

20BT2014**INDUSTRIAL BIOTECHNOLOGY &
METABOLIC ENGINEERING**

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P	WA/RA	SSH/HS	CS	SA	S	BS
45	-	-	-	-	-	-	-	-

Course Description and Objectives:

This course offers an introduction and concepts relating to Industrial biotechnology and Metabolic Engineering and their Applications. This provides and insights to understand the production of commercially and therapeutically important metabolites and bioproducts like enzymes, recombinant proteins. Also, the overview of cellular metabolism and connection between metabolic pathways.

Course Outcomes:

Upon successful completion of the course, the students will be able to:

- *Understand the overview of Industrial fermentation process, equipments operations and production.*
- *To apply the metabolic engineering applications in pharmaceuticals, chemical, bioprocess fields.*
- *Summarize the processes involved in industrial production of enzymes.*
- *Understand the concept of bioconversions and its applications*
- *Analyze the metabolic pathway and structure metabolic networks.*

SKILLS:

- ✓ *Isolation and screening of the bacteria for production of metabolites.*
- ✓ *Strain improvement for overproduction of enzymes*
- ✓ *Metabolomics data and bimolecular interaction network analysis*

ACTIVITIES:

- *Isolate amylase/ peroxidase/ urease from various sources.*
- *Purify the enzyme by different methods.*
- *Estimate K_M and V_{max} of different enzyme reactions.*
- *Immobilize peroxidase on various substrates cloth, fabric, glass bead and encapsulation.*

UNIT - I

Introduction to Industrial Biotechnology: Overview of industrial fermentation process, Unit operations in Upstream and Downstream Processing, Products relating to traditional biotechnology (production of beer, production of cheese) in the form of process flow sheeting.

UNIT - II

Production of Commercially Important Enzymes & Recombinant Proteins: Proteases, Amylases Lipases, Pectinases, and other commercially important enzymes for the food & pharmaceutical industries; Production of recombinant proteins (Insulin, Interleukin & Interferon's), Production of vaccines.

UNIT - III

Introduction to Metabolic Engineering: Basic concepts of Metabolic Engineering – Overview of cellular metabolism – Different models for cellular reactions, induction – Jacob Monod model and its regulation, Differential regulation by isoenzymes, Feedback regulation. Applications in pharmaceuticals, chemical bioprocess, Food Technology, and biomass conversion.

UNIT - IV

Bioconversions & Regulation of Enzyme Production: Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Co metabolism, Product inhibition, mixed or sequential bioconversions, Conversion of insoluble substances. Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, Feedback repression, Catabolite Repression, optimization and control of metabolic activities. The modification of existing - or the introduction of entirely new - metabolic pathways.

UNIT - V

Metabolic Pathways & Metabolomics: Metabolic pathway modeling, Analysis of metabolic control and the structure metabolic networks, metabolic pathway synthesis algorithms. Metabolomics, Metabolomics measurements using NMR, Spectrophotometry, LCMS.

TEXT BOOKS:

1. Wang, D.I.C Cooney C.L., Demain A.L., Dunnill P. Humphrey, "Fermentation and Enzyme Technology", A.E. Lilly M.D., John Wiley and sons, 1980.
2. Stanbury P.F. and Whitaker A., "Principles of Fermentation Technology", Pergamon Press, 1984.
3. Zubay G., "Biochemistry, Macmillan Publishers", 1989.
4. Lee, S.Y. and Papoutsakis, E.T. "Metabolic Engineering". Marcel Dekker, 1998.
5. Voit, E.O. "Computational Analysis of Biochemical Systems: A Practical Guide for Biochemists and Molecular Biologists". Cambridge University Press, 2000.

REFERENCE BOOK:

1. Gregory N. Stephanopoulos, "Metabolic Engineering Principles and Methodologies"- Aristos et al-Elsevier.
2. Gerhard Gottschalk, Bacterial Metabolism, 2nd Edition, Springer Verlag, 1986
4. S.A. Teukolsky, W.T. Vetterling, B.P. Flannery, W.H. Press, Numerical Recipes in C, Cambridge University Press, 1993.
3. Stephanopoulos GN, Aristidou AA, Nielsen J (1998) Metabolic Engineering: principles and methodologies. Academic Press, San Diego.
4. Scheper, T. "Metabolic Engineering" Vol 73 (Advances in Biochemical Engineering Biotechnology) Springer, 2001.
5. Rehm, H.J. and G. Reed, "Biotechnology: Products of Primary Metabolism" Vol.6 and "Biotechnology: Products of Secondary Metabolism" Vol.7, VCH / Wiley, 1997.
6. Warren John Ewens, Gregory R. Grant, Gregory Grant, R. "Statistical Methods in Bioinformatics", Springer, 2005.