



**5-Year Integrated Master of Technology (Integrated. M.Tech.) Curriculum and Syllabus for Biotechnology**

**Fifth Semester**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UBT-T301	CAREER ADVANCEMENT & SKILL DEVELOPMENT(BIO-COMPUTING I)	1	0	2	3
TIU-UBT-T303	ENZYMOLGY	3	0	0	3
TIU-UBT-T305	INDUSTRIAL BIOTECHNOLOGY	3	0	0	3
TIU-UBT-T307	BIOSEPARATION AND DOWNSTREAM PROCESSING TECHNOLOGY	3	0	0	3
TIU-UBT-T309	GENETICS AND BIostatISTICS	3	0	0	3
TIU-UBT-T311	ANIMAL BIOTECHNOLOGY	3	0	0	3
<b>Practical</b>					
TIU-UBT-L303	ENZYMES LABORATORY	0	0	2	2
TIU-UBT-L307	BIOSEPARATION TECHNOLOGY LABORATORY	0	0	2	2
TIU-UBT- L313	BIOINFORMATICS LABORATORY	0	0	1	1
<b>Sessional</b>					
TIU-UBT-S399	INDUSTRIAL VISIT	0	0	1	1
TIU-Ues-S399	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>26</b>



## **ENZYMولوجY**

**TIU-UBT-T303**

**L-T-P: 3-0-0**

**Credits: 3**

**Unit I:** Introduction, classification, mechanism of enzyme action, active site determination, identification of binding and catalytic sites, specificity of enzyme action, activation energy and transition state theory, role of entropy in catalysis.

**Unit II:** Kinetics of single substrate enzyme catalyzed reactions, Michaelis-Menten equation, turnover number, enzyme inhibition- competitive, non-competitive, and uncompetitive, allosteric enzymes and metabolic regulation.

**Unit III:** Immobilized enzyme catalysis; Effects of external mass transfer resistance, effects of inhibitors, temperature and pH on immobilized enzyme catalysis and deactivation, Various applications of enzymes, creation of chimeric enzyme, enzymes produced by recombinant technology.

## **INDUSTRIAL BIOTECHNOLOGY**

**TIU-UBT-T305**

**L-T-P: 3-0-0**

**Credits: 3**

**Unit I:** Selection of microorganism, screening for metabolites, strain improvement and various rDNA technologies for strain improvement including site directed mutagenesis.

**Unit II:** Fermentation, raw materials for fermentation, submerged, surface and solid-state systems, whole cell and enzyme immobilized systems Solid substrate fermentation (SSF): Principles and application; Surface fermentation Comparison between SSF, Surface fermentation.

**Unit III:** Production of enzymes from microbial, plant and animal sources, purification and recovery of enzymes, biogas and biofuel production technology, industrial technology for manufacture of various industrially important products like wine, cheese, bread, vaccine, organic solvent, antibiotics, monoclonal antibody hormone and cytokines.



## **BIOSEPARATION TECHNOLOGY AND DOWNSTREAM PROCESSING**

**TIU-UBT-T307**

**L-T-P: 3-0-0**

**Credits: 3**

**Unit 1-**Introduction to Bioseparation Technology, Role and importance of Bioseparation in biotechnological processes, Logic of Bioseparation Technology, Discussion of different live problems related to Bioseparation; students logical ability testing

**Unit 2-**Solid- Liquid separation techniques; Cross flow & End Flow Filtration, Centrifugation: Analytical and Preparative Ultracentrifugation; Different types: Density gradient, Isopycnic; Rate zonal centrifugation etc. Cell Disruption Process for intracellular product separation, Removal of insoluble's, biomass (particulate debris), Flocculation, Sedimentation, Centrifugation etc. Membrane based separation (MF and UF) theory, Procedure and Application. Microfiltration, Ultrafiltration, and Reverse Osmosis Precipitation Methods: - Salting in and salting out. Aqueous two-phase extraction and in situ product removal. Chromatographic Separation Techniques, Theory, Types. Gel Permeation, Ion Exchange, Affinity Chromatography, HPLC, UPLC, GC etc.

