BHARATHIAR UNIVERSITY, COIMBATORE.

M. Sc BIOTECHNOLOGY DEGREE COURSE WITH COMPULSORY DIPLOMA IN BIOPROCESS TECHNOLOGY (AFFILIATED COLLEGES)

(Effective from the academic Year 2008-2009)

SCHEME OF EXAMINATIONS – CBCS PATTERN

Semester	Study Components	Course title	Ins. Hrs/ week	Exam			Credit
				CIA	Uni. exam	Total	
I	**Paper I**	Cell & Molecular Biology	4	25	75	100	4
I	**Paper II**	Biochemistry	4	25	75	100	4
I	**Paper III**	Microbiology	4	25	75	100	4
I	**Paper IV**	Biophysics & Biostatistics	4	25	75	100	4
I	**Paper V**	Molecular Genetics	4	25	75	100	5
I		Practical I	3	-	-	-	-
I		Practical II	4	-	-	-	-
I	**Elective/ Diploma Paper I**	Fundamentals of Fermentation Technology	3	25	75	100	3
II	**Paper VI**	Immunology & Immunotechnology	5	25	75	100	5
II	**Paper VII**	Genetic Engineering	4	25	75	100	4
II	**Paper VIII**	Microbial Biotechnology	4	25	75	100	4
II	**Paper IX**	Plant Biotechnology	4	25	75	100	4
II		Practical I	5	40	60	100	4
II		Practical II	5	40	60	100	4
II	**Elective/ Diploma Paper II**	Fundamentals of Bioprocess Technology & Biochemical Engineering	3	25	75	100	3
III	**Paper X**	Animal Biotechnology	5	25	75	100	4
III	**Paper XI**	Medical Biotechnology	5	25	75	100	5
III	**Paper XII**	Environmental Biotechnology	5	25	75	100	4
III	**Paper XIII**	Bionanotechnology	5	25	75	100	4
III		Practical III	5	-	-	-	-
III	**Elective/ Diploma Paper III**	Downstream Processing	5	25	75	100	3
IV		Practical III	5	40	60	100	5
IV		Project	20	-	-	200*	10
IV	**Elective/ Diploma Paper IV**	Bioethics, Biosafety and IPR	5	25	75	100	3
		Total				2200	90

*** For Project report - 80%; Viva-voce - 20% (Project is pertain to the field of Biotechnology)**

Paper I : Cell & Molecular Biology

Subject description: This paper provides a thorough knowledge about structure and function of cells, cellular energetic, protein trafficking, bio molecules and cellular development.

Objective: Understanding the structural and functional aspects of the cell provides the student with a strong foundation in the molecular mechanisms underlying cellular function.

Goal: Students after completion of this paper will be exceptionally well prepared to pursue careers in cellular and sub cellular biological research, biomedical research, or medicine or allied health fields.

CONTENTS:

UNIT I

Types of cells Prokaryotic and Eukaryotic cell structure and intracellular organelles – nucleus, Mitochondria, Chloroplast, Ribosomes, Peroxysomes and Microbodies; Fractionation & Purification of subcellular organelles; Molecular events of mitosis & meiosis.

UNIT II

Cytoskeleton Cell motility and cellular movements, Microtubules, Microfilament. Protein localization: Protein targeting to various organelles and secretion of proteins by exocytosis, receptor mediated endocytosis .

UNIT III

DNA replication, RNA transcription and processing, interaction of mRNA,rRNA and tRNA on protein synthesis. Mitochondrial electron transport system, oxidative reactions in microbodies, pathways of photosynthesis – light & dark reactions.

UNIT IV

Structure and functions of plasma membrane cell recognition, cell to cell signaling, surface receptor and receptor – response mechanisms, cell adhesion. Cancer: characteristics & causes, oncogenes and tumour suppressor genes.

UNIT V

Homeotic genes in development, Developmental pattern of Drosophila & Aragidopsis. Spatial and temporal regulation of gene expression, specialized cell structure and function (Muscle cell, nerve cell & motile cell).

REFERENCES:

1. Molecular Biology of cell, Albert's. B et al
2. Molecular Cell Biology, Darnell Lodish Baltimore scientific Books. Inc 1994.
3. Molecular & Cellular Biology
4. Stephen. I. Wolfe. Wadsworth publishing company. 1993.

Paper II: BIOCHEMISTRY

Subject description: This paper presents the study of identification and quantitative determination of the substances, studies of their structure, determining how they are synthesized metabolized and degraded in organisms, and elucidating their rile in the operation of the organism.

Objective: On the successful completion of the course the students will get an overall understanding of structure of atoms, molecules and chemical bonds, enzyme kinetics, bio polymers and metabolic reactions in a living system.

Goal: This paper in biochemistry has been designed to provide the student with a firm foundation in the biochemical aspects of cellular functions which forms a base for their future research.

Contents:

Unit 1:

Structure of atoms (C.H, N, O, S, and P) and molecules: chemicals bonds- covalent bonding and hydrophobic interactions.

Principles of physical chemistry: Thermodynamics and it's principles in biology, Dissociation and association constants, concepts of pH. Acids, bases and buffers of biological importance. Bioenergetics: Laws of Thermodynamics, Concept of free energy and standard free energy, energy rich bonds , weak interactions, Biological energy transducers, Energy metabolism – exergonic, endergonic and coupled reactions, Respiration and oxidative phosphorylation, introduction to metabolism: anabolism, catabolism and amphibclism, cycles, shuttle mechanisms and anaplearotic pathway.

Unit II

Enzymes and co –enzymes: IUBMB classification and nomenclature of enzymes, active site, Lock and key Machanism and induced fir hypothesis, Forces involved in enzyme substrate interaction. Mechanism of enzyme catalysis: Lysozyme, Enzyme kinetics- negative and positive co-operatively, MMKinetics, Transformations of MM equation and their significance, enzyme inhibition: Reversible – Competitive, Noncompetitive, uncompetitive, Irreversible inhibition, Kinetics of Enzyme inhibition, Drug discovery: enzymes and receptors as drug targers HMG CoA reductase inhibitor as a drugh for hyper cholesteraemia. Regulation of enzyme activity, .Isoenzymes, allosteric enzymes, ribozymes, abzymes and artifical enzymes.

Unit III:

Classification, structure, functions and reactions of carbohydrates, Metabolism of carbohydeates (including regulation and energerics): Glycolysis, Gluconeogenesis, Glycogensis,glycogenolysis, HMP shunt, TCA, and glyoxylate cycle, Inter conversion of pentose and hexoses.

Unit IV

Classification, Structure, functions and reactions of Lipids, Metabolism of carbohydrates (including regulation): Biosynthesis of saturated fatty acids, Triglycerides, phospholipids and Sterols (for sterols structure is not compulsory), Catabolism of Fatty acids: - oxidation, Catabolism of triglycerides and phospholipids, Structure and functions of Glycolipids and Lipoproteins.

Classification, structure, functions and reactions of nucleic acids, Biosynthesis of Purines and pyrimidines, Salvage pathway, Regulation of Purine and pyrimidine biosynthesis.

