ion exchange, gel filtration, affinity chromatography, hydrophobic interaction and reverse phase chromatography- **Six lectures**

F. Integrated bioprocesses- Bioprocess integration for efficient production and recovery, expanded bed separations, affinity precipitations, aqueous two-phase processes, monolithic chromatographic separations – **Six lectures.**

G. Polishing, crystallization, drying, scale-up consideration, process monitoring and process economics – **Three lectures**

H. Environmental bioprocesses- Interaction of mixed microbial population, biological wastewater treatment, anaerobic digesters, bioremediation – **Three lectures.**

I. Case studies and new developments of bioprocesses- paper readings and presentations – **Four lectures**

Books recommended:

1. Blanch, H. W. and Clark, D. S. “Biochemical Engineering”. Marcel Dekker, Inc.,
2. Bailey, J. E. and Ollis, D. F. “Biochemical Engieering Fundamentals”. McGraw-Hill, Inc.,
3. Belter, P. A., Cussler, E. L. and Hu, W. S. “Bioseparations: Downstream Processing for Biotechnology”, John Wiley & Sons
4. Desai, Mohamed. A. Downstream Processing of Proteins: Methods and Protocols. Humana Press
5. Shuler, M. L. and Kargi, F. Bioprocess Engineering- Basic Concepts