

**M.Sc., (BIO-TECHNOLOGY) SEMESTER - III**

## BTH 301: GENETIC ENGINEERING

### UNIT - I:

Isolation of gene/DNA fragments. Mechanical shearing, restriction digestion, cDNA synthesis, PCR amplification and chemical synthesis of gene.

Restriction enzymes - Outlines of bacterial restriction and modification systems – Classification of restriction enzymes - Type II restriction enzyme: Nomenclature, Production of DNA fragments with 3' protruding ends and blunt ends and their significance in molecular cloning - RFLP and its significance.

### UNIT - II:

PCR - Concept and technology- Properties of primers -Taq DNA polymerase and its significance - Inverse, multiplex PCR, RAPD and its significance. Real time PCR.

cDNA synthesis - Mechanism of cDNA synthesis, Strategies used to obtain full length cDNA. 5' and 3' RACE. Chemical synthesis - solid phase synthesis of oligonucleotides - Designing gene from amino acid sequence. *In vitro* synthesis of gene.

### UNIT – III:

Vectors for construction of genomic libraries - cosmids, bacterial artificial chromosomes (BACs), yeast artificial chromosomes (YACs) - vectors for construction of cDNA libraries - lambda ZAP. Multipurpose vectors - pUC 18/19, Blue script vectors - multiple cloning site - Strategies for unidirectional deletion of cloned DNA fragments - Generation of sequence of cloned DNA fragments. Site directed mutagenesis.

Expression vectors – structure - promoters used in expression vectors - *lac*, *tac*,  $\lambda pL$ , T7 promoters and their significance in constructing expression vectors.

Promoter-probe vectors – Structure promoter probe vector - Reporter genes (*lacZ*, *gfp*, *gus*, luciferase) and strategies used to assay promoter activity.

Vectors used for cloning in to mammalian cells - SV40. Vectors - Cloning of plants - binary vectors.

### UNIT - IV:

Cloning strategies:

Ligation between cohesive and blunt end DNA fragments - T4 DNA ligase - Conversion of blunt end DNA fragment into cohesive ended DNA - linkers, adapters, homopolymer tailing. Introduction of cloned genes into host - Transformation, transduction, conjugation, transfection, electroporation, particle bombardment, microinjection, liposome mediated DNA delivery.

Identification and characterization of cloned genes - Screening of genomic/cDNA libraries - genetic, molecular hybridization - immunochemical techniques

## REFERENCES

1. DNA replication, 2<sup>nd</sup> ed. 1991. A. Kornberg and T.A. Baker. W.H. Freeman and Company, New York. NY. PP931.
2. Gene transfer and expression protocols: Methods in Molecular Biology, Vol.7,1991. E.J. Murray Ed. Humana Press, Clifton, NJ. PP 439.
3. Genes IV, 1990. B. Lewin. Oxford University Press. PP 857.
4. Microbial genetics. 1994. Freifelder, D. Springer.
5. Glossary of Genetics. 5 ed. Classical and molecular, 1994, Reiger. R. et al., Springer.
6. Gene regulation, 2<sup>nd</sup> ed. 1994. D. Latchman. Scientific Publication.
7. Bacterial and Bacteriophage genetics. 1994. E.A. Birge. Springer Science Publication.
8. Genetics : A molecular approach. 2<sup>nd</sup> ed. 1992. T.B. Brown. Panima Publications. PP 496.
9. Principles of Gene Manipulation. 1991. R.W. Old and S.B. Prim-Rose. 2<sup>nd</sup> ed. Blackwell Scientific.

## Practical Course

1. Molecular Biology, Vol. 7,1991. E.J. Murray ed. Humana Press. Clifton, NJ. PP 439. Genes IV. 1990. B. Lewin. Oxford University Press. PP 857.
2. Guide to molecular cloning techniques : Methods in enzymology. Vol. 152. 1987. S.L. Berger and A.R. Kimmel Ed. Academic Press. PP812.
3. Methods in molecular genetics : Molecular microbiology techniques Vol.3. 1994, Kenneth W. Adolph. Ed, Academic Press. PP 2150.
4. Laboratory Manual in Molecular Genetics. 1994. Z.F. Burton and J.M.Kaguni. Harcourt Brace. PP 224.
5. Methods in Molecular Genetics. Vol.5, 1994. Kenneth. W. Adolph. Harcourt Brace. PP 425,
6. Molecular Cloning : A Laboratory Manual. 1989. 2<sup>nd</sup> ed. J. Sambrook, E.F. Fritsch and T. Maniatis. Cold Spring Harbor Laboratory Press.
7. Methods in Enzymology. Vol.152. Guide to molecular cloning techniques. 1987. S.L. Berger and A.R. Kimmel. Eds. Academic Press.
8. Recombinant DNA Laboratory manual. 1989. J.W. Zyskind and S.I. Bernstein. Academic Press
9. Methods in Molecular Genetics. Vol. 7, Viral Gene Techniques. Ed. By Kenneth W. Adolph, Academic Press, 1995.
10. Gene transfer and expression protocols ; Methods in Molecular Biology, Vol.7.1991. E.J. Murray Ed. Humana Press. Clifton, NJ. PP 439.