Unit -V

Proteins: Classification and structure of amino acids (Classification based on nutritional, chemical and polarity), peptides and poly peptides, classification of Proteins based on structure and function. Levels of Organization of proteins: Primary – peptide bond, Ramachandran Plot, secondary -□ helix, □ pleated sheets and □ - bend, tertiary structure of proteins- Motifs and domains and polypeptides. Metabolism of aminoacids: Birds eye view of Biosynthesis and catabolism of amino acids (structure not compulsory) integration of metabolism

References:

1. Principles of Biochemistry – Smith et al., Mc Graw Hill International book Company 8th ed
2. Principles of Biochemistry – Lehninger, Nelson, Cox, CBS publishers.
3. Fundamentals of Biochemistry – Voet et al., Jhon Wiley and Sons Inc.
4. Biochemistry – Zubay, WCB Publishers.
5. Harpers Biochemistry, R.K. Murray, D.K.Granner, P.A Mayes and V.W. Rodwell, Practise Halt International
6. Biochemistry – Stryer.
7. Text book of Biochemistry with clinical Correlations – Homas. M.Devlin.H.John Wiley & sons. Publications.

Websites:

8. http://www.iubmb.unibe.ch/
9. http://www.iubmb-nicholson.org/
10. http://www.iubmb-nicholson.org/chart.html
11. http://www.iubmb-nicholson.org/animaps.html
12. http://www.iubmb-nicholosn.org/pdf/InbornErrors.Pdf

Paper III : MICROBIOLOGY

Subject description: This course presents the types, morphology, biochemical, physiological characteristics of microorganisms.

Goals: To make the student to understand the concept of the biology of Microorganisms.

Objectives:

- On successful completion the subject student should have understand:

- Understood History and development of Microbiology and Taxonomy
- Basic concepts in Microbial physiology and cultivation of bacteria

Contents:

Unit I:

History of Microbiology

Discovery of the microbial world: Controversy over spontaneous generation; discovery of role of microbes in causation of disease, first pure culture, development of culture media by koch and his school, Microscopy: Light, phase contrast, fluorescent, TEM, SEM and scanning tunneling Microscopy, Methods of staining and Microscopic observation of Bacteria and Fungi.

Classification and phylogeny of bacteria:

Species classification: problems in taxonomic arrangement: New approaches to bacterial taxonomy including ribotyping 16 S rRNA sequencing and phylogenetic analysis. Numerical taxonomy, Chemotaxonomy and sero-taxonomny. Morphoiogy, cell wall: Structure and composition. Cell membrane, Mechanisms of transport in Bacterial cell and functions of prokaryotic cell.s

Unit II:

Methods of Microbiology:

Principles of Microbial nutrition – Carbon, nitrogen, sulphur, growth factors, nutritional requirements of Bacteria, Nutritional classification of Bacteria, Culture media preparation, Types of media Selective media, Enrichment media and Differential media, Sterilization methods (physical, Chemical and mechanical)

Unit III

Microbial metabolism – Glycolysis, Krebs cycle, glyoxylate cycle, ED pathway. ATP synthesis, aerobic and aerobic respiration, photosynthesis, Fermentation, Methanogenesis. Biosynthesis of purines, Pyrimidines and peptidoglycan, Fatty acid biosynthesis, synthesis of phospholipids, Aminoacid biosyntheis : Asparate family, pyruvate family and aliphatic to aromatic interconversion.

Unit IV

Viruses: Discovery, structure, Baltimores classification of viruses : Lysogenic and lytic cycles. Cultivation of Viruses – detection and enumeration of viruses, viral assay.

Unit V:

Biogeochemical cycles (P, O, N- symbiotic and asymbiotic nitrogen fixation, sulphur and carbon cycles). Symbiotic and asymbiotic associations, Biopesticides, Bioinsecticides.

References

1. General Microbiology – Roger, Y.Stanier. John. I.Ingraham. Mark. I.Wheelis and page R. Painter. 5th Ed.1986: Macmillion Press Ltd. Hampshire.
2. Microbiology – An Introduction: Cerald. J.Tortora . Berdell. R.Funke. Christine.I. Case 5th Ed. 1955: The Benjamin/ Cummings Publishing Co. Inc. USA.
3. Microbiology: Essential and Applications: Larry Mckane. Judy Kandel. 2nd Ed. 1996. McGraw hill Inc.
4. Microbiology – Present. Harley, Klein, 4th Ed. 1999: McGraw Hill Inc.

Paper IV : BIOPHYSICS AND BIOSTATISTICS

Subject description: This course presents the basic concepts of Biophysics and biostatistics.

Goals: To make the student to understand the fundamentals of Biophysics data analysis by Biostatistics.

Objectives

- On Successful completion the subject student should have understand:
- Understand fundamentals of Biophysics and Bio statistical Methods.

Contents:

Unit I:

Proteins: Aranio acids – Conformations. Phi and Psi angles. Ramachandran plot. Peptides – peptide bond isomerisation. Disulphide bonds, short range repulsion, electrostatic forces, van der waals interaction. Hydrogen bonds, Determination structure of proteins: NMR, 3D structure by x- ray diffraction. Inter and intramolecular interactions.

Unit II

Nucleic acids: Transitional angels and their ranges. Sugar puckering models, the pseudorotation cycle, syn – anti orientation of glycosyl bond. Details geometries of Watson- Crick and Hoogsteen base pairs- Thermodynamic description of stacking interactions – classification of A,B and Z type double helices. Biophysics of protein – DNA Interactions.

Unit –III

Basic principles of spectrophotometry. The laws of absorption, principles and instrumentation for UV- visible and IR spectroscopy. Principles, theory and applications of spectrofluorometry, and Flame photometry.

Unit – IV

Biostatistics – Definitions – Scope of Biostatistics, Probability Analysis – Variables in Biology, Classification and tabulation of data – Graphical and diagrammatic representation – scale diagrams – Histograms – frequency polygon- Frequency curves. Measures of Central tendency – arithmetic mean, median and mode. Calculation of mean, median, mode in series of individual observation discrete series, continuous open end classes.

Unit – V

Measures of Dispersion – standard deviation and standard curves. Chi – square test, student t test, regression, correlation, one way and two way ANOVA. Experimentation design: Completely randomized design, Factorial design, placket- Burman designs, resonse surface designs: Central Composite Designs (adapted from Montgomery) and Box-Behnken design. Application of experimental design for optimization of culture conditions. Demonstration of statease statistical software for media standardization., Application of statistical software for biological research.

References books:

1. Biophyscial chemistry – principles and Techniques- Upadhyay, Upadhyay Nath.
2. Biophysical chemistry – Cantor and Schinmel.
3. Introductory Biostatistics by chap. T.Lee (Wiley – Interscience
4. Statistical methods edited by Stephen W.Looney (Humana publications)
5. Biostatistics: A Methodology for the Health Sciences, Second Edition, by Gerald Van belle (Wiley – Interscience publication)
6. http://www.itl.nist.gov/div898/handbook/prisection3/pri3.htm(online e book)
7. http://www.statease.com/de7_man.html(software tutorial websidte)

Paper V : MOLECULAR GENETICS

Subject description: this course presents the heredity and mechanisms of genetic regulation.

Goals: To make the student to understand the concept of genetics.

Objectives:

On successful completion the subject student should have understand:

What a gene is. How a gene is modulated and regulated. Models of transmissions and the defects

Contents

Unit I

Introduction to molecular genetics: Mendelian genetics – Mendel's work, Laws of heredity, Test cross, incomplete dominance Epistasis : Multiple allelism, Sex Determination in Plants and animals, concepts of allosomes and autosomes , XX-XY, XX-XO,ZW-ZZ, ZO-ZZ types, linkage

and Crossing Over, Coupling and repulsion hypothesis, linkage in maize and Drosophila, Mechanism of crossing Over, and its importance, chromosome mapping, chromosomal variations. General account of structural and numerical aberrations, Cytoplasmic inheritance Variations. Human Genetics, Karyotype in man, inherited disorders – Allosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and Cri – Du-Chat syndrome).

