

**SIKSHA 'O' ANUSANDHAN UNIVERSITY**

**COURSES OF STUDIES**

**FOR**

**M.Sc. INDUSTRIAL BIOTECHNOLOGY**

**(With effect from 2009-2010 batch)**

**SEMESTER SYSTEM**



**KHANDAGIRI SQUARE, PO- KHANDAGIRI  
BHUBANESWAR – 751030**

# SIKSHA 'O'ANUSANDHAN UNIVERSITY

## COURSES OF STUDIES

### M.Sc. INDUSTRIAL BIOTECHNOLOGY (With effect from 2009-2010 batch)

#### SEMESTER SYSTEM

The course comprises four semesters. One Semester = 15 weeks. Theory 1 Credit = 1hr/week. Practical 2 credit = 3hrs/week. Theory paper carries 100 marks and practical paper carries 100 marks each (Students seminar 100 marks and Project 100 marks will be evaluated at IV Semester).

#### COURSE STRUCTURE

##### Semester –I

IBT 1.1	Cell Biology and Genetics	(40 Lectures / 4 Credits)
IBT 1.2	Biomolecules & Enzymology	(40 Lectures / 4 Credits)
IBT 1.3	Molecular Biology	(40 Lectures / 4 Credits)
IBT 1.4	Bioinstrumentation	(40 Lectures / 4 Credits)
IBT 1.5	Practicals	(50 Practical Classes / 8 Credits)

##### Semester –II

IBT 2.1	Plant and Animal Biotechnology	(40 Lectures / 4 Credits)
IBT 2.2	Genomics and Proteomics	(40 Lectures / 4 Credits)
IBT 2.3	Microbial Technology	(40 Lectures / 4 Credits)
IBT 2.4	Environmental Biotechnology	(40 Lectures / 4 Credits)
IBT 2.5	Practicals	(50 Practical Classes / 8 Credits)

##### Semester-III

IBT 3.1	Genetic Engineering	(40 Lectures / 4 Credits)
IBT 3.2	Industrial Microbiology	(40 Lectures / 4 Credits)
IBT 3.3	Pharmaceutical Biotechnology	(40 Lectures / 4 Credits)
IBT 3.4	Biostatistics & Bioinformatics	(40 Lectures / 4 Credits)
IBT 3.5	Practicals	(50 Practical Classes / 8 Credits)

##### Semester-IV

IBT 4.1	Seminar Presentation	(2 Credits)
IBT 4.2	Project	(12 Credits)

## COURSE STRUCTURE

### SEMESTER-I

#### IBT 1.1: Cell Biology and Genetics

**Full Marks-100**

Cell Theory, Variability (Size, Shape, Complexity Functions); Structural Organization of Prokaryotic and Eukaryotic Cells; Structure and Function of Cell Organelles(Nucleus, Mitochondria, Chloroplast, Cell wall, Plasma membrane, Endoplasmic reticulum, Golgi Apparatus , Lysosomes and Peroxisomes).

Transport Across Cell Membranes; Cell Division: Mitosis and Meiosis; Cell Cycles (Molecular Events and Models); Cytoskeletons(Microtubules and Microfilaments); Cell Motility (Cilia and flagella); Cellular Basis of Differentiation and Development (Gametogenesis, Fertilization, and Development in Drosophila and Arabidopsis).

Mendel's experiments, monohybrid and dihybrid cross;Sexual vis-a-vis sexual reproduction; Applications of chi square test; Deviation from Mendelian segregation; Linkage; Genetic map; Mendelism in Human genetics: Pedigree analysis; Inheritance characteristics of sex-linked and autosomal traits; Chromosomes as physical basis of inheritance; Chromosomal aberrations.

Sex-linked deleterious genes; Non-Mendelian inheritance; Parental imprinting; Anticipation; Dynamic mutations and neurological abnormalities; Dysgenic effect of medicine; Cancer genetics; Immunogenetics; Mapping of human genome; Somatic cell genetics; DNA polymorphism in mapping; Structure and function; Biochemical genetics; Polygenic inheritance.

