



# Syllabus for B.Tech/Integrated M.Tech- Biotechnology

Last Edited and Passed  
through BOS: 30<sup>th</sup> Aug, 2019



**CORE STRUCTURE OF SYLLABUS FOR FOUR  
YEAR (EIGHT SEMESTER) B.TECH  
BIOTECHNOLOGY AND FIVE YEAR (TEN  
SEMESTER) INTEGRATED M.TECH  
BIOTECHNOLOGY**

**2<sup>ND</sup> YEAR (3<sup>RD</sup> SEMESTER)**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UEN-T201	CAREER ADVANCEMENT & SKILL DEVELOPMENT	0	0	2	2
TIU-UBT-T203	MICROBIOLOGY	3	0	0	3
TIU-UBT-T205	BIOCHEMISTRY	3	0	0	3
TIU-UBT-T207	ENVIRONMENTAL BIOTECHNOLOGY	3	0	0	3
TIU-UBT-T209	MOLECULAR BIOLOGY	3	0	0	3
TIU-UBT-T212	CELL BIOLOGY	3	0	0	3
<b>Practical</b>					
TIU-UBT-L203	MICROBIOLOGY LABORATORY	0	0	1.5	1.5
TIU-UBT-L205	BIOCHEMISTRY LABORATORY	0	0	1.5	1.5



Sessional					
TIU-UES-S299	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
Total Credits					22/18

**2<sup>ND</sup> YEAR (4<sup>TH</sup> SEMESTER)**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIU-UEN-T200	CAREER ADVANCEMENT & SKILL DEVELOPMENT	0	0	2	2
TIU-UBT-T202	GENETIC ENGINEERING	3	0	0	3
TIU-UBT-T204	IMMUNOTECHNOLOGY	3	0	0	3
TIU-UBT-T206	BIOPROCESS ENGINEERING	3	0	0	3
TIU-UBT-T216	NANOTECHNOLOGY & BIOMATERIAL SCIENCE	3	0	0	3
Practical					
TIU-UBT-L202	GENETIC ENGINEERING LABORATORY	0	0	1.5	1.5
TIU-UBT-L204	IMMUNOTECHNOLOGY LABORATORY	0	0	1.5	1.5
Sessional					
TIU-UES-S298	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
Total Credits					19/15

**3<sup>RD</sup> YEAR-5<sup>TH</sup> SEMESTER**



Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UBT-T301	<b>CAREER ADVANCEMENT &amp; SKILL DEVELOPMENT(BIO-COMPUTING I)</b>	0	0	2	2
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	1.5	1.5
TIU-UBT-L307	BIOSEPARATION TECHNOLOGY LABORATORY	0	0	1.5	1.5
<b>Sessional</b>					
TIU-UES-S399	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>22/18</b>



**3<sup>RD</sup> YEAR-6<sup>TH</sup> SEMESTER**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UBT-T300	CAREER ADVANCEMENT & SKILL DEVELOPMENT( <b>BIO-COMPUTING II</b> )	0	0	2	2
TIU-UBT-T314	PLANT BIOTECHNOLOGY	3	0	0	3
TIU-UBT-T322	MOLECULAR DIAGNOSTICS	3	0	0	3
TIU-UBT-T318	REGULATION OF GENE EXPRESSION	3	0	0	3
TIU-UBT-T320	<b>FOOD &amp; PHARMACEUTICAL BIOTECHNOLOGY</b>	3	0	0	3
<b>Practical</b>					
<b>TIU-UBT-L316</b>	<b>GENETICS &amp; BIOSTATISTICS LABORATORY</b>	0	0	1.5	1.5
TIU-UBT-L314	PLANT BIOLOGY LABORATORY	0	0	1.5	1.5
<b>Sessional</b>					
TIU-UES-S398	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>19/15</b>



**4<sup>TH</sup> YEAR-7<sup>TH</sup> SEMESTER (B.TECH)**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UBT-T401	CAREER ADVANCEMENT & SKILL DEVELOPMENT (Competitive Exam Preparation)	0	0	2	2
TIU-UBT-T407	BIOSAFETY, BIOETHICS AND IPR	3	0	0	3
TIU-UBT-T417	METHODS IN BIOLOGY	3	0	0	3
<b>Practical</b>					
TIU-UBT-P499	PROJECT WORK	0	0	10	10
<b>Sessional</b>					
TIU-UES-S497	TRAINING	0	0	2	2
TIU-UES-S499	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>22/18</b>