## BTH 302: CELL AND TISSUE CULTURE

### UNIT - I:

Introduction to plant tissue culture: Preparatory techniques - cleaning, sterilization, sterile handling tissue culture lab requirements. Media - Composition, preparation and sterilization. Genetic manipulation through tissue culture techniques - Concepts of differentiation and dedifferentiation.

Callus - growth pattern/characteristics, Organogenesis and plant regeneration. Somatic embryogenesis. Anther, endosperm and pollen cultures, Significance and advantages of haploid plants. Production of virus-free plants by meristem tip and other tissue culture techniques.

### UNIT - II:

Cell culture techniques for micropropagation of elite plants - Food and fruit crops, forest trees, fibre crops, ornamental plants, medicinal plants and endangered plants.

Cell culture techniques for production of useful compounds - Hairy root cultures - transformed roots using Agro bacterium rhizogenesis - Production of secondary metabolites of commercial importance - Elicitors - factors affecting their yield, immobilized cell systems, bioreactors.

Selection of clones for nutritional, disease resistance, salt and drought resistance. Germplasm preservation by tissue technology, Artificial synthetic seeds. Protoplast culture -isolation of protoplasts, culture and fusion methods, Somatic hybrids and cybrids.

### UNIT - III:

Introduction to animal cells and tissue culture - Components of cell culture, cell types and cell lines, different substrates, types of culture.

The biology of stem cells: Overview; different types of stem cells - embryonic stem cells, fetal tissue stem cells, adult stem cells; nuclear transfer of stem cells; human and animal cloning.

Embryonic stem cells: The blastocyst and inner cell mass cells - primitive endoderm implantation; blastocyst development *in vitro*; Isolation and propagation of embryonic stem cells; chimeras; Generation of knockout mice.

Stem cell plasticity: Overview; Self renewal potential; differentiation versus stem cell renewal; Transdifferentiation; Cell cycle dynamics of different stem cells.

Stem cell assays and protocols: Isolation of defined stem cell populations; progenitor cell

assays, sources of progenitor cells, cytokine and chemotherapy approaches to mobilization of progenitor cells; Flow cytometric techniques; Methods of cell selection using monoclonal antibodies; magnetic approaches to cell separation, Dyna beads, nano particle preparations; growth factors and *ex-vivo* expansion of hematopoietic stem / progenitor cells bioreactors for expansion.

Stem cell therapies: Clinical applications of stem cell therapy; Neurodegenerative diseases- parkinson's disease, Alzheimer's, spinal cord injury, other brain syndromes; tissue systems failures - diabetes, cardiomyopathy, kidney failure, liver failure - hemophilia, lymphoma and leukemic malignancies requiring stem cell therapy.

#### **UNIT - IV:**

Nuclear transfer technology: Transfer of nuclei into eggs; development potential of transplanted nuclei; reprogramming a nucleus.

Animal cloning and application in wild life and life stock: Overview; Challenges in human therapeutic cloning; Somatic cell nuclear transfer in humans; Pronuclear early embryonic development.

Human embryonic stem cells and society: The religious, legal, ethical and scientific debate; the failure of the debate; the regulatory aspects of therapeutical use of stem cells

#### **REFERENCES**

1. Bioprocessing engineering principles. 1995. P.M. Doran. Har court Brace. PP 464.
2. Biochemical engineering. 1992. James. M. Lee Prentice-Hall.
3. Biochemical engineering fundamentals. 2 ed. 1986. J.E. Bailey and D.F. Oilis. Me Graw-Hill Publication.
4. Chemical Process Control : An introduction to theory and practice. 1984. G. Stephanopoulos. Prentice-hall.
5. Modelling and control of Fermentation Process. Ed. J.R. Leigh.
6. Biochemical Engineering by S. Aiba, AE Humphery, NF Miltis, University of Tokyo press,
7. Chemical Engineering by JM Coulson and JF Richarson, Pergamen Press.
8. Fundamentals of Biotechnology by P. Prave, U, Faust. W.Sitting and DASukatsch, VCH.
9. A Text Book on Biotechnology by HD Kumar, Affiliated East West Press Private Ltd.