#### BOOKS:

##### Text Book:

1. Cell and Molecular Biology, Robertis and Robertis, CBS Publication, New Delhi, 8<sup>th</sup> Ed, 2006.
2. Molecular Biology of the Cell, B Alberts, D Bray, J Lewis, M Raff, K Roberts and JD Watson, Garland Publishing Inc. New York, 2<sup>nd</sup> Ed., 1994.
3. Reproduction in Eukaryotic Cells, DM Prescott, Academic Press.
4. Cell in Development and Inheritance, EB Willson, Mac Millan New York
5. Principles of Genetics, Gardener, Simmons, Willey India, 8<sup>th</sup> Ed., 2007.
6. A text book of Genetics, V B Rastogi, Kedarnath Ram publication, Latest Ed.
7. Principles of Genetics, J H Well, New Age International, Latest Ed.

##### References:

1. Fertilization Biology of Steroid and Nuclear Hormone Receptors, LP Freedman, Brikhuser
2. The Coiled Spring, Ethan Bier, Cold Spring, Harbor Press
3. Molecular Cell Biology, Lodies et al.
4. Developmental Biology, SF Gillbert, Sinauer Associates Inc.

**IBT 1.2: Biomolecules And Enzymology****Full Marks-100**

Concept of Biomolecules (Chemical composition, Three dimensional structure, Chemical Reactivity, Macromolecules and their monomeric subunits, Chemical bonds, Water, pH, pK , Acids, Bases, Buffers.

Amino Acids and Proteins (types, properties, peptides, amino acids sequence of proteins and its Importance, Covalent structure of proteins, three dimensional structure of protein)

Carbohydrates (Monosaccharides, Disaccharides, Polysaccharides, Proteoglycans, Glycoprotein and Glycolipids); Lipids (Storage Lipids, Structural Lipids, Lipids with specific biological properties); Nucleotides and Nucleic Acids (Types, Structure, Properties and Functions).

Nomenclature and Classification of Enzymes; Extraction Assay & Purification of Enzymes; Enzyme Kinematics; Enzyme inhibition; Mechanism of Enzyme Action; General principles of mechanism, mechanisms of enzyme reactions catalyzed by Lysozymes, RNase, Chymotrypsin, Glutathione reductase; Regulation of Enzyme Action; Industrial and Clinical Application of Enzymes.

**BOOKS:****Text Book:**

1. Fundamental of Biochemistry, D Voet, JG Voet and Pratt, J Wiley and Sons, 2<sup>nd</sup> Ed, 2006.
2. Principles of Biochemistry, David L. Nelson and Michael M. Cox, W.H Freeman and Company, 4<sup>th</sup> Ed., 2005.
3. Practical Biochemistry, Willson and Walker, Cambridge Univ. Press, Latest Ed.
4. Laboratory Techniques in Biochemistry, CNR Rao, Universities Press, Hyderabad, 1999.

**References:**

1. Biochemical Calculations, Irwin H. Segal, John Wiley and Sons Inc.
2. General Chemistry, Linus Pauling, W. H. Freeman and Company.
3. Physical Biochemistry, D Friefilder. WH Freeman and Company.
4. Tools of Biochemistry, T G Cooper.
5. Essential of Molecular Biology, David Friefilder, Jones and Barllett Publications.
6. Proteins Structure and Molecular properties, TE Creighton, W H Freeman and Company.
7. Genes VIII, B Lewin, Oxford University Press.
8. Introduction of Protein Structure, C Braden and J Tooze, Garland Publishing, New York.
9. Encyclopaedia of Molecular Biology, J J Kendrew, Blackwel Scientific Publications Oxford.
10. Physical Chemistry of Macromolecules, Tanford C. John Wiley and Sons.

11. Introduction to Biophysical Chemistry, RB Martin, Mc Graw Hill, New York.
12. Biophysical Chemistry – Cantor, WH Freeman.
13. Protein Structure, Max Perutz.
14. A Biologists Guide to Principles and Techniques of Practical Biochemistry, K Wilson and K H Goulding, E L B S Ed., 1986.

### **IBT 1.3: Molecular Biology**

**Full Marks-100**

Introduction to Molecular Biology and Genetics; DNA Replication: Prokaryotic and Eukaryotic DNA replication, Mechanism of DNA replication, Enzyme and accessory proteins involved in DNA replication; DNA Repair and Recombination.