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

Course code	SPECIAL PAPER
	ELECTIVE 1: Environmental Pollution/ GIS & REMOTE SENSING
	ELECTIVE 2: Cellular and Molecular Immunology, Immunoproteomics & Bioinformatics
	ELECTIVE 3: Pharmaceutical Biotechnology (Phytochemistry, Phytopharmacology, Medicinal Chemistry and Nanobiotechnology)
	ELECTIVE 4: Protein Structure & Function Study
	ELECTIVE 5: Environmental Microbiology & Biotechnology
	ELECTIVE 6: Agriculture Biotechnology & Bioinformatics



**ELECTIVE 7: Plant Molecular Biology, Biotechnology & Tissue Culture**

**4<sup>TH</sup> YEAR-7<sup>TH</sup> SEMESTER (INTEGRATED M.TECH)**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UBT-T401	CAREER ADVANCEMENT & SKILL DEVELOPMENT (Competitive Exam Preparation)	0	0	2	2
TIU-UBT-T407	BIOSAFETY, BIOETHICS AND IPR	3	0	0	3
TIU-UBT-T417	METHODS IN BIOLOGY	3	0	0	3
<b>Practical</b>					
TIU-UBT-P499	PROJECT WORK	0	0	10	10
<b>Sessional</b>					
TIU-UES-S497	TRAINING	0	0	2	2
TIU-UES-S499	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>22/18</b>

- Integrated M. Tech students have to take 3 elective subjects.

Course code	SPECIAL PAPER
	ELECTIVE 1: Environmental Pollution/ GIS & REMOTE SENSING
	ELECTIVE 2: Cellular and Molecular Immunology, Immunoproteomics & Bioinformatics
	ELECTIVE 3: Pharmaceutical Biotechnology (Phytochemistry, Phytopharmacology, Medicinal Chemistry and Nanobiotechnology)
	ELECTIVE 4: Protein Structure & Function Study



	<b>ELECTIVE 5: Environmental Microbiology &amp; Biotechnology</b>
	<b>ELECTIVE 6: Agriculture Biotechnology &amp; Bioinformatics</b>
	<b>ELECTIVE 7: Plant Molecular Biology, Biotechnology &amp; Tissue Culture</b>

**4<sup>th</sup> year-8<sup>th</sup> SEMESTER (B.TECH)**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UBT-T400	CAREER ADVANCEMENT & SKILL DEVELOPMENT (GRAND VIVA)	0	0	2	2
<b>Practical</b>					
TIU-UBT-P498	PROJECT WORK	0	0	15	15
<b>Seasonal</b>					
TIU-UES-S498	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>19/15</b>

**4<sup>TH</sup> YEAR-8<sup>TH</sup> SEMESTER (INTEGRATED M.TECH)**

Course Code	Course Title	Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UBT-T400	CAREER ADVANCEMENT & SKILL DEVELOPMENT (GRAND VIVA)	0	0	2	2
<b>Practical</b>					
TIU-IBT-P498	PROJECT WORK	0	0	15	15
TIU-IBT-P500	ADVANCED BIOLOGICAL TECHNIQUES-II	0	0	3	3
<b>Sessional</b>					





TIU-IES-S498	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>19/15</b>

**5<sup>TH</sup> YEAR-9<sup>TH</sup> SEMESTER (INTEGRATED M.TECH)**

Course Code	Course Title	Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-IBT-T501	DEPARTMENTAL CASD: REVIEW WRITING & PRESENTATION	0	0	2	2
<b>Practical</b>					
TIU-IBT-P599	PROJECT WORK	0	0	18	18
<b>Sessional</b>					
TIU-IES-S599	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>22/18</b>

**5<sup>TH</sup> YEAR-10<sup>TH</sup> SEMESTER (INTEGRATED M.TECH)**

Course Code	Course Title	Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-IBT-T502	DEPARTMENTAL CASD: RESEARCH METHODOLOGY	0	0	2	2
<b>Practical</b>					
TIU-IBT-P598	PROJECT WORK	0	0	18	18
<b>Sessional</b>					
TIU-IES-S598	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>22/18</b>



**2<sup>ND</sup> YEAR (3<sup>RD</sup> SEMESTER)**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UEN-T201	CAREER ADVANCEMENT & SKILL DEVELOPMENT	1	0	2	3
TIU-UBT-T203	MICROBIOLOGY	3	0	0	3
TIU-UBT-T205	BIOCHEMISTRY	3	0	0	3
TIU-UBT-T207	ENVIRONMENTAL BIOTECHNOLOGY	3	0	0	3
TIU-UBT-T209	MOLECULAR BIOLOGY	3	0	0	3
TIU-UBT-T212	CELL BIOLOGY	3	0	0	3
<b>Practical</b>					
TIU-UBT-L203	MICROBIOLOGY LABORATORY	0	0	2	2
TIU-UBT-L205	BIOCHEMISTRY LABORATORY	0	0	2	2
TIU-UBT-L207	LABORATORY SAFETY AND MANAGEMENT	0	0	1	1
<b>Sessional</b>					
TIU-UBT-S299	INDUSTRIAL VISIT	0	0	1	1
TIU-UES-S299	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>26</b>