## **BTH 303 A: FOOD AND INDUSTRIAL BIOTECHNOLOGY**

### **UNIT - I:**

Scope of biotechnology in the food and drink industry: Contamination of foods by pesticides, fertilizers, industrial waste and chemical contaminants. Principles underlying food spoilage - chemical, physical and physiological changes caused by microorganisms. Control measures for food poisoning. Principles of food preservation, foods produced by microorganisms. Milk and Dairy products, Cereal products, Brewing, Protein products, Food additives and ingredients, Fruits and vegetables, large scale cultivation of edible mushrooms, meat and sausage products.

### **UNIT - II:**

Nitrogen fixation and mass production of biofertilizers - diazotrophic microorganisms, Biochemical aspects of diazotrophy. Genetics of free living and symbiotic diazotrophs. Blue Green Algae and Azolla, Micorrhizae, Vermiculture, Mass cultivation of commercially valuable macro and micro algae for agar agar, alginates, single cell protein and other products

### **UNIT - III:**

Energy and Biotechnology : Biomass, solar energy technology, Agriculture and forestry, conversion to fuel, bio fuel cells and other devices. Biogas production – design and types of biogas digesters. Production of biohydrogen.

Microbial leaching, Metal transformation, accumulation and immobilization by microbes. Application of microbes in mining and petroleum industry. Microbial enhanced oil recovery. Biodegradation of xenobiotic compounds, Hazards from xenobiotics.

### **UNIT - IV:**

Materials and Biotechnology : Biomolecules production - microbial polysacchrides, organic acids, amino acids, vitamins, antibiotics, enzymes, alcohols, food flavours, significance of Agrobacterium in enhancing food quality and yield Microbial toxins.

Pharmaceuticals - vaccines, hormones, diagnostics. Applications of enzymes in industry and medicine; immobilized enzymes - their preparation and applications. Use of microbes in biodegradation of organic wastes. Industrial production of fungal, bacterial and viral biopesticides.

### **REFERENCES:**

1. Fermentation : A Practical approach. 1990. B. Me Neil and L.M. Harvey. IRL Press. PP 226.
2. Biofertilizers in Agriculture and Agroforestry. 3ed. 1994. Subbarao. Oxford & IBH Publications.

3. Manual of Industrial Microbiology and Biotechnology. 1986. Edited by Arnold L. Demain and Nadine. A. Solomon. PP 466,
4. Bioreactors in Biotechnology-A Practical Approach. AR. Seregg.
5. Downstream Process : Equipment and Techniques. Advances in Biotechnological Process. Vol. 8,1988. Ed. A. Mizrahi, Alan R. Liss. Ince.
6. Biotechnology and the Food Industry. 1989. Ed.P.L.Rogers and G.H. Plat, Gordon & Breach. Sci. Publication.
7. Principles of fermentation technology. 1984. P.F. Stanbury and A. Witaker. Perman Press.
8. Biochemistry and genetic regulation of commercially important antibiotics. 1983. L.C. Ving,
9. Enzymes in industry and Medicine. 1987. G.F. Bickerstaff. Edward Arnold Publishers.
10. Biotechnology: Principles and Applications, 1994, by J. Hrggins, D.J. Best and J. Jones.
11. Fundamentals of Biotechnology, 1987. P. Prave, V. Paust, W. Sitting and D.A. Sukatsch (eds). VCH.
12. Crueger, W., and Crueger: Biotechnology; A Textbook of Industrial Microbiology, 2<sup>nd</sup> ed. Sinauer Associates. Inc. Sunderiand Mass/1990.
13. Demain, A.L., and N.A. Solomon, eds., Manual of Industrial Microbiology and Biotechnology, American Society for Microbiology. Washington. D.C., 1986.
14. Frazier, W.C.,and D.C. Esthoff: Food Microbiology, 4<sup>th</sup> ed., Me Graw-Hill, New York, 1988.
15. U.S. Congress, Office of Technology Assessment: "Biotechnology in a Global Economy" OTA-BA-494, Government Printing Office, Washington, D.C., 1991.
16. Industrial microbiology, Prescott and Dunn. 1997. Ed. Gerald Reed.

### **Practical Course**

1. Manual of Industrial microbiology and biotechnology. 1986. Edited by Arnold L. Demain and Nadine. A. Solomon. PP466.
2. Vanderzant, C., and D. Splittstoesser.: Compendium of Methods for the Microbiological Examination of Foods, American Public Health Association, Washington, D.C. 1992.

## **BTH 303 B: BIOPROCESS ENGINEERING AND TECHNOLOGY**

### **UNIT -1:**

Isolation, screening and maintenance of industrially important microbes; microbial growth and death kinetics (an example from each group, particularly with reference to industrially useful microorganisms); Strain improvement for increased yield and other desirable characteristics.

