



**4-Year Bachelor of Technology (B.Tech.) Curriculum and
Syllabus for Biotechnology
Seven Semester**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIU-UBT-T401	CAREER ADVANCEMENT & SKILL DEVELOPMENT(JOURNAL CLUB)	1	0	2	3
TIU-UBT-E401	ELECTIVE 1: CELL SIGNALLING AND EUKARYOTIC GENE EXPRESSION	3	0	0	3
TIU-UBT-E403	ELECTIVE 2: CLINICAL AND PHARMACEUTICAL BIOTECHNOLOGY	3	0	0	3
TIU-UBT-E405	ELECTIVE 3: AGRICULTURAL BIOTECHNOLOGY	3	0	0	3
TIU-UBT-E407	ELECTIVE 4: MOLECULAR IMMUNOLOGY	3	0	0	3
TIU-UBT-E409	ELECTIVE 5: RECOMBINANT DNA TECHNOLOGY AND PROTEIN ENGINEERING	3	0	0	3
TIU-UBT-T415	IPR AND TECHNOLOGY MANAGEMENT	3	0	0	3
TIU-UBT-T417	METHODS IN BIOLOGY	3	0	0	3
Practical					
TIU-UBT-P499	PROJECT WORK/INDUSTRIAL TRAINING	0	0	10	10
Sessional					
TIU-UES-S497	TRAINING (JUNE-JULY)	0	0	2	2
TIU-UES-S499	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
Total Credits					26

- B. Tech students have to take 1 elective subject.



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ELECTIVE 1: CELL SIGNALLING AND EUKARYOTIC GENE EXPRESSION

TIU-UBT-E401

L-T-P: 3-0-0

Credits: 3

Unit I: Cell signalling Basics: Receptors, Inducers, Agonists, Antagonists, Regulation of gene expression. Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, bacterial and plant two-component signalling systems, bacterial chemotaxis and quorum sensing.

Unit II: Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, neurotransmission and its regulation.

Unit III: Cancer: Genetic rearrangements in progenitor cells, 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, Signalling Immunology

ELECTIVE 2: CLINICAL AND PHARMACEUTICAL BIOTECHNOLOGY

TIU-UBT-E403

L-T-P: 3-0-0

Credits: 3

Unit I: Basic Pharmacology: General Pharmacological Principle; Definition, Routes of drug administration; Pharmacokinetics: Transport through biological membrane; Basic concept of ADME; Pharmacodynamics: Principle of drug action, Mechanism of drug action, Factors modifying drug action; Adverse drug effect.

Unit II: Drug Designing: Fundamentals of drug designing, The Pharmacophore, The Drug Discovery: Combinatorial Chemistry, Structure based design, QSAR and drug design, Computational Drug design, Example of drug design, Limitation of De Novo design, Example of different Rational Drug Design Software, Future perspectives. Chiral Technology: Introduction, Chiral compounds: synthesis of chiral compounds, Separation of Enantiomers, Importance of Enantiomer separation. Role of Chiral compounds Marketing, Role of Biotechnology in Chiral synthesis.



Unit III: Molecular Pharming: Introduction, Creating transgenics, Biopharmaceuticals: Generation of Vaccine. Pharmacogenomics: Introduction, Identification of drug responsive genes, Microarray Gene Chips, Pharmacogenomics of multigenic diseases: Coronary Artery Disease, Schizophrenia, And Cancer. Benefits of Pharmacogenomics. Herbal Drug Development: Introduction to natural products, definition and types of principle bioactive components, Antioxidant Redox Signalling and Cellular Longevity. Benefits of herbal drugs over other therapeutic approaches. Current Research on herbal drug development

ELECTIVE 3: AGRICULTURAL BIOTECHNOLOGY

TIU-UBT-E405

L-T-P: 3-0-0

Credits: 3

Unit I: DNA molecular markers; Principles, type and applications; RFLP, AFLP, RAPD, SSR, SNP, Structural and functional genomics, gene mapping, genome mapping, gene tagging and comparative genomics and applications, Restriction enzymes and their uses, Salient features of most commonly used vectors i.e. plasmids, bacteriophages, phagmids, cosmids, BACs and PACs, YACs, binary vectors, expression vectors, Gene cloning and sub-cloning strategies, chromosome walking, genetic transformation, Risk assessment and IPR

Unit II: Isolation of genes of economic importance, Gene construction for tissue-specific expression, Different methods of gene transfer to plants, *viz.* direct and vector-mediated, Molecular analysis of transformants, Molecular biology of various stresses like drought, salt, heavy metals and temperature, and biotic stresses like bacterial, fungal and viral diseases, Signal transduction and its molecular basis, Potential applications of plant genetic engineering for crop improvement, i.e. insect-pest resistance, abiotic stress resistance, herbicide resistance, storage protein quality, increasing shelf-life, oil quality, Current status of transgenics, biosafety norms and controlled field trials and release of transgenics (GMOs)

Unit III: Basic techniques in cell culture and somatic cell genesis, Clonal propagation, Concept of cellular totipotency, Anther culture, Somaclonal and gametoclonal variations, Hybrid embryo culture and embryo rescue, Somatic hybridization and cybridization, Application of tissue culture in crop improvement, Secondary metabolite production, Bioprospecting, Biofortification, Gene pyramiding and gene fusion, RNAi technology, *In vitro* mutagenesis, cryopreservation and plant culture repository



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ELECTIVE 4: MOLECULAR IMMUNOLOGY

TIU-IBT-E407

L-T-P: 3-0-0

Credits: 3

Module I: Immune signal transduction, Immune endocytosis, Immune cell motility, Cell stress response

Module II: Communication between cells of immune systems, adhesion molecules, cytokines.

