BHARATHIAR UNIVERSITY, COIMBATORE- 641046
M.Sc., INDUSTRIAL BIOTECHNOLOGY (UNIVERSITY)
FOR THE STUDENTS ADMITTED DURING THE ACADEMIC YEAR
2009-2010 BATCH & ONWARDS
SCHEME OF EXAMINATION

Semester/ Code No.	Paper	Subject	Hrs Per week	University examination		Credits
				Duration in Hrs.	Max. Marks	
SEMESTER I						
09MBTAC01	Paper- I	Basics of Microbiology	4	3	100	4
09MBTAC02	Paper- II	Cell Biology and Physiology	4	3	100	4
09MBTAC03	Paper- III	Microbial Genetics and Recombinant DNA Technology	4	3	100	4
09MBTGE012A **(OR)** 09MBTGE012B	Elective IA **(OR)** Elective IB	I A. Plant Biotechnology (**OR**) I B. Animal Biotechnology	4	3	100	4
	Supportive I		2	3	50	2
09MBTACP1	Practical I	Microbiology, Biochemistry, r DNA Technology and Plant/ Animal Biotechnology	6	6	100	4
SEMESTER II						
09MBTAC04	Paper- IV	Bioprocess Engineering	4	3	100	4
09MBTAC05	Paper- V	Food Biotechnology	4	3	100	4
09MBTAC06	Paper- VI	Environmental Biotechnology	4	3	100	4
09MBTGE013A **(OR)** 09MBTGE013B	Elective IIA (OR) Elective IIB	II A. Plant Molecular Pharma Biotechnology **(OR)** II B. Cancer Biology	4	3	100	4
	Supportive II		2	3	50	2
09MBTACP2	Practical II	Bioprocess Engineering, Food and Environmental Biotechnology	6	6	100	4
SEMESTER III						
09MBTAC07	Paper- VII	Molecular Pathogenesis	4	3	100	4
09MBTAC08	Paper- VIII	Biopharmaceuticals	4	3	100	4
09MBTAC09	Paper- IX	Bio safety, Bioethics and IPR	4	3	100	4
09MBTGE014	Elective- III	Immunology and Immunotechnology	4	3	100	4
	Supportive- III		2	3	50	2
09MBTACP3	Practical – III	Disease Diagnosis, Biopharmaceuticals and Immunotechnology	6	6	100	4
SEMESTER IV						
		Field/ Industrial visit report and viva			50	2
		Project report and viva voce examination*			150	6

Total Marks : 1850 ; Credits: 74

* The report should be a bonafide work carried out by the candidate in the department or any other recognized institute or laboratory under the guidance of a faculty/external guide and should be authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the department attended by all faculties and reviewed by external examiner. Candidate who has presented the work as 'Not qualified as per CBCS' must resubmit the project again in the ensuing academic year.

PAPER I: 09MBTAC01 BASICS OF MICROBIOLOGY

PREAMBLE

Scope

This paper deals with various types of classification of microbes. The paper also throws light on multifarious habitats of microbes and provides information about all the microbial cellular functions and various metabolic pathways in microbes.

Objective

To impart knowledge on classification of microbes. This paper is also designed to provide knowledge on metabolic function and biochemical reaction going on inside the microbial cell

Goal:

This paper enables the students to identify any microorganisms. The students will be able to understand and predict the intermediate metabolism of any microbe used in Industrial production processes

CONTENTS

UNIT I

Classification and molecular systematics: Taxonomy – Classification of viruses, bacteria and fungi. Molecular systematics – Classical, numerical, polyphasic and molecular (G+C analysis, DNA-DNA hybridization, 16s rRNA sequencing and construction of phylogenetic tree) taxonomy

UNIT II

Archae: Earliest life forms – halophiles, methanogens, hyper-thermophiles, thermoplasma; **Bacteria:** Classification (Bergey's manual); salient features of each group. **Viruses:** Bacterial,plant, animal and tumour viruses; classification and structure of viruses, positive, negative and double stranded; replication – lytic and lysogenic.

UNIT III

Fungi : Classification (Alexopoulose); salient features of each class – habitat, cell and thallus organization; nutrition and reproduction. **Algae:** Classification (Smith); salient features of each class – habitat, cell and thallus organization; pigmentation, nutrition and reproduction.

UNIT IV

Microbial techniques: Isolation of microbes from various sources, serial dilution technique, pure culture techniques and culture preservation techniques. Microbial culture collection centres. Staining techniques – Gram, endospore, negative, flagellar and methylene blue staining. Inoculum development – Development of inocula for yeast, bacterial, mycelial and vegetative fungal processes; aseptic inoculation of the fermentor.

Sterilization methods: Moist heat; dry heat, flame, filter, gas (ethylene oxide), Richards' rapid method - HTST (high temperature/short time) treatments – continuous sterilizers and pasteurizers - Sterility, asepsis, Uses of UV and non-ionizing radiation. Sterilization methods – medium sterilization, batch sterilization, contiuous sterilization, filter sterilization. **Microbiological media**: Types of media, composition of media – carbon sources, nitrogen sources, vitamins and growth factors, mineral, inducers, precursors and inhibitors. Selection and

optimization of media. **Strain improvement methods:** Non recombinant methods – mutation and protoplast fusion; Recombinant method - recombinant cell culture process – guidelines for choosing host, vector systems, plasmid sterility in recombinant cell culture, limits to over expression.