### **UNIT - II:**

Bioreactor designs; types of fermentation and fermenters; Concepts of basic modes of fermentation – batch, fed batch and continuous; conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermentation economics; Fermentation media; Fermenter design - mechanically agitated; pneumatic and hydrodynamic fermenters; Large scale animal and plant cell cultivation and air sterilization: Upstream processing; media formulation; sterilization; aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale up and scale down process.

### **UNIT - III:**

Kinetics of Enzyme catalyzed reactions - immobilization - Kinetics of immobilized enzyme catalyzed reactions - Kinetics of balanced growth - Transient growth kinetics. Gas-liquid mass transfer in cellular systems - Aeration – Agitation - Estimation of oxygen transfer rates.

### **UNIT - IV:**

Bioseparation - filtration, centrifugation, sedimentation, flocculation; cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; reverse osmosis and ultra filtration; drying; crystallization; Storage and packaging; Treatment of effluent and its disposal. Large scale production and purification of recombinant therapeutics (streptokinase, epidermal growth factor, insulin)

### **REFERENCES:**

1. Bio processing Engineering principles. 1995. P.M.Doran. Har court Brace. PP 464
2. Biochemical engineering . 1992. James .M.Lee Prentice -Hall.
3. Biochemical engineering Fundamentals, 2ed 1986 J.E.Bailey and D.F.Oilis. Me Graw-Hill Publication.
4. Chemical Process Control: An Introduction to theory and practice. 1984.G.Stephanopoulos, Prentice-hall.
5. Modelling and controlling of fermentation Process. Ed. J.R.Leigh
6. Biochemical Engineering by S.Aiba, AE Humphery, NF Millis, University, of Tokyo Press.
7. Chemical Engineering by JM Coulson and JF Richarson ,Pergamen Press.
8. Fundamentals of Biotechnology by P.Prave , U.Faust W.Sitting and DASukatsch, VCH.

9. A Text Book on Biotechnology by HD Kumar, Affiliated East West Press Private Ltd.

## BTH 303 C: GENOMICS AND PROTEOMICS

### UNIT I

Introduction to genome structure and Organization, Organelle genomes. Comparative genomics: genomes (DNA and protein sequence), Protein structures (geometry), Gene regulation (logic, systems), Immunology (systems). The nature and complexity of bio-molecular data. The intertwining of algorithms and statistics in the design of genomics tools. The “Gold-Bug” – a metaphor for Bioinformatics.

### UNIT II

Genetic and Physical Mapping, Linkage analysis. Genome sequencing: DNA sequencing methodology, Assembly of DNA sequence, Contig approach and shotgun approach, BACs and YACs. The structure, function and evolution of the human genome. Strategies for large-scale sequencing projects. Human disease genes. Expression. Bioinformatics for the analysis of sequence data; approaches for determining gene expression patterns and functions. Transcriptome, Studying Gene expression in microorganisms, Microarrays – DNA chips.

### UNIT III

An introduction to proteomics. Property of proteins, 2D electrophoresis. Protein detection, High-performance liquid chromatography (HPLC), fundamentals of high-performance liquid chromatography reverse-phase chromatography. Strong cation exchange chromatography, multidimensional HPLC. Mass spectrometry, various methods available. Use of methods in proteomics.

### UNIT-IV

Protein structure, secondary structure and super-secondary structure. Mechanisms of protein folding, tertiary folds. Formation of oligomers. Relationship between protein structure and function. Prions. Structure prediction and human proteomics. Mutant proteins. Use of computer simulations and knowledge-based methods in the design process. *De-novo* design; Use of databases of sequence and structure. Protein structure and drug discovery, Proteins in disease

### Reference

1. Robert B Northrop, Anne N Connor: Introduction to Molecular Biology, Genomics and Proteomics for Biomedical Engineers, CRC Press.
2. Brown TA, Genomes, 3rd Edition, Garland Science, 2006.
3. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006
4. Discovering Genomics, Proteomics and Bioinformatics, 2<sup>nd</sup> edition-A. Malcolm Campbell and Laurie J. Heyer (ISBN 0-8053-4722-4)-Cold Spring Harbor Laboratory press and Benjamin Cummings, 28 Feb 2006.
5. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and
6. Bioinformatics, 2nd Edition, Benjamin Cummings, 2007.
7. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.

8. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998.
9. H. Rehm, Protein Biochemistry and Proteomics, 4th Edition, Academic Press, 2006.

## BTH 304: BIOCHEMICAL METHODOLOGY

### UNIT - I:

Chromatography paper, Thin layer, gas liquid, HPLC and Molecular sieving.

### UNIT- II:

Centrifugation preparation and analytical centrifuges, Rotors, Rate zonal and equilibrium density gradient centrifugation, Isolation of cell or granules.