Unit –II

Molecular organization of chromosome: DNA as the genetic material, DNA Replication in prokaryotes – Enzymes and proteins involved in replication, theta model and rolling circle model. Copy number control. Mutations Types: spontaneous and induced, Mutagens: Physical and chemical, Mutation at the molecular level. DNA Repair causes and mechanism – photo reactivation, excision repair, mismatch repair, SOS repair Recombination in prokaryotes Rec-A and other recombinases.

Unit –III

Transformation, Conjunction and Transduction in Bacteria, Structure of Prokaryotic and Eukaryotic genes- genetic code, properties and Wobble Hypothesis, Transcription in prokaryotes. Mechanism, Promoters and RNA polymerase, transcription factors. Translation mechanism in Prokaryotes.

Unit IV

Regulation of Gene expression in Prokaryotes – Operon concept (Lac and Trp). Attenuation and antitermination. DNA methylation, Regulatory sequences and Transaction factor, Transcriptional regulation in prokaryotes and translational regulation.

Insertional elements and transposons. Extra cnromosomal inheritance, Transposable elements in Maize and Drosophila.

Unit V

Genetic control and development: Genetic determinants of Development. Early embryonic development in animals, Development of Drosophila and Arabidopsis Population genetics and evolution: allele frequencies and genetic frequencies Hardy – Weinberg principle. Genetic and evolution: Mutation and migration, Natural selection. Genetic Shift, Quantitative genetics and multi factorial interactions, causes of variation and artificial selection. Genetic and multifactorial interactions, causes of variation and artificial selection. Genetic Load and Genetic counseling.

References

1. Gardner (2001) Principles pf genetics, John Wiley & Sons Inc, New York.
2. Robert Tamarin, (1996) Principles of genetics, 5th Ed WMC Brown publication, Boston
3. Berjamin Lewin (2004) Genes VIII, Pearson Education Corporation, New jersey
4. Alberts B,(1994) molecular biology of the cell, Garland publishing Inc New York
5. Lodish & Baltimore, (2004) molecular cell biology, II Ed W H freeman & company, New York
6. Friedfielder.D,(1987) Molecular biology II Ed., Narosa publishing house , New Delhi.

PRACTICAL – I

(Microbiology, Molecular Genetics, Microbial Biotechnology and environment Biotechnology)

SUBJECT DESCRIPTION: This course deals with the study of microorganisms and its application in various fields.

GOALS: To learn the various microbiological techniques, Gene transfer mechanisms and applications of microorganisms in industries.

OBJECTIVE

After the successful completion of the course the students will be aware of

1. Handling of microorganisms
2. Various microbiological techniques – isolation and maintenance of pure cultures.
3. Microbial production of industrially important products
4. Impact of microorganisms on the environment.

Contents

1. Microbiology : 3 right field, phase Contrast & Fluorescent microscope
2. Culture media preparation – Liquid and solid media.
3. Selective and differential media
4. Methods of sterilization and testing of sterility.
5. Enumeration of Bacteria, Fungi and Actinomycetes from soil.
6. Pure culture techniques – pour, Streak and Spread plate
7. Maintenance and preservation of cultures.
8. Bacterial staining – simple, Gram, Spore and Fungal wet mount – LCB
9. Motility test.
10. Bacterial growth curve
11. Antibiotic sensitivity test.
12. Bacterial transformation and conjugation.
13. Immobilization of microorganisms and enzymes.
14. Production of alcohol by yeast
15. Production of citric acid
16. Biomass Production
17. MPN test
18. Biochemical tests- carbohydrate fermentation test. IMVIC, TSI test, catalase test, oxidase test and urease test,
19. Production of extracellular enzyme from bacteria by shake flask method –Amylase or Lipase.

REFERENCES:

1. Microbiology: A laboratory Manual by James G. Cappuccino, & Natalie Sherman.
2. Experiments in Microbiology by K.R. Aneja.

PRACTICALS –II

(Molecular Biology, Biochemistry and immunology)

SUBJECT DESCRIPTION: This course deals with the study of biochemical analysis of various biomolecule and immunological techniques for the diagnosis of various diseases.

GOALS: To learn the various techniques in immunology and biochemistry for the study of biomolecules and for the detection of antigens.

OBJECTIVES: After the successful completion of the course the students will be aware of various biochemical analysis & Immunological techniques.

Contents

1. Preparation of buffers: Phosphate, Acetate. Tris and Borate buffer (Each buffer with fice different pH values).
2. Principles of Colorimeter, Spectrophotometer and pH meter (Demonstration).
3. Subcellular fractionation – Mitochondria and chloroplast.
4. Mitosis and Meiosis
5. Estimation of proteins – UV method, Lowry and Bradford method.
6. Estimation of sugars – Anthrone method.
7. Quantification of Vitamin C.
8. Estimation of amino acids
9. Paper chromatography (circular and ascending)
10. TLC.
11. Molecular weight determination of any unknown protein (Purified) with molecular weight markers by SDS-PAGE, Staining of gels by Coomassie brilliant blue and silver staining.
12. Demonstration of HPLC
13. Amylase or Lipase enzyme assay : Effect of Enzyme concentration, pH and temperature
14. Amylase or Lipase enzyme assay: Effect of substrate concentration and determination of Km by using MM and LWB plot.
15. ABO Blood grouping
16. Blood smear preparation – WBC total cell counting
17. Differential staining
18. Routes of immunization
19. Immunoelectrophoresis
20. Purificaiton of lgG from antiserum by DEAE cellulose Chromatography or Protein – A Affinity chromatography.
21. ELISA

References:

1. Practical Biochemistry by Sadasivam., er al.,
2. Practical Biochemistry by J.Jayaraman
3. Modern Practical biochemistry by Boyer.

PAPER VI : IMMUNOLOGY AND IMMUNOTECHNOLOGY

Subject description: this course presents the defense system of the higher vertebrates against invading pathogen.

Goals: to make the student to understand the defense mechanism and their regulations

Objectives: on successful completion the subject student should have understand:

What is immunity, how it discriminate self and non-self, how it is regulated and what are the applications

Contents

Unit – I

History and scope of immunology. Types of Immunity: Passive, Active and Acquired immunity. Humoral, Cell Mediated immunity. Cells and organs of immune response and their functions. Antigens Types, haptens, epitopes and Factors influencing antigenicity.

Antibodies Structure types, properties and functions of immunoglobulins.

Unit – II

Cells of immune system. T-Cells, B-Cells, antigen presenting cells, cell mediated subset of T-Cells helper and suppressor cells, natural killer cells. Lymphoid organs (primary and secondary) MHC molecules, Antigen presentation, B cell and T cell activation, cytokines

Complement system. Structure, components, properties and functions.

Unit –III

Antigen antibody reactions: in vitro tests- precipitation, immune-electrophoresis, Heamagglutination, Labeled antibody (RIA ELISA and immuno – fluroscent techniques)

Hypersensitivity and Allergic reactions Blood cell components, ABO blood grouping RH typing. Application of immunological techniques: hybridoma technology:- Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their applications. Human monoclonals catalytic antibodies and planti bodies.

Unit IV

Hyper sensitivity reactions, auto immuno disorders, deficiencies (Primary and secondary) and immuno tolerance. Tumor immunology: tumor antigens, immune responses and terapy \, tissue and organ transplant.

Unit V

Immunity to bacteria, viruses and parasites vaccines and immunization: passive and Active immunization Types of vaccines – Inactivated, attenuated and Recombinant Vaccines – Peptide and DNA vaccines, Synthetic vaccines, epitope mapping.

