

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046
M.SC., INDUSTRIAL BIOTECHNOLOGY (UNIVERSITY)
DEPARTMENT OF MICROBIAL BIOTECHNOLOGY
FOR THE STUDENTS ADMITTED DURING THE ACADEMIC YEAR
2016 – 2017 BATCH & ONWARDS
SCHEME OF EXAMINATION

Semester/ Code No.	Paper	Subject	University examination			Credit
			Internal Mark	External Mark	Total Mark	
SEMESTER I						
16MBTAC01	Paper-I	Molecular cell biology	25	75	100	4
16MBTAC02	Paper - II	Microbiology	25	75	100	4
16MBTAC03	Paper - III	Microbial physiology and biochemistry	25	75	100	4
16MBTAC04	Paper - IV	Microbial genetics and recombinant DNA technology	25	75	100	4
16MBTGE12 A	Elective 1A	Molecular pathogenesis	25	75	100	4
16MBTGE12B	Elective 1B	Fundamentals of Nanotechnology				
	Supportive 1		12	38	50	2
16MBTACP1	Practical - I	Biomolecular techniques	40	60	100	4
SEMESTER II						
16MBTAC05	Paper-V	Cell culture techniques	25	75	100	4
16MBTAC06	Paper - VI	Immunology and Immunotechnology				
16MBTAC07	Paper - VII	Bioprocess Technology	25	75	100	4
16MBTAC08	Paper - VIII	Biosafety, Bioethics and IPR	25	75	100	4
16MBTGE13A	Elective 2A	Disease diagnosis	25	75	100	4
16MBTGE13B	Elective 2B	Industrial Application of Nanotechnology	25	75	100	4
	Supportive 2		12	38	50	2
16MBTACP2	Practical - II	Tissue Culture, Agro-Industrial and Immuno Techniques	40	60	100	4
SEMESTER III						
16MBTAC09	Paper-IX	Food Biotechnology	25	75	100	4
16MBTAC10	Paper – X	Environmental Biotechnology				
16MBTAC11	Paper – XI	Bioinformatics and Bioinstrumentation	25	75	100	4
16MBTAC12	Paper – XII	Pharmaceutical chemistry	25	75	100	4
16MBTAC13	Paper - XIII	Good manufacturing practices and quality assurance	25	75	100	4
16MBTGE14 A	Elective 3A	Cancer Biology	25	75	100	4
16MBTGE14B	Elective 3B	Secondary metabolites				
	Supportive 3		12	38	50	2
16MBTACP3	Practical - III	Food, Environmental and Insilico analysis	40	60	100	4

SEMESTER IV						
		Project viva voce*	50	100	150	6
		Industrial / Institute visit and Summer Training (Viva voce)**	50		50	2
		Grand total			2250	90

* 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.

** The Industrial training report should be submitted by the candidate. This report must be presented and defended by the candidate in the department attended by all faculties.

SUPPORTIVE COURSES OFFERED

Semester	Paper	Subject	Hrs Per week	University examination		Credits
				Duration in Hrs.	Max. Marks	
SEMESTER I	10MBT	Microbial Biotechnology	2	3	50	2
SEMESTER II	09MBTD	Food biotechnology	2	3	50	2
SEMESTER III	09MBT	Clinical microbiology	2	3	50	2

SEMESTER I

PAPER I: 16MBTAC01 MOLECULAR CELL BIOLOGY

PREAMBLE

Scope: This paper provides a thorough knowledge about structure and function of cells, cellular signaling, 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).

UNIT V

Cellular development: Extracellular matrix – Components; cell to cell and cell-matrix adhesion, cell junctions; Cellular signaling – components of signaling, receptors (cell surface – GPCR, RTK, TGF- β , Hedgehog, Wnt, Notch-Delta, NF- κ B, ion channels; intracellular – NO, Nuclear receptor), secondary messengers, effectors ; Integration of signals; 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.

REFERENCE BOOKS

1. Introduction to genetics: A molecular approach, T.A. Brown, Garland Science, 2011.
2. Molecular Biology of the Gene (7th Edition, J.D.Watson, Tania A. Baker, Stephen P. Bell , Michael Levine, Richard Losick) Benjamin/Cummings Publ. Co., Inc., California, 2013.
3. Genes XI (9th 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: 16MBTAC02 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 systematic: 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 and Actinomycetes: Classification and Characteristics.

