BHARATHIAR UNIVERSITY: COIMBATORE – 641 046
M.SC., INDUSTRIAL BIOTECHNOLOGY (UNIVERSITY)
(For the students admitted during the academic year 2014 – 2015 batch & onwards)
SCHEME OF EXAMINATION

Semester/ Code No.	Paper	Subject	University examination			Credit
			Int. Mark	Ext. Mark	Total	
SEMESTER I						
14MBTAC01	Paper-I	Molecular Cell Biology	25	75	100	4
14MBTAC02	Paper - II	Basics of Microbiology	25	75	100	4
14MBTAC03	Paper - III	Microbial Physiology and Biochemistry	25	75	100	4
14MBTAC04	Paper - IV	Microbial Genetics and Recombinant DNA Technology	25	75	100	4
14MBTGE12	Elective	Computational Biology	25	75	100	4
	Supportive 1		12	38	50	2
14MBTACP1	Practical - I	Biomolecular and Computational Techniques	25	75	100	4
SEMESTER II						
14MBTAC05	Paper-V	Cell Culture Techniques	25	75	100	4
14MBTAC06	Paper - VI	Good Manufacturing Practices and Quality Assurance	25	75	100	4
14MBTAC07	Paper - VII	Bioprocess Engineering	25	75	100	4
14MBTAC08	Paper - VIII	Agro-industrial Biotechnology	25	75	100	4
14MBTGE13	Elective	Nanobiotechnology	25	75	100	4
	Supportive 2		12	38	50	2
14MBTACP2	Practical - II	Tissue Culture, Agro-industrial and Nano Techniques	25	75	100	4
SEMESTER III						
14MBTAC09	Paper-IX	Food Biotechnology	25	75	100	4
14MBTAC10	Paper - X	Molecular Pathogenesis and Clinical Diagnosis	25	75	100	4
14MBTAC11	Paper - XI	Biopharmaceuticals	25	75	100	4
14MBTAC12	Paper - XII	Environmental Biotechnology	25	75	100	4
14MBTAC13	Paper - XIII	Biosafety, Bioethics and IPR	25	75	100	4
14MBTGE14	Elective	Immunology and Immunotechniques	25	75	100	4
	Supportive 3		12	38	50	2
14MBTACP3	Practical - III	Food, Clinical and Environmental Techniques	25	75	100	4
SEMESTER IV						
		Project Viva-voce*			150	6
		Industrial / Institute visit and Summer Training (Viva voce)**			50	2
		Grand total			**2250**	**90**

SEMESTER I

PAPER I: 14MBTAC01 MOLECULAR CELL BIOLOGY

PREAMBLE

Scope: This paper provides a thorough knowledge about structure and function of cells, cellular 2ystemati, 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

Cell architecture: Structure of cells – structure of prokaryotic and eukaryotic cells; Surface appendages – Cilia and Flagella, Capsules, Pili, Fimbriae and slime layers; Cell walls – Algae, fungi, bacteria ; Membranes of Gram positive, Gram negative bacteria and acid fast bacteria; protoplast, spheroplast and endospores; Transport across membrane – active and passive transport, transport channels and pumps, transport across nuclear membrane; Neurotransmission, neuromuscular junction.

UNIT II

Cellular constituents: Cytoskeleton and structural components – Microfilaments, Intermediate filaments, Microtubules; Mitochondria – structure, biogenesis; Chloroplast – structure, biogenesis; Endoplasmic reticulum and Golgi complex – structure, function, vesicular transport and import into cell organelles; Structure and function of ribosomes, mesosomes, lysosomes, peroxysomes.

UNIT III

Nucleus: Nucleus structure – structural organization, nucleosome, supranucleosomal structures, specialized chromosomes, polytene and lamp brush chromosomes and chromosome banding; Nucleic acid structure: DNA and RNA.

UNIT IV

Cell cycle: Mechanism of cell division – Mitosis, meiosis and genetic recombination; regulation of cell cycle – factors and genes regulating cell cycle (Cyclins, CDK and CDKI). Biochemistry and molecular biology of Cancer – malignant growth, tumour suppressor genes (p53, RB) and oncogenes (Ras), chemical carcinogenesis, hormonal imbalances.

UNIT V

Cellular development: Extracellular matrix – cell to cell and cell-matrix adhesion, cell junctions; Cellular 2ystematic – components of 2ystematic, receptors (cell surface – GPCR, RTK, TGF-β, Hedgehog, Wnt, Notch-Delta, NF-Kb, ion channels; intracellular – NO, Nuclear receptor), secondary messengers, effectors ; cell differentiation; gametogenesis and fertilization; development of Drosophila and Arabidopsis – spatial and temporal regulation of gene expression.

TEXT BOOKS

1. Molecular Biology of Cell, Alberts, B et al.
2. Molecular cell Biology, Darnell, Lodish, Baltimore, Scientific American Books, Inc., 1994.