Reference books

1. Essentials of Immunology (6th Edition): Ivan Riot – Blackwell Scientific Publications, Oxford, 1988
2. Fundamentals of Immunology: Paul W.E (Eds) Ravan prss, New York, 1988
3. Antibodies A laboratory Manual: Harlow and David Lane (1988), cold spring harbor laboratory.
4. Janis Kuby (1997) Immunology, WH Freeman & Company, New york.
5. Tizard (1995) Immunology IV Ed Saunders college publishers, New York.

PAPER VII : GENETIC ENGINEERING

SUBJECT DESCRIPTION:

This course presents the principles and applications of Genetic Engineering explaining the molecular techniques, cloning strategies and applications of Genetic Engineering.

GOALS: To enable the students to learn the various molecular biology techniques, principles and applications of genetic Engineering.

OBJECTIVES:

On successful completion of the course the students will be aware of

1. The guidelines for genetic Engineering research which involves all the molecular Biology techniques
2. Cloning techniques
3. Application of Genetic Engineering

CONTENTS:

UNIT – 1

Guidelines for Genetic Engineering Research:

Basic techniques – Isolation and purification of nucleic acids, Agarose gel electrophoresis, southern, northern and western blotting, enzymology of recombinant DNA and DNA markers.

UNIT – II

Gone Cloning vectors: Bacteriophages – lambda and M13, phagemids, Cosmids, yeast vectors, Plant and animal vectors, Restriction mapping of DNA fragments and map construction, DNA sequencing. Vector engineering and codon optimization.

UNIT III

Cloning in E-coli, cloning in organisms other than E-coli, specialized vectors – expressions & fusion vectors. Genomic Library; c DNA library- types & screening, RFLP & RAPD.

UNIT IV

Site – directed mutagenesis, detection of mutation by SSCP and heteroduplex analysis, Protein Engineering : processing and stabilization of recombinant proteins. Applications pf protein Engineering.

UNIT – V

Gene therapy: Different types and applications, salient features of Human Genome project: chromosome jumping & Walking PCR: Types & applications, patenting of life forms, ethical issues in Genetic Engineering.

REFERENCE:

1. Gene cloning, An introduction, by T.A. BROWN
2. Molecular Biotechnology, By GLICK
3. Principles of Genetic Maniputaltion, By Old & primrose.

PAPER VIII : MICROBIAL BIOTECHNOLOGY

SUBJECT DESCRIPTION:

This course presents the principles and applications of microorganisms for the production of useful biological materials.

GOALS:

To enable the students to learn the various microbial Biotechnology applications.

OBJECTIVES:

On successful completion of the course the students will be aware of screening and optimization and production of useful biomaterials from microorganisms

Contents:

Unit I :

Isolation, screening of microorganisms- strain selection and improvement methods; Principles of microbial nutrition, and media formulations for cell growth and product formation, Factors influencing the choice of various carbon, nitrogen sources; vitamins, minerals, precursors, and antifoam agents. Importance of medium pH and temperature. Development of inocula for industrial fermentations.

Unit II

Industrial and Agricultural Biotechnology – Microbial synthesis of commercial products, aminoacids, vitaminB2, and B12 antibiotics: Peniciilin, Tetracyclin and streptomycin, Organic

acid: acetic acid and citric acid, alcoholic beverages (beer and wine) and industrial enzymes: amylase, Lipase and Cellulase. Food microbiology: Fermented dairy products of Baker's Yeast.

Unit III

Biomass production, SCP, Biofuel and biofertilizers, Prodection of native and recombinant proteins in bacteria and yeast – vaccine production in microbes, biopolymers and Bioinsecticides.

Unit IV:

Environmental Biotechnology and Microbes:

Waste water treatment (Primary, secondary, and tertiary treatment) processes. Activated sludge oxidation ponds, Trickling filters, anaerobic digestion and Biomass Production, Treatment schemes for waste waters of dairy, distillery, tannery, sugar and oil industries

Unit V:

Biodegradation of cellulosic and non cellulosic (Xenobiotic) Wastes, Bioremediation of contaminated areas, Bioleaching, and solid waste management using microorganisms.

Text Books

1. Microbial Biotechnology by Glazer et al., 1995 W.H. Freeman & Co. New York
2. Molecular Biotechnology by Glick, B.R and J.J. Pasternak, 1998. Second Edition ASM Press, Washington
3. Environmental Biotechnology by Alan scrag 1992 Pearson Education Ltd, England
4. Environmental Biotechnology by S.N. Jogdand, 1995. Himalaya Publishing Hcuse, Bombay
5. Wastewater engineering – Treatment, Disposal and Reuse, Metcalf and Eddy Inc. Tat Mc Graw Hill, New Delhi
6. Comprehensive Biotechnology by Murray .Moo – Young Editor in chief. Pergamon Press Oxford
7. Environmental chemistry by A.K. de Wiley Eastern Ltd., New Delhi
8. Introduction to biodeterioration by D.Allsepp and K.J. Seal, ELBS/ Edward Arnold

Reference:

1. Principles of Fermentation Technology by standbury, P, F. and H. whitaker, 1997 Aditya Books (P) Ltd, New Delghi
2. Industrial Microbilogy by Casida L.E.Jr New Age International Publishers.
3. Industrial Microbiology by Prescott and Dunn.]
4. Biotechnology by W.Cruger and A.Crueger. 2004 Panima Publication, New Delhi.
5. The Biology of Algae by F.E. Round, Arnold Publishers, London, 1965
6. Marine Botany by E.Yale Dawson, Holt, Rinehart and Winston, inc, 1966
7. Structure and Reproduction pf Algae Vol. I & II by FE. Fritsch, Cambridge University Prss, 1935
8. Physiology & Biochemistry of Algae by R.A. Lewin, Academic Press, New York, 1962
9. Smith, G.M. 1965. Cryptogamic Botany, Vol. I Alage & Fungi, McGRaw Hill, new York, 1965.

PAPER IX : PLANT BIOTECHNOLOGY

SUBJECT DESCRIPTION

The course deals with the study of various culturing techniques of plant cells and its applications. It also gives emphasis on Gene transferring methods.

GOALS

The enable the students to learn various culturing techniques of plant cells, Gene transferring mechanisms and production of transgenic palnts.

OBJECTIVES

On successful completion course the students will be aware of

- Various invitro culture techniques
- Preservation of plant cells
- Gene transferring mechanisms
- Transgenic

CONTENTS:

Unit – I

Conventional plant breeding methods- Selection, hybridization, mutation and polyploidy

Cell and tissue culture in plants: Tissues culture media (Composition and preparation), Micropropagation: Callus and suspension culture, somaclonal variation, somatic embryogenesis: Embryo culture, protoplast isolation and somatic hybridization; cybrids; Haploid plants, Artificial seeds and hardening.

Unit –II

Genome organization in plants: Nuclear genome, chloroplast genome, mitochondrial genome, CMS Protein targeting to chloroplast and mitochondria, Heat shock proteins, seed storage proteins

Unit –III

Molecular markers aided breeding, Rflp Maps, RAPD markers, STS, microsatellites SCAR (sequence characterized amplified Regions), SSCT (Single strand conformational Polumorphism), AFLP, molecular marker assisted selection. Arid and semi – arid technology, green house and green – home technology

Unit – IV

Plant transformation technology: features of Ti and Ri plasmids, uses of Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes, methods of nuclear transformation, virtual vectors and their applications. Transgenic biology; Role of

virulence genes. Gene transfer methods in plants: multiple gene transfers, vector – less or direct DNA transfer.