**Unit 3-** Crystallization:- Principles-Nucleation- Crystal growth-Kinetics. Drying –Principles-Water in biological solids, Vacuum shelf and rotary dryer, Freeze dryer and Spray dryer, Packaging and Quality Assurance, Economics and downstream processing in BT: Cost cutting strategies, Optimal methods of product recovery (efficacy and cost effectiveness).

## **GENETICS AND BIostatISTICS**

**TIU-UBT-T309**

**L-T-P: 3-1-0**

**Credits: 3**

**Unit I: Classical Genetics:** Mendelian inheritance, physical basis of inheritance, epistasis: gene interaction, multiple alleles, complementation, linkage, recombination and chromosome mapping, extrachromosomal inheritance, sex determination, special types of chromosomes. Chromosomal variations: numerical - euploidy and aneuploidy; structural - deletion, duplication, inversion and translocation.

**Unit II: Microbial Genetics:** Bacterial Genetics: plasmids: types, structure, copy number, transfer. Transformation-natural transformation systems, mechanism, gene mapping by



transformation; chemical-mediated and electro-transformation, Conjugation-discovery, nature of donor strains and compatibility, interrupted mating and temporal mapping, Hfr, F12 heteroduplex analysis, chromosome transfer in other bacteria, molecular pathway of recombination, Transduction- Generalized and specialized transduction; gene mapping by transduction.

**Unit III:** Mean, Median, Mode, Standard Deviation and Error, Co-relation and Regression, Chi-square, T-test, Goodness of Fit, p-value, ANOVA.

## **ANIMAL BIOTECHNOLOGY**

**TIU-UBT-T311**

**L-T-P: 3-0-0**

**Credits: 3**

**Module I:** Animal cell culture, basic principles, Laboratory requirements for animal cell culture: Sterile handling area, Sterilization of different materials used in animal cell culture, Aseptic concepts, Instrumentation and equipments for animal cell culture, History of cell culture, Primary and secondary cell culture, serum free and serum based media, scaling-up, characterization and preservation of cell lines, cytotoxicity and viability assays, Different types of cell cultures, Trypsinization, Cell separation, Continuous cell lines, Suspension culture, Organ culture, Development of cell lines, Characterization and maintenance of cell lines, stem cells, Cryopreservation, Common cell culture contaminants.

**Module II:** Animal diseases, diagnosis, therapy, variations of diseases, modes of transmission of diseases, control and management of disease spreading

**Module III:** Stem cells, micromanipulation of embryos, generation of modified stem cells, transgenic animals, retroviruses and DNA microinjection method, transgenic mice, cattle, knock in and knock out animals, Importance of transgenic animals in biotechnology and ethical issues, valuable genes for animal biotechnology.

## **ENZYMES LABORATORY**

**TIU-UBT-L303**

**L-T-P: 0-0-2**

**Credits: 2**

- Determination of enzyme kinetic parameters by spectrophotometric method
- Demonstration of effect of pH and temperature on enzyme activity
- Study of inhibitors on enzymatic activity (competitive, uncompetitive,



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- noncompetitive)  
• Isozyme Assays

## **INDUSTRIAL BIOTECHNOLOGY AND DOWNSTREAM PROCESSING LABORATORY**

**TIU-UBT-L305**

**L-T-P: 0-0-2 Credits: 2**

- Production of ethanol from sugarcane juice and its partial purification
- Demonstration of wine production in a fermenter
- Milk microbiology
- Assay of antibiotic production and demonstration of antibiotic resistance
- Bioseparation of Protein from a complex mixture
- Bioseparation of Carbohydrate from a complex mixture
  
- Bioseparation of Lipid from a complex mixture

## **BIOINFORMATICS LABORATORY**

**TIU-UBT-L313**

**L-T-P: 0-0-1**

**Credits: 1**

- Sequence Retrieval from BLAST and its Annotation
- Phylogenetic Analysis
- Prediction of the structural components of a gene
- Designing PCR primers for expression vectors
- Protein secondary and tertiary structure prediction
- Protein Localization