REFERENCES

1. Introduction to genetics: A molecular approach, T.A. Brown, Garland Science, 2011.
2. Molecular Biology of the Gene (7^{th} Edition, J.D.Watson, Tania A. Baker, Stephen P. Bell , Michael Levine, Richard Losick) Benjamin/Cummings Publ. Co., Inc., California, 2013.
3. Genes XI (9^{th} Edition) Benjamin Lewin, Jones & Bartlett Learning, 2008
4. Molecular biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed) Wiley-Blackwell Publishers, 1995

PAPER II: 14MBTAC02 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 3ystematic: Classical, numerical, polyphasic and molecular (G+C analysis, DNA-DNA hybridization, 16s Rrna sequencing and construction of phylogenetic tree) techniques.

Archae: Earliest life forms – halophiles, methanogens, hyper-thermophiles, thermoplasma;

Bacteria: Classification (Bergey's manual); salient features of each group.

UNIT II

Viruses: Classification and structure of viruses, positive, negative and double stranded; Bacterial, plant, animal and tumour viruses; replication – lytic and lysogenic. **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 III

Microbial techniques: Culture techniques: Isolation of microbes from various sources, serial dilution technique, pure culture techniques , Anaerobic culture methods (chemical and physical) and culture préservation techniques. Microbial culture collection centres. **Staining techniques** – Gram, endospore, negative, flagellar and methylene blue staining. . **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-RSM. **Sterilisation techniques:** Moist heat; dry heat, pasteurization, Richards' rapid method – HTST (high temperature/short time) treatments; filter sterilization, gas (ethylene oxide),chemical sterilization, radiation.

UNIT IV

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 – Physical factors – radiations, temperature, Ph and pressure; 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. Response to environment – growth and reproduction; growth inhibition and death, movement, differentiation; modification to the environment – changes in chemical composition, changes in physical properties

TEXT BOOKS

1. Microbial Physiology and Biochemistry- Anthony H. *Rose*, John Frome Wilkinson.Grelet, N. (1955). I, Burgess *Publishing*.
2. Microbiology by Pelczar, Reid and Chan, 5th edition, McGraw Hill Book Company.

REFERENCES

1. Microbiology by Prescott, Prescott, Harley and Klein's 5th edition McGraw-Hill publishers.
2. Microbiology, Fundamental and Applications by R.A. Atlas, 2nd edition,McMillan Publishers.
3. General Microbiology by Powar and Daginawala, 2nd edition, Himalaya Publishing House.
4. Fermentation Technology by Stanbury & Whitaker,2nd edition, Butterworth-Heinemann Limited

PAPER III: 14MBTAC03 MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

PREAMBLE

Scope

This paper provides information about all the microbial cellular functions and various metabolic pathways in microbes.

Objective

This paper is designed to provide knowledge on metabolic function and biochemical reaction going on inside the microbial cell

Goal

The students will be able to understand and predict the intermediate metabolism of any microbe used in Industrial production processes

CONTENTS

UNIT I

Principles of microbial metabolism: Methods used to study, microbial metabolism – nutrient balance, metabolically blocked microbes; radiolabelled compounds.

Bioenergetics: **Energy yielding metabolism** – Energy from organic compounds – carbohydrates – aerobic (EMP, HMP, ED, TCA, ET) in prokaryotes and eukaryotes; complete oxidation.

UNIT II

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 III

Energy from aromatic compounds – two carbon compounds, one carbon compounds, endogenous reserve polymers). **Energy from hydrocarbons** – alkanes, alkenes, acyclic aromatic hydrocarbons.

Energy from nitrogenous compounds – catabolism of amino acids, purines and pyrimidines, triglycerides and fatty acids.

Biosynthesis: **Metabolism of one carbon compounds** – Calvin cycle, acetyl CoA pathway ; synthesis of oligosaccharides and polysaccharides ; **Aminoacid synthesis -** Nitrogen assimilation, nitrogen fixation, incorporation of ammonia into organic compounds (GOGAT pathway).

UNIT IV

Biosynthesis of protein, purines, pyramidines and nucleic acids.

Biosynthesis of fatty acids and lipids.

UNIT V

Regulation of metabolism: Gene regulation: prokaryotic gene regulation- Operon concept; lac operon and tryptophan operon; Eukaryotic gene regulation: transcriptional and translational regulations; regulation of enzymes action; regulation of enzyme synthesis.

