

THIRUVALLUVAR UNIVERSITY
MASTER OF SCIENCE
DEGREE COURSE
M.Sc. APPLIED MICROBIOLOGY
UNDER CBCS
[with effect from 2008-2009]

The Course of Study and the Scheme of Examinations

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
I Year I Semester	Core	Paper I	General Microbiology and Microbial Diversity	5	5	3	25	75	100
	Core	Paper II	Food, Agriculture and Environmental Microbiology	5	5	3	25	75	100
	Core	Paper III	Immunotechnology	5	5	3	25	75	100
	Core Practical		(Subjects covering Paper I, II and III)	12	4	-	-	-	-
	Elective I	Paper I	Biofertilizer Technology	3	3	3	25	75	100
I Year II Semester	Core	Paper IV	Medical Microbiology	5	5	3	25	75	100
	Core	Paper V	Microbial Physiology and Biomolecules	5	5	3	25	75	100
	Core	Paper VI	Bioinformatics and Biostatistics	5	4	3	25	75	100
	Core	Practical I	(Subjects covering Paper I, II and III)	-	-	6 hrs / day 2 days	40	60	100
	Core	Practical II	(Subjects covering Paper IV, V and VI)	10	4	6 hrs / day 2 days	40	60	100
			Human Rights	2	2	3	25	75	100
	Elective II	Paper II	Haematology and Clinical Techniques	3	3	3	25	75	100
II Year III Semester	Core	Paper VII	Microbial Genetics and Molecular Biology	5	5	3	25	75	100

M.Sc. Applied Microbiology: Syllabus (CBCS)

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
	Core	Paper VIII	Microbial Gene Technology	5	5	3	25	75	100
	Core	Paper IX	Industrial Biotechnology	5	5	3	25	75	100
	Core Practical		(subjects covering Paper VII, VIII and IX)	9	4	-	-	-	-
	Elective III	Paper III	Biological Techniques	3	3	3	25	75	100
	Elective IV (Non-major Subject)	Paper IV	Herbal Technology	3	3	3	25	75	100
II Year IV Semester	Core	Paper X	Research Methodology	5	4	3	25	75	100
	Core	Practical III	(subjects covering Paper VII, VIII and IX)	-	-	6 hrs /day 2 days	40	60	100
	Core	Practical IV	(subjects covering Paper X)	10	3	6 hrs /day 2 days	40	60	100
	Elective	Paper IV	Bioremediation	3	3	3	25	75	100
			Project / Dissertation with <i>viva voce</i>	12	10		50	150	200
			Total	120	90				2200

THIRUVALLUVAR UNIVERSITY
M.Sc. APPLIED MICROBIOLOGY

SYLLABUS

UNDER CBCS

[with effect from 2008-2009]

I SEMESTER

PAPER I

GENERAL MICROBIOLOGY AND MICROBIAL DIVERSITY

Objectives

To enable the students to understand the basic knowledge in Microbiology and Microbial diversity.

UNIT-I

Discovery of Microbial world. Controversy over spontaneous generation. Evolutions of Microbiology with its recent developments in Medicine. Role of Microbes in transformation of organic matter and in the causative diseases. Modern trends in microbial taxonomy.

UNIT-II

Microscopy - Its principles and applications. Simple - Compound, Dark field, phase contrast, Fluorescent and Electron Microscopes - SEM, TEM. Principles, Operation and maintenance of autoclaves, Ovens, Centrifuges - refrigerated & ultra speed, calorimeters, spectrophotometers, lyophilizers, deep freezer. Staining methods - Gram, Acid Fast, metachromatic, granules, nuclear staining, capsule, silver impregnation, flagella and other special staining methods. Sterilization and disinfection methods and their quality control.

UNIT-III

Bacterial morphology, structure and characterization - cellular components of bacteria - sporulation and its mechanics - growth and nutrition - Nutritional requirements - Autotrophs, heterotrophs - enrichment culture - growth curve - Kinetics of Growth - Mathematical expression of exponential growth phase; Measurement of growth and growth yields - Batch Culture - Synchronous growth - Techniques of pure culture.

UNIT-IV

Classification of bacteria and salient features according to Bergey's manual of determinative Bacteriology. Microbial diversity in different ecosystems (halophiles, mesophiles, thermophiles, acidophiles, alkalophiles, barophiles and other extremophiles). Structure and function of viruses - classification of viruses - replication of viruses - bacteriophages, plant viruses and animal viruses.

UNIT-V

Classification of fungi according to Alexopoulos and Mims - cell structure, specialized somatic structure. Reproduction in fungi - Asexual, sexual and parasexual cycle - Life cycles of fungi. Structure and Classification of Algae - ultrastructure and life histories of microalgae belonging to various algal classes. Cyanobacteria, Prochlorales and Cyanelles.

Reference Books

1. Dubey RC and Maheswari DK (2005). A text book of Microbiology, Revised Multicolour edition, S.Chand Publishers, New Delhi.
2. Purohit SS (2005). Microbiology - Fundamentals and Applications. Student Edition Publishers, Jodhpur.
3. Pelczar & Kreig (2006). Microbiology 5th edition. Tata McGraw Hill, New Delhi
4. Powar & Dagainawala (2005). General Microbiology Vol.I & II 8th Edition, Himalaya Publishing House, Mumbai.
5. Salle, AJ (2001). Fundamentals & Principles of Bacteriology. 7th edition. Tata McGraw-Hill, Davis,

6. Delbecco, Eisen & Ginsburg (1990) Microbiology 5th Edition Harper & raw, New York
7. Gerhardt, Murray, Wood and Kreig 1994. Methods for General and Molecular Bacteriology, ASM Press, Washington.
8. Alexopoulos CJ and C W. Mims.(1993).Introductory Mycology (3rd edition) WileyEastern Ltd, New Delhi.
9. Elizabeth Moore-Landecker. (1996). Fundamentals of the fungi.(4th edition). PrenticeHall International, Inc, London.
10. Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall, Englewood Cliff, New Jersey.
11. Roger Hull (2002). Mathews' Plant Virology. (4thEdition).Academic press-A Harcourt Science and technology company, New York.

PAPER II

FOOD, AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY

Objectives

To enable students to understand the various microbes involved in food, agriculture and environment.

UNIT-I

Importance of studying food and dairy microbiology. Primary sources of microorganisms in foods. Factors influencing microbial growth in foods - extrinsic and intrinsic. Principles of food preservation - preservation methods - irradiations - drying, heat processing, chilling and freezing, high pressure, modification of atmosphere and chemical preservatives. Nutritional value of fermented foods. SCP and their uses - contamination, preservation and spoilage of fruits vegetables, meat and poultry products.

UNIT-II

Microbiology of fermented milk - Starter lactic cultures, fermented milk products - Food sanitation in food manufacture and in the retail trade - Food control agencies and its regulations. Bacterial pathogens such as Brucella, Clostridium, Bacillus, E. coli, Listeria, Salmonella, Staphylococcus, Vibrio and Yersinia.

UNIT-III

Distribution of soil microorganisms in soil. Factors influencing the soil microflora - Role of microorganisms in soil fertility. Interactions among microorganisms, mutualisms, comensalism, competition, amensalism, parasitism, predation - Interactions between microbes and plants - rhizosphere, phyllosphere, mycorrhizae. Microbial interactions in animals-Rument microbiology - Microbial contribution to food digestion.

