

**Course Name: Cellular Bioprocess Technology**

**Course Number:** BY513

**Credit:** 3-0-0-3

**Prerequisites:** - IC 136 - Understanding Biotechnology & its Applications **OR** Consent of Faculty member

**Students intended for:** B. Tech. 3<sup>rd</sup> and 4<sup>th</sup> year, MS/MSc. /M. Tech., Ph.D.

**Elective or Core:** Core for M. Tech. Biotechnology, Elective for others

**Semester:** Odd/Even

**Course objective:**

This course delivers the fundamentals and practical analysis of cell culture technology, bioprocess principles and strategies to optimise the industrial cellular strains. The students will learn the concepts of bioprocessing and its application in industries, media design, cultivation, fermentation technology, bioreactor design and optimization of cellular behaviour. The laboratory component provides the hands-on experience benefitting the students with right skills required for industrial, academic and research career. Field visit will provide the right exposure to see how things work in large scale industrial units allowing the students to innovate in this area.

**Module 1 [3 Lectures]**

**Introduction to Cell culture technology for Bioprocessing:**

Cell culture engineering, cell culture products (metabolites, enzymes etc), Cellular systems as molecular factories – plants and microbial systems relevant to industries. Introduction to Bioprocessing.

**Module 2 [14 Lectures]**

**Medium Design and kinetics of cell cultivation:**

Optimization of cell growth environment. A guide for medium design. Types of media and classes of medium components. Components of different cell culture medium. Medium for the Industrial production culture, Stoichiometry and Kinetics of Cell Cultivation – composition, cell mass and size, Quantitative Description of Cell Growth & Product Formation, Kinetic Model of Cell Growth. Monod Model and its Derivatives.

**Module 3 [16 Lectures]**

**Fermentation technology, Bioreactor design principles and operating mode:**

Fermentation technology, Bioreactor types and design principles -Simple Stirred Tank Bioreactor, Airlift Bioreactor, Fluidized Bed Bioreactor, Membrane Bioreactor. Operating Mode of Bioreactors - Batch, fedbatch and Continuous Processes. Control strategies of physiological parameters - Oxygen transfer, redox, pH etc. Growth rates. Product recovery and quality analysis. Introduction to Analytical techniques, Scaling Up and Scaling Down for Cell Culture Bioreactors.

**Module 4 [9 Lectures]**

**Metabolic engineering, CBP technology and modeling of cellular factories:**

Developing optimal host cells by rational metabolic engineering – an overview. Modelling of metabolic pathways of cellular Systems. Consolidated Bioprocessing (CBP) technology in the context of biofuels and sustainable chemicals.

**Text and Reference books:**

- Cell Culture Bioprocess Engineering by Wei-Shou Hu ISBN-13: 978-0985662608
- Encyclopedia of Bioprocess Technology John Wiley and Sons, Inc., Online ISBN: 9780471250586; DOI: 10.1002/0471250589
- Developing organisms for consolidated bioprocessing of Biomass to ethanol by Willem H. van Zyl, Riaan den Haan and Daniel C. la Grange, 2011; DOI: 10.5772/18171
- Other relevant tutorial material and scientific publications will be provided