TEXT BOOKS:

1. Brock Biology of Microorganisms (**14**th Edition) Michael T. Madigan , John M. Martinko, Kelly S. Bender , Daniel H. Buckley , David A. Stahl , January 12, 2014 ; ISBN-10: 0321897390 ; ISBN-13: 978-0321897398
2. Microbial Physiology, **4**th Edition Michael P. Sector), Albert G. Moat (Editor), John W. Foster (Editor), Michael P. Spector
3. Microbial Biochemistry-**2**nd Edition - Georges N. Cohen Springer, Feb 2, 2011 - SCIENCE

REFERENCE BOOKS:

1. Chemical microbiology – An introduction to microbial physiology – AH Rose, Butterworth, London
2. The Physiology and Biochemistry of Prokaryotes - **4th** Edition David White, James Drummond , Clay Fuqua , December 2011

PAPER IV: 14MBTAC04 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

Origin of Molecular Genetics-Structure of DNA-Mutations-Luria and Delbruck's Fluctuation Test-Spontaneous mutations-nonsense, missense, frame-shift mutations-Induced mutagenesis-Physical agents-UV,X-Rays-Chemical agents-NTG, Base Analogues etc., Reversion-AMES Test-DNA Replication-Messelson and Stahl's Experiment-Okazaki's fragment-DNA polymerases-DNA damage-SOS response-DNA repair.

UNIT II

Gene transfer in bacteria-Transformation-discovery and its significance-competence and factors involved-joint transformation and its uses-Conjugation-F+ and F^- nature of *E.coli*-Origin of Hfr and F' strains-Zygotic induction -Chromosome transfer by Hfr - circular nature of *E.coli* DNA -Use of Hfr strains in genetic mapping-Transduction - λ phage and specialized transduction - Generalised transduction-P1 phage-origin of transducing particles-pre zygotic and post zygotic exclusion-Co-transduction-fine structure mapping of genes by P1 transduction-Wu's Formula-Ratio Test

UNIT III

Elucidation of genetic code- Benzer, Khorana and Crick's contributions-Triplet nature of the Genetic code and Adaptor hypothesis-Wobble hypothesis- Bacterial translation, Suppression of nonsense, missense and frame-shift mutations-Intragenic and extragenic suppressions of

mutations-modern aspects-structure and function relationship-Gene expression-RNA polymerase-σ factors-other accessory transcription factors-small RNAs'- Concept of Gene and operon-Regulation of gene expression- well studied operon models-*lac*, *trp* and *ara* operon

UNIT IV

Birth of r-DNA technology- Agarose Gel electrophoresis and its principle-Restriction enzymes and their role in r-DNA technology-Restriction-modification system of *E.coli*-Types of restriction enzymes - Plasmid vectors as cloning vehicles-Vectors for protein over expression, protein secretion and controlled expression-Bacteriophages as cloning vehicles-λ mediated vectors-M13 phage and its use

UNIT V

Gene Cloning -Purpose – Genomic Library construction-Polymerase chain Reaction (PCR)-Cloning into gram negative, gram positive bacteria and Yeast-Screening of recombinants- α complementation and blue-white selection - Construction of cDNA Library - use of phagemids and Cosmids-DNA sequencing- DNA and RNA hybridization- Southern and Northern blotting-DNA sequencing- Sangers method-Basics of pyrosequencing, next generation sequencing strategies-western blotting for proteins-Semi-quantitative and Real time PCR to quantify gene expression-Yeast two hybrid system-Application of r-DNA technology in human genetics and forensic science-RAPD, RFLP, AFLP, SSCP.

TEXT BOOKS

1. Principles of Gene Manipulation and Genomics-S.B.Primrose and R.M.Twyman, 2006.John Wiley & Sons Ltd.
2. Molecular Genetics: An introductory narrative, Second Edition - Gunther.S.Stent and Richard Calendar,2002. CBS Publishers and distributors.

REFERENCE BOOKS

1. A Short Course in Bacterial Genetics: A Laboratory Manual and Handbook for Escherichia coli and Related Bacteria- Jeffrey. H. Miller,1992.CSHL Press.
2. Fundamental Bacterial Genetics - Nancy Trun and Janine Trempy, 2004. Blackwell publishing
3. From Genes to Genomes: Concepts and Applications of DNA Technology, Second Edition-Jeremy.W.Dale and Malcolm Von Schantz, 2007. John Wiley & Sons Ltd.

ELECTIVE I: 14MBTGE12 COMPUTATIONAL BIOLOGY

PREAMBLE

SCOPE: This paper is designed to provide the information to understand the principles of analyzing biological data, building models and testing hypotheses using computer science paradigms

OBJECTIVE: To enable the students to understand the use of databases available and apply the information for understanding biological system

GOAL: The students should be able to integrate and interpret the information available in the databases to solve any biological structure and function

CONTENTS

UNIT I

Bioinformatics - Definition, History, Web servers, computer systems, languages, - machine, high level and assembly. Internet basics – internet connection, web browsing and URL.

Introduction to biological databases - Sequence databases, structural databases, specialized databases, sequence retrieval system from net - SRS, Entrez

UNIT III

Introduction to genomics: genome structure, physical mapping of genome, genome sequencing, functional genomics, genome wide mutation for annotation, plant transcriptomics and expression analysis by SAGE, MPSS, DDDPCR, and Microarray.

Genome organization in pro and eukaryotes: whole genome sequencing technologies; assembly of sequence reads; annotation and other methods of genome; sequence analysis; minimal genome concept.