UNIT-IV

Biogeochemical - carbon cycle - role of microbes in carbon cycle - trophic relationships - mobilization and immobilisation of carbon with rhizosphere. Nitrogen cycle - mechanism of biological nitrogen fixation - ammonification - nitrification - denitrification and microorganisms involved in such processes. Phosphorous cycle - Sulphur cycle. Biofertilizer for sustainable agriculture *Rhizobium Azospirillum, Azotobacter, Azolla*, BGA -mass production methods - applications methods of biofertilizers - significance of biofertilizers.

UNIT-V

Air pollution - sources, major pollutants, adverse effect on living organisms -acid rain and its impact on ecosystem-gaseous emission - Green house effect -Global warming - Ozone layer depletion and its effect - Droplet nuclei -Aerosol - Assessment of air quality - Airborne diseases, their symptoms and preventive measures. Types of wastes, characterization of solid and liquid waste. Solid waste treatment - saccharification - pyrolysis - composting. Water pollution - sources and nature of pollutants in water - Sewage - industrial effluent - agrochemicals - Eutrophication - waterborne diseases. Potable water. Assessment of microbiological quality of water. Brief account on bioterrorism.

Reference Books

1. Adams MR and Moss MO. (1995). Food Microbiology, The Royal Society of Chemistry, Cambridge.
2. Alexander M. (1977) Introduction to soil microbiology. John Wiley & Sons, Inc., New York.
3. Andrews AT, Varley J. (1994) Biochemistry of milk products. Royal Society of Chemistry.
4. Banwart GJ. (1989), Basic food microbiology, Chapman & Hall, New York.
5. Ec Eldowney S, Hardman DJ, Waite DJ, Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.
6. Frazier WC and Westhoff DC. (1988) Food microbiology, TATA McGraw Hill Publishing Company Ltd. New Delhi.

7. Grant WD, Long PL. (1981) Environmental Microbiology. Blackie Glasgow and London.
8. Hobbs BC and Roberts D. (1993) Food poisoning and food hygiene, Edward Arnold (A division of Hodder and Stoughton), London.
9. Jay JM. (1987) Modern food microbiology, CBS Publishers and distributors, New Delhi.
10. Robinson RK. (1990) The microbiology of milk. Elsevier Applied Science, London.
11. Robinson RK. (1990) Dairy Microbiology, Elsevier Applied Science, London.
12. Rogers JE and Writman WB (1991) Microbial production and consumption and green house gases: Methane: Nitrogen oxides and Halomethanes. American Society for Microbiology, Washington DC.
13. Dirk J, Elsas V, Trevors JT, Wellington, EMH (1997) Modern Soil Microbiology, Marcel Dekker INC, New York.
14. Ramanathan, and Muthukaruppan SM (2005) Environmental Microbiology. OmSakthi Pathipagam, Annamalai Nagar.

PAPER III

IMMUNOTECHNOLOGY

Objectives

To enable the students to understand the immunity and immune system.

UNIT-I

Introduction: Infection, immunity, types of immunity - innate and adaptive, phagocytosis and extracellular killing, immunity to specific infection, milestones in immunology - evolution of immunology.

Immune Systems: Anatomy of the lympho - reticular system, primary lymphoid organs - bone marrow & thymus, Secondary lymphoid tissues - spleen, lymph nodes & gut associated lymphoid tissue, immuno reactive cells - T and B lymphocytes, macrophages, granulocyte and NK cells.

UNIT-II

Antigens and Immunogenicity: Terminologies and definitions - antigen, immunogen, haptens, superantigens, tolerogen, epitope, paratope and antigenic determinants. Features associated with antigenicity and immunogenicity. Basis of antigen specificity.

Antigen receptors: Cell surface proteins of Major Histocompatibility Complex (MHC): types, - class I, II and III distribution and function, MHC in relation to transplantation and HLA typing. T cell receptor complex (TCR).

UNIT-III

Antibodies - B cell receptors. Three dimensional structure of immunoglobulin molecule - Types of immunoglobulins. Biological and chemical properties of immunoglobulin. Antigen, antibody attraction- forces, affinity, avidity and specificity. Antibody synthesis and diversity - genetic basis. Monoclonal antibody production - Hybridoma technology.

Complement system: Basics of complement protein - different pathways of complement activation - the pathway of membrane attack [common pathway], classical and alternate.

UNIT-IV

Acquired immune response: Humoral immune response - various phases of humoral immune response. Cell mediated immune response - cell mediated cytotoxicity, delayed type hypersensitivity.

Immune regulation: Immune response - various events in induction of immune response. Means of immunosuppression - physical, chemical and biological. Tolerance - auto and acquired. Immunopotential - specific and non specific potentiators (adjuvants). Cytokines, Lymphokines and Chemokines.

UNIT-V

Prophylaxis: Vaccines - heat killed, attenuated, rDNA vaccine, synthetic peptide vaccine, plasma derived vaccine, anti - idiotype vaccine and DNA vaccine. Active immunization - vaccines & toxoids - bacterial, viral. Passive immunization - antitoxins, immuno-globulin, specific immuno-globulin, hyper immuno-gamma globulin.

Immuno Pathology - A brief account: Immunology of infectious diseases. Immunodeficiency disorders - primary and secondary. Hypersensitivity / immunologic mechanism of tissue damage. Autoimmune diseases.

Reference Books

1. Chapel H and Halbey M (1986) Essentials of Clinical Immunology, ELBS.
2. Donal M. Weir, John Steward. (1993). Immunology VII edition. ELBS, London
3. Ivan M. Roit. (1994) Essential Immunology - Blackwell Scientific Publications, Oxford.
4. Jacqueline S, Williams and Wilkins A. (1998) Basic Immunology - Waverly Company.
5. Janeway Travers. (1997). Immuno biology - The immuno system in health and Disease. 3rd edition Current Biology Ltd., London, New York.
6. Lydyard P, Whelan A and Fanzer MW (2000) Instant notes in Immunology, Edited By Hames BD, Viva Books Private Ltd.
7. Mark Reakman Diego Vergani. Basic and clinical immunology, Longman Asia Ltd., Hong kong.
8. Paul (1998) Fundamental Immunology. III Edition.

9. Peter J. Delves, Ivan M. Roit (eds) [1998] Academic Press - Encyclopedia of Immunology - 2nd edition.
10. Richard M. Hyde. [1995]. Immunology III edition. National Medical series, Williams and Wilkins, Harward Publishing Company.
11. Clark WR [1991]. The experimental foundations of modern immunology, John Wiley and Sons Inc. New York.

ELECTIVE

PAPER I

BIOFERTILIZER TECHNOLOGY

Objectives

To make the students to understand
the microorganisms as potential biofertilizer organisms
the technology of inoculum production.
to make the students entrepreneurs.

UNIT-I

Introduction to biofertilizers - Structure and characteristic features of the following biofertilizer organisms: Bacteria: *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*. Cyanobacteria: *Anabaena*, *Nostoc*, *Hapalosiphon*. Fungi: *Glomus*, *Gigaspora*, *Sclerocystis*, *Amanita*, *Laccaria*.

UNIT-II

Biofertilization processes - Decomposition of organic matter and soil fertility and vermicomposting. Mechanism of phosphate solubilization and phosphate mobilization. Nitrogen fixation - Free living and symbiotic nitrogen fixation. Biotechnological application in nitrogen fixation.

UNIT-III

Nitrogenous Biofertilizers I: Bacteria - Isolation and purification of *Azospirillum* and *Azotobacter*, mass multiplication of *Azospirillum* and *Azotobacter*, formulation of inoculum of *Azospirillum* and *Azotobacter*, application of inoculants of *Azospirillum* and *Azotobacter*. Isolation and purification of *Rhizobium*, mass multiplication and inoculum production of *Rhizobium*, Methods of application of *Rhizobium* inoculants.