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 (Alexopoulos); 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 preservation techniques. Microbial culture collection centres. **Staining techniques** – Gram, endospore, negative, flagellar and methylene blue staining. Biochemical characterization (IMVIC test). **Microbiological media:** Types and composition of media. **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 stability 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. Antimicrobial compounds – principles and mechanism of action, Antibiotic resistance.

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 Dagainawala, 2nd edition, Himalaya Publishing House.
4. Fermentation Technology by Stanbury & Whitaker, 2nd edition, Butterworth-Heinemann Limited.
5. Text book of Industrial Microbiology, 2nd edition by Wulf Crueger and Anneliese Crueger, Sinauer Associates Inc.

PAPER III: 16MBTAC03 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, pyrimidines 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 (14th 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, 4th Edition [Michael P. Sector](#)), [Albert G. Moat](#) (Editor), [John W. Foster](#) (Editor), [Michael P. Spector](#)
3. [Microbial Biochemistry-2nd 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: 16MBTAC04 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 IA: 16MBTGE12A MOLECULAR PATHOGENESIS

PREAMBLE

Scope: This paper is designed to provide the information on the pathogenic organisms and also to understand the principles of pathogenecity and protection

Objective: To impart knowledge on the process of infection and control

Goal: The students will be able to apply this knowledge in understanding the nature and causes of infection.

UNIT I:

Introduction: History; Microbes and parasites: Bacteria, Fungi, Viruses, Protozoa, Helminthes and Arthropods, Prions

UNIT II:

Infection: Host-parasite relationship, mode of transmission in infection, factors predisposing to microbial pathogenecity, types of infectious diseases

UNIT III:

Normal microflora of human body: Skin, Eye, Mouth, GI tract, Urinogenital tract.;; Nosocomial Infections: General clinical syndrome-Fever, Sepsis, Chronic fatigue; In animate environment; Epidemiology; Prevention in staff and patients; Immunization

UNIT IV:

Invasion of Microbes: Adsorption to the potential sites, Quorum sensing, membrane trafficking in eukaryotic cells, routes of invasion and selection of intracellular niche, bacterial manipulation of host cell cytoskeleton

UNIT V:

Strategies of host defense: Physical barrier; Innate Immunity; Adaptive Immunity; Elimination of microbes by the host

Text books

1. Dimmock, N.J. and S.B. Pimrose, (1994). *Introduction to Modern Virology* (4th Edition). Blackwell Scientific Publications, Oxford.
2. Flint, S.J., L.W. Enquist., R. Krung., V.R. Racaniello. and A.M. Skalka, (2000). *Principles of Virology, Molecular Biology, pathogenesis and control*. ASM Press, Washinton D.C.
3. *Medical Microbiology* (1997). Edited by Greenwood. D, Slack. R and Peutherer. J, ELST Publishers

REFERENCES

1. Bailey and Scott's Diagnostic Microbiology (2002). Betty A. Forbes, Daniel F. Sahn, 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. Saunders group.

ELECTIVE IB: 16MBTGE12B FUNDAMENTALS OF NANOBIO TECHNOLOGY

PREAMBLE

Scope: Basics of nanoscience and nanobiotechnology will be covered and manipulation of tiny materials with improved properties will be studied.

Objective: This paper is aimed to provide an enhanced and complete understanding of nanobiotechnology for the students to perceive various nanomaterial syntheses.

Goal: After the successful completion of this paper, the students are expected to gain an essential knowledge about nanomaterial synthesis.

UNIT I

Nanoscience basics: Definition, size, shape of types of nanomaterials

UNIT II

Nanomaterial synthesis: Lithography - Top down & Bottom-up approach; Physical methods (Plasma, Laser), Chemical method (Sol-gel, Co-precipitation) & Biological method (Microbes)

UNIT III

Nanomaterials types: Metal nanoparticles, Quantum dots, Fullerenes, CNT

UNIT IV

Nanomaterial Properties: Introduction to nanomaterial properties (Electrical, Thermal, Optical, Magnetic and Mechanical), Monolayer, Self assembly; supramolecular chemistry

UNIT V

Nanomaterial characterization: Electron microscopy – TEM, SEM & AFM – For particle imaging, XRD and FTIR for analyze the size, shape, structure, chemistry, crystallography

TEXTBOOK

1. **Fundamentals of Nanotechnology.** Gabor L. Hornyak, John J. Moore, H.F. Tibbals, Joydeep Dutta. December 22, 2008 by CRC Press. Textbook - 786 Pages.
2. **Introduction to Nanoscience.** Stuart Lindsay. Oxford university press. Textbook – 448 pages.