Transcription: Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, regulatory elements and mechanism of transcription regulation, Transcriptional and post-transcriptional gene silencing

Modification in RNA: 5' –Cap formation, transcription, formation, 3-end processing and polyadenylation, Splicing, editing, Nuclear export of mRNA, mRNA stability. Translation: Prokaryotic and Eukaryotic translation, the translation machinery, mechanism of initiation, elongation and termination, regulation of translation, Co- and post- translational modifications of proteins.

Oncogenes and Tumor Suppressor Genes: Viral and cellular oncogenes, Tumor suppressor genes from humans, Structure, function and mechanisms of action of pRB and p 53 tumor suppressor proteins.

### **BOOKS:**

#### **Text Book:**

1. Genomes 3, TA Brown, Garland Science, Taylor & Francis Group, New York, London, 3<sup>rd</sup> ed., 2006.
2. Essential of Molecular Biology, David Friefilder, Jones and Barlett Publications.
3. Molecular Biology of the Cell, B Alberts, D Bray, J Lewis, M Raff, K Roberts and JD Watson, Garland Publishing Inc. New York, 2<sup>nd</sup> ed., 2004.
4. Cell and Molecular Biology, PK Gupta, Rastogi Publication, 3<sup>rd</sup> Ed., 2007.

#### **References Book:**

1. Genes VIII, B Lewin, Jones and Bartlett Publisher, 1<sup>st</sup> Ed, 2008.
2. Molecular Biology of the Gene, JD Watson, N H Hopkins, JW Roberts, JA Steitz and AM Weiner, The Benjamin / Cummings Pub. Co. Inc. California, 7<sup>th</sup> ed., 1987.
3. Molecular Cloning, A Laboratory Manual, J Sambrook, EF Frisch and T Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.

4. Introduction to Practical Molecular Biology, PD Dabre, John Wiley and Sons Ltd, New York, 1988.
5. Molecular Biology, Labfax, TA Brown (ed) Bios Scientific Publishers Ltd, Oxford, 1991.
6. Molecular cell Biology, J Damell, H Lodish and D Baltimore, Scientific American books, Inc. USA, 2<sup>nd</sup> ed., 1994.
7. Molecular Biology and Biotechnology A Comprehensive Desk Reference, R.A. Mayers, VCH Publishers, Inc. New York, 1995.

#### **IBT 1.4: Bioinstrumentation**

**Full marks-100**

Microscopy: Principles of Light microscope, Phase-contrast microscope, Florescence microscope, Transmission and scanning microscope.

Principle and Use of analytical instruments: pH meter, Oxymeter, UV\_VIS Spectrophotometer, Florescence spectrophotometer, IR- spectrophotometer, ESR and NMR Spectroscopy.

Separation Techniques in Biology: Molecular separation by Chromatography, Electrophoresis, organelles separation by centrifugation, cell separation by flow cytometry, density of gradient centrifugation.

Isotopes Techniques in Biology: Radio and Mass Isotopes, Sample preparation for radioactive counting, autoradiography, metabolic labeling measurement of radioactivity, safety and handling.

#### **BOOKS:**

##### **Text Book:**

1. Biophysical Chemistry, Upadhyaya and Nath, Himalaya Publishing House, 4<sup>th</sup> Ed, 2007
2. Practical Biochemistry, Willson and Walker, Cambridge Univ. Press, Latest Ed.
3. Understanding Chemistry, CNR Rao, Universities Press, Hyderabad.
4. Microbiology, Pelczar M.J. Jr.Chan, E.C.S. & Creig, N.R.Tata McGraw Hill

##### **References Book:**

1. Tools of Biochemistry, T G Cooper.
2. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work.

#### **IBT 1.5: PRACTICAL**

**Full marks-100**

1. Microscopy
2. Cell Division
3. Karyotype Analysis
4. Preparation of buffer and pH measurement

5. Validation of Beers and Lamberts law
6. Determination of absorption maxima of given chemicals
7. Determination of pK
8. Isolation and estimation of nucleic acid
9. Estimation of protein
10. Estimation of sugar
11. Paper chromatography of amino acids
12. Thin layer chromatography
13. Isolation of genomic DNA
14. Quantification of genomic DNA
15. Electrophoresis of protein
16. Electrophoresis of DNA

## **SEMESTER-II**

### **IBT 2.1: Plant and Animal Biotechnology**

**Full Marks-100**

Introduction of cell and tissue culture laboratory requirements, tissue culture media, micropropagation, shoot tip culture, callus culture, suspension culture, protoplast culture. Haploid production, triploid production, zygotic embryo culture, somatic embryogenesis, Somaclonal variation and crop improvement.