UNIT V

Microbial ecology: Soil, aquatic and aerobiology; Influence of environment on microbial physiology – chemical factors; nutrients – water, C, H, O, N, P, S, growth factors- amino acids, purines, pyrimidines, nucleosides, nucleotides, vitamins, lipids, inorganic nutrients, antimicrobial compounds, metabolic inhibitors. Physical factors – radiations, temperature, pH and pressure. Response to environment – growth and reproduction; growth inhibition and death, movement, differentiation, modification to the environment – changes in chemical composition, changes in physical properties

REFERENCES

1. Microbiology by Pelczar, Reid and Chan, McGraw Hill Book Company.
2. Microbiology, Fundamental and Applications by R.A. Atlas, McMillan Publishers.
3. General Microbiology by Powar and Daginawala, Himalaya Publishing House.
4. Microbial genetics by David Friefelder

PAPER II : 09MBTA02 CELL BIOLOGY AND PHYSIOLOGY

Preamble:

Scope: This paper provides a thorough knowledge about structure and function of cells, cellular energetics, 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 environmental fields.

UNIT I

Cell architecture: Structure and function of cells - prokaryotes and eukaryotes; Structure and organization of Membrane - Model membranes (Liposomes) and proteins in membrane systems; Surface appendages – Cilia and Flagella, Capsules, Pili, Fimbriae and slime layers; Cell walls – Algae, fungi, bacteria; Membrane transport - active and passive, transport channels and pumps, Neurotransmission, neuromuscular junction; cytoskeleton and structural components; Extra cellular matrix – cell to cell and cell matrix adhesion, gap junctions

UNIT II

Cellular energetics: Mitochondria – structure, biogenesis; Chloroplast – structure, biogenesis; Molecular events of electron transport chain, ATP synthesis, photosynthesis and photorespiration

Protein traffickng: Structure of Endoplasmic reticulum, Golgi complex, lysosomes; protein synthesis and modification; vesicular transport and import into cell organelles

UNIT III

Principles of microbial metabolism: Methods used to study, microbial metabolism – nutrient balance, metabolically blocked microbes; radiolabelled compounds; transport through membrane – solute transport process, characteristics, effect of environment; endocytosis

Bioenergetics: Energy yielding metabolism – energy from organic compounds – carbohydrates – aerobic (EMP, HMP, ED, TCA, ET) in prokaryotes and eukaryotes; complete oxidation. Anaerobic fermentation – alcoholic fermentation, propionic acid fermentation, formic acid fermentation; Energy from inorganic compounds - ET in chemolithotrophs, production of reducing power in chemolithotrophs; Energy from visible radiation – photosynthesis in eukaryotes, blue-green algae, bacteria

UNIT IV

Cell cycle: Mechanism of cell division - Mitosis; meiosis and genetic recombination; regulation of cell cycle; factors and genes regulating cell cycle. Biochemistry and molecular biology of Cancer – malignant growth, tumour suppressor genes and oncogenes; chemical carcinogenesis, hormonal imbalances; Cellular signaling

UNIT V

Regulation of metabolism: Synthesis of nucleotides, DNA, RNA and protein; genetic control, regulation of enzymes action; regulation of enzyme synthesis; molecular mechanism in regulation of enzyme synthesis

Physiology of cell differentiation – morphological changes in vegetative organism, yeast-mycelial dimorphism, spore formation – endospores in Bacilli, ascospores in yeasts, formation of multicellular structures

REFERENCES

1.Molecular Biology of Cell, Alberts, B et al.
2.Molecular cell Biology, Darnell, Lodish, Baltimore, Scientific American Books, Inc., 1994.
3.Molecular and cellular Biology, Stephen L.Wolfe, Wadsworth Publishing company, 1993.
4.Reproduction in Eukaryotic cells, DM Prescott, Academic Press.
5.Reproduction in Eukaryotic cells, DM Prescott, Academic Press.
6.Developmental Biology, SF Gilbert, Sinauer Associates Inc.
7.Cell in Developmental and Inheritance, EB Wilson, MacMilan New York.
8.The coiled Spring, Ethen Bier, Cold Spring Harbor Press.
9.Fertilization, FT Longo, Chapman and Hall

10. Molecular Biology of Steroid and Nuclear Hormone Receptors, LP Freedman, Birkhuser
11. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000

12. Introduction to Practical Molecular Biology, P.D.Dabre, John Wiley & Sons Ltd., New York, 1998.
13. Molecular Biology LabFax, T.A. Brown (Ed.),Bios Scientific Publishers Ltd., Oxford,1991
14. Molecular Biology of the Gene (4th Edition, J.D.Watson, N.H.Hopkins, J.W.Roberts, J.A. Steitz and A.M.Weiner, The Benjamin/Cummings Publ. Co., Inc., California,1987 Genes VI (6th Edition) Benjamin Lewin, Oxford University Press, U.K., 1998
15. Molecular biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed) VCH Publishers, Inc., New York, 1995

PAPER III: 09MBTACO3 MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY

PREAMBLE

Scope

The content throws light on genomic structure of microbe and various molecular tools used for genetic manipulation

Objective

This paper aims to improve the knowledge on genomic structure of microbes and applications of genetic engineering

Goal

The students will be able to utilize this knowledge for improving the products and production process in Industries.

CONTENTS

UNIT I

Chromosome structure and function: Fine structure of gene, genetic code; Genetic rearrangement – organization of coding sequences and repetitive sequences. Genetic system of bacteria – transformation, transduction, recombination; plasmids and transposons; Genetic systems of viruses – phage I, ---, RNA viruses and retroviruses. Genetic system of fungi – Yeast and Neurospora. Genetic system of protozoa and mycoplasma

UNIT II

The law of DNA constancy and C - value paradox; DNA damage, mutation – types of mutation; physical and chemical mutagenesis; molecular basis of spontaneous and induced mutations, site directed mutagenesis. AMES test for mutagenesis; DNA repair. Recombination – homologous recombination, Holiday junction, gene targeting, gene-disruption, FL/FRT and Cre/Lox recombination, Rec A and other recombinases.