UNIT IV

Introduction to proteomics

Principles of protein classification: Based on the structural features, phylogenetic relationship, CATH – Classification by class, architecture, Topology, SCOP - structural classification of Protein, FSSP – FOLD classification based on structure – structure alignment, MMDB – molecular modeling database, SARF – spatial arrangement of backbone fragments

Protein structure prediction – Gene and protein expression data, protein interaction data, similarity and database structure tools, FASTA, BLAST - Sequence and similarity – sequence alignment – local, global pairwise and multiple sequence, introduction to scoring matrix – PAM and Blossum, introduction to phylogenetic trees.

UNIT V

Methods and applications of proteome analysis: Expression proteomics; 2D and multidimensional chromatography. MALDI method and applications in protoemics. Protein interaction analysis.

TEXT BOOKS

1. Introduction to bioinformatics by T.A Atwood
2. Introduction to computers by Alexis Leon and Mathews Leon

3. Genomics: The Science and Technology Behind the Human Genome Project (2000). Edited by C.Cantor and C.L.Smith, Wiley -Interscience, New York

REFERENCE BOOKS

1. Genome Mapping – A Practical Approach (1997) by P.H. Dear, Oxford University Press, Oxford.
2. Reviews and Articles from Journals such as Nature, Science, PNAS (USA), NucleicAcids Research, Trends Series & Current Opinion Series.
3. Protein Research: New Frontiers in Functional Genomics (1997). Edited by M.R. Wilkins, K.L. Williams, R.D.Appel and D.F. Hochstrasser, Springer – Verlag, NewYork2-D Proteome Analysis Protocols (1998). Edited by A.L. Link, Humana Press, Totowa, NJ.
4. Proteins and Proteomics. 2002. R.J. Simpson. Cold Spring Harbor Lab. Press. New York.

PRACTICAL I: 14MBTACP1 BIOMOLECULAR AND COMPUTATIONAL TECHNIQUES

1. Isolation of microbes (Bacteria, Fungi and Actinomycetes) from soil and water
2. Isolation of pure culture and maintenance of aerobic and anaerobic bacteria
3. Staining (Gram staining, Negative staining, Flagellar staining and Lactophenol cotton blue staining) of microbes
4. Identification of bacteria using 16sRNA typing and phylogenetic tree construction
5. Observation of mitotic cell division using onion root tips
6. Isolation of Polytene chromosome from *Chyronomous* larvae
7. Isolation of genomic DNA from bacteria
8. Isolation of plasmid DNA from bacteria
9. Restriction digestion and ligation of bacterial DNA
10. Preparation of competent cells
11. Gene transfer in bacteria by calcium mediated method and identification of recombinants by antibiotic marker
12. Protoplast isolation from fungal/plant cells and viability testing
13. Quantification of DNA and RNA
14. Quantification of protein, reducing sugar and fatty acids
15. Molecular visualization of proteins (PYMOL)
16. Gene structure and function prediction (GENEMARK)
17. Gene structure prediction (GENSCAN)
18. Protein sequence analysis and protein secondary structure prediction (EXPASY and PROTEOMICS tools)
19. Molecular phylogeny (PHYLIP)
20. Analysis of protein and nucleic acid sequences (EMBOSS)

SEMESTER II
PAPER V: 14MBTAC05 CELL CULTURE TECHNIQUES

PREAMBLE

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

Objective: To enable the students gain information on culturing techniques and genetic manipulation.

Goal: The students will be able to plan any transformation experiments in plants and animals 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 Marker Assisted Selection- RFLP, AFLP, RAPD, SSR, SSCP.

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

Animal cell culture techniques: Introduction - Biology of cultured cells. The basic constituents of animal cell culture - Culture vessel and Culture media- Balanced salt solutions and simple growth medium, Physical, chemical and metabolic functions of different constituents of culture medium; Serum and protein free defined media and their applications. Types of cell culture - primary and established culture; organ culture; tissue culture; three dimensional culture feeder layers; disaggregation of tissue and primary cell culture; cell separation; cell synchronization; cryopreservation.

UNIT IV

Stem cell Biology: Stem cells-Introduction –Biology-Classification-Unipotent,Pluripotent and Totipotent. Sources of stem cells-Embryonic stem cells,Embryonic germ cells, Adult stem cells (Mesenchymal, Hematopietic, Induced pluripotent stem cells(iPS),Umbilical cord blood cells, Bone marrow cells, Adipose tissue). Stem cells Culturing-Characterization-Genetic markers-Membrane markers. Differentiation of stem cells and its applications in treating Diabetes, Nervous system and cardiac disorders.

UNIT V

Tissue Engineering: Principles – Tissue Engineering triad – Basic Constitutents (Matix molecules, Ligands, Growth factors, Biomaterials). Tissue Engineering Bioreactors-Biodegradable polymers in Tissue Engineering. Applications-Wound repair-Skin grafts-Artificial breast reconstruction, Fetal tissue engineering, Renal replacement devices.