## **MICROBIOLOGY**

**TIU-UBT-T203**

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

**Credits 3**

**Module I:** Microbial taxonomy including modern approaches such as DNA homology and numerical taxonomy, staining and microscopy, classification of bacteria, introduction to virus, viroids, prion proteins.

**Module II:** Morphology and cell structure of prokaryotes and eukaryotes (bacteria, fungi, algae and viruses), bacterial growth and reproduction, bacterial genetics (transformation, conjugation and transduction), mutation, bacterial growth and reproduction, sporulation and cell differentiation, microbial metabolism: nutrition; media and methods; Antibiotics.

**Module III:** Nitrogen Sulphur and Phosphorus cycle. Air, water and soil microbiology. Common microbial diseases.

## **BIOCHEMISTRY**

**TIU-UBT-T205**

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

**Credits: 3**

**Unit I: Introduction to biochemistry:** pH, buffer, classical thermodynamics, entropy, enthalpy, Gibbs free energy.

**Unit II: Structure function of biomolecules:** Composition, structure and function of biomolecules: nucleic acids (A, B, Z forms), amino acids, proteins (Ramachandran plot, folding secondary, tertiary and quaternary structure; domains; motif and folds (Myoglobin, Hemoglobin, Lysozyme, Ribonuclease A, Carboxypeptidase and Chymotrypsin), carbohydrates, lipids, hormones and vitamins.

**Unit III: Metabolism of biomolecules:** Metabolism: carbohydrates (glycolysis, citric acid cycle and oxidative phosphorylation, lipid, amino acid and nucleotide metabolism, photosynthesis.

## **ENVIRONMENTAL BIOTECHNOLOGY**

**TIU-UBT-T207**

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

**Credits: 3**

**Module: Introduction:** Biodiversity and Conservation. Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental laws and rules, standards for ambient air, noise, emission and effluents, use of GIS and remote sensing in environmental monitoring, environment and forestry



**Module II: Bioremediation:** Bioremediation: definition; types; notable examples; bioremediation of xenobiotics present in environment, biodegradation: biodegradation of pollutants by microorganisms, biotransformation reaction, bioremediation of hydrocarbons and heavy metals from environment

**Module III: Pollution control:**

**Air Pollution and its control:** Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, design of cyclones, ESP, fabric filters and absorbers.

**Water Pollution and its Control:** Sources of water pollution waste water management by physical, chemical and biological methods, pre-treatment, solids removal by setting and sedimentation, filtration centrifugation, coagulation and flocculation; activated sludge and lagoons, trickling filter.

**Soil pollution and its control:** Application of different ex situ and in situ methods of remediation, solids waste disposal - composting, landfill, briquetting/gasification and incineration

## MOLECULAR BIOLOGY

TIU-UBT-T209

L-T-P: 3-0-0

Credits: 3

**Unit I: DNA replication, repair and recombination:** Hershey Chase Experiment, Messelson and Stahl Experiment, Unit of replication, enzymes involved, replication origin, replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.

**Unit II: 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.

**Unit III: 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 protein.

## CELL BIOLOGY

TIU-UBT-T212

L-T-P: 3-0-0

Credits: 3

**Unit I:** Structure of cell: Cell wall and cell membrane, cellular organelles (nucleus, mitochondria, golgi apparatus, ER, lysosomes etc) and their structure and function.



**Unit II:** Cell  
chromosomes and chromatin structure.

cycle and check points, cell division,

**Unit III:** Brief introduction to cancer and stem cells.

## **MICROBIOLOGY LABORATORY**

**TIU-UBT-L203**

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

**Credits: 2**

- Preparation of media and slants for bacterial culture
- Isolation of pure culture in slant techniques and by streak plate techniques
- Dilution plating for viable count
- Simple staining and gram staining of bacteria
- Biochemical Characterization of Bacteria: Catalase, Oxidase and Urease Tests,
- Antibiotic Assay (Disc Diffusion Method)

## **BIOCHEMISTRY LABORATORY**

**TIU-UBT-L205**

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

- Concept of Normality, Molarity, Molality, Percentage solutions and their inter-conversion
- Operation of pH meter and pH 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

## **LABORATORY SAFETY AND MANAGEMENT**

**TIU-UBT-L207**

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

**Credits: 1**

- Chemical and Reagent Grouping
- Personal Safety
- Standard Operating Principles
- Chemical Safety
- Biological Safety



## **Book list**

### **Biochemistry**

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.G & Pratt, C.W.
8. Introduction to Protein Structure (1999). Branden C. & Tooze J.