UNIT III

Cutting and joining of DNA molecules: Biology of vectors – plasmids, bacteriophages, single stranded DNA vectors, cosmids, phasmids, specialized vectors

Cloning strategies: cloning of genomic DNA, cDNA cloning; screening strategies; differential cloning

UNIT IV

Introducing DNA into bacterial cells: Cloning in Gram negative and Gram positive bacteria, streptomycetes and fungi including *Saccharomyces cerevisiae*
Sequencing: Basic DNA sequencing, whole genome sequencing, analyzing sequence data.

UNIT V

Techniques in genetic engineering: Blotting techniques – Southern, Northern and Western blotting; transformation of *E. coli*, PCR; probe construction, RFLP, AFLP, RAPD, SSCP and SNP. Construction of cDNA library, molecular mapping of genome – genetic and physical maps.
Antisense and ribozyme technology: Molecular mechanism of anti-sense molecules, inhibition of splicing, poly adenylation and translation, disruption of RNA structure and capping. Biochemistry of Ribozyme – Hammer head, hairpin and other ribozymes; strategies for designing ribozymes; application of ribozymes and antisense technologies.

REFERENCES

1. Microbial genetics – Friedfelder
2. Principles of gene manipulation – Old and Primrose
3. Genes VII by Lewine
4. Hartl. D.L. A primer of population genetics. III edition, Sinauer associates inc. Sunderland, 2000
5. Molecular cell Biology, Darnell, Lodish, Baltimore, Scientific American Books, Inc., 1994.
6. Molecular and cellular Biology, Stephen L.Wolfe, Wadsworth publishing company, 1993

ELECTIVE IA: 09MBTE012A PLANT BIOTECHNOLOGY

PREAMBLE

Scope

This imparts theoretical knowledge on tissue culture and transformation techniques in plants.

Objective

To enable the students gain information on culturing techniques and genetic manipulation of plants.

Goal

The students will be able to plan any transformation experiments in plants to get newer products and new varieties.

CONTENTS

UNIT I

Cell and tissue culture in plants: Tissue culture media (composition and preparation), Genetic methods and application of superior culture; protoplast, anther, pollen, ovary and embryo culture; organogenesis, somatic embryogenesis; hardening and green house technology; synthetic seeds, germ plasm conservation; Somoclonal variation; protoplast fusion and somatic hybridization – cybrids

UNIT II

Transgenesis in plants: Gene transfer in plants **–** Gene transfer through vectors - Biology of vectors used - Ti and Ri plasmids, binary vectors, viral vectors; cloning strategy and method of gene transfer; Vectorless gene transfer – electroporation and gene gun method. DNA bar coding.

UNIT III

Application of transgenic plants: Herbicide resistance: phosphoinothricin, glyphosate, sufonyl urea and atrazine. Insect resistance: *Bt* genes, non-*Bt* genes like protease inhibitors, alpha amylase inhibitor. Disease resistance: chitinase, 1,3-beta glucanase, RIP, antifungal proteins, thionins, PR proteins.

UNIT IV

Application of transgenic plants: Virus resistance: coat protein mediated, nucleocapsid gene. Nematode resistance. Abiotic stress: Drought, cold and salt. Post-harvest losses: long shelf life of fruits and flowers, use of ACC synthase, polygalacturanase, ACC oxidase, male sterile lines, bar and barnase systems, carbohydrate composition and storage, ADP glucose pyrophosphatase, RNAi and Reverse genetics.

UNIT V

Biotechnology based small scale industries: Floriculture – orchids and Bonzai techniques; Production, formulation, packing and marketing of single cell proteins (mushrooms, spirullina and yeast); Biofertilizers, BGA, Azolla, phosphobacter and vermicompost; Biopesticides – *Trichoderma viridae.*

REFERENCES

1. An introduction to genetic engineering in plants, Mantel, Mathews and Mickee, 1985. Blackwell Scientific Publishers. London.
2. *In Vitro* culture of higher plants by R.L.M. Pierik, 1987. Martinus Nijhoff Publisher, Dordrecht.
3. Plant cell culture. A practical approach. Second edition. Edited by R.A. Dixon and R.A. Gonzales.1994.Oxford University Press. Oxford.
4. Plant Molecular Biology by Donald Grierson and S.V. Convey.1984. Blackie and Son Limited. New York
5. Plant Biotechnology by Mantell, S.H and Smith, H. 1983. Cambridge University press, UK
6. Plants, genes and agriculture by M.J. Chrispeels and D.F. Sadava.2000.The American Scientific Publishers, USA.
7. Practical Application of Plant Molecular Biology by R.J. Henry.1997. Chapmans and Hall.

8. Plant Biotechnology by J.Hammond, P. Mc Garvey and V. Yusibov, 2000. Springer Verlag, UK
9. Plant Biotechnology and Transgenic Plants, Edited by Kirsi-Marja Oksman-Caldentey and Wolfgang H. Barz. 2002, Marcel Dekker, Inc. New York.
10. Plant Biotechnology (The genetic manipulation of plants) by Adrian Slater, Nigel W. Scott and Mark R. Fowler, 2003, Oxford University press, UK.
11. Molecular Plant Biology: A practical approach (Vol. I and II), Edited by Gilmartin and Bowler, 2002, Oxford University press, UK.

ELECTIVE IB: 09MBTE012B ANIMAL BIOTECHNOLOGY

PREAMBLE

Scope

This imparts theoretical knowledge on cell culture and transformation techniques in animals.

Objective

To enable the students gain information on animal cell culture technique and genetic manipulation of animals.

Goal

The students will be able to plan any transformation experiments in animal models to get high quality products and breeds.