TEXT BOOKS

1. An introduction to genetic engineering in plants, Mantel, Mathews and Mickee, 1985. Blackwell Scientific Publishers. London.
   Plant Biotechnology by Mantell, S.H and Smith, H. 1983. Cambridge University press, UK
2. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition-
   R. Ian Freshney (Wiley Publishing)
3. Animal Cell Culture: A Practical Approach, 3rd Edition -John R. W. Masters (Oxford University Press)
4. Principles of Tissue Engineering, 4th Edition, Robert Lanza, Robert Langer, Joseph P. Vacanti.(Academic Press)
5. Principles of genetic manipulation; Ed. Old and Primrose, 6th Edition. Blackwell science publication.

REFERENCES

1. *In Vitro* culture of higher plants by R.L.M. Pierik, 1987. Martinus Nijhoff Publisher, Dordrecht.
2. Plant cell culture. A practical approach. Second edition. Edited by R.A. Dixon and R.A. Gonzales.1994.Oxford University Press. Oxford.
3. Plant Molecular Biology by Donald Grierson and S.V. Convey.1984. Blackie and Son Limited. New York
4. Methods in cell biology; Volume 57, Animal cell culture methods, Ed. Jennie P. Mather, David
   Barnes, Academic press.
6. Mammalian cell biotechnology; A practical approach, Ed. M. Butler, Oxford University press.
7. Stem Cells: Scientific Progress and Future Research Directions (http://stemcells.nih.gov/)
8. Essentials of Stem Cell Biology, 2nd Edition - Robert Lanza, John Gearhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut (Academic Press)

PAPER VI : 14MBTAC06 GOOD MANUFACTURING PRACTICES AND QUALITY ASSURANCE

PREAMBLE

Scope: The course introduces definitions and requirements in GMP and gives knowledge about production of compounds for human use, and describes requirements from authorities on GMP, laws and regulations for production.

Objective: To provide the student with an understanding of the principles and practice of GMP and also realise the importance of GMP and compliance of GMP.

Goal: Students will be conversant in all core elements of GMP as practiced in a real-world workplace setting.

CONTENTS

UNIT I

Principles and Importance of GMP – Definition of GMP, Quality management, Personnel, Risk management, Quality control, Documentation, Inspections.

Public Health Protection - adulteration definition - approved chemicals (lubricants, steam additives, etc.) - toxic chemical control and storage - hazard review: chemical, physical, biological - potential sources (humans, animals, environment) and controls

Premises - Design, construction, and maintenance of the production and staff areas in the facility, Layout (design) of the facility - separation from farm/animals/pets (small scale) - perimeter, entrances, drainage - construction, heating/ventilation, humidity control - separation raw versus. pasteurize; product flow - equipment / pipe layout / drainage - water source (treatment, hardness) monitoring

UNIT II

Equipment - Design, construction, and maintenance of equipment, Equipment arrangement and operation, cleaning-in-place process.

Personnel - Ensuring facility personnel are qualified for their job responsibilities, personal health and disease control, personal hygiene; clothing, habits, hand wash, restrooms, plant traffic control.

UNIT III

Sanitation - Sanitation programs: sanitary manufacture, packaging/labeling, including: Establishing a hygiene program for the facility - documented cleaning procedures for premises and equipment - Employee health and hygiene - Documenting health requirements and following health-related procedures. Cleaning and sanitation compounds and their uses – for process equipments - for environmental cleaning (drains, coolers, etc.) - influence of water quality, formulation control - concentrations and time. Environment sanitation and monitoring - environmental monitoring / pathogen testing - pest control programs.

UNIT IV

Raw Material Testing - Testing raw materials - Identifying when product or raw materials must be tested - Accepting raw materials from a vendor without additional regular testing - Supplier certification.

Good practices in production and control - Controlling the manufacturing process - Stages in the production cycle – contracting quality tools – R & D - Self-inspection programs for

fabricators, packagers/labelers - Testing requirements for packaging materials including supplier certification. **Finished Product Testing** - Finished product testing - Writing product specifications - Conditions and options for finished product testing, distributors - product storage - packaging, distribution. **Process Control** - refrigeration (potential hazardous compounds), pasteurization - culture, pH, incubation temperature, aging temperature.

UNIT V

Quality Control Department and Audits - Establishing a QC department - Investigating product quality. Audits- Records -Maintaining accurate, clear, and precise documents - Identifying individuals responsible for maintaining documents. Validation - Qualification, Process validation, Cleaning validation and Computer validation. GMP regulations - US-FDA, Europe, Japan, ICH, PICS/S, WHO.