UNIT-IV

Isolation and purification of Cyanobacteria. Mass multiplication of cyanobacterial bioinoculants - Trough or Tank method, Pit method, Field method; methods of application of cyanobacterial inoculum. *Azolla* - mass cultivation and application in rice fields.

UNIT-V

Mycorrhizae - Ecto and endomycorrhizae and their importance in agriculture. Isolation of AM fungi - Wet sieving method and sucrose gradient method. Mass production of AM inoculants and field applications. Isolation and Purification of phosphate solubilizers. Mass multiplication and field applications of phosphate solubilizer [*Pseudomonas striata*]. Biofertilizers - Storage, shelf life, quality control and marketing.

Reference Books

1. Bagyaraj, D.J. and A. Manjunath. 1990. Mycorrhizal symbiosis and plant growth, Univ. of Agricultural Sciences, Bangalore, India.
2. Purohit, S.S., P.R. Kothari and S.K. Mathur, 1993. Basic and Agricultural Biotechnology, Agro Botanical Pub. India.
3. Subba Rao, N. S. 1988. Biological nitrogen fixation: recent developments, Mohan Pramlani for Oxford and IBH Pub. Co. (P) Ltd., India.
4. Subba Rao, N.S., G.S. Venkataraman and S. Kannaiyan 1993. Biological nitrogen fixation, ICAR Pub., New Delhi.
5. Somani, L.L., S.C. Bhandari, K.K. Vyas and S.N. Saxena. 1990. Biofertilizers, Scientific Publishers - Jodhpur.
6. Tilak, K.V.B. 1991. Bacterial Biofertilizers, ICAR Pub., New Delhi.

II SEMESTER

PAPER IV

MEDICAL MICROBIOLOGY

Objectives

To create awareness of microbial diseases of human beings and causes and cures.

UNIT-I

Basics in Medical microbiology - Infectious diseases overview. Medically important microbes. Microbial diseases - sources, route of transmission. Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulence and virulence factors - Signs and symptoms of microbial diseases. Treatment, Prevention and control of microbial infections. Immunity of microbial diseases.

UNIT-II

Diagnosis of microbial diseases - Collection, transport and preliminary processing of clinical pathogens. Clinical, microbiological, immunological and molecular diagnosis of microbial diseases. Modern methods of microbial diagnosis.

UNIT-III

Bacteriology - Characteristics, classification, pathogenesis, pathology, diagnosis, treatment, prevention and control of diseases caused by *Staphylococci*, *Streptococci*, *Bacillus*, *Clostridium*, *Corynebacterium*, *Escherichia*, *Salmonella*, *Shigella*, *Klebsiella*, *Proteus*, *Vibrio*, *Pseudomonas*, *Mycobacteria*, *Spirochaetes*, *Rickettsia*.

UNIT-IV

Virology - Structure, multiplication, classification and medical importance of DNA viruses - Pox, Herpes, Hepatitis, Adeno; RNA viruses - Picorna, Orthomyxo, Paramyxo, Rabdo and HIV virus. Viral vaccines and antiviral agents.

UNIT-V

Mycology - Human mycotic infections caused by Dermatophytes, *Histoplasma*, *Cryptococcus*, *Candida*, opportunistic mycoses. Mycotoxins.

Parasitology - Medical importance of *Entamoeba*, *Giardia*, *Plasmodium*, *Taenia*, *Ascaris*, *Wucherhiria*. Laboratory techniques in parasitology.

Reference Books

1. Chaechter M. Medoff G. and Eisenstein BC. (1993) Mechanism of Microbial Diseases 2nd edition. Williams and Wilkins, Baltimore.
2. Collee, JG. Duguid JP, Fraser AG, Marimon BP. (1989) Mackie and Mc Cartney Practical Medical Microbiology, 13th Edition. Churchill Livingstone.
3. David Greenwood, Richard CD, Slack, John Forrest Peutherer. (1992) Medical Microbiology. 14th edition. ELBS with Churchill Livingstone.
4. Hugo WB and Russell AD. (1989) Pharmaceutical Microbiology IV edition. Blackwell Scientific Publication, Oxford.
5. Joan Stokes E, Ridgway GL and Wren MWD. (1993). Clinical Microbiology, 7th edition. Edward Arnold. A division of Hodder and Stoughton.
6. Ronald M. Atlas. (1989) Microbiology. Fundamentals and Applications. II edition, Maxwell Macmillan international editions.
7. Topley & Wilson's. (1990) Principles of Bacteriology, Virology and Immunity, VIII edition, Vol. III Bacterial Diseases, Edward Arnold, London.

PAPER V

MICROBIAL PHYSIOLOGY AND BIOMOLECULES

Objectives

To enable the students to understand the physiology of microbes and biomolecules.

UNIT-I

Basic concepts of metabolism. Carbohydrate metabolism - Glycolysis - HMD, TCA & ED and other pathways. Aerobic and anaerobic respirations - Generation of energy - substrate level and oxidation phosphorylation - Electron transport chain - Lipid metabolism - Beta oxidation - proteins - primary, secondary, tertiary and quaternary structures - Enzymes nomenclatures, classification and general properties - factors affecting enzyme synthesis and activities - Allosteric enzymes - photosynthesis - cyclic and non -cyclic photophosphorylation - Bioluminescence.

UNIT-II

Microbial pathogenicity - Toxins - Characterization - Mechanisms of action - Antimicrobial chemotherapy, antibiotics, classification, mode of action - antimicrobial resistance. Tests for sensitivity to antimicrobial agents - General considerations; Metabolic pathways and metabolic control mechanisms.

UNIT-III

A brief idea about classification, structure and properties of carbohydrates, amino acids, proteins and lipids including sterols and pigments. Nucleic acids - DNA and RNA - their topology and functions. Brief idea about artificial Nucleic acid - PNA. DNA Replication mechanisms, chromosome organization in microbes, differences in prokaryotic and eukaryotic replication, DNA repair - mechanism of excision repair, SOS repair and mismatch repair.

UNIT-IV

RNA synthesis - Process of transcription - initiation, elongation - termination. Synthesis of mRNA in prokaryotes and eukaryotes. Synthesis of rRNA and tRNA. RNA processing - capping and polyadenylation.

UNIT-V

Protein Synthesis - Genetic code, process of translation - initiation, elongation and termination. Signal sequences and protein transport.

Reference Books

1. Campbell MK (1999). Biochemistry, 3rd edition, Saunders College Publishing / Harcourt Brace College Publishers.
2. Freidberg EC, Walker GC, Siede W. (1995). DNA Repair and Mutagenesis, ASM Press.
3. Freifelder D. (1996). Molecular Biology, 2nd edition. Narosa Publishing House.
4. Geoffrey L. Zubay (1998). Biochemistry. Wm. C. Brown Publishers, 4th Edition.
5. Lewin, B. (2000) Genes VII. Oxford University Press.
6. Maloy SR, Cronan Jr. JE, Freifelder D (1994). Microbial Genetics. Jones and Bartlett Publishers.
7. Nelson D.L. and Cox, M.M. (2001). Lehninger Principles of Biochemistry, 3rd edition, Mac Millan Eworth Publishers.
8. Raaman, N. 2006. Phytochemical Techniques. New India Publishing Agency, New Delhi
9. Stryer L (1995). Biochemistry. W.H. Freeman and Company.
10. Voet D. and Voet J (1995) Biochemistry, 2nd edition, John Wiley and Sons Inc.