UNIT I

Animal cell culture techniques: Types of cell culture - primary and established culture; organ culture; tissue culture; three dimensional culture and tissue engineering; feeder layers; disaggregation of tissue and primary cell culture; cell separation; cell synchronization; cryopreservation.

UNIT II

Animal cell culture techniques: Culture media- Balanced salt solutions and simple growth medium, Physical, chemical and metabolic functions of different constituents of culture medium; Role of carbon dioxide, serum, growth factors, glutamine in cell culture; Serum and protein free defined media and their applications.

UNIT III

Transgenesis in animals: cell transformation; vectorless gene transfer – calcium mediated, electroporation, electrofusion, liposome mediated gene transfer, microinjection. Gene transfer through vectors - Adenoviruses, ALVs, Bacculoviruses, SV40.

UNIT IV

Application of transgenic animals: Animals as models for human diseases, live-stock improvement, bovine growth hormone, silk worm as bioreactors

UNIT V

Techniques, significance and applications of sericulture, apiculture, aquaculture (fish, prawn and pearl), poultry, diary and rabbit farming

REFERENCES

1. Animal cell culture; A practical approach, 4th Edition, by Freshney. R.I. John Wiley publication.
2. Methods in cell biology; Volume 57, Animal cell culture methods, Ed. Jennie P. Mather, David Barnes, Academic press.
3. Mammalian cell biotechnology; A practical approach, Ed. M. Butler, Oxford University press.
4. Exploring genetic mechanism; Ed. Maxine Singer and Paul Berg.
5. Principles of genetic manipulation; Ed. Old and Primrose, 6th Edition. Blackwell science publication.
6. Biotechnoloical innovations in Animal productivity, BIOTOL Series, Butterworth – Heineman Ltd. Oxford, 1992
7. An introduction to embryology. WB Sounders company, Philadelphia, Balinsky. BI, 1970

PAPER IV 09MBTAC04 BIOPROCESS ENGINEERING

PREAMBLE

Scope

This paper provides technical information on fermenter designing and kinetics involved in the fermentation processes.

Objective

This paper aims to empower the students with various designs of fermenter. The growth kinetics and process kinetics of the fermentation process enable the students to manipulate for improvement

Goal

The students will be able to design any fermentation production processes to improve the production on completion of the paper.

CONTENTS

UNIT I

Types and design of bioreactor:

Construction material; Basic components – Agitator, aerator, valves and steam traps, seals, stirrer glands; measurement and control of parameters (on-line and off line sensors) – temperature, flow rate, pressure, pH, DO, gas analysis, control pathways, computer in controlling; Air-lift, stirred tank, tower, fluidized bed, packed bed, pulsed, photo bioreactors, CSTR, PFR.

UNIT II

Process kinetics:

Kinetics of batch, fed-batch and continuous process; solid state and submerged; aerobic and anaerobic fermentation; mixed microbial populations; immobilization of cells and co-immobilization; immobilized cell reactors; Chemical kinetics and classification of chemical

reactors. Transport phenomena - Mass transfer, heat transfer, oxygen transfer; transfers in immobilized cells.

UNIT III

Production kinetics:

Design for single and multiple reaction**:** size comparisons of single reactor for single reactions, multiple reactor systems for single reaction, reactions in parallel, in series, and series-parallel reactions of first order. Heterogeneous reactions, kinetics and mechanism of heterogeneous, non catalytic, and catalytic reactions; Non ideal flow - residence time distribution studies, C,E, F and I curves; RTD in ideal reactors; Models for Non ideal flow – zero – parameter model, One parameter model and two parameter model

UNIT IV

Downstream processing:

Removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying and crystallization; Quality analysis and product formulation - Product appearance, product stabilization , shelf life analysis , usage specific formulations quality analysis and control.

UNIT V

Process design and analysis: Integrated analysis of material and energy balances, equipment sizing and priceing economic evaluation, stages in plant design project and process scheduling, process scale – up, and example of any one case study.

REFERENCES:

1. Instrumentation, measurement and analysis, II edition (2004), Nakra BC and Chaudhry KK, Tata McGrawHill Publishing Co. Ltd., New Delhi.
2. Fermentation Microbiology and Biotechnology (2002), Mansi El-Mansi and Charlie Bryce, Taylor and Francis Ltd., London (Replika Press Pvt. Ltd., Kundli – 131 028)
3. Manual of Industrial Microbiology and Biotechnology, III edition (1999), Arnold L. Demain and Julian Davies, ASM press, Washington DC
4. Principles of Fermentation technology, Stanbury PF and Whitaker A. Pergamon Press,Oxford
5. Biochemical Engineering,Aiba,S., Humphrey, A.E. and Millis, N.F.Univ. of Tokyo Press, Tokyo.
6. Biochemical Reactors, Atkinson,B., Pion Ltd. London.
7. Biochemical Engineering Fundamentals, Baily,J.E.and Ollis,D.F., McGraw-Hill Book Co. New york.
8. Bioprocess Technology: Fundamentals and Applications, KTH, Stockholm.
9. Process Engineering in Biotechnology, Jackson, A.T., Prentice Hall, Engelwood Cliffs.

10. Bioprocess Engineering: Basic Concepts, Shuler,M.L. and Kargi, F., Prentice Hall, Engelwood Cliffs.
11. Bioreaction Engineering Principles,Neilson,J. and Villadsen,J., Plenum Press.
12. Chemical Engineering Problems in Biotechnology, Shuler, M.L.(Ed.),AICHE.
13. Biochemical Engineering, Lee, J.M., Prentice Hall Inc.
14. Biochemical Engineering –Kinetics, Mass Transport, Reactors and Gene Expression, Vieth, W.F. , John wiley and Sons, Inc.
15. Chemical reaction enginerring . Levenspiel. O. III edition, 2003. Wiley Eastern, New Delhi
16. Elements of chemical reaction engineering. Fogler. H.S. II edition, 1992. Prentice Hall.
17. Process system analysis and control, McGraw Hill, Coughanour and Koppel.
18. Process biotechnology fundamentals, Viva books Pvt., Ltd., New Delhi,2001.