REFERENCES

1. **Introduction to Nanoscience and Nanotechnology 1st Edition** by [Chris Binns](#)• Wiley publishers. 320 Pages.
2. **Nanotechnology: A Gentle Introduction to the Next Big Idea** by Mark A. Ratner; Daniel Ratner. Pearson Education (US). 208 Pages.
3. **Textbook of Nanoscience and Nanotechnology.** Authors: Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. Springer, 2013. 244 Pages.

PRACTICAL I: 16MBTACP1 BIOMOLECULAR 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 *Chironomous* 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

SEMESTER II

PAPER V: 16MBTAC05 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

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; green house technology; synthetic seeds, germ plasm conservation; Somoclonal variation; protoplast fusion and somatic hybridization – cybrids;

UNIT II

Animal cell culture techniques: Introduction - Biology of cultured cells. Basic requirements for animal cell culture-Equipments and consumables. Animal cell c ulture 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.

UNIT III

Types of animal 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, Hematopoietic, Induced pluripotent stem cells (iPS), Umbilical cord blood cells, Adipose tissue). Stem cells characterization-Genetic markers-Membrane markers. Therapeutic applications of Stem cells.

UNIT V

Tissue Engineering: Principles – Tissue Engineering triad – Basic Constitutents (Matix molecules, Ligands, Growth factors, Biomaterials). Tissue Engineering Bioreactors-Biodegradable polymers in Tissue Engineering. Therapeutic applications of Tissue Engineering

TEXT BOOKS

1. An introduction to genetic engineering in plants, Mantel, Mathews and Mickee, 1985. Blackwell Scientific Publishers. London.
2. Plant Biotechnology by Mantell, S.H and Smith, H. 1983. Cambridge University press, UK
3. Culture of sAnimal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition- R. Ian Freshney (Wiley Publishing)
4. Animal Cell Culture: A Practical Approach, 3rd Edition -John R. W. Masters (Oxford University Press)
5. Principles of Tissue Engineering, 4th Edition, Robert Lanza, Robert Langer, Joseph P. Vacanti.(Academic Press)
6. 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.
5. Mammalian cell biotechnology; A practical approach, Ed. M. Butler, Oxford University press.
6. Stem Cells: Scientific Progress and Future Research Directions (<http://stemcells.nih.gov/>)
7. 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: 16MBTGE06 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 cells, Natural killer and Lymphokine 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.

PAPER VII: 16MBTAC07 BIOPROCESS TECHNOLOGY

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, 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. **Immobilization** - immobilization of cells and co-immobilization; **Transport phenomena** - Mass transfer, heat transfer, oxygen transfer.

UNIT III

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 stabilization and shelf life analysis and quality control. Fermentation economics of citric acid – process economics and project economics.

UNIT IV

Application of transgenic plants for Stress tolerance: Herbicide resistance: phosphinothricin and glyphosate; Insect resistance: *Bt* genes and alpha amylase inhibitor. Disease resistance: chitinase and 1,3-beta glucanase; 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, male sterile lines, RNAi and Reverse genetics; Nutritional enhancement- Golden rice; Edible vaccine.

UNIT V

Biotechnology based small scale industries: Floriculture – orchids and Bonzai techniques; Production, formulation, packing and marketing of single cell proteins (mushrooms, spirulina and yeast); Biofertilizers- *nif* and *nod* genes BGA, Azolla, phosphobacter and vermicompost; Biopesticides – *Bacillus thuringensis*, *Trichoderma viridae*. **Techniques, significance and applications of** sericulture, apiculture, aquaculture (fish, prawn and pearl), poultry, diary and rabbit farming