Module III: Immunity against tumors, host-parasite interactions

Module IV: Cell signaling in current diagnostics and treatment

ELECTIVE 5: RECOMBINANT DNA TECHNOLOGY AND PROTEIN ENGINEERING

TIU-UBT-E409

L-T-P: 3-0-0

Credits: 3

Module I: Protein stability and folding: Overview of protein structure, Higher level structure, Protein stability, Mechanism of protein folding (types, level, thermodynamics), Folding Rate, Molten globule; Techniques for studying of protein folding:: NMR, CD spectroscopy, Proteolysis; Location and functions of Molecular chaperones, chaperonin and co-chaperons, HSP chaperone system in *Ecoli* & Human; Proteasomes and proteosome mediated protein degradation; Protein folding errors: Alzheimer's, prions and Mad Cow (BSE, CJD), Cystic Fibrosis and cancer. Polyketides and non-ribosomal peptides; Combinational manipulation of polyketides and non ribosomal peptides; application of protein folding to design new drug. Determination of secondary structure- UV, CD and fluorescence Determination of quaternary structure - X-ray, Cryo TEM; Functional proteins - Hemoglobin and some well characterized enzymes / lectins / peptide hormones; Chemical modifications

Module II: Protein engineering: Introduction to steps of Protein design and Engineering, protein splicing and its application; Solid phase peptide synthesis, Production of Novel Proteins; Random and site directed mutagenesis, Methods for Expressing Recombinant Proteins; Industrial applications of Protein Engineering (Engineering of Stability, affinity for substrate, Protease Specificity, Cofactor requirements of Protein). Structure-function correlations in the context of protein ligand interactions & protein protein/nucleic acid/carbohydrate interactions.



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Module III: Proteomics: Introduction to proteomics; Two dimensional electrophoresis (2-D PAGE): Protein pre-fractionation and sample preparation, IEF, SDS-PAGE, visualization of protein spot. Protein identification by mass spectrometry: ESI-TOF, MALDI-TOF, MS/MS, PMF, protein sequencing; Post translational modification, Application of proteome analysis; Proteomics in Drug Development; Diagnosis of diseases by Proteomics; Protein array; Discovery of new biomarker; identification of protein-protein interactions and protein complexes; proteomics in drug delivery.

IPR AND TECHNOLOGY MANAGEMENT

TIU-UBT-T415

L-T-P: 3-0-0

Credits: 3

Unit I: Introduction to Intellectual Property, Copyright, Related Rights, Trademarks

Unit II: Geographical Indications, Industrial Design, Patents

Unit III: WIPO Administered Treaties on International Registration Systems and the PCT, Unfair competition, Protection of New Varieties of Plants, Intellectual Property and Development

ADVANCED BIOLOGICAL TECHNIQUES-I

TIU-IBT-P499

L-T-P: 3-0-0

Credits: 3

- Electrophoresis and Blotting Techniques
- Chromatographic techniques and mass spectrometry
- PCR based techniques RT PCR and Q PCR)
- DNA Sequencing
- Cell culture Techniques (plant Tissue Culture, Animal cell Culture)

BOOK LIST

BIOSAFETY, BIOETHICS AND IPR

1. Intellectual property rights in Biotechnology. A status report (1993). Singh, K.
2. Biotechnology and Patent laws: patenting living beings (2008) Sreenivasulu, N.S. and Raju C.B. Manupatra Publishers.
3. Patents for Chemicals, Pharmaceuticals and Biotechnology: Fundamentals of Global Law, Practice and



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Strategy (2010)

Grubb P. W. Grubb, P. L. Thomsen, P. R. Oxford University Press.

4. Patent law in Biotechnology, chemicals & pharmaceuticals. (1994) Harold C. Wegner Stockton Press
5. A User's Guide to Patents (2007) Trevor M. Cook. Tottel Publishing.
6. Intellectual property law (2008) Lionel Bently, Brad Sherman. Oxford University Press.
7. Biosafety and bioethics (2006) Rajmohan Joshi. Gyan Publishing House.
8. Laboratory biosafety manual. (2004). World Health Organization. WHO press, 2004.
9. Biological safety: principles and practices (2000) Diane O. Fleming, Debra Long Hunt. ASM Press.
10. CRC handbook of laboratory safety. (2000) A. Keith Furr. CRC Press.

PROTEIN CHEMISTRY AND PROTEIN ENGINEERING

1. R.M. Twyman ; Principles of Proteomics, Bioscientific Publishers^[SEP]

2. Daniel C. Liebler, Introduction to Proteomics: Tools for the New Biology, Humana Press

3. B. Alberts, D. Bray, J. Lewis et al, Molecular Biology of the Cell, Garland Pub. N.Y 1983^[SEP]

4. Richard J. Simpson, Proteins and Proteomics, I.K. International Pvt Ltd^[SEP]

5. Branden, C., Tooze, R., Introduction of Protein structure, Garland, 1st Edition, 1993.^[SEP]

6. Lilia Alberghina., Protein Engineering in Industrial Biotechnology, Harwood Academic publishers, 2003

7. Biochemistry & Molecular Biology Practical by Wilson and Walker

8. Protein engineering and design by Paul R. Carey, academic press, 1996, 361 pages.

9. Introduction to Protein Structure (Garland Press, Second Edition), by Carl Branden and John

Tooze.

10. Introduction to protein structure by Thomas Creighton^[SEP] DNA structure and function by R.

Sinden^[SEP] Nucleic Acids: Structures, Properties, and Functions (University Science Books) edited
by Victor Bloomfield, Donald Crothers, and Ignacio Tinoco