### UNIT - III:

Types of electrophoresis, paper and gel (starch, acrylamide, agrose) electrophoresis. Disc, slab, vertical Electrophoresis Blotting techniques (Western, southern and Northern).

### UNIT - IV:

Electromagnetic spectrum of light, simple theory of absorption of light bio molecules. Beers-lambert law, types of detectors. Photometry UV - visible spectrophotometer, IR spectroscopy AAS, CD and ORD, Mass spectroscopy, NMR spectroscopy.

### REFERENCES:

1. Biochemical techniques: Theory and Practical. 1987. J.F. Robft and B.J. White, Waveland Press. Inc. Prospect Heights. IL PP407.
2. Principles and Techniques of Practical Biochemistry. 1994. 4<sup>th</sup> ed. Eds. K. Wilson and J. Walker.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology. 2<sup>nd</sup> ed. David Freifelder. W.H. Freeman and Company. New York.
4. Affinity Chromatography: Bio selective adsorption on insert matrices. 1992. W.H. Scouten, John Wiley & Sons, New York, PP 348.
5. Applications of HPLC in Biochemistry: Laboratory Techniques in Biochemistry and Molecular Biology. 1987. AFallon, R.F.G, Booth and L.D. Bell. Eds. Elsevier Science Publishers, Amsterdam, the Netherlands. PP 338.
6. Electron microscopy; Principles and Techniques for
  - a. biologists. 1992. J.J. Bozola and L.D. Rusei, Jones and
  - b. Bartlett Publishers, Boston, M.A. PP 542. 7 Electrophoresis: Theory, techniques and biochemical
  - c. applications. 2<sup>nd</sup> ed. 1986. At. Andrews. Oxford University
  - d. Press. Oxford. PP452.
7. Enzymatic analysis: A practical guide. 1993. Janet. V. Passonnequ and Oliver. H. Lowry, Humana Press, Totowa. N.J. PP400.
8. Enzyme assay: A Practical Approach. 1992. R. Eienthal and MJ. Danson. Eds. IRL Press. PP. 351.
9. Flow Cytometry: A practical approach. 1990. M.G Ormerod. Ed. IRL Press PP 279.

**M.Sc., (BIO-TECHNOLOGY) SEMESTER - IV**

## BTH 401: ENVIRONMENTAL BIOTECHNOLOGY

### UNIT -1:

Structure of model ecosystem - terrestrial, aquatic ecosystems - Energy flow - Degradation of ecosystem. Consequences - Ecosystem managements - Energy conservation - Alternative energy sources - Biofuels: Production of bioethanol, boibutanol from agriculture waste - Problems and perspectives - Biodiesels: mass cultivation of *Jatropha* and use of *Jatropha*, marine algae for producton of biodiesel.

### UNIT-II:

Nature of recalcitrant compounds - Anthropogenic activities generating recalcitrant chemical waste - BHC, DDT, nitrophenols, polycyclic aromatic carbons. Biodegradation - microbial conversion of recalcitrant toxic compounds into TCA cycle intermediates eg: *Pseudomonas putida*. Degradation pathways - naphthaline, BHC, and nitrophenols. Use of microbes for reconstruction of ecosystems - Genetics of biodegradation. Microbes as biosensors for detecting pollution. Superbug – cleaning of oil spills.

### UNIT - III:

Biological methods of pest management - Role of Juvenile hormones, pheromones and its analogues for pest management, Chromosomal manipulation and androgenesis of pest , sterile male technology, Biological control of weeds. Bacterial (BT), viral, fungal insecticides - Technology for mass production and formulation of biopesticides - Problems and prospects.

Biofertilizers - Important diazotropic, microbes - mechanism of symbiotic and asymbiotic biological nitrogen fixation - Regulation of nitrogen fixing genes (Nif genes). Manipulation of Nif genes for constitutive expression of nitrogenase - Ammonia transport and its significance. Mass production of biofertilizers - *Ribozium*, *Azolla*.

### UNIT - IV:

Waste management - Nature and classification of agriculture, domestic and industrial waste - Recycling methods. Solid waste treatment. Biological and non-biological methods of waste water treatment. Reclamation of treated waste water.

### REFERENCES:

1. Biotechnology from A to Z. 1993. William Bains, IRL Press, Oxford, England PP 358.
2. DNA Science : A first course in Recombinant DMA technology. 1990. D.A. Micklos and G.A. Freyer. Carolina Biological Supply Co., Burlington, NC, PP 477.
3. DNA finger printing: An Introduction. 1990. L.T. Kirby, Stockton Press, New York, NY PP 365.
4. Molecular biotechnology principles and applications of recombinant DNA. 1994. B.R. Glick and J.J. Pasternak. Panima book distributors. PP 500.