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

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

REFERENCES

1. Practical Application of Plant Molecular Biology by R.J. Henry.1997. Chapman 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.
5. Instrumentation, measurement and analysis, II edition, Nakra BC and Chaudhry KK, Tata McGrawHill Publishing Co. Ltd., New Delhi, 2004
6. Fermentation Microbiology and Biotechnology , Mansi El-Mansi and Charlie Bryce, Taylor and Francis Ltd., 2002.
7. Manual of Industrial Microbiology and Biotechnology, III edition, Arnold L. Demain and Julian Davies, ASM press, Washington DC, 1999.
8. Biochemical Engineering Fundamentals, Baily,J., Bailey J. and Ollis,D.F., McGraw-Hill Book Co. New York, 1986.
9. Pharmaceutical Biotechnology: Fundamentals and Applications, 3rd edition, Daan J. A. Crommelin, Robert D. Sindelar, and , Bernd Meibohm, 2007.
10. Handbook of Downstream processing, Edin Goldberg, Blackie and Academic Professional, 1997.

PAPER VIII : 16MBTAC08 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 Perspective of Ethics, Personal vs professional ethics: Moral Reasoning – Ethical theories Deontological, Utilitarianism – Ethical leadership (integrity and ingenuity) - framework for ethical decision making- Michael Macdonald model & Storch model.

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 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, 2nd Edition, [Jose Cibelli](#), [Robert Lanza](#) , [Keith H.S. Campbell](#) , [Michael D. West](#), 2013
2. Ethics in Engineering 4th Edition by Martin, Mike W.; Schinzinger, Tata McGraw Hill Science, 2005
3. Ethical Issues in Biotechnology, Richard Sherlock, John D. Morrey, Jan 1 2002, Rowman & Littlefield.
4. <http://books.cambridge.org/0521384737.htm>
5. <http://online.sfsu.edu/%7Erone/GEessays/gedanger.htm>
6. http://www.actahort.org/members/showpdf?booknrarnr=447_125
7. <http://www.cordis.lu/elsa/src/about.htm>
8. <http://www.csmt.ewu.edu/csmt/chem/jcorkill/bioch480/bioLN98.html>
9. <http://www.accessexcellence.org/AE/AEPC/BE02/ethics/ethintro.html>

Elective IIA: 16MBTGE14B DISEASE DIAGNOSIS

PREAMBLE

Scope: The contents of the paper encodes information on the diagnosis of the pathogenic organisms

Objective: To provide knowledge on the traditional and modern diagnostic tools

Goal: The students will be able to apply this knowledge in identifying the organism responsible for infection and also the disease.

UNIT I:

Sampling site-normally sterile and with normal microflora; Sample collection-method of collection, transport and processing of samples, interpretation of results;

UNIT II:

Diagnostic methods: Cultured-selective media; microscopy, monoclonal antibodies; microbial antigen;

UNIT III:

Diagnostic methods: 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; Protozoans: Multilocus enzyme electrophoresis, PCR, LAMP, Helminthes Real time PCR and Arthropods: PCR based, Maldi TOF TOF; Next generation sequencing.

UNIT IV:

Bacterial and Fungal diseases: Bacteria- *Streptococcus*, Coliforms, *Salmonella*, and *Mycobacterium*; Fungi-Major fungal diseases, Dermatophytoses, Candidiosis and Aspergillosis; Virus: DNA and RNA Viruses- Rota virus, Herpes virus, Influenza virus, Pox virus, Rhabdo Virus, Hepatitis Virus, Retro Virus and AIDS

UNIT V:

Protozoan diseases- Amoebiosis, Malaria, Leishmaniasis; Helminthes diseases-*Fasciola 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. Saunders group.
3. Molecular Diagnostics for the Clinical Laboratorian 2nd ed. (2006). W.B.Coleman. Humana Press.

ELECTIVE IIB: 16MBTGE13B INDUSTRIAL APPLICATIONS OF NANOBIOTECHNOLOGY

PREAMBLE

Scope: The applications of nanotechnology are wide spread starting from material engineering, electronics, food industry, cosmetics and medicine. Therefore, this paper is included for learning paradigm.

Objective: The objective of this paper is to offer a platform for students who are fascinated in pursuing a career in nanotechnology and willing to learn its potential in different fields.

Goal: To enable students to design and generate new and novel nanomaterials for various industrial applications and marketing the potential of such products.