Germplasm conservation, synthetic seed formation, production of secondary metabolites through tissue culture, green house technology, application of plant tissue culture.

Primary and established cell line cultures. Equipments and materials for animal cell culture technology. Biology and characterization of the cultured cells. Application of animal cell culture.

Stem cell cultures, embryonic stem cells and their applications. Cell culture based vaccines. Somatic cell genetics Organ and histotypic cultures measurement of cell death.

### **BOOKS:**

#### **Text Book:**

1. Introduction to plant biotechnology, H.S.Chawla, Oxford & IBH.Co.Pvt. Ltd., New Delhi, 1<sup>st</sup> ed., 2007.
2. Plant Tissue Culture, M.K.Razdan, Oxford & BH Publication
3. Plant Cell & Tissue Culture, Narayan Swamy, Tata Mc Graw Hill Publication.
4. Elements of Biotechnology, P.K. Gupta
5. Plant Tissue Culture, Basic and Applied, T.B. Jha and B. Ghosh, Universities press, 1<sup>st</sup> ed., 2005.
6. Culture of Animal Cells, Manual Basic Technique, R.Ian Freshney, 4<sup>th</sup> ed.

**References Book:**

1. Somaclonal variation as a tool for crop improvement, A.C. Cassell, P.W Jones, Kluwer Academic Publishers, Dordrecht, latest (ed).
2. Primary and Secondary Metabolism of Plant Cell Culture, K.H.Newmann, W. Barz, E. Reinhard, Springer-Verlag, Berlin, latest (ed).
3. Conservation of Plant Genetic Resources *in vitro* vol.1: General aspects, M.K Razdan & E.C.Cocking, Scientific Publishers Inc., USA, latest (ed).
4. *In vitro* Methods for Conservation of Plant Genetic Resources, J.H. Dodds, Chapman and Hall, U.K., latest (ed).
5. Plant Tissue Culture: Theory and Practice, S.S. Bhowani & M.K.Razdan, Elsevier, Amsterdam, latest (ed).

**IBT 2.2: Genomics and Proteomics****Full Marks-100**

Molecular Mapping of Genome: Genetic and physical maps, physical mapping and map-based cloning, choice of mapping population sample sequence repeat tool. Southern and fluorescence in situ hybridization for genome analysis. Chromosome microdissection and microcloning.

Molecular markers in genome analysis. RFLP, RAPD, AFLP, ISSR, micro satellite, SNP analysis, molecular markers linked to disease resistance genes. Application of RFLP in forensic, disease prognosis, genetic counseling. Pedigree. Varietal etc. Animal trafficking and poaching, Germplasm maintenance, taxonomy and Biodiversity.

Genome Sequencing: Genome sizes, organelle genomes, genomic libraries. YAC, BAC libraries, Strategies for sequencing genome, packaging, transfection and recovery of clones. Application of sequence information for identification of defective genes.

Proteins Localization: Synthesis of secretory and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxysomes, Receptor mediated endocytosis

**BOOKS:****Text Book:**

1. Physical Chemistry of Macromolecules, Tanford, C., John Wiley and Sons.
2. Biophysical Chemistry, Cantoz, WH Freeman.
3. A Textbook of Biotechnology, R.C.Dube, S.Chand Publication, Latest Ed.

**References Book:**

1. Essentials of Molecular Biology, David Friefilder, Jones and Barllett Publications.

2. Proteins Structure and Molecular Properties, TE Creighton, WH Freeman and company.
3. Genes IX, B. Lewin, Oxford University Press.
4. Introduction to Protein Structure, C. Branden and J. Tooze, Garland Publishing, New York.
5. Encyclopaedia of Molecular Biology, J. Kendrew, Blackwell Scientific Publications, Oxford.
6. Introduction to Biophysical Chemistry, RB Martin, McGraw Hill, New York.
7. Protein Structure, Max Perutz.