### **Fundamentals of Microbiology**

1. Brock's Biology of microorganisms. (2007). Madigan, M., Martinko & Parker, J. Pearson Prentice Hall
2. Microbiology: Fundamentals and Applications. (1989). Atlas, R.M.
3. Microbiology (1996). M J Pelezar, Chan E C S and Krige
4. Industrial Microbiology. (1987). G Reed, Prescott & Dunn, CBS Publishers.
5. General Microbiology. (1987). Stanier, R.Y., Ingraham, Wheelis and Painter

### **Environmental Biotechnology**

1. Environmental Biotechnology Theory and applications – Evans et al., 2000.
2. Environmental Biotechnology – Gareth M. Evans et al., 2003
3. Biotechnology, Recombinant DNA Technology, Environmental Biotechnology – S. Mahesh et al., 2003

### **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) Schlesf, R.
9. Microbial Genetics (2006). S. Malov, J. Cronan Jr and Friefelder, D
10. Concept of Genetics (2002). Klug, W.S. & Michael, R & Cummins, M.R.

### **CELL BIOLOGY**

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) Schlesf, R.



**2<sup>nd</sup> year-4<sup>TH</sup> SEMESTER**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UEN-T200	CAREER ADVANCEMENT & SKILL DEVELOPMENT	1	0	2	3
TIU-UBT-T202	GENETIC ENGINEERING	3	0	0	3
TIU-UBT-T204	IMMUNOTECHNOLOGY	3	0	0	3
TIU-UBT-T206	BIOPROCESS ENGINEERING	3	0	0	3
TIU-UBT-T214	NANOTECHNOLOGY	3	0	0	3
<b>Practical</b>					
TIU-UBT-L202	GENETIC ENGINEERING LABORATORY	0	0	3	3
TIU-UBT-L204	IMMUNOTECHNOLOGY LABORATORY	0	0	3	3
<b>Sessional</b>					
TIU-UBT-S298	INDUSTRIAL VISIT	0	0	3	3
TIU-UES-S298	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>26</b>



## **GENETIC ENGINEERING**

**TIU-UBT-T202**

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

**Credits: 3**

**Unit I:** Restriction and modification enzymes (types and mechanism of action), vectors and plasmids (bacteriophage, viral vectors, cosmids, Ti plasmid, YAC, BAC, mammalian and plant expression vectors), siRNA technology.

**Unit II: Polymerase chain reaction** and its types, random primers, cloning and expression, cDNA libraries, screening of cDNA and genomic libraries, synthesis and labeling of DNA and RNA probes, nick translation, end labeling, hybridization probe method, antibody screening, southern, western and northern hybridization.

**Unit III:** DNA sequencing-Maxam-Gilbert, Sanger's method and Deep sequencing, Site directed mutagenesis, genetic transformation, transgene silencing, RAPD, RFLP, AFLP.

**Unit IV:** Applications of genetic engineering: drug development, stability of enzymes (heat stability)

## **IMMUNOTECHNOLOGY**

**TIU-UBT-T204**

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

**Credits: 3**

**Unit I:** Introduction, innate and acquired immunity, active, passive and adoptive immunization, complement system, clonal selection theory, humoral and cellular Immunity, Regulation of Immune response, Cellular responses, primary and secondary lymphoid organs, activation and function of T and B cells, role of Major Histocompatibility Complex (MHC) in antigen processing and presentation.

**Unit II:** Infection and immunity, host defence against various classes of pathogen, mechanism by which pathogens evade immune responses, active and passive immunization.

**Unit III:** Transplantation, relationship between donor and recipient, role of MHC molecules in Allograft rejection, Autoimmunity, criteria and causes of autoimmune diseases-(Autoimmune hemolytic anemia, myasthenia gravis, systemic lupus erythematosus, multiple sclerosis, rheumatoid arthritis), hypersensitivity (Type I, II, III, IV), Immune Tolerance.





## **BIOPROCESS ENGINEERING**

**TIU-UBT-T206**

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

**Credits: 3**

**Unit I:** Basics on fermentation technology, different types of fermenters, Characteristics of fermentation broth and by-products, Optimization and modelling of fermentation process – single variable design, multivariate screening designs, critical factor analysis, optimization designs for two or more factor, singlet method; Metabolic and flux control analysis.