UNIT I

Food, Environment and Cosmetic industries: Food Packaging- Nanoclay and Nanocomposite, Nanoremediation for groundwater treatment (Nanofiltration or membrane filtration), sensing, Nanocosmetics and its safety

UNIT II

Nanoelectronics and nanophotonics: Microelectronic devices, DNA/Gene chips, Solar cell; Fuel cells and Biofuel cells, OLED

UNIT III

Material and polymer engineering: Ceramics-Characteristics and Properties; Proteins, Carbohydrates, Natural and synthetic polymers

UNIT IV

Nanobiotechnology in cancer diagnosis: Conventional imaging, Improvement of resolution using nanotechnology, CT, MRI, Sensors, Cancer markers, SPR, QCM

UNIT V

Nanobiotechnology in cancer therapy: Targeted drug delivery, Drug delivery routes and technologies (Invasive – Injection/nanoneedle (Intramuscular, Intravenous & Non-invasive; Nasal, topical) si RNA

TEXTBOOK

1. **BioMEMS and Biomedical Nanotechnology.** Edited by **Ferrari**, Mauro. Springer Publishers, 1856 Pages.
2. **Biomaterials and Medical Devices.** Editors: **Mahyudin**, Ferdiansyah, **Hermawan**, Hendra (Eds.) Springer Publishers, 242 pages.
3. Nanoenergy: Nanotechnology Applied for Energy Production. Editors: **de Souza**, Flavio Leandro, **Leite**, Edson Roberto (Eds.) Springer-Verlag, 200 Pages.

REFERENCE BOOKS

1. **Significance of Nanotechnology in Food Industry.** [C. Chellaram](#), [G. Murugaboopathi](#), [A.A. John](#), [R. Sivakumar](#), [S. Ganesan](#), [S. Krithika](#), [G. Priya](#). [APCBEE Procedia](#), [Volume 8](#), 2014, Pages 109–113.
2. **Introduction to Ceramics:** [David Kingery](#), [H.K. Bowen](#), [Donald R. Uhlmann](#). Wiley publishers, 2012, 1048 pages

PRACTICAL II: 16MBTACP2 TISSUE CULTURE, AGRO-INDUSTRIAL AND IMMUNO 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. Isolation of bacteriophage
9. Hemagglutination
10. Blood film preparation and identification of cells
11. Immuno electrophoresis
12. Rocket immuno electrophoresis
13. Detection of specific antigen by ELISA technique
14. Optimization of culture conditions for amylase production by Pareto chart and RSM
15. Purification of enzyme using Ion exchange column and Gel filtration column chromatography by FPLC
16. Determination of molecular weight of protein by SDS PAGE and Native PAGE
17. Western blotting of protein to PVDF membrane
18. Enzyme immobilization
19. Biofertilizer production and formulation using *Rhizobium* culture
20. Biopesticide production and formulation using *Trichoderma viride*

21. Nano particle synthesis from microbes
22. Characterisation of nano particles by SEM, XRD and FTIR

SEMESTER III

PAPER IX: 16MBTAC09 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, psychometric 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. Connecticut.
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

PAPER X: 16MBTAC10 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 trophic 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, filtration, 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.

PAPER XI: 16MBTAC11 BIOINFORMATICS AND BIOINSTRUMENTATION

PREAMBLE

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

OBJECTIVE: To enable the students to understand the use of databases available, analysing biomolecules 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 II

Protein structure prediction –Similarity and database structure tools, FASTA, BLAST - Sequence and similarity – sequence alignment – local, global pairwise and multiple sequence, Introduction to phylogenetic trees.

UNIT III

Bioinstrumentations: Separation of Biomolecules: Centrifugation-Preparative, Analytical and Density gradient centrifugation. Chromatographic Techniques-Theory and application of Paper Chromatography, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography. Electrophoretic Techniques: Theory and Application of PAGE, SDS PAGE.

UNIT IV

Structural analysis of Biomolecules: UV, IR, NMR, LASER Raman Spectroscopy, Mass Spectroscopy, Fluorescence Spectroscopy.

Cell analysis: Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Confocal Microscopy.

UNIT V

Biostatistics: Definition, Types of biological data, Representation of biological data. Measurement of central tendency; Measurement of dispersion; Data analysis – Student's t-test, Chi-square test, F-test, ANOVA, Correlation and Regression, Probability.