Unit –V

Application of plant transformations for productivity and performance: Engineering plants for herbicide resistance, insect resistance, virus resistance, disease resistance, antifungal proteins, PR Proteins, nematode resistance, abiotic stress, long shelf life of fruits and flowers.

Reference:

1. An Introduction to genetic engineering in plants, Mantel. S.H, Mathews. J.A, Mickee, R.A, 1985 Black well Scientific Publishers, London.
2. In Vitro culture of plants by R.L.M. pierik, 1987. Martinus Nijhoff publishers , Dordrecht
3. Palnt cell culture, A practical approach,(2nd ed). Edited by R.A. Dixon and R.A. Gonzales. 1994. Oxford University Press, Oxford.
4. Plant Molecular Biology by Grierson and son Ltd, New york
5. Palnt Molecular Genetics by Monica. A.Hughes,1999, Pearson Education Ltd, England
6. Plant Biotechnology by Mantell and Smith, 1983, Cambridge University Press
7. Plants, Genes and agriculture by M.J. Chrispeels and D.F.Sadava .2000. the American scientific publishers.
8. practical Application of plant molecular biology by R.J.Henry, 1997, Chepmans and Hall
9. Elements of Biotechnological by P.K.Gupta, 1996. Rastogi and Co.Meerut
10. Plant Biotechnology by J.Hammond, P.Mcgarey and V.Yusibov (Eds) 2000 Springer verag
11. Plant cell and tissue culture in the production of food ingredients by T.J. Fu. G.Sings and W.R. Curtis kluwer Academic/plenum press
12. Biotechnology in crop improvement by H.S Chawla. 1998 International Book Distributor Company.

PAPER X : ANIMAL BIOTECHNOLOGY

SUBJECT DESCRIPTION:

The course deals with the study of embryology, various culturing techniques of animal cells and its applications. It also gives emphasis on gene transferring methods.

GOALS:

To enable the students to learn various culturing techniques of animal cells, Gene transferring mechanisms and production of transgenic animals.

OBJECTIVES:

On successful completion of the course the students will be aware of

1. Various in vitro culture techniques
2. Preservation of animals cells
3. Gene transferring mechanisms
4. Transgenic & cloning

CONTENT:

UNIT 1

Animal cells; preparation of culture media: Role of carbon dioxide, serum, growth factors in cell culture, serum and protein free defined media.

UNIT II

Types of animal cell culture – Primary cell culture : organ culture; Primary explants culture ; cell lines . Tissue engineering, cell separation, cryo preservation.

Biology of cells in culture ; tissue typing : measurement of cell growth and death

cytotoxicity assays : production of native and recombinant proteins in animal cell .

UNIT III

Gene transfer in cells; physical, chemical and biological methods. Applications of animal cell culture – Hybridoma technology and its applications; gene targeting, silencing and knock-out.

UNIT IV

Gametogenesis ; spermatogenesis and oogenesis ; Fertilization in animals ; Blastulation ; gastrulation ; early embryonic development -- fate map. Conventional methods of improvement of animal live stock: artificial insemination , In Vitro fertilization ,Embryo culture , Embryo sexing , splitting and cloning .

UNIT V

Production of transgenic animals; applications of producing transgenic animals , clongin of animals: aquaculture biotechnology of silk worm -lie cycle of silk worm for the commercial production of silk, baculovirus in Biocontrol & foreign gene expression; improving qualities of silk, Integrated pest management.

REFERENCE:

1. Animal cell culture: A practical approach, 4th edition by Freshney. R.I. john Wiley publication
2. Mammalian cell biotechnology: A Practical approach. Rd.M. Butter, Oxford University Press
3. Animal cell culture by. S.J.Morgan and D.C. Darling

PAPER XI : MEDICAL BIOTECHNOLOGY

Subject description:

This Paper presents the basics of medical science and immunodiagnostics concepts as applied to molecular diagnostics and medical biotechonology.

Goals:

This paper is introduced to impart advanced training to the students with post graduate qualifications in Biotechnology to carry out diagnostic experiments and to acquire requisite skills for the design and development of novel diagnostic methodologies using mainly in medical science.

Objectives:

On successful completion on the course the students should have:

- Understood the basics of medical science
- Learnt the concepts of pathogenesis, role of diagnostic tests and kit development
- Learnt the modern trends in Medical Biotechnology

Contents

Unit I:

An introduction to biotechniques in clinical medicine: Sampling, analysis, reporting ,and interpretation of results

Disorders of Kidney: acute renal failure, chronic renal failure, proteinuria and nephritic syndrome and urinary calculi

Disorders of Liver : Biochemical assessment of liver function. Liver diseases acute hepatitis, chronic hepatitis, acute liver failure, cirrhosis, alcohol and liver. Inherited abnormalities of bilirubin metabolism: Gilber's Crigler – Najjar, Dubin-johnson, jaundice and Rotor, Drugs and the liver. Biotechnological approaches to liver diseases:

Disorders of hypothalamus and pituitary : Disorders of anterior pituitary hormones: Hypopituitarism Anorexia nervosa, Grwoth hormone deficiency, Growth hormone excess: acromegaly and gigantism, Hyperprolactinaema

Disorders of poster pituitary hormones : Vasopressin and Diabetes incipidus

Unit II:

Disorders of Adrenal glands:

Disorders of Adrenal cortex: Adrenal hypofunction (Addison's disease).Adrenal hyperfunction:Cuushing'ssyndrome, conn's syndrome congenital adrenal hyperplasiam (CAH), Disorders of adrenal medulla: catacholamines.

Disorders of Thyroid gland: Hyperthyridism, hypothyroidism, thyroiditis, goiter and thyroid cancer.

Disorder of Gonads: Disorders of male gonadal function: Delayed puberty and hypogonadism in females, AMenirrhoea and oligomernorrhoea, the climacteric, Hirsutism and virillism and infertility. Biochemistry of pregnancy and lactation.

Disorders of carbohydrate metabolim : Diabetes mellitus – Etiology and pathogenesis, diagnosis and management. Metabolic complications of diabetes: Ketoacidosis, pathogenesis. Non – ketotic hyperglycaemia, lactic acidosis, diabetic nephropathy, Lipoprotein metabolism in diabetes, Diabetes in pregnancy, Glycosuria, hypoglycaemia - diagnosis and management.

UNIT III

Disorders of Plasma proteins and enzymes:

Hypoalbuminaemia, hypoganmaglobulinaemia, hypergammaglobulinaemia Plasma enzymes:Alkaline phosphatase, aminotransferase, Gamma glutamyl transferase, Lactate dehydrogenase, Creatine kinase, Amyiase and Cholinesterase.

Disorders of haemoproteins, porphyrins and Irons:

Hameoproteins – Hameoglobinopathies, Thalassaemias, and abnormal haemoglobin derivatives – Methaemoglobin, Carboxyhaemoglobin. Porphyrins:acute and chronic poorphyrias, Iron: Diagnostic tests for Iron status Iron deficiency and Herediatary (primary) haemochromatosis.

Disorders of Lipids, lipo proteins and cardiovascular diasease:

Secondary hyper lipidaemia, Types of Primary hyperlipidaemias. Lipoprotein deficiency – abetalipproteinaemia,Hypobetalipoproteinaemia and Tangier diasease. Diseases of-Heart Myocardial infarction, Heart failure and Hypertension.