**Unit II:** Bioreactor design and operation: classification of reactors; Ideal mixed v/s plug flow reactor; designing parameters for reactors (stirred tank reactor, airlift reactor, plug flow reactor), rheology of fermentation broth, Bioreactor design and operation: gas-liquid mass transfer, heat transfer, analysis of dimension less parameters and their application (aeration number, power number and Reynold's number; Scale-up of bioprocesses: parameters used in scale-up and problems associated with scale-up.

**Unit III:** Engineering principle of bio processing- Upstream production and downstream; Bioprocess design and development from lab to industrial scale; Microbial, animal and plant cell culture platforms.

## **NANOTECHNOLOGY**

**TIU-UBT-T214**

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

**Credits: 3**

**Unit I:** Introduction to nanoscience and nanotechnology; Concept of 3D, 2D, 1D and 0D nano particles and their behaviour, Different important types of nanoparticles: Quantum Dot, Nanowire, Nanotube, Nanocage, Buckminster fullerene etc. Synthesis and characterization of nanoparticles and nano-structured machinery, Top Down and Bottom Up Approach, Scanning probe microscopy (SPM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM). Photoreceptors as single photon optical detector; manipulating redox systems application in nanotechnology.

**Unit II:** Introduction to Bio-nanotechnology, naturally found nanoparticles, Molecular motors: natural molecular motors like myosin, kinesin, dynein, flagella, ATP synthase, RNA and DNA helicases, topoisomerases etc. Ion channels as molecular switches.

**Unit III:** Introduction to Nanomedicine, Application of Nanomedicine; Biosensors; Biodegradable nanoparticles for drug and gene delivery to cells and tissues: liposome, dendrimer, gold nano particle, silver



nano particle.

Smart Drugs, DNA based nano devices, Nanorobotics, Nanomedical Diagnosis and treatment. Improved Human Abilities; Chromosome Replacement Therapy.

## **GENETIC ENGINEERING LABORATORY**

**TIU-UBT-L202**

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

**Credits: 3**

- Isolation of genomic DNA from bacteria
- PCR amplification of GOI
- Miniprep isolation of plasmid DNA
- Restriction digestion of plasmid DNA and agarose gel electrophoresis of restriction digests and PCR products
- Cloning of PCR product into the isolated plasmid and transformation
- Identification and characterization of transformed colonies

## **IMMUNOTECHNOLOGY LABORATORY**

**TIU-UBT-L204**

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

**Credits: 3**

- Blood grouping
- Assessment of antigen similarity using Ouchterlony double diffusion test.
- DOT ELISA test
- Quantitative ELISA
- Immuno-electrophoresis
- Western Blotting

## **BOOK LIST**

### **GENETIC ENGINEERING**

**1. Principles of gene manipulations (1996) Old,R.W. &Primrose,S.B.**



2. The basic principles of gene cloning (1996). Brown, T.A.
3. An introduction to Genetic engineering.(1994). Nicholl,D.S.T.
4. Recombinant DNA. (1992). Watson et al.
5. Genetic engineering fundamentals: An introduction to principles & applications. (1989). Kammermever,K. &Virginica,C.
6. From Genes to Clones: Introduction to Gene Technology. (1987). Winnacker, E.L.

## **IMMUNOTECHNOLOGY**

1. Essential Immunology (2005) Roitt I.M. and Delves P.J.
2. Immunology – Roitt I, Bostoff J. & Male D.
3. Immunology (2006) Luttmann M, Bratke K, Kupper M & Myrtek D.
4. Immunology (2007) Goldsby R.A., Kindt T.J., Osbrne B.A. and Kuby J.

## **BIOPROCESS ENGINEERING**

1. Encyclopedia of bioprocess technology. Vol 1-5. (1999). Flickinger, M.C. & Drew, S.W.(Ed).
2. Fermentation technology. (1994). Cassida.
3. Bioprocess engineering: Down stream processing & recovery of bioproducts, safety in biotechnology and regulations. (1990). Behrens, D. & Kramer, P.(Ed)

## **NANOTECHNOLOGY**

1. A introduction to Nanoscience and Nanotechnology.(PHI). K.K.Chattopadhyay and A.N.Banerjee
2. Nanophysics And Nanotechnology An Introduction To Modern Concepts In Nanoscience Second Updated And Enlarged Edition Pb 2013 By Wolf L E. Wiley India books,WOLF L E books,Technology and Engineering Books online,buy Technology and Engineering Books,Technology and Engineering Books india, Technology and Engineering



**3<sup>rd</sup> year-5<sup>TH</sup> 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-L305	INDUSTRIAL BIOTECHNOLOGY AND DOWNSTREAM PROCESSING 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
Total Credits					26

## ENZYMOLOGY

### 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, 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 & Ollis, Biochemical Engg. Fundamentals, McGraw-Hill, 1990





3. Fundamentals, Viva Books Pvt. Ltd. 2001.

Mukhopadhyay, S.N. Process Biotechnology

4. Muni Cheryan, 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 BIOSTATISTICS**

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.