### **IBT 2.3: Microbial Technology**

**Full Marks-100**

General Microbiology: Introduction to Microbial Kingdom – bacteria, mold, yeast, algae virus, morphology, sub cellular structure, cell wall, sporulation, archaebacteria, and extremophiles, microbial taxonomy-modern approaches, Different microbial culture techniques-media, pure culture, isolation and preservation, staining, gram staining, flagella, k acid fast, capsules, spores.

Growth: Microbial nutrition and physiology, phototrophs, heterotrophs, autotrophs and chemotrophs, sterilization, disinfections, growth rates, continuous culture, synchronous and asynchronous growth.

Metabolism: Metabolism of Carbohydrate in aerobes and anaerobes, ether-doudroff and glyoxylate and glyoxylate pathway, anaerobic respiration, nitrogen metabolism (Nitrogen fixation, cyanobacteria) sulphur cycle.

Microbial Genetic: Mutation, isolation of mutants, bacterial recombination, transformation, transduction, conjugation, transposons

Test of Sterility: Sampling media, control tests, inactivation of inhibitory substances. Microbial assay of antibiotics : Penicillin, streptomycin, vitamin-B<sub>12</sub>

### **BOOKS:**

#### **Text Book:**

1. Microbiology, Pelczar M.J. Jr.Chan, E.C.S. & Creig, N.R.Tata McGraw Hill
2. Microbial Genetics, Maloy, S.R.Cronan, J.E.Jr. And Freifelder, D.Jones, Bartlett Publishers.
3. Microbiology Laboratory Manual, Cappuccino, J.G. & Sherman, N.Addison Wesley.

#### **References Book:**

1. General Microbiology, Stainer, R.Y.Ingrahm, J.L.Wheelis, ML & Painter, P.R., The MacMillan Press Ltd.
2. Brock Biology of Microorganisms, Madigan, M.T.Martiko, J.M. & Parker, J.Prentice Hall

3. Microbiological Applications, A Laboratory Manual in General Microbiology, Benson, H.J.WCB, Wm C Brown Publishers.

### **IBT 2.4: Environmental Biotechnology**

**Full Marks-100**

Environment: Basic Concepts & Issues; Environmental pollution types of pollution, methods for the measurement of pollution, methodology of environmental management-the problem solving approach, its limitations; Air pollution and its control through biotechnology.

Water pollution and its control, water as a scarce natural resource, need for water management, measurement of water pollution, sources of water pollution, waste water collection, waste water treatment physical, chemical and biological treatment process. Microbiology of water, water treatments aerobic, process activated sludge oxidation ditches, tricking filter, towers, rotating discs, rotating drums, oxidation ponds.

Anaerobic process, anaerobic, digestion, anaerobic filters, upflow anaerobic sludge blanket reactions; Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic; Microbiology of degradation of Xenobiotics in environment. Ecological considerations decay behaviour & degradation plasmids. Hydrocarbons substituted hydrocarbons oil pollution, surfactants pesticides.

Bioremediation of contaminated soils and wasteland; Biopesticides in integrated pest management; Solid wastes sources and management (composting wormiculture and methane production); Global Environmental problems Ozone depletion, UV-B, green-house effect and acid rain, their impact and biotechnological approaches for management.

### **BOOKS:**

#### **Text Book:**

1. A text book of Biotechnology, H K Das, Willey India (P) Ltd., 3<sup>rd</sup> Ed, 2008.
2. Biotechnology- Expanding origin, B D Singh, Kalyani Publication, New Delhi, 2<sup>nd</sup> Ed., 2008.
3. Text Book of Environmental Biotechnology, P K Moahapatra, J.K.Inter Pub, House Pvt., 1<sup>st</sup> ed., 2006.
4. Environmental Engineering, G Kiely, Tata McGraw Hill.
5. Ecology and environment, PD Sharma, Rostogi Publication, Latest Ed.

