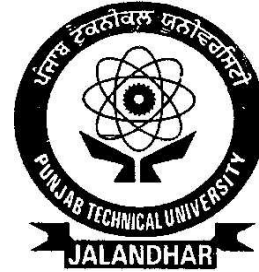


Punjab Technical University



Jalandhar

Propelling Punjab to a Prosperous Knowledge Society.....

***Syllabus of M.Tech Biotechnology
Year 2010 onwards***

PUNJAB TECHNICAL UNIVERSITY

*JALANDHAR-KAPURTHALA HIGHWAY,
KAPURTHALA-144601 (PUNJAB) www.ptu.ac.in*

Course Code	Course Title	Load Distribution			Marks Distribution		Total Marks
		L	T	P	Internal	External	
MTBT 101	Microbial biotechnology	3	-		20	80	100
MTBT 103	Biomolecules & Biotechnology	3	-		20	80	100
MTBT 105	Bioprocess Engineering & Technology	3	-		20	80	100
MTBT 107	Biostatistics	3	-		20	80	100
MTBT 109 *	Pharmaceutical Biotechnology	3	-		20	80	100
MTBT 111*	Environmental Engg. And Waste Management	3	-				
MTBT 113	LAB-I (Biomolecules And Microbial Biotechnology Lab)			8	40	60	100
MTBT 115	LAB – II (Bioprocess Engineering And Technology Lab)			8	40	60	100
TOTAL							700

*

Note: These are Special Papers. Students have to opt any one out of MTBT 109 and MTBT 111

MTBT-101

BIOMOLECULES AND BIOTECHNOLOGY

L:3 T:0 P:0

- **Structure and Function** of Carbohydrates, Lipids, Proteins, Amino acids and Nucleic acids.
- **Bioenergetics and Thermodynamics:** Common biochemical reactions, Phosphoryl group transfer, biological oxidation- reduction reactions.
- **Biosignalling:** General features, G-proteins, Tyrosine kinase based signaling, multivalent adaptor proteins, gated ion channels, integrins, signalling in micro-organisms and plants.
- **Enzymes:** Catalytic mechanism of few enzymes: Lysozyme, Chymotrypsin and serine protease, different classes of enzymes and their industrial application, application of enzymes in solution and in immobilized state, use of enzyme inhibitors as therapeutic agents.
- **Salient features** of carbohydrate, lipid, amino acid & nucleic acid metabolism
- **Metabolic Regulations:** Different Modes of regulation, Hormonal regulation and integration of metabolism
- **Biotechnology:** Biotechnology-an interdisciplinary pursuit, conventional & modern biotechnology, various natural raw materials for biotechnology, genetics & biotechnology, current trends and underlying principles of microbial, plant, animal & environmental biotechnology; safety, social, moral & ethical aspects of biotechnology

References:

1. Principles of Biochemistry by A. Lehninger revised by Nelson and Cox, 2008.
2. Biochemistry by Mathews, Van Holde and Ahern. IIIrd Edition.
3. Biochemistry by White, Handler and R.B.Smith 7th Ed.
4. Biochemistry by L.Stryer Third Edition.
5. Fundamentals of Biochemistry by Conn and Stumph.
6. Biotechnology, 3rd Edition by J.E. Smith, Cambridge Univ. Press (1996)
7. Biotechnology-an Introduction by S.R. Barnum, Thompson Brooks/Cole (2007)

8. Plant Biotechnology-the genetic manipulation of plants, 2nd Edition by A Slater, N.W. Scott M.R. Fowler, Oxford Univ Press (2008)

MTBT – 103

MICROBIAL BIOTECHNOLOGY

L:3 T:0 P:0

Role & Importance of Microbes in the field of Biotechnology: Microbial Technology, Human Therapeutics, Agriculture, Waste Water Treatment, Hazardous Waste Management, Feedstock.

- **Industrially Important Microbes:** *E coli*, *Saccharomyces*, *Penicillium*, (morphology, growth requirements and genetics)
- **Screening of Microbes of Industrial Importance:** Primary and Secondary Screening, Potential of Thermophilic Archae in biotechnology.
- **Strain improvement techniques:** Introduction, Bioprospecting, Genetic manipulation of micro-organisms (Mutation, protoplast fusion, r-DNA technology, modification of gene expression), Preservation of micro-organisms.
- **Industrial importance of microbes in production of :**
 - **Enzymes** (Amylase, Invertase, Proteolytic),
 - **Vaccines** (Recombinant and Synthetic Vaccines) ,
 - **Antibiotics** (penicillin, streptomycin),
 - **Biomass, Organic acids** (citric acid, acetic acid, gluconic acid and α - keto glutaric acid),
 - **Vitamins** (Vitamin B₁₂, Vitamin A, Riboflavin),
 - **Ethanol Production**,
 - **Biofertilizers** (Nitrogen- fixing, phosphate solubilizing),
 - **Biodegradable plastics** (3- Hydroxybutyrate, 3-Hydroxyvalerate),
 - **Bio-insecticides** (*Bacillus sp.*, Baculovirus),
 - **Probiotics.**
- **Introduction and role of microbes in the degradation of pollutants / toxic compounds.**