### 3<sup>rd</sup> year-6<sup>TH</sup> SEMESTER

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-UBT-T300	CAREER ADVANCEMENT & SKILL DEVELOPMENT(BIO-COMPUTING II)	1	0	2	3
TIU-UBT-T314	PLANT BIOTECHNOLOGY	3	0	0	3
TIU-UBT-T316	MEDICAL BIOTECHNOLOGY	2	1	0	3
TIU-UBT-T318	REGULATION OF GENE EXPRESSION	3	0	0	3
TIU-UBT-T322	BIOMATERIALS AND TISSUE ENGINEERING	3	0	0	3
<b>Practical</b>					
TIU-UBT-L312	BIOPHYSICAL INSTRUMENTATION LABORATORY	0	0	3	3
TIU-UBT-L314	PLANT BIOLOGY LABORATORY	0	0	3	3
<b>Sessional</b>					
TIU-UBT-S398	INDUSTRIAL VISIT	0	0	3	3
TIU-UES-S398	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2



## PLANT BIOTECHNOLOGY

TIU-UBT-T314

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

**Credits: 3**

**Unit I:** Plant tissue culture and somatic cell genetics: Introduction to plant tissue culture: Tissue culture Media; Initiation and maintenance of callus and suspension cultures; single cell clones, micropropagation (production of pathogen free plants).

**Unit II:** Plant regeneration pathways–Organogenesis and Somatic embryogenesis; Endosperm culture and triploid production; Anther and pollen culture, and production of haploid and doubled haploid plants; Protoplast culture and fusion, Somatic hybrids; Organelle transfer and cybrids, hairy root culture and secondary metabolites, cryopreservation and production of synthetic seeds.

**Unit III:** Gene transfer (Agrobacterium and Ti plasmid and gene gun), Pseudomonas, and transgenic crop development. Marker assisted breeding: Introduction - molecular markers as new efficient tools in breeding, Molecular markers for genome mapping: Principles of genetic linkage, concept of genetic distance, development and choice of mapping populations, linkage map construction.

## MEDICAL BIOTECHNOLOGY

TIU-UBT-T316

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

**Credits: 3**

**Unit I: An introduction to medical biotechnology:** Biotechnology and health care; Basic human physiology; Definition of disease and its types: Genetic disease, Metabolic disease, Immune system malfunction and disease, Hormonal disease, Vitamin and minerals deficiency diseases.

**Unit II: Biochemical and Molecular Diagnostics:** Different biochemical test using protein and enzyme markers and their interpretation. e.g. Liver function test, kidney function test, blood sugar test, hormone assay etc. Molecular diagnostics: PCR based detection, Microarray, Protein profiling by HPLC, FACS, ELISA.



Prenatal diagnosis - Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Non-invasive techniques - Ultrasonography, X-ray, TIFA, maternal serum and fetal cells in maternal blood.

**Unit III: Molecular therapy:** Gene therapy: DNA based vaccine, RNA based therapeutics, Antisense therapeutics; Enzyme therapy; Hormone therapy; Cytokine therapy; Monoclonal Antibody therapy. An introduction to stem cell therapy and regenerative medicine.

## **REGULATION OF GENE EXPRESSION**

**TIU-UBT-T318**

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

**Credits: 3**

**Unit I:** Regulation of Prokaryotic Transcription and Translation: Lessons from bacteria; lac, trp, and ara operons; control of lysis and lysogeny in lambda phage; gene regulation in yeast - gal operon.

**Unit II:** Epigenetic control mechanisms: Histone modifying enzymes and their functions, enhancers, silencers, MNase Digestion.

**Unit III:** Techniques: Gel retardation assays, reporter gene assays, primer extension, S1 nuclease mapping assays, DNA fingerprinting, qPCR/RT-PCR, Y-2-H, Phage Display, Co-IP, ChIP, Western Blotting, ELISA, Microarray, Flowcytometry, SAGE.