## **BOOK LIST**

### **ENZYME TECHNOLOGY**

1. Enzymes. (1979). Dixon M. & Webb E.C.
2. Methods in Enzymology (relevant volumes of the series)
3. Fundamentals of Biochemistry. (1999). Voet, D., Voet, J.G & Pratt, C.W.
4. Genes VII. (2000). Lewin, B.
5. Biological Chemistry. (1986). Mahler, H.R. and Cordes E.
6. Bioseparations: Principles & Techniques (2005). Sivasankar B.
7. Enzymes- a practical introduction to structure mechanism and data analysis (2000). Copeland, R.A.
8. Enzymes: Biochemistry, Biotechnology & clinical chemistry (2004). Palmer, T.

### **BIOSEPARATION TECHNOLOGY AND DOWNSTREAM PROCESSING**

1. Schuler & Kargi, Bio-process Engg. PHI
2. Bailey & Olis, Biochemical Engg. Fundamentals, McGraw-Hill, 1990
3. Mukhopadhyay, S.N. Process Biotechnology Fundamentals, Viva Books Pvt. Ltd. 2001.
4. Muni Chervan, Handbook of Ultrafiltration
5. Perry, Chilton & Green, Chemical Engineers' Handbook, McGraw-Hill
6. Ho, W.S.W. & K. K. Sirkar, Membrane Handbook, Van Nostrand Reinhold, N.Y. (1992)
7. Encyclopedia of bioprocess technology. Vol 1-5. (1999). Flickinger, M.C. & Drew, S.W.(Ed).
8. Fermentation technology. (1994). Cassida.
9. Bioprocess engineering: Down stream processing & recovery of bioproducts, safety in biotechnology and regulations. (1990). Behrens, D. & Kramer, P.(Ed).

### **INDUSTRIAL BIOTECHNOLOGY**

1. Principles of fermentation technology. (1984). Stanbury, F. & Whitaker, A.
2. Immobilized enzymes: An introduction & application in biotechnology. (1980). Erevan, M.D.
3. Topics in enzyme & fermentation technology. (1984). Wiseman, A. (Ed).
4. "Industrial Microbiology" by Prescott
5. Industrial Biotechnology by S.N. Jogdand, First edition, Himalaya Publishing House, (2006).

### **ANIMAL BIOTECHNOLOGY**

1. In Vitro Cultivation of Animal Cells (1995) Butterworth – Heinemann
2. Animal Cell Culture (2000) – A Practical Approach John R.W. Masters
3. Culture of Animal Cells – A manual of Basic technique (2005) R.I. Freshney



## **GENETICS AND BIOSTATICS**

1. Genes X (2010). Lewin, B.
2. Essential Genes (2006) Lewin.
3. Essential Genetics: A genome perspective. Hartl and Jones. (4th Edition)
4. Principle of Genetics. Gardner, E.J., Simmons, M.J. & Snustad, D.P. (8th Edition)
5. Genetics (2002). Strickberger, M
6. Microbial Genetics (2006). S. Maloy, J. Cronan Jr and Friefelder, D
7. Concept of Genetics (2002). Klug, W.S. & Michael, R & Cummins, M.R.
8. Introduction to Biostatistics (1973). Sokal, R. et al.
9. Statistical methods: George, W.S. & Harward, W.G.
10. Statistical method in Biology. University Press Ltd.
11. Biostatistics. (1984). Zar, J.

## **BIOINFORMATICS**

1. Bioinformatics-sequence, structure and databanks, (2000) D. Higgins and W. Taylor A practical approach.
2. Bioinformatics computing (2003). B. Bergeman.
3. Bioinformatics databases and algorithms (2007) N. Gautham.
4. Basic Bioinformatics (2005) S. Ignacimuthus.
5. Bioinformatics: concepts skills and applications (2004). S.C. Rastogi, N. Mentiratta and P. Rastogi.
6. Bioinformatics: A modern approach, (2005) V.R. Srinivas.
7. Essential Bioinformatics (2006). J. Xiong).
8. Statistical methods in Bioinformatics: An introduction. (2005). W. Even and G. Grant.