PAPER V 09MBTAC05 FOOD BIOTECHNOLOGY

PREAMBLE

Scope

This paper adds information about the role of microorganisms in many food industries both in production and spoilage processes.

Objective

To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways

Goal

The students will be able to manipulate this knowledge in prevention of spoilage and also exploit the microbes for improved food quality.

CONTENTS

UNIT 1

Introduction: Components of food industry; Quality factors in food- Functional groups and properties. Diet and chronic diseases. Nutritive factors of food constituents – protein, carbohydrates, fats in nutrition, bioavailability of nutrients, stability of nutrients. Microbes as direct food (Single cell protein and Baker's yeast); mycoprotein and yeast extract; Genetic engineering in food industry (Chymosin, Noyamyl)

UNIT II

Fermentation products: Dairy products: - Production of starter cultures; Cheese - principles of cheese making. Cheddar Cheese, Swiss Cheese, Surface ripened Cheeses; Mold ripened Cheeses. General principles of manufacture of Yogurt, acidophilus milk, Kefir, Koumiss. Fermented foods: Soy sauce, Miso, ,Sufu, Natto, Idli, fermented fish products. Fermented vegetables: Sauer Krant, pickles, Olives. Fermented sausages.

UNIT III

Distilled beverages: Alcohol, wine, brandy and beer.

Food additives: Production of additives - organic acid (acetic acid, lactic acid and citric acid), amino acids (glutamic acid, lysine, threonine, arginine and histidine), food flavourants and pigments.

UNIT IV

Food spoilage and public health: *Staphylococcal, Salmonellosis, E.coli,* Botulism, aflatoxin and amine production; food spoiling enzymes; Deterioration of foods.

Food preservation: Principles of food preservation – methods of preservation: Physical (irradiation, drying, heat processing, chilling and freezing, high pressure and modification of atmosphere); Chemical (Sodium benzoate Class I & II); Boilogical: Probiotics and bacteriocins.

UNIT V

Food process technology: Packaging and canning of foods – preparation for packaging, thermal processing of foods: Microwave heating, thermal inactivation of microorganisms, thermal process, evaluations, freezing and thawing of foods. Food process operations: Evaporation - single and multi effect evaporation, dehydration, psychomatric charts, drying-tunnel, tray, spray, drum, freeze, distillation; food processing aid through biotechnology. **Food sanitation:** Good manufacturing practices – Hazard analysis, Critical control points, Personnel hygiene

REFERENCES

1. Industrial Microbiology, 1983, 4th Edition, Prescott and Dunn's, Gerald Reed, AVI Publishing Company Inc. Conneticut.
2. Food Biotechnology. 1982. by Knorr, D. Marcel Dekker, New York
3. Biotechnology, 1983, VI-VIII, Rehm, H.J. and Reed,G, Verlag Chemie,Wainheim.
4. Genetic Engineering Applications for Industry, 1981, Paul,J.K.,Noyer Corporation, New Jersey.
5. Fundamentals of Food Process Engineering, 1980, Toledo,R.T., AVI Publishing Co., USA.
6. Food Engineering Operations, 1979, 2nd Edition, Brennan,J.G., Bulters,J.R., Gowelx,N.D and Lilly, A.E.V., Applied Science Publishers.
7. Food Process Engineering, 1977, 2nd Edition, Heldman, D.R., AVI Publishing Co.,USA.

PAPER VI 09MBTAC06 ENVIRONMENTAL BIOTECHNOLOGY

PREAMBLE

Scope

This paper imparts information about various pollution sources and preventive measures to control pollution.

Objective

To provide knowledge on the effects on pollution on living systems and the means to reduce the pollution

Goal

The student will be able to combat any pollution problems arising from industries.

CONTENTS

UNIT I

Basic concepts ecology: Interaction 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. Population ecology. 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 II

Environmental pollution: Types of pollution and pollution analysis – noise, air and gaseous pollution. **Noise pollution:** Source, measurement, impact on ecosystem and control. Air pollution : Types, source, method of sampling, measurement, impact on ecosystem and control. Control of noise and air pollution by biotechnological methods.

Gaseous pollutants and odours: General sources, methods of control; fundamentals of adsorption, mechanism of adsorption, equilibrium isotherms, break through curve, adsorption equipment, regeneration of adsorbent, application of adsorption for control of gaseous and odour emission

UNIT III

Water pollution: Impurities in water, water pollution by industrial waste, examination of water, collection of water samples, water analysis – physical, chemical and biological. Standards of water quality. **Water treatment processes:** Primary treatment, screening, skimming with coagulants, flocculation, filteration, aeration and disinfection; Secondary treatment: Aerobic processes – activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors; Tertiary treatment: Activated carbon treatment, reverse osmosis and electro dialysis.

UNIT IV

Solid waste management: sewage sludge treatment and utilization, refuse disposal, excreta disposal in unsewered area; composting and vermiculture.; biodegradation of noncellulosic wastes for environmental conservation and fuel; bioconversion of cellulosic wastes into protein and fuel; biodegradation of xenobiotics; bioremediation of contaminated soils and waste lands; radioactive product waste disposal.

UNIT V

Effluent treatment – Case studies: Sources of pollution, impact on ecosystem and treatment of following industrial effluents: starch, paper and pulp, tannery, dairy, distillery, oil refineries and pharmaceutical.