## **BIOMATERIALS AND TISSUE ENGINEERING**

**TIU-IBT-T322**

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

**Credits: 3**

**Module I:** History and fundamentals of tissue engineering: Complexity and organization of the vertebrate body, Cell source, Tissue dynamics & cell migration, Stem Cells & TE, Biomaterials for tissue engineering, Biodegradable materials, Tissue engineering examples: Bone & Cartilage Tissue Engineering

Definition of biomaterials – biologically derived materials or materials compatible with biology. Common biomaterials: some proteins, many carbohydrates and some specialized polymers. Collagen (protein in bone and connective tissues): Structure production and its use. Fibroin (protein in silk): Production and its use. Production of these proteins by conventional cloning methods.

**Module II: Carbohydrates:** Modified carbohydrates actin gas lubricants for biomedical applications; Polydextrose



made from  
artificial wood.

bacteria; Carbohydrates modified from enzymes;

**Module III: Biopolymers:** Synthesis from a simple biological monomer (hyaluronate polymers); Dextrans (used in chromatography columns); Rubberlike materials produced by bacteria and fungi (Polyhydroxybutyrate PHB), Polycaprolactone (PCL); Production of a copolymer of PHB and PHV (polyhydrovaleric acid), sold as Biopol by fermentation on *Alcaligenes eutrophus*; Biodegradable polymers

## **BIOPHYSICAL INSTRUMENTATION LABORATORY**

**TIU-UBT-L312**

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

**Credits: 3**

Explanation of Principle, Parts and Demonstration of the following instruments

- Laminar Air Flow Cabinet: Horizontal and Vertical
- Microscope: Compound Microscope, Fluorescence Microscope, Electron Microscope
- Spectrophotometer: Single Beam, Double Beam, Fluorescence, AAS
- Chromatography: SEC, Affinity Chromatography, IEC, HPLC, HPTLC, GC
- PAGE: SDS-PAGE and Native PAGE and Western Blot
- Protein unfolding by tryptophan fluorescence

## **PLANT BIOLOGY LABORATORY**

**TIU-UBT-L314**

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

**Credits: 3**

- Explant selection, sterilization and inoculation
- Callus culture from meristematic tissue and induction of growth, suspension culture
- Anther and Pollen culture
- Estimation of biologically important plant products

## **BOOK LIST**

### **REGULATION OF GENE EXPRESION**

- 1. Cell and Molecular Biology (1996) Karp, G.**
- 2. Cell Biology (1993) Sadava D. E.**



3. Cell and Molecular Biology (1995) Kish V. M. and Kleinsmith L.J.
4. Cell and Molecular Biology :deRobertis and deRobertis

## **PLANT BIOTECHNOLOGY**

1. Plant Tissue culture: Basic and applied (2006) T. Jha and B. Ghosh.
  2. Plant Biotechnology: Methods in tissue culture and gene transfer (2006). R. Keshavachandra and K.V. Peter.
  3. Plant, cell, tissue and organ culture (2005) Gamborg and Phillips.
  4. Plant cell and Tissue culture.(2005). I Vasil and T. Thorpe.
  5. Plant tissue culture: Theory and practice- revised editions. Bhojwani and MRajdan
  6. Plant cell & tissue culture. (1994). Vasil, I.K. & Thorpe, T.A.
- 
7. Plant tissue culture: Applications and limits. (1990). Bhojwani, S.S.

## **MEDICAL BIOTECHNOLOGY**

1. Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine by Andrew J.T.George (Editor), Catherine E. Urch (Editor) Publisher: Humana Press; edition (2000)
2. Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) by Jochen Decker, U. Reischl Amazon
3. Human Molecular Genetics by T. Strachan, AndrewRead Amazon Sales Rank:

## **TISSUE ENGINEERING**

1. Ratledge C and Kristiansen B, Basic Biotechnology, Cambridge University Press, 2ndEdition, 2001
2. Doi Y, Microbial Polyesters, VCH Weinheim, 1990



**4<sup>TH</sup> YEAR-7<sup>TH</sup> SEMESTER(B.TECH)**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
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
<b>Practical</b>					
TIU-UBT-	PROJECT WORK/INDUSTRIAL	0	0	10	10



P499	TRAINING				
<b>Sessional</b>					
TIU-UES-S497	TRAINING (JUNE-JULY)	0	0	2	2
TIU-UES-S499	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>26</b>

**4<sup>TH</sup> YEAR-7<sup>TH</sup> SEMESTER (INTEGRATED M.TECH)**

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
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
<b>Practical</b>					
TIU-IBT-	ADVANCED BIOLOGICAL	0	0	3	3





<b>P499</b>	<b>TECHNIQUES-I</b>				
<b>TIU-UBT-P499</b>	<b>PROJECT WORK/INDUSTRIAL TRAINING</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>10</b>
<b>Sessional</b>					
<b>TIU-UES-S497</b>	<b>TRAINING (JUNE-JULY)</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>
<b>TIU-UES-S499</b>	<b>ENTREPRENEURSHIP SKILL DEVELOPMENT</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>
	<b>Total Credits</b>				<b>35</b>

## **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, integrins, 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  
modifying drug action; Adverse drug effect.

action, Mechanism of drug action, Factors

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, phagemids, 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



## **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 *E. coli* & Human; Proteasomes and proteasome 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.