Inherited metabolic diseases:

Glucose -6phosphatase deficiency, Galactisaemia, cystic fibrosis, role of DNA analysis for the prenatal diagnosis of metabolic diseases.

Unit: IV

Infections of Bacteria and Parasites:

The History of Infectious diseases, host pathogen interactions**.**

Toxins of Bacteria: serotoxins and Endo toxins.

Parasites of biomedical importance: Malarial parasite, Filarial worm, *Trypanosome gambience and Entmoeba histolytica.*

Unit: V

Pathogenic Viruses and fungi:

General characters of viruses, diagnosis of viral infarctions.

Interferons : Introducation, biomedical importance and properties of Interferons.

Diagnosis of fungal infections.

References:

Text Books:

1. Clinical Chemistry by William J.Marashall (Fifth edition, Mosby Publications).
2. An Illustrated color text of clinical Biochemistry by Allen Gaw Robert A.Cowan, illustrated by Robert Britton (1999, second edition, Churchill Living stone press).
3. Harper's Illustrated Biochemistry (27th Edition) by Robert K.Murray, Dary K.Granner, Victor w.Rodwell.
4. Lippincott's Illustrated reviews: Biochemistry (Lipppincott press, third Edition) by Richard Harvery and Pemela C.Champe.
5. Medical Microbiology by Paniker Medical Microbiology by Roitt Medical Parasitology by panicker.

Reference books:

1. Color Atals of Biochemistry (second edition, Thieme Publications, revised and enlarged)by jan Koolman and Klaus – Heinrich Roehm.
2. *Marks' Basic Medical Biochemistry*: A Clinical Approach (2nd Edition), by Colleen M.
3. *Medical Microbiology by Jawetz.*

Web Pages:

1. http://www.ncbi.nlm.nih.gov/sites/entrez?=books(NCBI ?Book Shelf)
2. **http**://web.instate,edu/theme/mwking /subjects.html(e.book)
3. http:www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=mmed.TOC&depth=2(e-book)
4. http:66.99.255.20/cms/biochem/medbiochem/medbiochem.htm
5. http:home.net/~dbc/cic_hamilton/clinical.html

PAPER XII : ENVIRONMENTAL BIOTECHNOLOGY

Subject Description :

Preamble:

Scope: To understand the natural environment, eco system ,environmental pollutions and treatment of waste water.

Objective: Students will get an idea about the hazards of environment and findout the solutions to protect the environment.

Goal: This course is important from the aspect of industrial biotechnology and will help students who want to take up a career in industries and for research in other areas like development, use and regulation of biological systems for remediation of contaminated environments (land, air, water), and for environment-friendly processes such as green manufacturing technologies and sustainable development.

UNIT - I

Basic concepts: Interactions between environment and biota; Concept of habitat and ecological niches; Limiting factor; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession; N.P.C and S cycles in nature. Concepts and theories of evolution - Population ecology - community structure.

UNIT - II

Ecosystem dynamics and management: Stability and complexity of ecosystems; Speciation and extinctions; environmental impact assessment; Principles of conservation; Conservation strategies; sustainable development. Global environmental problems: ozone depletion, UV-B green house effect and acid rain, their impact in biotechnological approaches for management.

UNIT - III

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 control: Need for water management, Measurement and sources water pollution. Kind of aquatic habitats, (fresh and marine), distribution and impact of environmental factors on the aquatic biota, productivity, mineral cycles and biodegradation different aquatic ecosystems.

UNIT - IV

Waste water treatment: Waste water collection, Physico-chemical properties of water, physical, chemical and biological treatment processes. Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries.

Management of estuarine, coastal water systems and man-made reservoirs; Biology and ecology of reservoirs.

UNIT - V

Xenobiotics: Ecological considerations, decay behaviour and degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biopesticides in integrated pest management. Bioremediation of contaminated soils and wastelands. Solid waste: Sources and management (composting, vermiculture and methane production). Environmental mutagenesis and toxicity testing.

References

1. Environmental Biotechnology by Alan Scragg. Pearson Education Limited, England.

2. Environmental biotechnology by S.N. Jogdand. Himalaya Publishing House.Bombay.

3. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., Tata Mc Graw Hill, NewDelhi

4. Environmental chemistry by A.K. De Wiley Eastern Ltd. NewDelhi.
5. Introduction to Biodeterioration by D. Allsopp and k.J. Seal, ELBS/Edward Arnold.

PAPER XIII : BIONANOTECHOLOGY

Subject description:

This paper presents the basic physical and biomolecular aspects of bionanomaterials, methods of analysis and characterization of Bionano Particles for drug modeling, docking microarray technology.

Goals:

This paper enables the student to understand the true applications of the upcoming field of Bionanotechnology in Biological world. It is also aimed to enhance the depth of knowledge about the use of Bionanoparticles in drug targeting and delivery and hence improve the scenario of the world of drug designing.

Objectives.

On completion of the course the students shall be made aware of

- Basics of Bionanotechnology.
- The latest trends in nano level application of bionanoparticles in the medical field.

Contents:

UNIT I

The journey of Biotechnology to Bionanotechnology. Historical perspectives. Introduction to Bionanotechnology: Opportunities & challenges of Bionanotechnology. Key features of Nano-size, Comparison of particle behavior at nanosize to macrosize .Strategies for Nanoarchitecture(top down & bottom up approaches). Biomolecular design and Bionanomachines in action.

UNIT II

Structural principles of Bionanotechnology: Natural Bionanomachinery .Overview of Nanodevices. Strategies for construction of Nanomachines. Carbon as a raw material, Importance of different forces and interactions in providing stability.

Protein folding Aspects:Stable structure,Globular proteins, Role of chaperones in folding. Self organization ,lipid bilayer, DNA based nanostrucrures . Flexibility of biomolecules.

UNIT III

Functional principles of Bionanotechnology. Information driven nanoassembly: Energetics; Biomaterials- Filaments and fibrils, Minerals combined with biomaterials for specific applications. Biomolecular motors; ATP Synthase,flagellar motors; Traffic across membranes- K channels, bacteriorhodopsin using light to pump protons, Biomolecular sensing taste, light sensors., Bacterial sensors, Self-replication, Machine phase Bionanotechnology-Muscle sarcomeres and nerves.

UNIT IV

Applications of Bionanotechnology. Microarray technology. Principle, types and Applications of Bionanoimaging. Characteristics & Applications of Quantum dots and fullernes. Magnetic Nano particles, Nanobiosensors, Biochips,Biorobotics, Synthesis of gold, Titania, Nanopore technology, Nanoarrays, DNA computers,Artificial life, Hybrid Materials.

UNIT V

Bionanotechnology- A remedy for all diseases. Invitro diagnosis. Medical Applications of Nanoparticles & Nanosystems. Nano drug delivery, Micelles for drug delivery. Nano drug delivery- Conventional drug delivery & targetted drug delivery and advantages. Delivery profile, Role of Nanotechnology in drug delivery & Cancer biology.Nanoparticle synthesis in plants, Bacteria and yeast.