PAPER VI

BIOINFORMATICS AND BIostatISTICS

Objectives

To enable the students to make use of the tools of bioinformatics and biostatistics to solve microbiological problems.

UNIT-I

Biology in the computer age - Computational Approaches to Biological questions.

Basics of computers - servers, workstations, operating systems, Unix, Linux. World Wide Web. Search engines, finding scientific articles - Pubmed - public biological databases.

UNIT-II

Sequence analysis - pairwise sequence comparison. Protein Data Bank, Swiss-prot, Genbank - sequence queries against biological databases - BLAST and FASTA - multifunctional tools for sequence analysis. Multiple sequence alignments, Phylogenetic alignment - profiles and motifs.

UNIT-III

Genomics and Proteomics - Sequencing genomes - sequence assembly - genome on the web - annotating and analysing genome sequences. Proteomics - biochemical pathway databases.

UNIT-IV

Predicting Protein structure and function from sequence - Determination of structure - feature detection - secondary structure prediction - predicting 3 D structure. Protein modelling.

UNIT-V

Biostatistics: Measures of Central tendency - mean (arithmetic, harmonic and geometric) median and mode; Correlation Co-efficient, Simple linear regression; basic idea of Significance Test, hypothesis tests, levels of significance, Student 't', 'Chi' square and goodness of fit.

Reference Books

1. Cynthia Gibas & Per Jambeck (2001). Developing Bioinformatics Computer Skills: Shroff Publishers & Distributors Pvt. Ltd (O'Reilly), Mumbai.
2. H.H. Rashidi & L.K Buehler (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
3. Des Higgins & Willie Taylor (2002). Bioinformatics: Sequence, structure and databanks, Oxford University Press.
4. Baxevanis A.D & Ouellette B.E.F (2001) Bioinformatics: A practical guide to the analysis of genes and proteins, Wiley Interscience - New York
5. Arora P.N & Malhon P.K (1996). Biostatistics Imalaya Publishing House, Mumbai.
6. Sokal & Rohif (1973). Introduction to Biostatistics, Toppan Co. Japan.
7. Stanton A & Clantz, Primer of Biostatistics - The McGraw Hill Inc., New York.

CORE PRACTICAL I

(Subjects covering Paper I, II and III)

Objectives

To enable the students to get hands-on training on various aspects of general, food, agricultural and environmental microbiology and immunotechnology.

UNIT-I

1. Cleaning of glassware and sterilization.
2. Preparation and use of glassware cleaning solutions, sterilization.
3. Micrometry - counting and measurements.
4. Isolation of anaerobic and aerobic bacteria - cyanobacteria, actinomycetes and fungi.
5. Pure and axenic culture techniques - serial dilution - pour plate, spread plate, streak plate methods and stab culture techniques.

UNIT-II

1. Bacterial Staining methods - simple, Gram's, acid fast, flagella, capsule and spore.
2. Fungal Staining methods - Lacto-phenol cotton blue.
3. Motility of bacteria.
4. Determination of growth - growth curve - generation time - synchronous and asynchronous growth - estimation of growth - microscopic - plate - membrane filter - turbidometry - dry weight - wet weight - chlorophyll.
5. Study of virus infected plant samples

UNIT-III

1. Microbial analysis of food products - bacterial and fungal
2. Microbial spoilage of refrigerated food
3. Extracellular enzyme activities - cellulase, protease, lipase and phosphatase
4. Milk microbiology - direct microscopic count - standard plate count - reductase test (resazurin/methylene blue) - isolation of microbes from yoghurt, curd.
5. Quantification of microorganisms in air - solid and liquid impingement techniques

UNIT-IV

1. Microbial flora from different soil types and habitats - isolation of nitrogen fixing bacteria, cyanobacteria and phosphate solubilizing organisms- development of Winogradsky Column
2. Field trip to dairy, food industries, sewage treatment plants.

UNIT-V

1. Precipitation techniques
Hands on: Agar gel diffusion - Ouchterlony's method.
Theory: Single radial immunodiffusion - staining.
Counter immuno electrophoresis & Rocket Immuno Electrophoresis.
2. Agglutination techniques
Hands on: Blood grouping and Rh factor - Latex agglutination - RF & ASLO.
Theory:
Heme agglutination RPHA / IHA.
3. Labelled Assays
Demo: Enzyme Linked Immunosorbent Assay (ELISA).
Theory: Immunofluorescence (IF) Immuno-histochemistry (IH) - Peroxidase antiperoxidase staining (PAP) - Radioimmunoassays (RIA)
4. Animal Tissue Culture
Demo: Tissue culture media preparation, Peripheral blood mononuclear cell (PBMC) separation - types of culture. Maintenance of culture.
5. Animal Experiments
Hands on: breeding and maintenance of experimental animals.
Surgical and experimental techniques - Thymectomy, splenectomy and harvesting of lymph nodes.

Reference Books

1. Aaronson S. (1970) Experimental Microbial Ecology, Academic Press, New York
2. Bhatia A (2000). Manual of Practical Immunology, Aruna Bhatia First ed, Palani Paramount Publication
3. Benson H.J (1994). Microbiological Applications, WmC Brown Publishers, Oxford.

4. Clesceri L.S, Greenberg A.E, Eaton AD. (1998) Standard methods for examination of water & waste water American Public Health Association.
5. Collins C.H, Lyne P.M, (1985). Microbiological methods. Butterworths, London.
6. Gerhardt P, Murray R.G, Wood W.A, Kreig, N.R. (ed) (1994). Methods of General and Molecular Bacteriology. American Society for Microbiology, Washington DC
7. Holt J.S, Kreig N.R, Sheath P.H.A, Williams S.T. (1994) Bergey's Manual of Determinative Bacteriology (9th ed.), Williams & Wilkins, Baltimore.
8. Hudson L and Henry FC (1999) Practical Immunology, 3rd edition, Blackwell Scientific Publishers, Oxford, London.
9. Miller L.E, Luke H.R, Peacock J.E and Tomar R.H (1990). Manual of Laboratory Immunology, 2nd edition, Lea and Febiger - London.
10. Official Methods of Analysis (1995), Arlington, Virginia, USA.
11. Patrick R. Murray. (editor chief) (1999) Manual of clinical microbiology, 7th edition, ASM Press, Washington D.C.
12. Prakash M., Arora, C.K. (1998) Pathological techniques - Anmol Publications Pvt. Ltd. N.D.
13. Rhodes P.M, Stanbury P.F. Applied Microbial Physiology - A practical approach. IRL Press, Oxford University Press, Oxford.
14. Talwar GP (ed). (1982) A handbook of Practical Immunology, Vikas Publishing House Pvt. Ltd.
15. Talwar GP (1983). Microscopic Immunoassays and Applications, Vikas International Students Edition, Vikas Publishing House Pvt. Ltd.
16. Tuffery AA (ed) (1996) Laboratory Animals - An Introduction, 2nd edition, John Wiley and Sons, New York.
17. Wilson K, Walker J. (1995) Practical Biochemistry Principles and Techniques, Cambridge University Press.

CORE PRACTICAL II

(Subjects covering Paper IV, V and VI)

Objectives

To impart knowledge on microbial diseases, metabolism and hands on training on computer applications in biology.