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
4. Handbook of Biomedical Instrumentation – R.S. Khandpur, Tata McGraw Hill
5. Biophysical chemistry – Upadhyay., Upadhyay and Nath
6. Practical Biochemistry – Principles and techniques -Wilson. K and Walker. J,
7. Biostatistics Basic Concepts And Methodology For The Health Sciences –Wayne W. Daniel, Chod L. Cross
8. Biostatistics: Basics and Advanced – Manju Pandey

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.
5. Instrumental methods of chemical analysis – P.K. Sharma

6. A Biologist's guide to principle and techniques of practical biochemistry – Brigan L. Williams.
7. Experimental methods in Biophysical chemistry- Nicolau, C.
8. Chromatographic methods- Alan Braithwaite, Frank J. Smith
9. Gel Electrophoresis of Nucleic acids-A Practical approach. Rickwood D and BD Hames.
10. Introduction to Spectroscopy- Donald L. Pavia Gary M. Lipman, George S Kriz.

PAPER XII: 16MBTAC12 PHARMACEUTICAL CHEMISTRY

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

Introduction to Pharmaceuticals : Routes of drug administration, Pharmacokinetics: Absorption, 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.

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; Protein molecular modeling by computer: Docking studies; Structure based drug designing using software.

UNIT IV

Pharmaceutical products: Microbial products - Antibiotics (penicillin, streptomycin, tetracycline), vitamins, probiotics. Plant secondary metabolites -alkaloids, flavanoids, steroids, terpenoids. Animal vaccines. Clinical trials.

UNIT V

Therapeutic proteins: Insulin, human growth hormone, clotting factors, interferons, interleukins, tissue plasminogen activators, erythropoietin, DNaseI, alginate lyase, muneins; Production, advantages, limitations and applications of monoclonal antibody.

TEXT BOOKS

1. Daan Crommelin, Robert D Sindelar, "Pharmaceutical Biotechnology", Taylor and Francis Publications, New York, 2002.
2. Remington's Pharmaceutical sciences, 18th edition, 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 XIII: 16MBTAC13 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://ebookey.org/Good-Manufacturing-Practices-for-Pharmaceuticals-Sixth-Edition_859976.html#uPYoXd8huFeqqXB9.99
3. A Primer – Good Laboratory Practices 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.

ELECTIVE IIIA: 16MBTGE14A CANCER BIOLOGY

PREAMBLE

Scope: A better understanding of the basic biology of cancer and its impact on the human body has led to more effective treatments, enhanced detection methods, and the development of prevention strategies.

Objective: To provide knowledge about the molecular events occurring in cancer and causes of cancer.

Goal: This course will provide a comprehensive overview of the biology and pathology of cancer facilitating the students to understand the disease.

UNIT I

Introduction to cancer: Hallmarks of cancer – characteristics of cancer cells, metastasis, angiogenesis, immortalization of cancer cells; transformation of normal cells to tumourous; Types of cancer.

UNIT II

Tumour genetics: Mutations; DNA damage and repair; DNA replication and cell cycle regulation; growth factors and regulation of growth; Epigenetics of cancer – mechanism of epigenetic inheritance, Imprinting and X inactivation, DNA methylation, Chromatin structure, epigenetics of cell differentiation, epigenetics of tissue homeostasis.

UNIT III

Molecular events of cancer: Oncogenes – Retroviral oncogenes, identification of human oncogenes - RAS; Tumour suppressor genes – classification, p53, Rb ; Tumour causing viruses; Cancer pathways: MAPK signaling, PI3K pathway, TGF β signaling, NF- κ B signaling pathway, STAT signaling.

UNIT IV

Diagnosis of cancer: Immunology of cancer tissues; Cancer diagnosis - Molecular diagnostics, scope, diagnosis of hematological cancers, diagnosis of carcinomas; Biomarkers of cancer.

UNIT V

Cancer therapy: surgery; chemotherapy; surgery with chemotherapy and/or radiation therapy; immunotherapy, targeted therapy, hormone therapy

REFERENCE BOOKS

1. Weinberg, Robert A. *The Biology of Cancer*. New York: Garland Science, 2007.
2. Molecular biology of Human cancers, An Advanced Student's Textbook by Olfgang Arthur Schulz Department of Urology and Center for Biological and Medical Research, Heinrich Heine University, Düsseldorf, Germany, Published by Springer, The Netherlands
3. <http://www.cancer.gov/about-cancer/treatment/types>

ELECTIVE IIIA: 16MBTGE14B SECONDARY METABOLITES

Preamble:

Scope: This paper adds information about the significance of secondary metabolites and provides knowledge regarding their applications in various fields.