**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 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
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
4. Richard J. Simpson, Proteins and Proteomics, I.K. International Pvt Ltd
5. Branden, C., Tooze, R., Introduction of Protein structure, Garland, 1st Edition, 1993
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; DNA structure and function by R. Sinden; Nucleic Acids: Structures, Properties, and Functions (University Science Books) edited by Victor Bloomfield, Donald Crothers, and Ignacio Tinoco

**4<sup>th</sup> year-8<sup>th</sup> SEMESTER (B.TECH)**



Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
<b>Theory</b>					
<b>TIU-UBT-T400</b>	<b>CAREER ADVANCEMENT &amp; SKILL DEVELOPMENT (GRAND VIVA)</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>
<b>Practical</b>					
<b>TIU-UBT-P498</b>	<b>PROJECT WORK</b>	<b>0</b>	<b>0</b>	<b>21</b>	<b>21</b>
<b>Seasonal</b>					
<b>TIU-UES-S498</b>	<b>ENTREPRENEURSHIP SKILL DEVELOPMENT</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>
<b>Total Credits</b>					<b>26</b>

**4<sup>TH</sup> YEAR-8<sup>TH</sup> SEMESTER (INTEGRATED M.TECH)**

Course Code	Course Title	Week			Credit
		L	T	P	
<b>Theory</b>					
<b>TIU-UBT-T400</b>	<b>CAREER ADVANCEMENT &amp; SKILL DEVELOPMENT (GRAND VIVA)</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>
<b>Practical</b>					
<b>TIU-IBT-P498</b>	<b>PROJECT WORK</b>	<b>0</b>	<b>0</b>	<b>21</b>	<b>21</b>
<b>TIU-IBT-P500</b>	<b>ADVANCED BIOLOGICAL TECHNIQUES-II</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>
<b>Sessional</b>					
<b>TIU-IES-</b>	<b>ENTREPRENEURSHIP SKILL</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>



S498	DEVELOPMENT				
<b>Total Credits</b>					<b>29</b>

**5<sup>TH</sup> YEAR-9<sup>TH</sup> SEMESTER (INTEGRATED M.TECH)**

Course Code	Course Title	Week			Credit
		L	T	P	
<b>Theory</b>					
TIU-IBT-T501	DEPARTMENTAL CASD: REVIEW WRITING & PRESENTATION	0	0	3	3
<b>Practical</b>					
TIU-IBT-P599	PROJECT WORK	0	0	21	21
<b>Sessional</b>					
TIU-IES-S599	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	2
<b>Total Credits</b>					<b>26</b>

**5<sup>TH</sup> YEAR-10<sup>TH</sup> SEMESTER (INTEGRATED M.TECH)**

Course Code	Course Title	Week	Credit
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		L	T	P	
<b>Theory</b>					
<b>TIU-IBT-T500</b>	<b>DEPARTMENTAL CASD: PROJECT WRITING</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>
<b>Practical</b>					
<b>TIU-IBT-P598</b>	<b>PROJECT WORK</b>	<b>0</b>	<b>0</b>	<b>21</b>	<b>21</b>
<b>Sessional</b>					
<b>TIU-IES-S598</b>	<b>ENTREPRENEURSHIP SKILL DEVELOPMENT</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>
<b>Total Credits</b>					<b>26</b>

**Project Work Scheme / Guidelines for the Students; Supervisors and Examiners**

Every student is required to carry out Experimental / Field Based Project Work on a related research topic of the subject /course. It must be an original work and will be evaluated by the examiner on the strength of experimental Project work. On the basis of this work; student must submit the Project Report (typed and properly bound) in three copies at least one month prior to commencement of the final Practical/lab Examination of Semester VIII.

The project report shall comprise of Introduction; Material and Methods; Results; Discussion; Summary; Conclusions and; References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head/Coursecoordinator/ Director of the Department/Centre or the Principal of the College.

The topic for the project work will be assigned to the student by supervisor at the beginning of third semester. The topic will be forwarded to the controller of examination by the head of the department. The Project Work will carry total 300 marks and will be evaluated by both external and internal examiner in the respective Department / Center / Affiliated College.