UNIT-I (Medical Microbiology)

1. Collection and transport of pathological specimens for microbiological examinations.
2. Bacteriological methods: Microscopic examination - blood - faeces - pus - sputum - throat swab and nose swab - urine - body fluids
3. Isolation and identification of the pathogen - culture and biochemical tests. Antimicrobial assay - sensitivity test - Stokes and Kirby Bauer methods - Disc diffusion - agar dilution - broth dilution - MBC/MIC. Quality control for antibiotics.
4. Mycological methods: Macroscopic observation - microscopic observation - culture
5. Identification of *Mucor*, *Rhizopus*, *Aspergillus*, *Penicillium*, *Candida*, *Trichophyton*, *Microsporum*, *Epidermophyton* - SDA/Corn Meal Agar - Slide culture method - Germ tube method - Sugar assimilation/fermentation tests. Examination of parasites in clinical specimens - ova/cyst in faeces.

UNIT-II (Medical Microbiology)

1. Clinical - observation: Theory: a) X ray chest 2) Mantoux test for Mycobacterium tuberculosis infection.
2. Haematology: Total count (TC): RBC and WBC, - Differential count (DC) - Haemoglobin level, - Bleeding time - Clotting time – ESR
3. Biochemical : Serum - SGOT, SGPT, cholesterol, creatinine bilirubin and protein. Urine - colour, turbidity, sugar, albumin, bile salt, - phenylketone urea, bence Jones protein, RBC, pus cells, pH, acidity and alkalinity.

UNIT-III (Microbial Physiology)

Isolation and Colorimetric estimation of

Hands on:

1. Amino acids - ninhydrin method
2. Protein - Biuret method/Lowry's method
3. Carbohydrate reducing sugars - Anthrone method/Benedicts method.
4. Blood cholesterol - Acetic anhydride method

UNIT-IV (Biomolecules)

Isolation and Colorimetric estimation of

Hands on:

1. DNA - Diphenylamine method
2. RNA - Orcinol method
3. Determination of Phosphorous content of nucleic acids - perchloric acid test.
4. Pigments [chlorophyll - carotenoids - phycobiliproteins]

UNIT-V (Bioinformatics - Demonstration only)

5. Basics of computers - basic commands - file creation, copying, moving & deleting in Linux & Windows. Using email - Using browsers - search engines, - Pubmed.
6. Using biological databases - Swissprot - Protein Data Bank and Genbank.
7. Different types of sequence analysis queries in BLAST and FASTA.
8. Multiple sequence alignments and Phylogenetic alignments.
9. Protein structure prediction software.
10. Genomes and Proteomes available on the web and their use.
11. Statistical software available on the web and their use.

Reference Books

1. Atlas RM (1993). Handbook of Microbiological Media, (ed) Parks L.C, CRC Press, London.
2. Balows A, Hansler Jr K.L, Isenberg H.D, Shalomy H.J (1991). Manual of Clinical Microbiology, American Society for Microbiology, Washington DC.
3. Boyer R (2001) Modern Experimental Biochemistry, 3rd edition: Benjamin / Cummings Publishing Company Inc.
4. Brawshaw L.J. (1988). Laboratory Immunology, Sandders College Publishing.
5. Clark J.M Jr and Switzer RI (1977) Experimental Biochemistry, 2nd Edition. W.H. Freeman, San Francisco.
6. Gerhardt P, Murray R.G, Wood W.A and Kreig N.R. (ed) (1994) Methods for General and Molecular Bacteriology - American Society for Microbiology, Washington D.C.
7. Jayaraman J (1981). Laboratory manual in Biochemistry, New Age Int. Publishers, New Delhi.
8. Lorian V (1991) Antibiotics in Laboratory Medicine, 3rd edition, Williams and Wilkins, Baltimore.
9. Myers R.M, Koshi G (1982) Diagnostic procedures in medical microbiology. IELC Combodia Press.
10. Plummer D.T (1987) An introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill, New Delhi.
11. Switzer R.L and Garrity L.F (1999) Experimental Biochemistry, 3rd edition, WH Freeman and Co
12. Warton D.C and McCarthy R.E (1972) Experiments and Methods in Biochemistry. MacMillan, New York.
13. Wilson K and Walker J (2000) Practical Biochemistry Principles and Techniques, 5th Edition, Cambridge University Press.
14. Work T.S and Work E (1972) Laboratory Techniques in Biochemistry and Molecular Biology. Vol. 3 - North-Holland, Amsterdam
15. World Wide Web

HUMAN RIGHTS

COMPULSORY PAPER

UNIT-I

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights.

UNIT-II

International Human Rights - Prescription and Enforcement upto World War II - Human Rights and the U.N.O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Covenant on Economic, Social and Cultural Rights and Optional Protocol.

UNIT-III

Human Rights Declarations - U.N. Human Rights Declarations - U.N. Human Commissioner.

UNIT-IV

Amnesty International - Human Rights and Helsinki Process - Regional Developments - European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

UNIT-V

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment.

Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

Books for Reference:

1. International Bill of Human Rights, Amnesty International Publication, 1988.
2. Human Rights, Questions and Answers, UNESCO, 1982
3. Mausice Cranston - What is Human Rights
4. Desai, A.R. - Violation of Democratic Rights in India
5. Pandey - Constitutional Law.
6. Timm. R.W. - Working for Justice and Human Rights.

7. Human Rights, A Selected Bibliography, USIS.
8. J.C.Johari - Human Rights and New World Order.
9. G.S. Bajwa - Human Rights in India.
10. Amnesty International, Human Rights in India.
11. P.C.Sinha & K. Cheous (Ed) - International Encyclopedia of Peace, Security Social Justice and Human Rights (Vols 1-7).
12. Devasia, V.V. - Human Rights and Victimology.

Magazines:

1. The Lawyer, Bombay
2. Human Rights Today, Columbia University
3. International Instruments of Human Rights, UN Publication
4. Human Rights Quarterly, John Hopkins University, U.S.A.

ELECTIVE

PAPER II

HAEMATOLOGY AND CLINICAL TECHNIQUES

Objectives

To enable the students to understand the blood types and clinical techniques.

UNIT-I

Blood: Definition, Characters, Composition.

Collection of Blood - Capillary Blood: From Adults/Infants, Examinations Employed. Advantages/Disadvantages - Venous Blood: From Adults/Infants, Examinations Employed.

Anticoagulants: Definition - Type: Wintrob's /EDTA /Heparin /Citrate, Concentration Examinations done.

UNIT-II

Counting of Blood Cells: Neubauer counting chamber - Total RBC count and WBC count: diluting Fluids, Macro Dilution/Micro Dilution Technique, Falsely Low and High Counts, Normal values - correction for TWBC - Absolute Eosinophil count - Differential Leucocyte count: Granulocyte/Agranulocytes: Morphology/Function, Staining Technique - Platelet Count: Morphological Characters/Functions, Direct/Indirect method - Reticulocyte count Dry/Wet Smear Technique.

Haemoglobin: Composition/Normal Values: - Determinations: Tallqvist/Acid Haematin/Alkaline Haematin, Haldane's Carboxy/Drabkin's/Dare, Spencers/Specific Gravity/ Gasometric, Chemical.

UNIT-III

Coagulation Mechanism: Factors: Bleeding Time Clotting Time. Haematological Indices - Packed Cell Volume: Wintrob's/Micro HCT method - Mean corpuscular Volume - Mean Corpuscular haemoglobin - Mean Corpuscular haemoglobin concentration - Volume index - volume thickness index - Mean corpuscular diameter - saturation index. Erythrocyte Sedimentation Rate - Principle - Determination: Wintrob's/Westgren.