References:

1. Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill.
2. Microbiology by L.M.Prescott, J.Harley, D.A.Klein 6TH Ed., Mc Graw- Hill International edition, 2005..
3. General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
4. Principles of Microbiology, R.M. Atlas, Wm C. Brown Publisher.
5. Microbial Biotechnology:Fundamentals of Applied Microbiology, A.N. Glazer and Hiroshi Nikaido, 1994
6. The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.
7. Industrial microbiology- L.E. Casida, New Age International Publishers.2005

MTBT – 105

BIOPROCESS ENGINEERING & TECHNOLOGY

L:3 T:0 P:0

- **Microbial Growth Kinetics**
- Factors affecting Microbial Growth; Stoichiometry: Mass Balances; Energy Balances; Growth Kinetics; Batch Culture , Continuous Culture , Fed Batch Culture, Feedback culture.
- Fermentation Kinetics: Framework for Kinetic Models ,Mass Balances for Bioreactor, Structure Compartmental & Unstructured Models
- Fermentor: Sterilization of air & Sterilization of Media, Aeration and Agitation;
- Bioprocess Control: Controllers, Process control and Cascade control, Direct Regulatory Control and Advanced Control,
- Operation of Aseptic Aerobic Fermentation Process
- Bioseparation, Biomass removal and Disruption; Centrifugation; Sedimentation; Flocculation; Microfiltration; Sonication; Bead Mills; Homogenizers; Chemical Lysis; Enzymatic Lysis, Precipitation (Ammonium Sulfate), Extraction(solvent, aqueous two phase, super critical),
- Membrane based purification: Ultrafiltration ; Reverse osmosis; Dialysis ; Preervaporation; Perstraction
- Chromatography: Adsorption, Size Exclusion, HPLC, Electrophoresis, Drying and Crystallization

References

1. Michael Shuler and Fikret Kargi, Bioprocess Engineering: Basic Concepts, 2nd Edition, Prentice Hall, Englewood Cliffs, NJ, 2002.
2. Pauline Doran, Bioprocess engineering principles, 1 Edition, Academic Press, 1995.
3. Colin Ratledge, Bjorn Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge University Press, 2001.
4. Roger Harrison et al., Bioseparations Science and Engineering, Oxford University Press, 2003.
5. E L V Harris and S. Angal, Protein Purification Methods, Ed. IRL Press at Oxford University Press, 1989.
6. P.A. Belter, E.L. Cussler and Wei-Shou Hu., Bioseparations-Downstream Processing for Biotechnology, Wiley-Interscience Publication, 1988.

MTBT – 107**BIOSTATISTICS****L:3 T:0 P:0**

- **Probability**

Counting and Probability: Addition rules; Permutations; Combinations; Inclusion-Exclusion Rule; Sampling with and without replacement; Conditional Probability; Bayes' Theorem; Independence

- **Descriptive Statistics**

Descriptive Statistics and Random Variables; Measures of Central Tendency: Mean, Median, Mode; Measures of Spread: Range, Percentile, Standard Deviation; Displaying Data: Histograms, Stem and- Leaf Plots, Box Plots, Frequency Distributions; Geometric Distributions: Continuous Random Variables: Normal, Exponential Distributions, Standard Normal Distribution, Binomial Distribution, Poisson Distribution.

- **Skewness, Kurtosis, Moments**

Measures of Skewness, Karl Pearson's Coefficient of Skewness, Moments about Arbitrary origin, Moments about zero, Sheppard's correction for grouping errors, Measures of kurtosis

- **Inferential Statistics and one sample Hypothesis Testing**

Samples and populations: Random, stratified and cluster sampling; Single- and Double-blind experiments; Sampling distributions: students t , chi-square, F distributions; Hypothesis testing: null and alternative hypotheses, decision criteria, critical values, type I and type II errors, Meaning of statistical significance; Power of a test; One sample hypothesis testing

- **Multi-Sample and Nonparametric Hypothesis Testing**

Two sample hypothesis testing; Nonparametric methods: Signed rank test; Analysis of variance: One-way ANOVA, two-way ANOVA.

- **Curve Fitting**

Regression and correlation: simple linear regression; Least squares method; Polynomial curve fitting.

