Approved/Modified in 49th BoA Meeting (28.03.2023)

Course Number: BE 203
Course Name: Enzymology and Bioprocessing
Credits: 3-0-2-4
Prerequisites: IC136
Intended for: B. Tech M.Tech. Integrated Dual Degree Bioengineering students
Distribution: Core for Integrated Dual Degree Bioengineering students, elective for other B.Tech students

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1. **Preamble:**

   This course introduces the fundamentals of enzymology and cellular bioprocessing. The first part of the course introduces the fundamentals of enzyme catalysis and its kinetic analysis. The second part introduces bioprocessing principles and related parameters that would influence cellular growth kinetics in typical bioreactor operation conditions. The laboratory component will provide basic hands-on understanding of the enzyme kinetics and bioprocessing.

2. **Course Outline:**

Theory: **[28 hours]**

Module 1: Fundamentals of Enzymology **[8 hours]**

Introduction to Enzymes, Classification of Enzymes, Specificity of Enzyme Action, The Fisher 'lock-and-key' hypothesis, The Koshland 'induced-fit' hypothesis
An Introduction to Bioenergetics, Catalysis and Kinetics, Kinetics of Single-Substrate Enzyme- Catalyzed Reactions, The Henri and Michaelis Menten Equation, The Briggs Haldane modification, The Lineweaver-Burk Plot, The Eadie Hofstee and Hanes Plot

Module 2: Enzyme Inhibition and Applications **[6 hours]** Reversible Inhibition: - Competitive Inhibition, Un-competitive Inhibition, Non-competitive Inhibition, Substrate Inhibition, Allosteric Inhibition and Irreversible Inhibition
Sigmoidal Kinetics and Allosteric Enzymes Case studies pertaining to industrial enzyme(s)

Module 3: Introduction to Cellular Bioprocessing **[8 hours]**

Bioprocessing – definition and introduction to control parameters in Bioprocessing such as dissolved oxygen, redox, pH, temperature etc.
Stoichiometry and Kinetics of cell cultivation – Quantitative description of cell growth and product formation, Kinetic Model of Cell Growth - Monod Model.
Bioreactor types and their Operating Modes – Batch, fed-batch and continuous

Module 4: Fermentation and Downstream Processing **[6 hours]**

Fermentation technology and Downstream processing
Case studies on lab-scale bioprocessing of biochemicals

Lab: **[28 hours]**

- Enzyme kinetics –Activity analysis, Effect of substrate concentration, Effect of temperature, Effect of pH
- Process parameter control in Stirred tank Bioreactor, Microbial cultivation in a batch and estimation of growth rates, Fermentation and downstream analysis of end products

3. **Text Books:**

a. Trevor Palmer, Philip Bonner, "Enzymes", 2nd Edition, Woodhead Publishing, 2007.
b. **Sarfaraz K. Niazi, Justin L. Brown, "Fundamentals of Modern Bioprocessing", 1st edition, CRC Press, 2017.**

4. **Reference Books:**

a. Alejandro G. Marangoni, "Enzyme Kinetics: A Modern Approach", John Wiley & Sons,2003.
b. Michael L. Shuler, Fikret Kargi, Matthew De Lisa, "Bioprocess Engineering: Basic Concepts", 3rd Edition, Prentice Hall, 2017.

5. **Similarity content declaration with existing courses:** None

Sl. No.	Course Code	Similarity Content	Approx. % of content
1	BY513	Cellular Bioprocessing	20%

6. **Justification of new course proposal if cumulative similarity content is >30%:**