UNIT-IV

Preparations of stains and staining techniques: - Wright stain, Leishmans stain, Giemsa's stain, Jaswanth singh and Bhattarcharji stain, Fields stain - Peroxidase stain: Examination of Blood smear - Peripheral smear report: Size/colour/shapes/inclusions. Blood parasites: Malarial parasite/Microfilaria.

UNIT-V

ABO Grouping: History/Discovery - slide / Tube Technique - Rh. Typing: Slide/Tube Technique, Bovine Replacement Technique - Coombs Test: Direct/Indirect - Donor screening - Cross Matching: Major/Minor - Collection OF blood/preservation /storage.

Reference Books

1. Mukerjee, K.2003.Medical Laboratory Technology.Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Sood, R. 2004. Medical Laboratory Technology Methods and Interpretations. Jaypee Brothers Medical Publishers(P) Ltd. New Delhi.

III SEMESTER

PAPER VII

MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Objectives

To enable the students to understand the basic and applied aspects of molecular biology and microbial genetics.

UNIT-I

Introduction to identification of Genetic Material (Griffith, Avery and Hershey and Chase Experiments). Gene as a unit of mutation and Recombination. Mutagenesis, Mutations and Mutants - Biochemical basis of Mutation, Spontaneous and induced mutations, Isolation of mutants, mutagenesis, reversion, suppression, genetic analysis of mutants.

UNIT-II

Gene Transfer Mechanisms - Transformation - competence cells, regulation, general process; Transduction - general and specialized; conjugation - Hfr, Triparental mating, self transmissible and mobilizable plasmids, pili.

UNIT-III

Biology of Plasmids - Extrachromosomal heredity - biology of bacterial plasmids, structure of the plasmids, F1, ColE1, pSC101 and Ti plasmids, - replication, control, partitioning, incompatibility and gene transfer.

UNIT-IV

Transposable genetic elements and Gene Mapping - Introduction - Discovery, insertion sequences, complex and compound transposons - T10, T5, and retroposon. Genetic mapping - Ecoli - Virus T4 phage – using r II system.

UNIT-V

Concept of gene and Gene regulation - Organization of gene in prokaryotes and Eukaryotes - Introduction, Operon concept, lac and Trp operons, promoters and repressors, regulation of gene expression - Transcriptional control - promoters, terminators, attenuators and anti terminators; Induction and repression; the lac operon - catabolite repression; Biosynthesis; trp operon - upstream activator sequences and enhancers, two component regulatory systems. Translational control - ribosome binding, codon usage, antisense RNA; post-translational modification (epigenetics).

Reference Books

1. Antony JF, Griffiths, Gilbert WM, Lewontin RC and Miller JH [2002]. Modern Genetic Analysis, Integrating Genes and Genomes, 2nd edition, WH Freeman and Company, New York.
2. Blackburn GM, Gait MJ. [1996]. Nucleic acids in chemistry and biology. Oxford University press.
3. Friedberg EC, Walker GC, Siede W. [1995]. DNA repair and mutagenesis. ASM press.
4. Malacinski GM and Freifelder D [1998] Essentials of Molecular Biology, 3rd edition, John and Bartlett Publishers.
5. Lewin B. [2000]. Genes VII. Oxford University press
6. Maloy SR, Cronan Jr. JE, Freifelder D [1994]. Microbial genetics. Jones and Bartlett publishers.
7. Singer M, Berg P. [1991]. Genes and Genomes. University Science Books.
8. Stryer L. [2002]. Biochemistry. 5th edition, W.H.Freeman and company.
9. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. [1998]. Molecular biology of the gene, 4th edition, Benjamin/Cummings publishing company.

PAPER VIII

MICROBIAL GENE TECHNOLOGY

Objectives

To enable the students to understand various tools and techniques for microbial gene manipulation.

UNIT-I

Gene Analysis and Techniques : Isolation of DNA and RNA from microbes. Handling & Quantification of Nucleic acids - Radiolabelling of Nucleic acids - End labeling - Nick translation - Labelling by primer extension - PFGE and its applications - Blotting techniques - Nucleic acid hybridization

UNIT-II

Restriction enzymes : Nomenclature - Classification - restriction and Methylation - Type II restriction endonuclease - use of restriction endonucleases - Restriction mapping and its applications - DNA modifying enzymes - nucleases - polymerases - DNA ligases

UNIT-III

DNA sequence analysis ; Maxam - Gilbert (Chemical) sequencing - Sanger - Coulson (DiDeoxy/enzymatic) sequencing . Automated DNA sequencing. Genome sequencing and Physical Mapping of genomes. PCR - methods and its application, Advantages. DNA fingerprinting in forensic application. Microarray and its applications

UNIT-IV

Vectors - nature - uses of vectors- types of vectors - Plasmids, Bacteriophages - Cosmid - Shuttle vectors; cloning strategies - cloning and selection of individual genes. Gene libraries; cDNA and genomic libraries - artificial chromosomes - BAC and YAC.

UNIT-V

Applications : Gene Annotations; Gene silencing; Human Genome Project; Legal aspects of rDNA technology and cloning. Development of gene functions. Recombinant DNA products and applications - Insulin, Hepatitis B antigen vaccine, Growth hormones. Quality Procedure - Pre Requisite Programme - Good Hygiene Procedure (GHP), Good Manufacture Procedure (GMP), Good laboratory Procedure (GLP), ISO-9000 - HACCP; Nanobiologics - Bioactive peptides as hormones, antimicrobials, vaccines, drug carriers and therapeutics.

Reference Books

1. T.A.Brown - 1995. Gene cloning - a introduction - Chapman & hall London.
2. Burrell, MM. (1993) Enzymes of Molecular Biology, Humana Press.
3. Calendar, R. (1988) Bacteriophages Vols. I, II and III. Plenum Press.
4. Chirikjian JG Eds (1995). Biotechnology - Theory and Techniques, Vol. 1, Jones and Burtlett Publishers.
5. David Freifielder 2005. Molecular Biology 2nd edition. Narosa Pub. New Delhi.
6. DNA Cloning, Vols, 1,2,3 and 4, IRL Press
7. Gerd Gellissen - 2005. Production of Recombinant Proteins: Novel Microbial and Eukaryotic Expression Systems . Viley VCH Publishers, 426 pages.
8. Glazer & Nikaido 1995. Microbial Biotechnology. WH Freeman &Co. Newyork
9. Harinder P. S. Makkar, Gerrit J. Viljoen - 2005. Applications Of Gene -Based Technologies for Improving Animal Production and Health In Developing. Page 175 - 793 pages - Springer pub.
10. Innis MA. (1995) PCR Strategies, Academic Press.
11. Kreuzer & Massey 2001 - rDNA & Biotechnology. A guide for Teachers, 2nd Edition, ASM press, Washington
12. Lewin B 2003. Genes VII. Oxford University press, New York
13. Lindahl T and West SC ed (1995). DNA repair and recombination, Chapman, Hall and Royal Publishers.
14. Primrose SB (1994) Molecular Biotechnology, 2nd edition, Blackwell Scientific Publications.
15. Old, RW. Primrose, SB. (1994) Principles of Gene Manipulation. Blackwell Scientific Publications.
16. Tuan, RS. (1997) Recombinant Gene expression protocols. Humana Press.
17. Watson, JD., Gilman, M, Witkowski, J. Zoller M. (1992) Recombinant DNA. Scientific American Books.

PAPER IX

INDUSTRIAL BIOTECHNOLOGY

Objectives

To enable the students to understand the microbial processes applicable in industries and scale-up processes.