- **Design of Experiments**

Single factor experiments; Randomized block design; Factorial designs

References

1. S. P. Gupta, Statistical Methods. S. Chand & Sons, 2008
2. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley, 2006.
3. Bernard Rosner, Fundamentals of Biostatistics, 5th Edition, Thomson Brooks/Cole, 2000.

MTBT – 109

PHARMACEUTICAL BIOTECHNOLOGY

L:3 T:0 P:0

- **Pharmaceuticals, Biologics and Biopharmaceuticals**

An Overview Pharmaceutical Biotechnology; Biopharmaceuticals - Current Status and Future Prospects

- **The Drug Discovery & Development Process**

Drug Discovery: High Throughput and Rational Drug Design; Pre-clinical, IND; Drug Development: Clinical Trials; NDA; Role of Regulatory Authorities in drug approval (US and Europe)

- **Strategies for search of new lead drugs/compounds**

Improvement of Existing Drugs; Systematic Screening including High-Throughput Screening

- **Biologics**

Proteins based drugs (Sources, Structure, Folding and Stability); Therapeutic Proteins, Pharmacokinetics and Pharmacodynamics of peptides and protein, Protein Engineering, Peptidomimetics.

- **Production and formulation of Biotech Compounds**

Cultivation, Production and Purification, Downstream Processing, Excipients, Microbiological consideration, Shelflife, Doses, Therapeutic Response, Route of Drug administration, Delivery system.

- **Generics and Biosimilars**

Therapeutic Equivalence, Regulatory approval (US and Europe)

References:

1. Pharmaceutical Biotechnology: Concepts and Applications, Gary Walsh, Wiley John & Sons, Inc. (2007)
2. Biopharmaceuticals, Gary Walsh, Wiley John & Sons, Inc. (2003)
3. Pharmaceutical Biotechnology by Dann, J.A, Cremmelin & Robert D., Sindelar, Taylor & Francis (2002)
4. Biopharmaceuticals and industrial prospective, Gary Walsh & B. Murphy, Kluwer publishers (1999)

MTBT- 111

ENVIRONMENTAL ENGINEERING AND WASTE MANAGEMENT

L:3 T:0 P:0

- **Ecology and Environment:** Sources of Air, Water and Solid Wastes.
- **Air Pollution:** Micrometeorology and Dispersion of pollutants in environment. Fate of pollutants.
 - **Air Pollution Control Technologies:** Centrifugal Collectors, Electrostatics, Precipitator, Bag filter and Wet Scrubbers. Design and efficiencies. Combustion generated pollution, vehicle emission control. Case studies.
 - **Water pollution:** Water quality modeling for streams. Characterization of effluents, effluent standards.
 - **Treatment methods:** Primary methods; setting, pH control, chemical treatment. Secondary methods; Biological treatment, Tertiary treatments; like ozonization, disinfection, etc.
 - **Solid Waste Collection:** Treatment and Disposal. Waste Recovery System.
 - **Biofuels :** Microbes as source of energy
 - **Bioremediation**
 - **Environmental modelling:** Biofilter Technology, Sewage Treatment, Hospital Waste Management

References:

- Introduction to environment engineering by P.A. Vesilind, S.M. Morgan and L.G. Heine.2009,Cengage Learning
- L.Canter "Environment Impact Assessment", *McGraw Hill*.
- E.P.Odum "Fundamentals of Ecology " *V.B.Saunders and Co.* 1974.
- W.J.Weber "Physics-Chemical Process for water quality control, *Wiley-international* Ed.
- L.L.Gaccio water and water population Handbook *Marcel Dekkar*, New York
- Microbial Biotechnology:Fundamentals of Applied Microbiology, A.N. Glazer and Hiroshi Nikaido, 1995

MTBT – 113

BIOMOLECULES AND MICROBIAL BIOTECHNOLOGY LAB

1. Isolation of industrially important micro organisms for microbial processes.
2. Determination of phenol coefficient.
3. Strain Improvement Techniques
4. Production and estimation of alkaline protease, Microbial production of antibiotics (Penicillin)
5. Microbial production of organic acids
6. Degradation of toxic compounds by microbes
7. Proteins: Separation of proteins by SDS-PAGE.
8. Biochemical estimation of DNA by diphenylamine reagent,
9. Biochemical estimation of RNA by orcinol reagent.
10. To check purity of DNA.
11. Separation of DNA samples on Agarose gel.

MTBT-115

BIOPROCESS ENGINEERING AND TECHNOLOGY LAB

1. Study of the Rheology of the fermentation fluids.
2. Study of the fermentation by using both shake flask method and lab bioreactor.
3. Determination of growth curve of a supplied micro organism and also determine substrate degradation profile and to compute specific growth rate and growth yield from the data obtained.
4. Comparative studies of ethanol production using different substrates,
5. Conventional filtration and membrane based filtration

6. Chromatographic techniques (paper – ascending and descending, TLC, Column)