#### **References Book:**

1. Waste water Engineering Treatment, Disposal & Reuse, Metacalf & Eddy, Inc., Tata McGraw Hill, New Delhi.
2. Comprehensive Biotechnology, M. Moo Young, Pergamon Vol.4, Press Oxford.
3. Environmental Chemistry, B K Sharma, Krishna Prakashan, 11<sup>th</sup> Ed.2007.

4. Environmental Chemistry, A K De, Wiley Eastern Ltd., New Delhi.
5. Introduction to Biodeterioration, D Allsopp and K.J.Sea, BLBS/Edward Arnold.

### **IBT 2.5: PRACTICALS**

#### **Full Marks-100**

1. Preparation of tissue culture media
2. Micropropagation Techniques
3. Callus induction and Growth measurement
4. Suspension culture Techniques
5. Plant conservation techniques
6. Plant hardening and field transfer
7. Synthetic seed formation
8. Induction of somaclonal variation
9. *In vitro* synthesis of secondary metabolites
10. P C R Techniques
11. RAPD Analysis
12. AFLP Analysis
13. ISSR Analysis
14. Preparation of liquid and solid media for growth of micro organism
15. Isolation and maintenance of organisms by plating , and streaking, and serial dilution methods.
16. Isolation of pure cultures from soil and water
17. Growth, growth curves, measurement of bacterial population by turbidometry and serial dilution method , effect of temperature , pH, carbon and nitrogen source on growth.
18. Microscopic examination of bacteria, yeast and molds and study of organisms by gram stain, acid fast stain and staining of spores.
19. Assay of antibiotics and determination of antibiotics resistance .
20. Determination of dissolved oxygen concentration of water samples
21. Determination of BOD of sewage sample.
22. Determination of COD of sewage sample.

### **Semester III**

#### **IBT 3.1: Genetic Engineering**

#### **Full Marks-100**

Scope of Genetic Engineering Principle and methods of recombinant DNA technology. Milestones in Genetic Engineering., Molecular tools and their applications: Restriction enzymes, modification of enzymes. Gene cloning vectors: plasmid, bacteriophage, phagmid, cosmid, artificial chromosomes.

Methods of gene transfer in plants: based on Ti and Ri plasmids, cointegrate, intermediate and helper plasmids, gene transfer technique using *Agrobacterium*: selectable and scorable markers (reporter genes); agroinfection and gene transfer; physical delivery methods or DNA mediated gene transfer; physical delivery methods or DNA mediated gene transfer (DMGT), (PFG stimulated micro injection, micro projectile or particle gun, electroporation)

cDNA synthesis and cloning: mRNA enrichment, reverse transcription, DNA primers linkers, adoption and their chemical synthesis, library construction and screening. Alternative strategies for gene cloning: Cloning interaction: genes two and three hybrid systems, cloning differentially expressed genes. Nucleic acid and micro array.

T-DNA and Transposon Tagging: Role of gene tagging in gene analysis. T-DNA and Transposon tagging, identification and isolation of gene through T-DNA or Transposon. Transgenic and gene Knockout technologies: Targeted gene replacement, chromosome engineering. Gene therapy: Vector engineering, strategy for gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and gene silencing.

## **Books**

### **Text Book:**

- 1 Principles of Gene Manipulation, S.B. Primrose, R.M. Twyman and R.W. Old, Blackwell Science Ltd, 6<sup>th</sup> ed. 2001.
- 2 Biotechnology- Expanding origin, B.D.Singh, Kalyani Publication, New Delhi, 1<sup>st</sup> ed., 2003.
- 3 A Text Book of Biotechnology, R.c. Dubey, S. Chand & Company, 1<sup>st</sup> ed., 2008.
- 4 DNA Science. A First Course in Recombinant Technology, D, A. Mickloss and G.A. Froyer Cold Spring Harbor Laboratory Press, New York, 1990.
- 5 Milestones in Biotechnology, Classic papers on Genetic Engineering, J.A. Davies and W.S. Reznikoff, Butterworth, Heinemann, Boston, 1992.
- 6 Route Maps in Gene Technology, M.R. Walker and R. Rapley, Blackwell Science Ltd., Oxford, 1997.