UNIT-I

Industrially important microorganisms : Screening techniques - Detection and assay of fermentation products - Strain improvements - Mutations, protoplast fusion and rDNA techniques for strain development.

UNIT-II

Industrial fermentation : Primary and secondary metabolites; Microbial Growth kinetics; Basic functions of fermenter - body construction, aeration, agitation, theories of aeration, oxygen transfer kinetics; Concepts of Newtonian and non - newtonian fluids - antifoam - Submerged and solid state fermentation - Scale up; Fermentation Biosensors; Downstream Processing.

UNIT-III

Industrial Production: Typical Fermentation processes for the industrial production of Wine, Beer, Bacitracin, Streptomycin, Riboflavin, B-carotene, Gibberellins, glutamic acid and surfactants. Commercially useful non-microbial products produced through microbes - insulin, interferons, B-cell growth factors, tissue plasmonogen activator. Microbial Enzymes - Enzyme immobilization, Microbial Insecticides. Production of SCP - *Spirulina* and yeast.

UNIT-IV

Algal biotechnology: Biotechnological potential of microalgae, food, feed and fuel production - pharmaceutically valuable of microalgae, pigments and H₂ gas from BGA.

UNIT-V

Nanobiotechnology: Introduction - history and recent developments - sources of nanoparticles - microbial producers of nanoparticles -advantages of microbial nanoparticles - applications - social and ethical implications - ethical concerns about patenting of living organisms and genetic materials.

Reference Books

1. Balasubramanian D, Bryce CFA, Dharmalingam K, Green J, Jayaraman K. (1996). Concepts in Biotechnology, University Press, India.
2. Baxevanis AD and BFF Ouellette, Wiley O.(ed) (2001) Bioinformatics - A practical guide to the analysis of genes and proteins. Interscience, New York.
3. Borowitzka MA, Borowitzka LJ (1989) Microalgal Biotechnology, Cambridge University Press.
4. Doolittle RF. (1990). Molecular evolution. Computer Analysis of Protein and Nucleic acid Sequences Methods in Enzymology. Academic Press, New York.
5. Faber K. (1992) Biotransformation in Organic Chemistry Springer Vulag.
6. Gerbardt P, Murray RG, Wood W A., Kreig NR. (1994) Methods for General and Molecular Bacteriology - American Society for Microbiology Washington D.C.
7. Glick BR, Pasternak JJ (1998) Molecular Biotechnology - Principles and Applications of Recombinant DNA, ASM Press, Washington DC.
8. Higgins D, Taylor W. (2000). Bioinformatics, sequence, structure and databanks A practical approach. Oxford University Press.
9. Gibas C and P. Jambek. (2001). Developing Bioinformatics computer skills O'Reilly, USA.
10. Glazer AN, Nikaido H. (1994) Microbial Biotechnology - Fundamentals of Applied Microbiology WH Freeman and Company, New York.
11. Glick BR, Pasternak JJ. (1994) Molecular Biotechnology, ASM Press, Washington DC.
12. Misener S, Krawetz SA. (2000) Bioinformatics Methods and Protocols. Humana Press, Totowa, New Jersey.
13. Miyamoto MM, Cracraft JL. Phylogenetic Analysis of DNA sequences. Oxford University Press. Oxford.
14. Pnoella P (1998) Introduction to Molecular Biology, WCB Mc Graw Hill, Boston, Massacheutts.
15. Rashidi HH, Buehler LK. (2000) Bioinformatics Basics. Applications in Biological Science and Medicine. CRC Press, Washington DC.
16. Raledge C and Kristiansen B Eds (2001) Basic Biotechnology, 2nd edition, Cambridge University Press.
17. Walsh G, Headon DR. (1994). Protein Biotechnology, John Wiley & Sons, New York.

ELECTIVE

PAPER III

BIOLOGICAL TECHNIQUES

UNIT I:

Microscopy and Related Techniques - Light Microscopy : Microscopic optics, components of microscopes. Basic principles and method of Bright field, Dark field, Phase contrast. Fluorescence, Polarization and confocal microscopes. Applications of various types of microscopy such as immunofluorescence - In situ hybridization. Electron Microscopy - Principle, Techniques and applications of Transmission Electron microscope (TEM) and Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM). Photomicrography and Video micrography Developing and printing of microphotographs.

UNIT II:

Analytical Techniques - Spectroscopic methods - UV-Visible, Atomic Absorption Spectrophotometer, Atomic Emission Spectroscopy. Centrifugation - Principles, various types including centrifugation Electroanalytical methods - electrolytic all 4 galvanic cell - Potentiometric, conductimetric, coulometric & voltametric analysis. Biosensors. Radioactive Analysis : Principles of radioactivity, GM counter & LS counter.

UNIT III:

Principles & Applications of Chromatographic Techniques : Adsorption - Ion exchange and gel permeation - affinity chromatography for separation of compounds including GC and HPLC.

UNIT IV:

Electrophoresis Techniques - protein - nucleic acid - immuno - two dimensional electrophoresis.

UNIT V:

Molecular Biological Techniques

- a) Microbiological techniques - purification, storage, measurement of microbial growth rate.
- b) Isolation and amplification of nucleic acid - Plasmid isolation, chromosomal DNA isolation. Polymerase chain reaction.
- c) Gene cloning techniques - Restriction digestion and Phosphatase treatment of cloning vectors. Cloning technique, separation and staining of DNA, qualification of DNA, gene transfer mechanisms - chemical and electroporation.
- d) Methods of detection of clones - Nucleic acid transfer by blotting, Hybridization plaque, colony hybridization, histochemical detection of A -galactosidase, antibody screening including colour development reaction.

Reference:

1. Cynthia Gibas & Per Jambek [2001]. Developing Bioinformatics Computer Skills, Shroff Publishers & Distributors Pvt. Ltd., O'reilly) Mumbai.
2. Demain, A.L. and Davies, J.E. [1999]. Manual of Industrial Microbiology & Biotechnology, ASM Press.
3. Glick, B.R. and Pasternak, J.J. [1994]. Molecular Biotechnology, ASM Press.
4. John G. Webster. [2004]. Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.
5. Misener, S. and Krawetz, S.A. [2000]. Bioinformatics Methods and Protocols. Human Press, Totowa, New Jersey.
6. Rashidi, H.H., and Buehler, L.K. [2002]. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
7. Sambrook, J. and Ruseell, D.W. [2001] Molecular Cloning – A Laboratory Manual [3rd edition, Vol. 1,2,3] Cold Spring Laboratory Press, New York.
8. Savile Pradbury. [1991]. Basic measurement techniques for light microscopy, Oxford University Press, Royal Microscopical Society.
9. Surzeki, S. [2000]. Basic Techniques in Molecular Biology, Springer.
10. Westermeier, R [1993]. Electroporesis in practice – VCH – Federal Republic of Germany.
11. Willett, J.E. [1991]. Gas Chromatography, John Wiley & Sons.
12. Wilson, K. and Walker [1995]. Practical Biochemistry Principles and Techniques, Cambridge University Press.

**ELECTIVE IV
PAPER IV
(NON MAJOR SUBJECT)
HERBAL TECHNOLOGY**

UNIT - I

Pharmacognosy - Definition and history, Indian systems of medicine - Siddha, ayurvedha, and Unani systems. Taxonomy of locally available medicinal plants, their chemical constituents and medicinal uses - Classification of Crude drugs - Chemistry of Drugs - Future of pharmacognosy.