TEXT BOOKS

Compendium of Good Practices in Biotechnology, BIOTOL series

REFERENCE BOOKS

1. A WHO guide to good manufacturing practice (GMP) requirements: Volume 1,2,3,4,5. Part 2-Validation, by Gillian Chaloner-Larsson, Ph.D, GCL Bioconsult, Ottawa

2. **Good Manufacturing Practices for Pharmaceuticals, Sixth Edition by: Graham Bunn** Publisher: Informa Healthcare; 6 edition | 424 pages (2007) http://ebookee.org/Good-Manufacturing-Practices-for-Pharmaceuticals-Sixth-Edition_859976.html#uPYoXd8huFeqqXB9.99

3. A Primer – Good Laboratory Prcatices and current manufacturing practice, by Ludwig Huber, Published by Agilent Technologies, Germany (2002) http://www.chem.agilent.com/Library/primers/Public/59886197.pdf.

4. GMP manual: Good manufacturing practices and implementation, http://www.gmp-publishing.com/media/ebooks/flyer/files/gmpmanual_eu_4c_online.pdf.

PAPER VII: 14MBTAC07 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: Fermentor structure - 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, computer control pathways. **Fermentors** - Air-lift, stirred tank, tower, fluidized bed, packed bed, pulsed, photo bioreactors, CSTR, PFR.

UNIT II

Process kinetics: Kinetics - batch, fed-batch and continuous process; Sterilization methods - batch sterilization, continuous sterilization of medium. and air. Solid state and submerged; aerobic and anaerobic fermentation. **Inoculum development –** Development of inocula for yeast, bacterial, mycelial and vegetative fungal processes; aseptic inoculation of the fermentor. **Mixed microbial populations**; **Immobilization** - immobilization of cells and co-immobilization; **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.

UNIT V

Quality analysis: Quality analysis and product formulation - Product appearance, product stabilization and shelf life analysis, usage specific formulations, quality analysis and control. Fermentation economics of citric acid – process economics and project economics.

TEXT BOOKS

1. Fundamentals of Bioanalytical Techniques and Instrumentation, Ghosal and Srivastava, PHI Learning Pvt. Ltd., 2009.
2. Principles of Fermentation technology, Stanbury PF and Whitaker A. Pergamon Press, 1984.
3. Introduction to Biochemical Engineering, D.G.Rao, Tata McGraw Hill Publishers, 2005.
4. Bioprocess Engineering: Basic Concepts, 2nd edition, Shuler,M.L. and Kargi, F., Prentice Hall, Engelwood Cliffs, 2001

REFERENCES

1. Instrumentation, measurement and analysis, II edition, Nakra BC and Chaudhry KK, Tata McGrawHill Publishing Co. Ltd., New Delhi, 2004
2. Fermentation Microbiology and Biotechnology , Mansi El-Mansi and Charlie Bryce, Taylor and Francis Ltd., 2002.
3. 3. Manual of Industrial Microbiology and Biotechnology, III edition, Arnold L. Demain and Julian Davies, ASM press, Washington DC, 1999.

4. Biochemical Engineering Fundamentals, Baily,J., Bailey J. and Ollis,D.F., McGraw-Hill Book Co. New York, 1986.
5. Pharmaceutical Biotechnology: Fundamentals and Applications, 3rd edition, Daan J. A. Crommelin, Robert D. Sindelar, and , Bernd Meibohm, 2007.
6. Handbook of Downstream processing, Edin Goldberg, Blackie and Academic Professional, 1997.

PAPER VIII: 14MBTAC08 AGRO INDUSTRIAL BIOTECHNOLOGY

PREAMBLE

Scope: This imparts theoretical knowledge on application of gene manipulation in plants and animals.

Objective: To enable the students gain information on genetic manipulated plants and animals produced and products commercialized.

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

CONTENTS

UNIT I

Application of transgenic plants for Stress tolerance: 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: Virus resistance: coat protein mediated, nucleocapsid gene. Nematode resistance. Abiotic stress: Drought, cold and salt.

UNIT II

Application of transgenic plants for quality enhancement: 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. Nutritional enhancement- Golden rice, Lycopene content. Edible vaccine

UNIT III

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

UNIT IV

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 V

Application of transgenic animals: Animals as models for human diseases, live-stock improvement, bovine growth hormone, silk worm as bioreactors **Techniques, significance and applications of** sericulture, apiculture, aquaculture (fish, prawn and pearl), poultry, diary and rabbit farming

TEXT BOOKS

1. Molecular Biotechnology: Principles and Applications of Recombinant DNA. Bernard R. Glick and Jack J. Pasternak. ASM Press. 2010.
2. Plants, genes and agriculture by M.J. Chrispeels and D.F. Sadava.2000.The American Scientific Publishers, USA.
3. Biotechnoloical innovations in Animal productivity, BIOTOL Series, Butterworth – Heineman Ltd. Oxford, 1992

REFERENCES

1. Practical Application of Plant Molecular Biology by R.J. Henry.1997. Chapmans and Hall.
2. Plant Biotechnology and Transgenic Plants, Edited by Kirsi-Marja Oksman-Caldentey and Wolfgang H. Barz. 2002, Marcel Dekker, Inc. New York.
3. Plant Biotechnology (The genetic manipulation of plants) by Adrian Slater, Nigel W. Scott and Mark R. Fowler, 2003, Oxford University press, UK.
4. Molecular Plant Biology: A practical approach (Vol. I and II), Edited by Gilmartin and Bowler, 2002, Oxford University press, UK.