5. Fundamentals of biotechnology. 1987. P. Prave, V. Faust, W. Sitting and D.A. Sukatsch. Ed. WCH. Weinhein.
6. Principals of Genetics. 8<sup>th</sup> ed. 1991. E.J.G. Gardner, M.J. Simmons and D.P. Snustad. John Wiley and Sons. PP713.
7. Biotechnology. 1988. J.E. Smith. Edward Arnold. London.
8. Molecular Cloning : A Laboratory manual. 1989. 2<sup>nd</sup> ed. J. Sambrook, E.F. Fritsch and T. maniat. Cold Spring Harbor Laboratory Press. 3 Volumes.
9. Principles of Gene Manipulation. 1991. R. W. Old and S.B. Prim-Roses. 2<sup>nd</sup> ed. Blackwell Scientific Publications.
10. Methods in Enzymology. Vol. 152. Guide to molecular cloning techniques. 1987. S.L. Berger and A.R. Kimmel, eds. Academic Press.

## **BTH 402: RESEARCH METHODOLOGY & EXTENSION STUDIES**

### **UNIT - I:**

Literature survey - Identification of problem – literature survey - Origin of problem, Formulation hypothesis based on existing information - Validation of hypothesis - Designing experimental techniques for validating the hypothesis - Execution of designed experiments - Analysis of data - Presentation of research findings - Preparation of technical report/manuscript for publication in peer reviewed scientific journals.

### **UNIT-II**

Adoption of villages/village for popularization of biotechnology application - Propagation of medicinal plants, mushroom culture, biogas production, vermicomposting, sericulture, apiculture, agroforestry, floriculture. Development of alternatives to plastic from agriculture waste/xerophytic plants.

### **UNIT-III**

Survey of Biotechnology based Industries in AP/South India - Visit to industries. Interaction with pharmaceutical industry in Drug designing, production and marketing.

### **UNIT - IV**

Communicable Diseases Incidence, Transmission and Control  
Non-communicable Diseases and Prevention  
Epidemiology  
Immunisation – Mass immunization programmes

### **REFERENCES:**

1. Gene cloning - Brown
2. Concepts in Biotechnology- Balasubramanyam.D
3. Basic Biotechnolgy - Colin Rotfedge and Kristainsen
4. Gene Biotechnology - Jogdand
5. From Genes to Clones , Introduction to Gene Technology- Winnacker, Ernst.L
6. Safety ,Moral. Social and Ethical issues related to geneticalls modified foods - Smith J.E.
7. Molecular Biology and Biotechnology - Meyer R A
8. Environmental Biotechnology- Forster and wase
9. Biotechnological Innovations in Environmental Management - Leach and Van Dam-mieras
10. Industrial Microbiology and Biotechnology- Demain and Solomon

## BTH 403 A: PLANT BIOTECHNOLOGY

### UNIT - I:

Concepts and scope of plant biotechnology -Application of genetic engineering technology for crop improvement - production of transgenic plants resistant to herbicides, pathogens, pests and abiotic stresses (drought, salt, frosts); production of transgenic plants with improved yields and nutritional quality; transgenic plants for production of viral antigens.

### UNIT - II:

Industry and Plant Biotechnology: Biosynthesis of plant compounds – Selection of cell lines for high yields of secondary metabolites – Enzymes from plants – Food and food additives from plants – Breeding strategies for enhancing the active principles in plants.

### UNIT - III:

Algae as a source of food, feed, single cell proteins, biofertilizers, industrial uses of algae. Mass cultivation of commercially valuable marine microalgae for agar agar, alginates and other products of commerce and their uses. Mass cultivation of macroalgae as a source of protein and feed. Indoor and out door cultivation of economically important algae – Use of algae in waste water treatment.

### UNIT - IV:

Nutrient film culture techniques - plant diseases – Physiology of infection in plants – disease resistance in plants - phytodiagnosics based on immunological and molecular techniques. Biological control of pests and diseases of crop plants and weeds - biopesticides - predators, parasites, insect viruses, antagonistic fungi and bacteria, antifeedants, and insecticidal activities of the compounds of Botanicals.