Objective: Understanding the importance of metabolites through their isolation and purification methods. This will provide a thorough knowledge to the students to carry out research on the metabolites and their applications.

Goal: Students after completion of this paper will be exceptionally well prepared to perform various extraction techniques (chromatography) and also exploit the role of metabolites in various fields.

Unit – I:

METABOLITES - discovery of metabolites - types of metabolites- traditional techniques in isolation of metabolites from plants. Importance of metabolites in traditional medicinal field, for treating various diseases.

Unit – II:

SECONDARY METABOLITES - Introduction- types and classification of secondary metabolites. Alkaloids, flavonoids, quinones, steroids, terpenoids, saponins, polyketides- Structure of the compound, properties (antimicrobial, antioxidant, hepatoprotective, anti cancer), biosynthesis (synthetic pathway).

Unit – III:

PLANT SECONDARY METABOLISM - Plant secondary products of industrial importance. Biochemistry of major secondary metabolic pathways. In vitro production of secondary metabolites: Plant growth regulators and elicitors. Bar coding of genes responsible for secondary metabolites.

Unit – IV:

ISOLATION OF CRUDE SECONDARY METABOLITES - extraction of secondary metabolites: solvent method- purification of secondary metabolites: Paper Chromatography, Thin Layer Chromatography, Column Chromatography, High Performance Liquid Chromatography- structural elucidation: analysis of functional groups (FT-IR), proton and carbon atoms (NMR and its types ^1H and ^{13}C), molecular mass of the compound [GC-MS (Chromatography- Mass Spectrometry) and LC- MS(Liquid Chromatography- Mass Spectrometry)].

Unit – V:

METABOLITES AS ANTIMICROBIAL AND ANTIOXIDANT AGENTS - antioxidant: introduction- process of scavenging mechanisms- efficacy in treating major disorders. Current scenario of secondary metabolites as a potential drug- applications as anticancer drug, biofertilizers, antibiotics, immunomodulators (application on field experiment and recent research).

References:

1. Biochemistry by Berg JM, Tymoczko J.L, Stryer L, Fifth Edition, New York: W.H. Freeman; 2002.
2. Introduction to Chemistry: General, Organic and Biological by Andy Schmitz, 2012 edition.

3. Plant Natural Products: Synthesis, biological functions and practical applications by Herwig O. Gutzeit and Jutta Ludwig – Muller, 2014 edition.
4. Lehninger Principles of Biochemistry by David L. Welson, Michael M. Cox. Fifth edition, 2008. Palgrane Macmillan publications.
5. Upadhayay, Upadhyay and Nath, Biophysical Chemistry.
6. Brigal. L. Williams, A biologist guide to principle and techniques of practical biochemistry.

PRACTICAL III: 16MBTACP3 FOOD, ENVIRONMENTAL AND IN7SILICO ANALYSIS

1. Production of cheese
2. Production of wine
3. Mushroom cultivation
4. Colourant production
5. Identification of food pathogen
6. Isolation of pathogen from patient
7. Haemolytic testing of bacteria
8. Differential test of *Staphylococci* through growth on agar plates (Mannitol agar, DNA agar plate and Coagulase test method)
9. Extraction of antioxidant from plant material and its assay
10. MIC assay of any one antibiotic – Kirby Boyer method
11. Estimation of coliforms by MPN in water
12. Quantitative estimation of iron in water
13. Quantitative estimation of chromium in water
14. Determination of BOD of effluent
15. Determination of COD of effluent
16. Production of methane from sewage sludge
17. Molecular visualization of proteins (PYMOL)
18. Gene structure and function prediction (GENEMARK)
19. Gene structure prediction (GENSCAN)
20. Protein sequence analysis and protein secondary structure prediction (EXPASY and PROTEOMICS tools)
21. Molecular phylogeny (PHYLIP)
22. Analysis of protein and nucleic acid sequences (EMBOSS)

SUPPORTIVE PAPER OFFERED

SUPPORTIVE I: MICROBIAL BIOTECHNOLOGY

PREAMBLE

Scope

This paper provides information on role of microorganisms in Industrial fermentation processes.