PRACTICAL II: 14MBTACP2 TISSUE CULTURE, AGRO-INDUSTRIAL AND NANO TECHNIQUES

1. Micropropagation of ex-plant
2. Isolation of DNA from plant cells
3. Giemsa banding and Karyotyping of chromosomes by lymphocyte culture
4. Animal cell culture – MTT assay and COMET assay
5. Determination of doubling time of bacteria by plotting growth curve
6. Determination of specific growth rate of bacteria
7. Screening of microbes for antibiotic production
8. Optimization of culture conditions for amylase production by Pareto chart and RSM
9. Purification of enzyme using Ion exchange column and Gel filtration column chromatography by FPLC
10. Determination of molecular weight of protein by SDS PAGE and Native PAGE
11. Western blotting of protein to PVDF membrane
12. Enzyme immobilization
13. Biofertilizer production and formulation using *Rhizobium* culture
14. Biopesticide production and formulation using *Trichoderma viride*
15. Nano particle synthesis from microbes
16. Characterisation of nano particles by SEM, XRD and FTIR

PAPER IX: 14MBTAC09 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. Nutritive factors of food constituents – protein, carbohydrates, fats in nutrition, bioavailability of nutrients, stability of nutrients. Microbes as direct food (chlorella, spirulina, mushrooms and Baker's yeast) and mycoprotein; Genetic engineering in food industry (Chymosin, Novamyl); Diet and chronic diseases.

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); Biological: 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

TEXT BOOKS

1. Industrial Microbiology, 1983, 4th Edition, Prescott and Dunn's, Gerald Reed, AVI Publishing Company Inc. Conneticut.
2. Food Microbiology- Frazier, 1987, Tata McGraw-Hill Education.

REFERENCES

1. Food Biotechnology. 1982. by Knorr, D. Marcel Dekker, New York
2. Biotechnology, 1983, VI-VIII, Rehm, H.J. and Reed,G, Verlag Chemie,Wainheim.
3. Genetic Engineering Applications for Industry, 1981, Paul,J.K.,Noyer Corporation, New Jersey.
4. Fundamentals of Food Process Engineering, 1980, Toledo,R.T., AVI Publishing Co., USA.
5. Food Engineering Operations, 1979, 2nd Edition, Brennan,J.G., Bulters,J.R., Gowelx,N.D and Lilly, A.E.V., Applied Science Publishers.
6. Food Process Engineering, 1977, 2nd Edition, Heldman, D.R., AVI Publishing

SEMESTER III

PAPER X: 14MBTAC10 MOLECULAR PATHOGENESIS AND CLINICAL DIAGNOSIS

PREAMBLE

Scope: This paper encodes information on molecular basis of causation of human disease.

Objective: To enable the students to know the molecular mechanism of microbial infections and methods of diagnosis of various diseases.

CONTENTS

UNIT I

Microbes and parasites: Historical introduction; Bacteria, Fungi, Viruses, Protozoas, Helminthes and Arthropods, Prions; Host-parasite relationship; Infection-mode of transmission in infection, factors predisposing to microbial pathogenecity, types of infectious diseases

UNIT II

Invasion of Microbes: Adsorption to the potential sites, membrane trafficking in eukaryotic cells, routes of invasion and selection of intracellular niche, bacterial manipulation of host cell cytoskeleton, nosocomial infection; Normal microflora of human body; Bacterial toxins and virulence genes; Strategies of host defense.

UNIT III

Methods of Disease Diagnosis: Sampling site-normally sterile and with normal microflora; Sample collection-method of collection, transport and processing of samples, interpretation of results; Diagnostic methods- cultured: microscopy, microbial antigen; non-cultured: PCR

based microbial typing: Eubacterial identification based on 16s rRNA sequences-Amplified ribosomal DNA Restriction analysis(ARDRA)-Culture independent analysis of bacteria-DGGE and TRFLP; Molecular diagnosis of fungal pathogens based on 18s rRNA sequences; Detection of viral pathogens through PCR; Monoclonal antibodies.

UNIT IV

Diagnosis of Infections : Bacteria- *Streptococcus*, Coliforms, *Salmonella*, *Shigella*, *Vibrio* and *Mycobacterium*; Fungi-Major fungal diseases, Dermatophytoses, Candidiosis and Aspergillosis DNA and RNA Viruses- Rota virus, Herpes virus, Influenza virus, POX virus, Rhabdo Virus, Hepatitis Virus and Retro Virus.

UNIT V

Diagnosis of Infections Viruses-AIDS Virus; Protozoan diseases-Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis; Helminthis diseases-*Fasicola hepatica* and *Ascaris lumbricoides*; Filariasis and Schistomiosis.

TEXT BOOKS

1. Medical Microbiology (1997). Edited by Greenwood. D, Slack. R and Peutherer. J, ELST Publishers
2. Henry's Clinical Diagnosis and Management by Laboratory Methods (2007). Mepherson.