### REFERENCES:

1. Molecular approaches to crop improvement. 1991. Dennis and Liwelly eds. PP. 164.
2. Plant cell and Tissue culture. A Laboratory Manual. 1994. Reinert. J. and Yeoman, M.M. Spring.
3. Plant biotechnology, 1994. Prakash and Pierik. Oxford & IBH Publishing Co.
4. Gene transfer to plants. 1995. Potrykus-I and Spangenberg, G. Des. Springer Scan.
5. Methods in Plant Molecular Biology and biotechnology, 1993. R. Bernard Click and Joh. E. ;Thompson, CRC, Press, PP. 384.
6. Genetic engineering with plant viruses. 1992. T. Michale. A. Wilson and J.W. Davies. CRC Press Inc, PP 384.
7. Plant cell Biotechnology. 1988. Borocoitzka M.A. and Borocoitzka L.J. Cambridge University Press.
8. Microalgal Biotechnology. 1988. Borocotizka M.A. and Borocoitzka L.J. Cambridge University Press.
9. Algal and Cyanobacterial biotechnology, 1989. Cresswell. R.C, Rees, T.A.V. and Shah, N.Eds. Longman Scientific and Technical, Essex, London.

**Practical Course**

1. Plant cell and Tissue culture. A laboratory manual. 1994. Reinert, J. and yeoman, M.M. Springer.

## BTH 403 B: ANIMAL BIOTECHNOLOGY

### UNIT - I:

Structure and function of male reproductive system - Hormonal regulation of spermatogenesis and spermeiogenesis; Inhibin and androgen binding proteins; Capacitation of spermatozoa.

Structure and function of female reproductive system - influence of hormones on development of ovarian follicles and oogenesis; Reproductive cycles; estrus and menstrual cycle; Ovulation, atresia and corpus luteum formation; Pregnancy and lactation; Implantation and placentation.

Contraception in males and females; Hormonal and chemical; Recent advances in contraception research.

### UNIT - II:

Introduction - Sex determination; Principles of animal breeding; Structure of the live stock breeding industry: dairy cattle, beef cattle, swine, sheep and poultry.

Selection for qualitatively inherited characters - Gene frequency and selecting against recessive genes; detecting heterozygotes for recessive; parental determination and verification; the use of markers and/ or molecular probes, selection criteria: multiple records, pedigree selection, family selection; progeny testing: breeding value, transmitting ability and heritability; correlated characters; selection for maternal ability; factors affecting selection response; genotypes - environment interactions.

Artificial insemination (AI) techniques and their development; Estrus synchronization; Semen collection, evaluation, storage, *in vitro* fertilization, Embryo transfer - ICSI and preservation of endangered species.

### UNIT-III

An overview of transgenic technology.

Development of transgenic mice and other animal models: by injection of foreign DNA/gene into zygote; optimization of construct for *in vivo* expression

Generation of chimeric, transgenic and knockout mice and other animals and their characterization

Potential application of transgenic animals : Models for various diseases/disorders, Production of peptides and proteins of biopharmaceutical interest (molecular pharming), Transgenic fishes, Transgenic poultry and Transgenic insects as

bioreactors.

**UNIT - IV:**

Applications of biotechnology to animal health - Production of vaccines, diagnostics, hormones and other products.

Animal nutrition and biotechnology - Microbial supplements, non-genetic and genetic manipulation of rumen microbes, Utilization of animal waste as live stock feed.

**REFERENCES:**

1. Culture of animal cell: A Manual of Basic techniques. 3<sup>rd</sup> ed. 1994. R.I. Reshner, Alan R. liss. Inc. New York, NY, 397.
2. Recombinant and synthetic vaccines 1994. G.P. 1 Taiwan K.V.S. Rao, V.S. Chauhan, Eds. PP. 528. Springerscan Publication,
3. Animal Cell Biotechnology, Vol.6, 1994, R.E. Spier, J.B. Griffiths, Eds. Harcourt Brace. PP 352.

## BTH 403 C: PHARMACEUTICAL BIOTECHNOLOGY

### UNIT -1:

Definition - History of development of Pharmaceutical Products by biotechnological methods like genetic recombinant vaccines, microbial and non-microbial products - scope of biotech products and biochemical in pharmaceutical industry. Need to design a drug, drug receptor interactions, antagonisms, biological activity, efficacy and stimulus, receptors and ion channels, ion gating co-operatively effect of solvent on drug - receptor interactions, drug docking.

### UNIT- II:

*In vitro* development of drugs and pharmaceutical : Methods of testing products for anti-microbial potentials, pharmacological activities and biopesticidal properties - conventional and rapid enzyme inhibitor techniques; *in vivo* methods - use of animals models for confirmation of *in vitro* properties - transgenic systems - preclinical, toxicological studies, Acute, subacute, chronic studies. Clinical trials -definition - design - specific objectives - types of clinical trials -phase I, II & III - randomised controlled clinical trials - multicentric double blind clinical trials - pharmaceutical/drug regulations for commercialising new biotech products for human use - FDA and Indian regulations.