References

1. Bionanotechnology: Lessons from Nature David S. Goodsell,.JOHN WILEY & SONS, INC., PUBLICATION
2. Implications of nanotechnology for environmental health research Editors Lynn Goldman and Christine Coussens, THE NATIONAL ACADEMIES PRESS www.nap.edu
3. Nanophotonics: Accessibility and Applicability This free PDF can be downloaded from: http://www.nap.edu/catalog/11907.html
4. *The Coming Era of Nanotechnology* by K. Eric Drexler. This free PDF can be downloaded from: Http://www.foresight.org/EOC/index.html

Article reference

1) Richard P. Feynman, Transcript of speech: "There's plenty of room at the bottom" (1959) http://www.zyvex.com/nanotech/feynman.html

2) Thomas Lawrence McKendree, "Implications of molecular nanotechnology technical performance parameters on previously defined space system architectures." Paper presented at the Fourth Foresight Conference on Molecular Nanotechnology (1995). http://www.zyvex.com/nanotech/nano4/mckendreePaper.html

3) National Space Society, "Position paper on space and molecular nanotechnology" http://www.islandone.org/MMSG/NSSNanoPosition.html

4) Admiral David E. Jeremiah, USN (ret.), "Nanotechnology and global security." Presentation at the Fourth Foresight Conference on Molecular Nanotechnology (1995). http://www.zyvex.com/nanotech/nano4/jeremiahPaper.html

5) Ralph C. Merkle, "Nanotechnology and medicine" http://www.zyvex.com/nanotech/nanotechAndMedicine.html

6) Ralph C. Merkle, "How long will it take to develop nanotechnology?" http://www.zyvex.com/nanotech/howlong.html

7) "Computers: History and development," Jones Telecom. & Multimedia Encyclopedia (Jones E-globe Library)

PRACTICAL III

Plant Biotechnology and recombinant DNA Technology.

SUBJECT DESCRIPTION:

This course deals with the study of different techniques of plant and animals cells. It also includes the methods of generating haploids, disease – free plants and transgenic lines.

GOALS

To learn various culturing methods of plant & animal cells & also helps in the production of imp oval varieties of plants.

OBJECTIVES:

After successful completion of the course the students will be aware of

1. Various culture techniques in PTC & ATC
2. Gene- transfer mechanisms
3. Production of transgenic plants.

Plant Biotechnology:

1. PTC Laboratory organization
2. aseptic manipulation
3. Preparation of PTC medium
4. In vitro germination and differentiation
5. embryo culture
6. Suspension culture]
7. suspension culture
8. filter sterilization
9. somatic embryogenesis
10. Protoplast isolation and protoplast fusion
11. artificial seeds production
12. Merited culture

Animal Biotechnology:

1. Preparation of ATC medium and membrane filtration
2. Preparation of primary culture from chick empbryo
3. Cell counting and cell viability

Recombinant DNa Technology:

1. Isolation of Genomic DNA from Bacteria
2. Isolation of Genomic DNA from animal tissues.
3. Isolation of Genomic DNA form plant tissues.
4. Isolation of RNA.
5. Isolation of Plasmid DNA.
6. DNA and RNA Agarose gel electrophoresis
7. PCR
8. Restriction digestion.
9. Legation experiments.

DIPLOMA IN BIOPROCESS TECHNOLOGY

PAPER I : FUNDAMENTALS FERMENTATION TECHNOLOGY

Course Number: Number of credit hours: 3

Subject description:

This paper presents the basics of fermentation technology, screening, isolation and characterization of pure strains for the optimization of culture conditions and, media components as applied to lab scale, pilot scale and industrial scale upstream processing.

Goals:

This paper is introduced to impart advanced training the students with post graduate qualification in Biotechnology to carry out enumeration of microorgainsms and selection of cell lines for the upstream processing in Bioprocess technology and biochemical engineering to acquire requisite

skills for the design and development bioreactors, production optimization, and preparation of sterile base materials for downstream processing.

Objectives:

On successful completion of the course the students should have:

- Understood the basics of fermentation technology
- Learnt the concepts screening, optimization and maintenance of cultures.

Contents:

Unit –I

Basic concepts in Fermentation technology and Bioprocess Technology, Bioprocess formulas, terms, symbols and units , quantification methods: quantification of proteins by Lowry et al: Bradford et al, UV method and HPLC, Enzyme assays: introduction, screening and assay methods of Amylase, protease, Lipase, Cellulase, pectinase and xylanase.

Unit II

Types of Fermentation process: submerged, Batch, Fed Batch, Continuous and Immobilized cell fermentation. Solid state Fermentation. Tray Reactors, Immobilized enzyme reactors and cell culture . Hairy root culture, Animal cell culture.

Unit – III

Microbial Kinetics: Batch, Fed- Batch and continuous cultures –Phases of batch growth – Kinetics of cell growth, product formation and substrate utilization – Role of endogenous and maintenance metabolism influence of pH and temperature design and analysis of ideal bioreactors

Unit IV

Cell Substrate and product balance equations and Derivation of performance equations for Batch, Fed batch, CSTR , PFR, TWO stage continuous reactors, and cell recycle reactors, Design and performance equations of immobilized enzyme reactors (batch, CSTR, and packed – bed).

Unit –V:

Transport phenomena: Introduction to mass, energy and momentum transfer – Dimension less numbers. Rheological properties of fermentation broths (Newtonian and non – Newtonian Behavior) Oxygen mass transfer, determination of oxygen mass transfer. Heat transfer requirements of microbial cultivations.

<u>Reference:</u>

Text Books

- Principles of Fermentation Technology – By Standby and Wittaker , second Edition.
- Bioprocess engineering – Basic concepts (second edition) by Michael L.Shuler
- Fundamentals of Biotechnology – By Prave

Reference books:

1. Comprehensive biotechnology: VOl I-III by M.Moo-Young H.W. Blacnf, S.Drew, and D.I.C. Wang.
2. Bioprocess Engineering Principles by P.M. Doran (1995) Academic press.
3. Biochemical Engineering Fundamentals, 2nd ed. By J.E. Bailey and D.F.Ollis, McGraw Hill (1986)
4. Biotol series. Product recovery in Bioprocess technology

Scientific journals: www.ent.ohiou.edu/~guting/publist.html

Web Pages: http://www.bae.ncsu.edu/undegrad/biopro_eng_info.htm

DIPLOMA IN BIOPROCESS TECHNOLOGY

PAPER II : Fundamentals of Bioprocess technology and Biochemical engineering

Subject description:

This Paper presents the basics of fermentation technology, screening, isolation and characterization of pure strains for the optimization of culture conditions and media components as applied to lab scale, pilot scale and industrial upstream processing.

Goals:

This paper is introduced to impart advanced training to the students with post graduate qualification in Biotechnology to carry out enumeration of microorganisms selection of cell lines for the upstream processing in bioprocess technology and biochemical engineering to acquire requisite skills for the design and development bioreactors, production optimization, preparation of sterile base materials for downstream processing.

Objectives:

On successful completion of the course the students should have:

- Understand the basics of bioreactor types, and design
- Learnt the concepts of Monitoring techniques
- Learnt the modern trends in upstream processing

Contents:

Unit I:

Design and analysis of Bioreactors:

Modeling of Non – ideal Behavior in Bioreactors, Tanks-in-series, and Dispersion models – application to design of continuous sterilizers; Design and operation of novel bioreactors : Air-lift loop reactors; Fluidized – bed bioreactors processors,

Unit II

Correlations for oxygen transfer scale up criteria for bioreactors based on oxygen transfer and power consumption. Product and other metabolites; State and parameter estimation techniques for biochemical processes;

Unit III.

Monitoring of bioprocesses : on line data analysis for measurement of important physico – chemical and biochemical parameters; methods of on-line and off-line biomass estimation; microbial calorimetry; flow injection analysis for measurement of substrates.

Computer - based data acquisition, monitoring and control – demonstration of LABVIEW software.