REFERENCES

1. Bailey and Scott's Diagnostic Microbiology (2002). Betty A. Forbes, Daniel F. Sahm, Alice S. Weissefeld, Ernest A Trevino. Published by C.V. Mosby
2. Fundamental of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Sauders group.
3. Molecular Diagnostics for the Clinical Laboratorian 2nd ed. (2006). W.B.Coleman. Humana Press.

PAPER XI : 14MBTAC11 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, Pharmacoketics: Absorbtion, Distribution, Metabolism- Oxidation, reduction, hydrolysis, conjugation and Elimination, absorption enhancement / solubility factor/ bioavailability; Pharmacodynamics; Assay systems and models (e.g., Knock-out Mice); Inter species scaling.

UNIT II

Drug discovery: Need for developing new drugs: Substances derived from bacteria, plants, insects, and animals; Sources of active principles; Combinatorial Synthesis: Chemistry, Biology, and Biotechnology; High throughput screening; Automation.

UNIT III

Drug designing: Procedure followed in drug design; Molecular modification of lead compounds and proteins; Prodrug and soft drugs; Physico-chemical parameters in drug design; QSAR; Active site determination of enzymes; Design of enzyme inhibitors; Immuno suppressor in antibody therapy; Potential pitfall in tumor targeting; Colloidal particulate carrier system. 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; Genetic Pre-Disposition, and Heterogeneity; Pharmaco-Genomics; Oligonucleotides and Gene therapy: ras-Antisense therapy, gene delivery system; Vector usage strategies for gene therapy; Clinical trials.

TEXT BOOKS

1. Daan Crommelin, Robert D Sindelar, “Pharmaceutical Biotechnology”, Tailor andFrancis Publications, New york, 2002.
2. Remington’s Pharamaceutial sciences, 18th edtion, Mack publishing & Co., Easton, PA (20th Ed, 2000).

REFERENCE

1. Heinrich Klefenz, “Industrial Pharmaceutical Biotechnology”, WILEY-VCH Publication, Germany, 2002.
2. Jay P Rho, Stan G Louie, “Hand book of Pharmaceutical Biotechnology”, Pharmaceutical products press, New York, 2003.
3. Lachman L Lieberman, HA, Kanig, J, “Theory and practice of industrial pharmacy”, 3rd edition, Varghese publishing & Co, New Delhi, 1986.

PAPER XII: 14MBTAC12 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.

TEXT BOOKS

1. Environmental Biotechnology by Alan Scragg.(2005). IInd edition. Pearson Education Limited,
England.
2. Environmental Biotechnology by S.N. Jogdand. (1995). Ist edition. Himalaya Publishing House.Bombay.

REFERENCES

1. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., Tata Mc Graw Hill, NewDelhi
2. Environmental chemistry by A.K. De Wiley Eastern Ltd. NewDelhi.
3. Introduction to Biodeterioration by D. Allsopp and k.J. Seal, ELBS/Edward Arnold.

ELECTIVE-III: 14MBTGE14 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. **Antibody-** biology, structure and functions in different classes of immunoglobulin. Antigens, 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; AIDS and other immunodeficiencies.

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.

TEXT BOOKS

1. J. Kuby, 2003, Immunology 5th edition, W.H. Freeman and Company, Newyork.
2. I.Roitt, 1994, Essential Immunology, Blackwell Science, Singapore.

REFERENCE BOOKS

1. C.V.Rao. 2002, An Introduction to Immunology, Narosa Publishing House, Chennai.
2. K.M.Pavri. 1996, Challenge of AIDS, National Book Trust, India.
3. I.R.Tizard, 1995, Immunology: An Introduction, 4th edition, Saunders College Publishers, New York.
4. A. Bul and K.Abbas, 1994, Cellular and Molecular immunology, W.D. Saunders and Co, Philadelphia.

PRACTICAL III: 14MBTACP3 FOOD, CLINICAL AND ENVIRONMENTAL TECHNIQUES

1. Production of cheese
2. Production of wine
3. Mushroom cultivation
4. Colourant production
5. Flavorant production
6. Identification of food pathogen
7. Extraction of antioxidant from plant material and its assay
8. Isolation of pathogen from patient
9. Haemolytic testing of bacteria
10. Differential test of *Staphylococci* through growth on agar plates (Mannitol agar, DNA agar plate and Coagulase test method)
11. Isolation of bacteriophage
12. MIC assay of any one antibiotic – Kirby Boyer method
13. Hemagglutination
14. Blood film preparation and identification of cells
15. Immuno electrophoresis
16. Rocket immuno electrophoresis
17. Detection of specific antigen by ELISA technique
18. Estimation of coliforms by MPN in water
19. Quantitative estimation of iron in water
20. Quantitative estimation of chromium in water
21. Determination of BOD of effluent
22. Determination of COD of effluent
23. Production of methane from sewage sludge