Microbes in mining, ore leaching, oil recovery, biopolymers, biosurfactants.

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.

ELECTIVE IIA: 09MBTGEO13A PLANT MOLECULAR PHARMA-BIOTECHNOGY

PREAMBLE

Scope: This will help the students to understand the knowledge medicinally important compounds synthesizes in plants and their application in industry.

Objective: To expose the students in the field of plant drugs industry and to make them to understand the synthesis and production of various drug compounds from plants.

Goal: Completion of this paper will pave the way for the student to start and pharma industry or get the jobs pharma company and also in doing research in metabolic engineering of important compounds.

CONTENTS

UNIT I

Herbal renaissance: History and development of plants in medicine. Survey of plants with medicinal properties; Secondary metabolites- plant secondary metabolite molecules, secondary metabolic pathways; Lower plants as medicinal sources.

UNIT II

Metabolic engineering and industrial products: Plant secondary metabolites, control mechanisms and manipulation of phenylproponoid pathway, shikimate pathway; alkaloids, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, purification strategies, oleosin partitioning technology.

UNIT III

Drugs derived from plants: Natural resources of medicine, Antitumor agent - Etoposide, Colchicine, Demecolcine, Irinotecan, Lapachol, Taxol, Vinblastine, Vincristine. Cardiotonic – Convallatoxin, Acetyldigoxin, Adoniside, Antiinflammatory – Aescin, Bromelain, Local anaesthetic – Cocaine, Choleretic – Curcumin, Cynarin, Topical antifungal – Thymol, Antihypertensive, tranquilizer – Rescinnamine, Reserpine, Rhomitoxin.

UNIT IV

Natural sources of peptides as thereapeutic agent: Growing plants for pharmaceutical production regulations. Therapeutic peptides form plants. Methods of extraction and purification of biologically active substances. *In vitro* culture system for the production pharma compounds,

hairy root culture for production of medicinally important plant compounds. Induction of secondary metabolite pathway by the use of biotic and abiotic elicitors.

UNIT V

Molecular pharming: Exploitation of Biotechnological techniques for plant therapeutic compounds - production of recombinant proteins in plants. Expression of antibodies in plants for immunotherapy. Expression of recombinant antibody fragments in plants.

References.

1.Trangeneic plants a production system for industrial and pharmaceutical Proteins, by Meran R Cwen, Meran R. L. Owen, J. (Jan) Pen – Science,1996.
2.Medicinal and aromatic compounds by Y.P. S. Bajaj Springer verlag, 1996.

ELECTIVE II B: 09MBTGEO13B CANCER BIOLOGY

PREAMBLE

Scope

This paper will impart knowledge on cancer development and its control.

Objective

The paper aims to explain the causation of cancer, role of oncogenes in cancer development, the molecular basis of cancer and its therapy.

Goal

This will help the student to understand etiology and prevention and therapy for cancer

CONTENTS

UNIT I

General principles of cancer biology: The cell cycle, Regulation of Cell cycle, Definitions of and distinctions between different types of growth disorder, dysplasia and carcinoma *in situ,* Modulation of cell cycle-in cancer, Different forms of cancers. invasion, metastases and tumor angiogenesis.

UNIT II

Cancer etiology: Natural history of carcinogenesis, Metabolism of carcinogenesis, Targets and mechanism of physical and chemical carcinogenesis.

UNIT III

Oncogenes: Oncogenes, Growth factor and growth factor receptors that are oncogenes, Identification/detection of oncogenes, Oncogenic viruses,. Oncogenes / proto Oncogenes activity.

UNIT IV

Molecular basis of cancer: Signaling pathways damaged or short-circuited in human tumors: RB genes network, cyclins, CDKs, CDKIs, Receptors and RTKs, SMADs, RAS-cascade, PTEN, NF1, Extracellular matrix signaling, hypoxia, angiogenesis-related pathways and VHL.
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UNIT V

Cancer prevention: Chemotherapeutic agents, Different forms of therapy, Chemotherapy, Radiation Therapy, Cancer stem cells, Animal Models in Developmental Therapeutics.

REFERENCES

1. King R.J.B., *Cancer Biology*, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W., *Cancer Biology*, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., *Virology a practical approach*, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., *Introduction to modern Virology*, Blackwell Scientific Publications, Oxford, 1988.

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PAPER VII 09MBTAC07 MOLECULAR PATHOGENESIS

PREAMBLE

Scope

This paper encodes information on molecular basis of causation of human disesases.

Objective

To enable the students to know the molecular mechanism of microbial attachment to the host cell, penetration, multiplication, production of toxins and virulence.

Goal

The information gained will help the students to know how pathogens colonize the host cells and cause disease symptoms.

CONTENTS

UNIT I

Microbial pathogens an overview: Bacteria – strict, facultative, intracellular, sporulating and non sporulating; extracellular parasites, yeasts and molds.

UNIT II

Adherence: Potential sites of pathogen interaction – extracellular matrix, adhesive glycoproteins. Molecular basis of cell adhesion and adhesion mediated signaling. Cell adhesion molecules and bacterial pathogens. Fimbriae and non fimbrillar adhesions.

UNIT III

Invasion and manipulation: Membrane trafficking in eukaryotic cells. Routes of invasion and selection of intracellular niche. Bacterial manipulation of host cell cytoskeleton.

UNIT IV

Bacterial toxins: Toxins acting on cell surface, soluble toxins with an intracellular target, direct delivery of toxins into host cells. Bacterial protein toxins as tools in cell biology.

UNIT V

Virulence: virulence genes and their regulation, virulence protein secretion pathways, microbial evasion strategies of host defence. Methods of study of microbial pathogenesis.