Objective

This paper aims to empower the students with various designs of fermenter. The knowledge on fermentation process enable the students to manipulate microbes for improvement

Goal

The students will be able to perform any fermentation production processes to obtain novel products on completion of the paper.

CONTENTS

UNIT I

Isolation, Preservation and Maintenance of Industrial Microorganisms. Media for industrial fermentation. Air and Media Sterilization.

UNIT II

Industrial microbiology – microbial synthesis of organic acids (Citric acid), alcohol (ethanol), alcoholic beverages (wine), antibiotics production (penicillin), vitamin(B12) and amino acid(glutamic acid)

UNIT III

Agricultural microbiology: SCP production- mushroom cultivation; Biofertilizers and bioinsecticides;

UNIT IV

Medical microbiology – methods of isolation of pathogenic organisms; vaccine production; Insulin production

UNIT V

Environmental biotechnology – Microbes in waste water treatment, microbial ore leaching and mineral recovery, oil recovery.

REFERENCES:

1. Principles of Fermentation Technology, Stanbury, P.F. and Whitaker, A., Pergamon Press, Oxford.
2. Manual of Industrial Microbiology and Biotechnology, III edition (1999), Arnold L. Demain and Julian Davies, ASM press, Washington DC
3. Food microbiology, Frazier
4. Industrial Microbiology, Casida
5. Industrial Microbiology, by Creuger and Creuger
6. Medical Microbiology – Ananthanarayanan and Panicker

SUPPORTIVE II: 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: 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.

UNIT II

Fermentation products: Dairy products: General principles of manufacture of Cheese and Yogurt; Fermented foods: Soy sauce and Miso; Fermented vegetable: Sauer Krant and pickles. Fermented sausages.

UNIT III

Distilled beverages: Alcohol, wine, brandy and beer; **Food additives:** Production of additives - organic acid (acetic acid), amino acid (glutamic acid), food flavourants and pigments.

UNIT IV

Food spoilage and public health: *Staphylococcal*, *Salmonellosis*, *E.coli*, Botulism, aflatoxin.

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); Boiological: Probiotics and bacteriocins.

UNIT V

Food process technology: Canning, Microwave heating, thermal inactivation of microorganisms, freezing and thawing of foods. Food process operations: Evaporation - single and multi effect evaporation, dehydration, psychometric charts; drying-tunnel, tray, spray, drum, freezeing; distillation; food processing aid through biotechnology.

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

SUPPORTIVE III: CLINICAL MICROBIOLOGY

PREAMBLE

Scope

This paper imparts information about the microorganisms involved in human pathogenesis, their spread and control.

Objective

To enable the students to better understand the disease epidemiology, immune system, antibiotics, vaccines and gene therapy.

Goal

The students will be able to identify the pathogens causing disease, the specific antibiotic for the treatment and also the techniques of vaccine production.

CONTENTS

UNIT 1

Infection and immunity: General principles of infection, antigens, antibodies, antigen – antibody reactions, complement system.

UNIT II

Pathogenic/Parasitic organisms: Bacterial, viral and protozoal infections of the gastrointestinal system, nervous system, lung, liver, and eye; sexually transmitted diseases, skin infections, zoonoses, arthropod borne diseases. Transmission and spread of diseases – disease epidemiology.

UNIT III

Control and prevention of infections: Drugs and antibiotics, drug resistance, mycobacteria, leprosy and malarial parasite – importance, life cycle, spread and control. Control of vectors – mosquito control – biotechnological approaches.

UNIT IV

Vaccines : Types and methods of action. Biotechnological approaches to disease control and vaccine production. Genetic disorders and gene therapy.

UNIT V

Biochemical changes due to infections: Blood test and tissue analysis. Isolation and identification of organisms from tissue samples. Disease detection – conventional and molecular techniques.

REFERENCES

1. Immunology, Roitt, I.M., Brestoff and Male D.K., 1996.
2. Text book of microbiology, C.J.K. Panicker.
3. Molecular biotechnology, Glick.
4. Clinical microbiology, Ananthanarayanan.