### **References Book:**

1. Molecular Cloning, A Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold, Spring Harbor Laboratory Press, New York, 2000.
2. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J; Cseke, CRC Press, Florida, 1995.
3. Molecular Biotechnology, S.B. Primrose. Blackwell Scientific Publishers, Oxford, latest Ed., 1994
4. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes, S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford, 1998
5. Methods in Enzymology vol. 152, Guide to Molecular Cloning Techniques, S.L. Berger and A.R. Kimmel, Academic Press, Inc. San Diego, 1998
6. Methods in Enzymology Vol 185, Gene Expression Technology, D.V. Goeddel, Academic Press, Inc., San Diego, 1990
7. Biochemistry, U.Satyanarayana &U. Chakrapani, Uppala author publisher interlinks, 3<sup>rd</sup> ed., 2006

**IBT 3.2: Industrial Microbiology****Full Marks-100**

Introduction to bioprocess engineering bioreactors and membrane bioreactors, isolation, preservation and maintenance of industrial microorganisms. Biology of microorganism: (Saccharomyces, Aspergillus, Penicillia, spore forming bacteria etc);

Idea of fermentation, Cell growth, Regulation of metabolism, Substrate assimilation/Product Secretion; Different fermentative system; Batch and continuous Process, Fermentor Design, Surface and submerged liquid substrate fermentation; Solid substrate fermentations, Fermentation substrate raw materials, Down stream processing,

Bio-mass production (Alcohol, lactic acid, cheese making, bread making soya based foods, meat fermentation, vinegar, industrial chemical, bio polymer, bio insecticides, food additive [amino acids, nucleosides, vitamins, fats and oils], health care products {antibiotics steroids, vaccines}, Production of industrial solvents[alcohol, acetone butanol etc.]); Industrial Enzymes (amylase, proteases, lipases), concepts of immobilized enzymes. Introduction to food technology, elementary idea of canning and packing fat-based edible products, sterilization and pasteurization of food products

Down stream processing: introduction, removal of microbial cells and solid matter, foam separation, precipitation, filtrations, centrifugation, cell disruption and membrane process. Drying and crystallization, effluent treatment DOC and COD treatment and disposal of effluents.

**Books****Text Book:**

1. Enzymes in food processing, Gerald Reed, Academic press.
2. Comprehensive Biotechnology Vol III & IV, Editor M.Moo young.
3. Industrial Microbiology, Prescott
4. Principles of fermentation technology, P F Stanbury and A Whitaker, Pergamon press (1984)

**References Book:**

1. General Microbiology, Stanier, et. al., 5<sup>th</sup> ed.
2. Industrial Microbiology, Casida

**IBT 3.3: Pharmaceutical biotechnology****Full Marks-100**

Antibody production (polyclonal and monoclonal), the first would be covered by the basic immunology (innate immunity and adaptive/acquired immunity), antibody

synthesis, commercial production of polyclonal and monoclonal antibody, (hybridoma technology) Uses and application of monoclonal antibody and current status.

Microbial Transformation: Microbial transformation of Steroids, peptides and alkaloids. Advantages and Commercial applications. Protein folding and Its Kinetics. Chevron plot, Molecular Chevron, Multi sub MOUDLE protein and protein miss folding. Protein engineering in production, protein sequencing

Secondary structure prediction tools; Chou-Fasman, GOR, Hidden Markov model (HMM) and Neural Network method (PHD); Structural Alignment: Basics of Structural Alignment, DP, and RMSD.

Tertiary Protein Structure analysis: Homology Modelling, Fold recognition Ab Initio Methods, Molecular modeling Drug design.

### **Books:**

#### **Text Book:**

1. Basic and Clinical Immunology, D.P. Stites, J.D.Stobo, H.H.Fudenberg J.V. Wells, Large medical publications 5<sup>th</sup> ed.
2. Isolation, Characterization and Utilization of T-lymphocyte clones, C.Garrison Fathman, F.W. Fitch Academic Press.
3. Pharmaceutical Biotechnology, S. P.Vyas & B.K. Dixit, CBS Publication
4. Pharmaceutical Biotechnology, K Sambhamurthy, Ashutosh Kar, New Age Publication.
5. Culture of Animal Cells, A Manual Basic Techniques, R I Freshney, John Willey and Sons, 5<sup>th</sup> Ed.