REFERENCE

1. Cossart P., Boquet P., Nomark S., Rappouli R. edited "Cellular Microbiology" ASM Press Washington, 2005
2. Eduardo Groismann "Principles of bacteria pathogenesis" Academic press Orlando, FL, 2001.

PAPER VIII : 09MBTAC08 BIOPHARMACEUTICALS

PREAMBLE

Scope

This paper encodes information on drug designing, drug discovery and drug metabolism.

Objective

To enable the students to know the actual path of metabolism of drugs and drug discovery.

Goal

The information gained will help the students to formulate novel drugs.

CONTENTS

UNIT I

Biological systems and models: Routes of administration, adsorption enhancement / solubility factor/ bioavailability, site specific delivery; Pharmacodynamics of protein therapeutics; Inter species scaling; Chemical modification of proteins/ therapeutics; Potential pitfall in tumor targeting; Colloidal particulate carrier system; Immuno suppressor in antibody therapy; Assay systems; High throughput screening; Automation; Combinatorial Synthesis: Chemistry, Biology, and Biotechnology; Genotyping: Genetic Pre-Disposition, and Heterogeneity; Pharmaco-Genomics.

UNIT II

Drug metabolism: Oxidation, reduction, hydrolysis, conjugation. Need for developing new drugs: Procedure followed in drug design; Molecular modification of lead compounds; Prodrug and soft drugs; Physico-chemical parameters in drug design; QSAR; Active site determination of enzymes; Design of enzyme inhibitors.

UNIT III

Pharmacokinetics &Drug discovery: Substances derived from bacteria, plants, insects, and animals; Sources of active principles; Assay systems and models (e.g., Knock-out Mice) Protein molecular modeling by computer: Docking studies; Structure based drug designing using software (Insight II LS)

UNIT IV

Pharmaceutical products: Microbial products - Antibiotics (penicillin, streptomycin, tetracycline), vitamins, probiotics. Plant secondary metabolites - control mechanism and manipulation of pheny-propanoid pathway and shikimate pathway. Tissue culture production of alkaloids, flavanoids, steroids, terpenoids; animal vaccines

UNIT V

Pharmaceutical products of DNA technology: Therapeutic proteins – Insulin, human growth hormone, clotting factors, interferons, interleukins, tissue plasminogen activators, erythropoietin, DNAseI, alginate lyase, muteins; Production, advantages, limitations and applications of monoclonal antibody; Oligonucleotides and Gene therapy: ras-Antisense therapy, gene delivery system; Vector usage strategies for gene therapy; Clinical trials.

REFERENCE

1. Heinrich Klefenz, "Industrial Pharmaceutical Biotechnology", WILEY-VCH Publication, Germany, 2002.
2. Daan Crommelin, Robert D Sindelar, "Pharmaceutical Biotechnology", Tailor and Francis Publications, New york, 2002.
3. Jay P Rho, Stan G Louie, "Hand book of Pharmaceutical Biotechnology", Pharmaceutical products press, New york, 2003.
4. Lachman L Lieberman, HA, Kanig, J, "Theory and practice of industrial pharmacy", 3rd edition, Varghese publishing & Co, New Delhi,1986.
5. Remington's Pharamaceutial sciences, 18th edtion, Mack publishing & Co., Easton, PA (20th Ed, 2000).

ELECTIVE 3: 09MBTE014 IMMUNOLOGY AND IMMUNOTECHNOLOGY

PREAMBLE

Scope

This paper explains about the functioning of immune system in our body and the techniques related to immunology.

Objective

This paper aims to impart information on how the immune system protects the body against the foreign particle information. Also provides information on the exploitation of the immune system for drug designing

Goal

The students will be able to understand the protection mechanism in our body which will help them in designing new products for the betterment of human kind.

CONTENTS

Unit I

Cells of the immune system: Macrophages,Band T lymphocytes, Dendritic cellsNatural killer and Lymphockine activated killer cells, Eosinophils, neutrophils and Mast cells. **Organs of the immune system:** Bone marrow, Spleen, lymph nodes, MALT. Haemopoiesis and differentiation, lymphocyte trafficking. **Antigen-** biology, structure and functions if different classes of immunoglobulin. Biology of superantigens.

Unit II

Antigen antibody reactions Applications of Immunological techniques, genetic control of immune response, effector mechanisms, MHC, antigen recognition and presentation, activation of B and T lymphocytes.

Unit III

Humoral and cell mediated immunity: Cell mediated cytotoxicity: Mechanism of T cell and NK Cell mediated lysis, Antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity. Cytokines and their role in immune regulation, Biology of Complement system, Complement fixation test and assessment of immune complexes in tissues. Immune suppression and immune tolerance.

Unit IV

Hyper sensitivity reactions, Autoimmune disorders, Transplantation immunology: MLR, HLA Typing, Bone marrow transplantation, Organ transplants. Immunity to Infectious agents - Bacteria, Viruses, Malaria, Anthrax and Helminthes. Tumor immunology: Tumor antigens, immune response to tumors, cancer immunotherapy, Vaccines. AIDS and other immunodeficiencaes, Structure of HIV, envealope glycoproteins, destruction of T cells: immunologic symptoms of AIDS, AIDS vaccine, therapy for treatment..

Unit V

Vaccine technology and recombinant vaccines: Identification of B and T epitopes for vaccine development. *In situ* characterization of cells from tissues , Immunoscreening of recombinant library, Hybridoma – Monoclonal Antibody, Production and applications of MAb in diagnosis and therapy, Catalytic Antibodies. FACS.