### UNIT – III:

Biotech products as medicines and pharmaceutical products: Biochemicals - enzymes like proteases - chemical like ethanol, vinegar, citric acid and glutamic acid; vitamins like B12; drugs for infection and metabolic, immunomodulatory -insulin - interferons, B-cell growth factors, Tissue plasminogen activator. r-DNA based production of regulatory proteins, blood products, hormones, vaccines, Application of RFLP in forensic, disease prognosis, genetic counselling, pedigree, variation.

### UNIT - IV:

Vaccines - cell culture based vaccines - genetic recombinant vaccines - recombinant vector based vaccines -live and subunit - their production model - fermentation technology - expression systems - guideline for the production of genetic recombinant vaccines - Eg. Hepatitis B vaccine, HIV vaccine and other vaccines in pipeline. Application of biotechnology to Animal health and disease diagnosis, Development of kits and their application in disease diagnosis. Gene therapy, vector engineering, strategies of gene delivery, gene replacement, augmentation, gene correction, gene regulation and silencing safety and bioethical issues in biotechnology.

### REFERENCES:

1. Biopharmaceuticals- Walsh , John Willey and Sons, New York 1998
2. Pharmaceutical Biotechnology- Daan J.A.Crommelin, Robert D. Sindelar, Daan JACrommelin Amazon.
3. Physical Methods to characterize Pharmaceutical Proteins- James. N.Herron, Wim Jiskoor and Daan J.A.Crommelin Amazon. From clone to clinic (Developments in Biotherapy)-Daan J.A.Crommelin and H.Schellekom

- Amazon.Wm.
4. Hand Book of Pharmaceutical Biotechnology- Jay P.Rho, Star4lonie The Haworth press.
  5. Alice Sr. Bringhamtpn, NY13904, US Drug discovery, Tamas bartifai, Harold L.Dorn's The Scientific world Ltd., Newburry, U.K.

## **BTH 404 : APPLICATIONS OF BIOTECHNOLOGY**

### **UNIT - I:**

History and scope of Biotechnology, Definition of Biotechnology, Old & Modern Biotechnology, Different areas of Biotechnology.

### **UNIT- II:**

Biotechnology and Agricultural, Micro propagation, (Cell and Tissue culture) Transgenic plants, Biofertilization, organic farming, Biopesticides.

### **UNIT - III:**

Application of Biotechnology in Animal sciences, Animal cell and tissue culture, production of transgenic animals, cloning of animals (IVF & ET) cryopreservation somatic production of animals, application of human vaccines in improving productivity.

### **UNIT - IV:**

Biotechnology and Environment: Microbial agents and Biochemical methods of xenobiotic degradation, OEMs, Waste water and solid waste management.

### **REFERENCES:**

Gene cloning - Brown  
Concepts in Biotechnology- Balasubramanyam.D  
Basic Biotechnolgy - Colin Rotledge and Kristainsen  
Gene Biotechnology - Jogdan  
From Genes to Clones , Introduction to Gene  
Technology- Winnacker, Ernst.L  
Safety .Moral, Social and Ethical issues related to  
geneticalls modified foods - Smith J.E.  
Molecular Biology and Biotechnology - Meyer R A  
Environmental Biotechnology- Forster and wase  
Biotechnological Innovations in Environmental  
Management - Leach and Van Dam-mieras  
Industrial Microbiology and Biotechnology- Demain and Solomon

## **BTH 405: LEGAL, ETHICAL & MORAL IMPLICATIONS OF BIOTECHNOLOGY**

### **UNIT - I:**

Intellectual property rights - Definition - types -patents - copy rights-trade marks: essential requirements for IPR, procedures of filing patents-provisional and complete specifications-Pan-Co-operation treaty (PCT)-application: GATT and IPR: WTO Act - Global and Indian Biodiversity Act- Indian Patnt Act and their revised versions.

### **UNIT - II:**

Legal and Ethical aspects of Biotechnology -Prenatal diagnosis - Genetic screening - Surrogate mothers and exploitation of women - designing of plants and animals - gene therapy - cloning - Manipulation of human genome -Technology transfer.

### **UNIT - III:**

Social and Moral aspects of Biotechnology -Biotechnology and International trade - Privatisation and patenting of Biotechnology products - Role of Government, Industries and society in promoting, accepting and regulating the rDNA research.

### **UNIT – IV:**

Environmental and Health aspects of Biotechnology - Generally engineered organisms - Introduction of novel species and natural equilibrium - Environmental security and safety - Precautionary measures - Genetically modified foods - health safety.

### **REFERENCES:**

Gene cloning - Brown

Concepts in Biotechnology- Balasubramanyam.D

Basic Biotechnolgy - Colin Rotledge and Kristainsen

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From Genes to Clones, Introduction to Gene Technology-Winnacker, Ernst.L

Safety, Moral, Social and Ethical issues related to geneticalls modified foods - Smith J.E.

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