



2-Year Master of Science (M.Sc.) Curriculum and Syllabus for Biotechnology

First Semester

M.Sc. Syllabus Biotechnology 1st Year 1st Semester					
Course code	Course Title	L	P	T	Total Credits
TIU-PBT-T103	Biochemistry	3	0	0	3
TIU-PBT-T105	Molecular Biology	3	0	0	3
TIU-PBT-T117	Environmental Science	3	0	0	3
TIU-PBT-T115	Cell Biology and Signaling	3	0	0	3
TIU-PBT-L103	Biochemistry Lab	0	2	0	2
TIU-PBT-L111	Molecular Biology Lab	0	2	0	2
TIU-PBT-L109	Bioinformatics Lab	0	2	0	2
TIU-PBT-S199	Industrial Visit	0	1	0	1
TIU-PES-S199	Entrepreneurship Skill Development	0	2	0	2
TIU-PEN-T101	Career Advancement Skill Development	3	0	0	3
	Total Credit	18	8	0	27

Detailed M.Sc. Syllabus Biotechnology 1st Year 1st Semester

TIU-PBT-T103: Biochemistry

Unit-I: Water as universal solvent, pH, Buffer, Blood Buffer, colloidal solution, osmosis and its Maintenance, Solution (Normality, Molarity etc.).

Unit-II: Cell membrane (Fluid Mosaic Model, Membrane Fluidity), Membrane Transport.

Unit-III: Structural and Functional details of: Carbohydrate, Protein, Fat, Nucleic Acid, Vitamins and Hormones. Structure and function: Hemoglobin, Myoglobin, Chlorophyll.



Unit-IV: Antioxidant and Redox Signaling, Oxidative stress related disease, Medicinal foods.

TIU-PBT-T105: Molecular Biology

Unit I: DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, and DNA damage and repair mechanisms.

RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl-tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins.

Unit II: Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

Unit III: Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

Unit IV: Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.

TIU-PBT-T115: Cell Biology and Signaling

Unit I: Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. **Structural organization and function of intracellular organelles:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

Unit II: Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. **Cell signaling:** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers,



regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

Unit III: Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. **Cancer:** Oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

TIU-PBT-T117: ENVIRONMENTAL SCIENCE

UNIT I: Environment- Basic concepts and issues; Environmental pollution: types of pollution, measurement of pollution; Methodology of environmental management - the problem solving approach, its limitations. Biodegradation: Biodegradation of pollutants by microorganisms: Persistent organic pollutants; non biological degradation of pollutants: Decay behaviour & degradative plasmids; Hydrocarbons, Substituted hydrocarbons, Oil pollution, Surfactant. Bioremediation: definition; types; notable examples; Xenobiotics in environment: Biodegradation of Hydrocarbons; Substituted hydrocarbons; Surfactant; Pesticides; Lignin; Tannin; Synthetic dyes; Biotransformation: Oxidation reactions: Cytochrome P450 monooxygenase system; Alcohol and aldehyde dehydrogenases; Peroxidases. Reduction reactions: Cytochrome P450 and flavin dependent reactions. Hydrolysis reactions: Carboxyl esterases. Conjugation reactions: Glutathione S transferases. Regulation of biotransformation

Unit II: Water pollution and its Control : Water as a scarce natural resource; Need for water management; Measurement of water pollution; Sources of water pollution; Wastewater collection; Wastewater treatment-physical, chemical and biological treatment processes, Microbiology of wastewater treatments; Aerobic processes: Activated sludge, Oxidation ditches, Trickling filter, Towers, Rotating discs, Rotating drums, Oxidation ponds; Anaerobic processes: Anaerobic processes; Anaerobic digestion, Anaerobic filters, Upflow anaerobic sludge blanket reactors; Treatment schemes for wastewaters of dairy, distillery, sugar, antibiotic industries. Solid wastes; Sources and management: composting, wormiculture and methane production, Food, feed and energy from solid waste (biomass and agrowastes)

Unit III: Global Environmental Problems: Ozone depletion, UV-B and greenhouse effect, Acid rain, its impact and biotechnological approaches for management. Biodiversity and biotechnology: Classification and quantification of biodiversity; Value; loss and conservation of Biodiversity. Biotechnological methods of conservation: Cryopreservation and micropropagation. Environmental Monitoring and Impact Assessment: Biological monitoring program; bioindicators, Environmental Audit: Introduction; Types; General Methodology; Environmental Laws: Problems in making and implementing environmental laws; Indian environmental laws; national environmental policy (draft) 2004; GIS and remote sensing



Unit IV: Biosafety: Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena . **Environmental Problems:** Ozone depletion, UV-B and greenhouse effect, Acid rain, its impact and biotechnological, and approaches for management. **Biodiversity and biotechnology:** Classification and quantification of biodiversity; Value; loss and conservation of Biodiversity. Biotechnological methods of conservation: Cryopreservation and micropropagation. **Environmental Monitoring and Impact Assessment:** Biological monitoring program; bioindicators, Environmental Audit: Introduction; Types; General Methodology; Environmental Laws: Problems in making and implementing environmental laws; Indian environmental laws; national environmental policy (draft) 2004; GIS and remote sensing

TIU-PBT-L103: Biochemistry Lab

- Concept of Normality, Molarity, Molality, Percentage solutions and their inter-conversion
- Operation of pH meter and pHing buffers
- Isoelectric point determination of amino acids
- Introduction to spectrophotometer, absorption maxima
- Estimation of nucleic acids, amino acids, proteins, carbohydrates and fats
- Separation of amino acids by Paper chromatography and TLC

TIU-PBT-L111: Molecular Biology Lab

- Isolation of genomic DNA from bacteria
- Isolation of genomic DNA from plant
- Isolation of genomic DNA from animal cells
- Isolation of plasmid DNA from bacteria
- Agarose gel electrophoresis of genomic and plasmid DNA
- Karyotyping of mammalian cells
- Cell Fractionation (Demonstration)



TIU-PBT-L109: Bioinformatics Lab

- 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

Advanced Biological Chemistry

- 1. Principles of Biochemistry (2008). Lehninger A.L. (ed.)**
- 2. Biochemistry. (2002). Stryer, L.**
- 3. Principles of Biochemistry. (1995). Zubay, G.L., Parson, W.W. & Vance, D.E.**
- 4. Harper's Biochemistry.(1990). Murray, R.K. et al**
- 5. Biochemistry. (2004). Voet, D. & Voet J.G.**
- 6. Biochemistry and Molecular Biology.(2005). Elliott, W.H. & Elliott, D.C.**
- 7. Fundamentals of Biochemistry. (1999). Voet, D., Voet, J. & Pratt, C.W.**
- 8. Introduction to Protein Structure (1999). Branden C. & Tooze J.**

Molecular Biology

- 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. Molecular Biology of the Cell (2002) Alberts. et al.**
- 7. Molecular Biology of the Gene (2008) Watson et al.**
- 8. Cell and Molecular Genetics (1987) Schlessel, R.**
- 9. Microbial Genetics (2006). S. Maloy, J. Cronan Jr and Friefelder, D**
- 10. Concept of Genetics (2002). Klug, W.S. & Michael, R & Cummins, M.R.**

CELL BIOLOGY AND CELL SIGNALLING

- 1. Molecular Biology of the Cell (2002) Alberts. et al.**
- 2. Molecular Biology of the Gene (2008) Watson et al.**
- 3. Cell and Molecular Genetics (1987) Schlessel, R**