Unit IV

Recombinant cell culture processes, guidelines for choosing host-vector systems, plasmid stability in recombinant cell culture. Limits to over expression, modeling of recombinant bacterial cultures

Unit –V

Modern Biotechnological process :; Bioreactor strategies for maximizing product formation; bioprocess design considerations for plant and animal cell cultures. Modeling and simulation of bioprocesses; Study of structured models for analysis of various bioprocesses, demonstration of model simulation using MATLAN-SIMULINK and ISIM software packages.

Reference:

Text Books:

1. Principles of Fermentation Technology – By Standbury and Wittaker, Second Edition.
2. Bioprocess engineering – Basic concepts (Second edition) by Michael L.Shuler
3. Fundamentals of Biotechnology – By Prave

Reference books:

1. Comprehensive Biotechnology: Vol. I-III by Murray Moo-Young H.W. Blance S.Drew and D.I.C Wang
2. Bioprocess Engineering Principles by P.M. Doran (1995) Academic Press.

3. Biochemical Engineering Fundamentals, 2nd Ed. By J.E. Bailey and ollis . McGraw Hill (1986)
4. Biotol series: Product recovery in Bioprocess technology
Scientific Journals: www.emt.ohiou.edu/~guting/publist.html

Web pages: http.//www.bae.ncsu.edu/undergrad/boipro_eng_info.htm

DIPLOMA IN BIOPROCESS TECHNOLOGY

PAPER III : DOWNSTREAM PROCESSING

Subject description:

This paper presents the basics of fermentation technology and downstream processing.

Goals:

This paper is introduced to impart advanced training to the students with post graduate qualification in Biotechnology to carry out enumeration of microorganisms and selection of cell lines for the upstream processing in Bioprocess technology and biochemical engineering to acquire requisite skills for the design and development bioreactors, production optimization, and preparation of sterile base materials for downstream processing.

Objectives:

On successful completion of the course the students should have:

- Learn the modern trends in downstream processing.

Contents:

UNIT I:

Removal of Microbial cells and solid mater: Separation of insoluble products: Foam separation, Precipitation, Filtration, Centrifugation, coagulation, and flocculation. Cell disruptions: Mechanical and non mechanical methods. Solid – Liquid and Size – based separations,

Unit II:

Cell disruption – mechanical and chemical methods; cake filtration and micro filtration; centrifugation and sedimentation. Membrane processes – dialysis, ultra filtration. Reverse osmosis and electro dialysis.

UNIT –III: Principles of Mass transfer: diffusion, liquid – Liquid extraction, Batch and continuous extractions. Design of extra action towers. Adsorption, separation:

UNIT IV Membrane separation processes, Isolation of Products of proteins with salts and with organic solvents; adsorption Processes. Electrophoresis separation Processes

UNIT –V Chromatographic separation

Principles of chromatographic separation – gel filtration, reversed phase, hydrophobic interaction, ion exchange, IMAC and bio affinity chromatography, design and selection of chromatographic matrices; Modes of operation; design of Large-scale chromatographic separation processes;. Final product purification and preparation: Crystallization; Drying and Iyophilisation; formulation strategies.

Text books:

- *Principles of Fermentation technology-By Stan bury and wit taker, second Edition.*
- *Bioprocess engineering-basic concepts (second edition) by Michael L.Shuler*
- *Fundamentals of Biotechnology-By Pave*
- *R.E.Treybal, "Mass Transfer Operations", 3rd Edn., McGraw Hill Book Co., New York,1980*
- *W.L.McCabe, J.C.Smith and p.Harriot, "Unit operations of chemical Fngineering", 5th edn., McGraw Hill Book Co.,York,1993*
- *C.J Gianakopulos, "Transport processes in Chemical Operations", 3rd Edn., Prentice Hall of India, New Delhi,1996.*
- *Pa UI a Belter, EL Cussler and wei Shan Hu, Bioseparation-downstream processing for Biotechnology –Wiley Inter sciencePub. (1988)*
- *Product recovery in bioprocess technology Biotechnol. Series. Biotechnical series,Butterworth geinmann,(1992)*
- *J Asenjo (ed)separation processes in Biotechnology, Marcel-Dekker(1993)*
- *Veerrall, M.S.and Hudson MJSeparations for Biotechology, Ellis horwood Ltd.,(1990)*

REFERENCE:

1. J.M.Coulson and J.F, Richardson, "ChemicalEngineering", Vol.II&III,Pergamon Press,New York.1977.
2. Badger and Banchero, "Introduction to Chemical engineering", tata McGracc Hill, New Delhi.
3. Cooper and gunn "Tutorial Pharmacy" CBS Publisjers, New Delhi
4. *Comprehensive biotechnology*:Vol. I-III by M.Moo-H.W.Blanch,S.Drew, and D.I.C Wang.
5. Bioprocess engineering Principles by P.M.Doran(1995)Academic press.
6. Biochemical engineering fundamentals, 2nd ed. By J.E.Bailey and D.F.Ollis, McGray Gill(1986)
7. Biotol series:Product recovery in Bioprocess technology

Scientific Journals:

www.ent.ohiou.edu/~/guting/publist.html

Web pages:

http:/www.bae.ncsu.edu/undergrad/biopro_eng_info.htm

DIPLOMA IN BIOPROCESS TECHNOLOGY

PAPER IV : BIOETHICS, BIOSAFETY AND IPR

Preamble:
Scope: This course has been designed to provide the students insights into the valuable areas of biotechnology, which plays a crucial role in determining its future use and applications.
Objective: Students get an idea about the advantages and disadvantages of biotechnological applications, ethical implications and intellectual property rights.
Goal: To study the diversity of plants and animal life in a particular habitat, ethical issues and potential of biotechnology for the benefit of man kind.

Unit I
Introduction to ethics/bioethics – framework for ethical decision making; biotechnology and ethics –benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare

Unit II
Ethical implications of cloning: Reproductive cloning, therapeutic cloning; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research-
GM crops and GMO's – biotechnology and biopiracy – ELSI of human genome project

Unit III
Introduction to biosafety – biosafety issues in biotechnology – risk assessment and risk Management – safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containment

Unit IV
Introduction to intellectual property and intellectual property rights – types: patents, copy rights,Trade marks, design rights, geographical indications – importance of IPR - world intellectual Property rights organization (WIPO)

Unit V
What can and what cannot be patented? – Patenting life – legal protection of biotechnological Inventions – Patenting in India: Indian patent act.

References:
1. Principles of cloning, Jose Cibelli, Robert P. lanza, Keith H. S . Campbell, Michael D.West, Academic Press, 2002
2. http://books.cambridge.org/0521384737.htm
3. http://online.sfsu.edu/%7Erone/GEessays/gedanger.htm
4. http://www.actahort.org/members/showpdf?booknrarnr=447_125
5. http://www.cordis.lu/elsa/src/about.htm

6. http://www.csmt.ewu.edu/csmt/chem/jcorkill/bioch480/bioLN98.html
7. http://www.accessexcellence.org/AE/AEPC/BE02/ethics/ethintro.html
8. http://lawlib.samford.edu/cio/ciofeb03.pdf
9. http://www.biomedcentral.com/content/pdf/1472-6939-2-2.pdf
10. http://lifesciences.cornell.edu/vision/accelerating_focus05.php
11. http://thompson.com/libraries/fooddrug/
12. http://assets.cambridge.org/0521792495/sample/0521792495WS.PDF
13. http://europa.eu.int/eurlex/pri/en/oj/dat/1998/I_213/I_21319980730en00130021.pdf
14. http://www.clubofamsterdam.com/content.asp?contentid=281
15. Biosafety issues related to transgenic crops, DBT guidelines, Biotech Consortium India Limited, New Delhi