References

1. J. Kuby, 2003, Immunology 5th edition , W.H. Freeman and Company, Newyork..
2. C.V.Rao. 2002, An Introduction to Immunology, Narosa Publishing House, Chennai.
3. K.M.Pavri. 1996, Challenge of AIDS, National Book Trust, India.
4. I.R.Tizard, 1995, Immunology: An Introduction , 4th edition , Saunders College Publishers, New York.
5. I.Roitt, 1994, Essential Immunology, Blackwell Science, Singapore.
6. A. Bul and K.Abbas, 1994, Cellular and Molecular immunology, W.D. Saunders And Co, Philadelphia

PAPER IX : 09MBTAC09 BIOSAFETY, BIOETHICS & IPR

PREAMBLE

Scope

This paper provides information on ethical issues involved in biotechnology experiments. This also addresses on Biosafety aspects in Biotechnology and intellectual property rights.

Objective

To enable the students to know about the legal issues affecting the biotechnology research and how to establish ownership of a novel finding

Goal

The students will be able to understand the legal aspects involved in the biotechnology research

CONTENTS

UNIT I

Introduction to ethics and bioethics : Personal ethics: profession and professionalism – Moral Reasoning – Ethical theories – person as an experimenter – Moral leadership (integrity and ingenuinity) - framework for ethical decision making;

UNIT II

Biotechnology and ethics: Biotechnology in agriculture and environment: benefits and risks – benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare.

UNIT III

Ethical implications of cloning: Reproductive cloning , therapeutic cloning ; Ethical, legal and socio-economic 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 IV

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 V Introduction to intellectual property and intellectual property rights rights: Types, patents, copy rights, trade marks, design rights, geographical indications – importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO)

REFERENCES:

1. Principles of cloning, Jose Cibelli, Robert P. lanza, Keith H. S . Campbell, Michael D.West, Academic Press,2002Glimpses of Biodiversity – B.Bltosetti
2. Ethics in engineering, Martin. M.W. and Schinzinger.R. III Edition, Tata McGraw-Hill, New Delhi. 2003.
3. http://books.cambridge.org/0521384737.htm
4. http://online.sfsu.edu/%7Erone/GEessays/gedanger.htm
5. http://www.actahort.org/members/showpdf?booknrarnr=447_125
6. http://www.cordis.lu/elsa/src/about.htm
7. http://www.csmt.ewu.edu/csmt/chem/jcorkill/bioch480/bioLN98.html
8. http://www.accessexcellence.org/AE/AEPC/BE02/ethics/ethintro.html

PRACTICAL I : MICROBIOLOGY, BIOCHEMISTRY, rDNA TECHNOLOGY AND PLANT/ANIMAL BIOTECHNOLOGY

1. Isolation, pure culture and maintenance of aerobic and anaerobic microbes.
2. Staining techniques including fluorescent techniques
3. Identification techniques – Morphological, Biochemical and molecular techniques
4. 16S RNA typing: Phylogenetic tree construction
5. Preservation of pure culture – Lyophilisation
6. Isolation of DNA from Bacteria
7. Isolation of plasmids
8. Restriction and ligation
9. Preparation of competent cell
10. Gene transfer in microbes – calcium mediated, electroporation, vector mediated
11. Identification of recombinants – antibiotic markers, Blue-white colony
12. PCR
13. Blotting techniques –Western

PLANT BIOTECHNOLOGY

14. Isolation of DNA from plant cells
15. Plant tissue culture techniques – micro propagation from various ex plants: meristematic, nodal, stem, leaf, hairy root culture
16. Agrobacterium mediated gene transfer
17. Gene transfer by micro projectile gun
18. Biofertilizers - Production and formulation of *Rhizobium* culture
19. Biopesticide production and formulation of *Trichoderma viride*

ANIMAL BIOTECHNOLOGY

14. Animal cell culture techniques
15. Microinjection – Demo in any of the advanced laboratories
16. Sericulture and Aquaculture – visit to concern lab and report submission

PRACTICAL II : BIOPROCESS ENGINEERING, FOOD AND ENVIRONMENTAL BIOTECHNOLOGY

1. Growth kinetics
2. Effect of pH and temperature on growth kinetics
3. Media formulation
4. Optimization of culture conditions for amylase production by using RSM software
5. Downstream process – purification of any one protein / enzyme from fermented broth
6. Cell and enzyme immobilization
7. Production of cheese
8. Bread making
9. Production of wine

10. Production of citric acid
11.Mushroom cultivation
12. Colourant production – *Serratia*
13. Flavorant production
14. Identification of food pathogens
15. Qualitative analysis of any one industrial effluent
16. Adsorption kinetic studies in any one metal removal process
17. Production of methane from sewage sludge
18. Production of ethanol from cellulosic waste
19. Vermicomposting
20. Demonstration of any one pesticide degradation process

PRACTICAL III: DISEASE DIGNOSIS, BIOPHARMACEUTICALS AND IMMUNOLOGY

1. Isolation of pathogen from patient
2. Hemolysis
3. Differential test of Staphylococci through growth on agar plates (Mannitol agar, DNA agar plate and Coagulase test method)
4. Phage typing
5. Widal test by tube agglutination method
6. Precipitation reaction using ring test.
7. VDRL serological test for syphilis.
8. RPR card test test for syphilis
9. Detection of specific antigen by using ELISA technique.
10. The HIV DOT test for Aids patients.
11. Blood examination for Rh factor
12. ELISA
13. Screening of microbes for antibiotic production
14. MIC assay of any one antibiotic – Kirby Boyer method
15. Extraction of antioxidant from plant material and its assay
16. Hemagglutination
17. Blood film preparation and identification of cells
18. Methods of injection and bleeding
19. Immunization and collection of serum
20. Radial immunodiffusion
21. Double immunodiffusion
22. Immuno electrophoresis
23. Rocket immunoelectrophoresis
24. Purification of IgG from serum