#### **References Book:**

1. Monoclonal antibodies, Principles and practice by J.W. Goding, Academic Press.
2. Hybridoma Technology in the Biosciences and Medicine, T.A.Sringer Plenum Press, N.Y.
3. Hybridoma Techniques, A Laboratory Course by VR. Muthukkaruppan, S. Baskar and F. Sinigaglia, Macmillan India Ltd.

### **IBT 3.4: Biostatistics and Bioinformatics**

**Full Marks-100**

Variables, collection, tabulation and graphical representation of data, frequency distribution, central tendency, measure of dispersion: mean deviation, standard deviation, standard error of mean and skewness, Poisson and Gaussian distributions.

Additive and multiplicative laws of probability concept and correlation; regression; methods of least squares. Test of hypothesis, student t-test and paired t-test, chi

squares tests, Z-test, F-test random number generation-testing and use; Probability density and cumulative distribution function; systematic and random sampling.

Applications and prospects, Bioinformatics and internet, NCBI data base, genome and protein information resources, submitting DNA sequence to data base, sequence alignment and database searching, sequence analysis, multiple sequence alignment, homology and analogy, pattern recognition.

Analysis package. NTSYS-PC, Phylip, Free tree, Phylogenetic analysis: fundamentals elements of phylogenetic model, tree interpretation, tree evaluation comparative genome analysis large scale genome analysis,

## **Books**

### **Text Book:**

1. Introduction to Bioinformatics by Arthur Lesk
2. Fundamentals Of Biostatistics, Bernard Rosner Thomson Learning
3. An Introduction To Bioinformatics Algorithms, Neil C. Jones, Pavel A. Pevzner, Mit Press, Pavel Pevzner, Mit Pr
4. Fundamental Concepts of Bioinformatics, Dan E. Krane, Michael L. Raymer Addison-Wesley
5. Bioinformatics and Functional Genomics, J. Pevsner
6. Introduction to Bioinformatics, S.C.Rastogi
7. Biostatistic, S.P.Gupta.

### **References Book:**

1. Statistics for the Life Sciences by Myra L. Samuels, Jeffrey A. Witmer, Jeffery A. Witmer, Prentice Hall
2. Bioinformatics, D.W. Mount, CBS Pub & DIS, New Delhi, 2<sup>nd</sup> ed., 2005.
3. Fundamentals Concepts of Bioinformatics, Krane, Raymer, Dorling, Kindersley (India) Pvt.Ltd., New Delhi.2<sup>nd</sup> ed., 2005.
4. Biostatistics For The Biological And Health Sciences, Mario F. Triola, Marc Triola, Marc M. Triola, Addison Wesley.
5. BLAST, Ian Korf, Mark & Josaph; O'Reily Pub.

## **IBT 3.5 Practical**

**Full Marks-100**

1. Chi square test
2. T-test
3. BLAST search
4. Isolation of Genomic DNA from bacteria,
5. Isolation of mRNA
6. Restriction enzyme digestion, ligation ,

7. Southern blotting,
8. Northern blotting,
9. Western Blotting
10. Overexpression of proteins
11. Blood film preparation and identification of cells,
12. Double diffusion and Immunoelectrophoresis,
13. Radial Immunodiffusion,
14. ELISA
15. Immunodiagnosics (using commercial kits).
16. Isolation of industrially important microorganisms for microbial processes.
17. Isolation of lactobacillus sp. From Curd,
18. Production of lactic acid from whey
19. Production of baker's yeast,
20. Production of alcohol,
21. Detection of microbial protease production,
22. Cellulase production by microorganisms
23. Production and estimation lipase etc.,
24. Microbial production of antibiotics,
25. Use of alginate for cell immobilization.
26. Transformation with wild type *Agrobacterium*.

#### **Semester-IV**

- IBT 4.1: Seminar Presentation: Students will have to present a seminar basing on their 6 months project undertaken during this semester.
- IBT 4.2: Project work: Students may undertake a 6 months project work from any reputed academic and research institute or industry.