UNIT - II

Classification of medicinal plants - Vernacular name and family - Geographical source, cultivation, collection, and processing for market and commerce in crude drugs. Morphological and histological studies, chemical constituents - Therapeutic and other pharmaceutical uses. Underground stem - ginger, Alpinia - Roots - Rauolfia - Belladonna - Aerial parts - Bark - Cinchona.

UNIT - III

Leaves - Adathoda, Eucalyptus - Flower - Clove fruits seeds - Nux vomica Nutmegs, Gooseberry - unorganized drugs - Gum - Acacia - Resin - Turpentine, fixed oil - castor oil.

UNIT - IV

Herbal medicines for Human ailments - Drugs acting on cardiac diseases, cerebral diseases, Nasal, diseases - Blood pressure Drugs acting on Nervous system - Depressants. - stimulants - Respiration and Drugs - Urogenital system and drugs - Psychoactive plants.

UNIT - V

Propagation of medicinal plants - Micro and macro propagation conservation of rare medicinal plants Role of biotechnology in medicinal plants banks - cultivation of medicinal and aromatic plants - Drug adulteration - methods of Drug evaluation, Herbal food - Food processing - packaging - Herbal sale and Export of medicinal plants - marketing - Intellectual property rights - Export laws.

References

1. George Edward Trease and W.C. Evans - Pharmacognosy 12th edition, English Language Books Society, Baelliere Tindall.
2. Handa, S.S. and Kapoor, V.K. Pharamcognosy by 2nd Edition, Vallabh Prakashan Publishers, New Delhi.
3. Jain, S.K (1980) Indian Medicinal plants.
4. Kokate, C.K., Durohit, A.P. and Gokhale, S.R., Pharmacognosy by 12th edition - Nirali Prakasham Publishers, Pune.
5. Kumar N.C. (1993) An Introduction to Medical Botany and Pharmacognosy.
6. Nadkarni (1981) Indian Materia Medica.
7. Shah, S.C. and Qudary (1990) A text book of Pharmacognosy.
8. Wallis, T.E, Text book of pharmacognosy by 5th edition. CBS publishers and distributors, New Delhi.

IV SEMESTER

PAPER X

RESEARCH METHODOLOGY

Objectives

To enable the student to :

understand the principles and applications of classical and modern techniques in Biology

develop skill in preparation of reports, writing research communications and thesis

interpret and analyze the experimental data using different biostatistical tools.

UNIT-I

Microscopy: light microscope - basic principles, types, (phase contrast, dark field and fluorescent microscope). Electron microscopy - principles, working function, electron probe, transmitted electron, image formation, back scattering, secondary electrons. X-ray diffraction, Auger electron, cathode luminescence. Types of EM: TEM, SEM, STEM - sample preparation for EM analysis. Camera Lucida - Principles and uses.

UNIT-II

Electromagnetic radiation: definition, components, biological effective wavelength (UV and visible), Spectrophotometry: principles and working function of spectrophotometers, types (single beam, double beam, Atomic absorption spectrophotometer, IR and NMR. Applications of various spectrophotometers.

UNIT-III

Radioactivity: nature of radioactivity, types of radioisotopes, half-life, Unit of radioactivity, detection and measurements. Geiger Muller counter, liquid scintillation counter, principles and working function. Autoradiography, application of radioisotopes in biological research. Centrifugation: Basic principles, sedimentation coefficient, centrifugal forces. Types of centrifuges - clinical, high speed, refrigerated, ultra. Types of centrifugation - rotar types, density gradient, differential centrifugation. Applications of centrifugation.

UNIT-IV

Chromatography - Principle, types and working function (Paper chromatography, TLC, GC, GC-MS and HPLC), Applications. Electrophoresis - Principle, types and methods. Horizontal, vertical, PAGE, Agarose electrophoresis, Applications. Pulse Field gel electrophoresis (PFGE) - Principle and applications. Gel documentation and molecular weight analysis.

UNIT-V

Molecular Techniques - DNA and plasmid isolation. Amplification of 16S rRNA or specific genes using PCR techniques, RAPD, STRR and LTRR analysis using PCR, RFLP analysis cloning strategies, DNA sequencing - Sanger's Dideoxy and Maxam and Gilbert's methods. Automated DNA sequencing, Blotting techniques - southern, western, Dot blot-hybridization. Immunoblotting, ELISA - Applications in biological research.

Thesis writing; defining research problem, research design, general format, literature survey, primary source - articles, reviews, abstract, current contents (both text and CCOD), reference card, data analysis, data interpretation, report writing, proof correction.

References Books

1. Wrigglesworth, J.M. 1984, Biochemical research technique - a practical introduction. John Wiley, New York.
2. Patki, L.R., Bhalchandra, L. and Jeevaji, I.H., 1989, An introduction to microtechniques, S. Chand and Company Ltd., New Delhi.
3. Keith Wilson and John Walker, 1994. Practical Biochemistry - principles and techniques, Cambridge Press, New York.
4. Keith Wilson and Goulding, K.H. 1986, a biologists guide to principles and techniques of practical biochemistry, ELBS, London.
5. Kothari, C.R., 1988. Research methodology, Wiley Eastern Ltd., New Delhi.
6. Irfan A. Khan and Atiya Khanum, 1994. Fundamental of Biostatistics, Ukaaz publishers, India.
7. Anderson, J., Durosn, B.H. and Poole, M. 1986. Thesis and assignment writing, Wiley Eastern Ltd., New Delhi.

CORE PRACTICAL III
(Subjects covering Paper VII, VIII and IX)

Objectives

To impart practical knowledge on various aspects of molecular biology, microbial genetics, gene technology and industrial biotechnology.

UNIT-I

1. Isolation of DNA and RNA from microbial system - quantification - chemical methods dinitrophenol, orcinol - physical methods - UV absorption.
2. Isolation of plasmid DNA from bacteria (mini preparation).
3. Isolation of plasmid DNA from cyanobacteria (mini preparation)
4. Size characterization of DNA by agarose gel electrophoresis.
5. Enzyme immobilization technique.

UNIT-II

1. Isolation of antibiotic resistant microbes.
2. Induction of mutation by ultra-violet radiation and chemical mutagens.

UNIT-III

1. Protoplast / Spheroplast isolation.
2. Purification of plasmids - large scale.

UNIT-IV

1. Preparation of competent *E. coli* cells.
2. Transformation of Plasmid DNA to the *E. coli* cells.
3. PCR amplification - 16S rRNA and RAPD.
4. Southern blotting
5. Northern blotting.

UNIT-V

1. Separation of proteins by column chromatography, ion exchange - gel exclusion - adsorption
2. Separation of proteins by SDS - PAGE and native gel.
3. Production of proteases - optimization of conditions - pH - temperature.
4. Antibiotic assays - MIC - antibiotic resistance
5. Lipid separation using TLC.

Reference Books

1. Ausubel FM, Brent R, Kingston, RE, Moore, D.D, Seidman J.G., Smith J.A and Struhl K. (1994). Current Protocols in molecular biology. Vol. 1 & 2. John Wiley & Sons Inc.
2. Dharmalingam K. (1986). Experiments with MI3, Macmillan India Ltd. Chennai.
3. Gerhardt P, Murray RG, Wood WA and Kreig NR. (1994), Methods for general and molecular Bacteriology.
4. Hames BD and Rickwood D. (1990) Gel Electrophoresis - a practical approach (1990), Oxford University Press, New York.
5. Harwod A). (1994). Protocols for Gene Analysis. Humana Press.
6. Lorian V. (1991) Antibiotics in Laboratory Medicine Williams & Wilkins.
7. Sambrook J and Russell DW (2001) Molecular cloning - A Laboratory manual (3rd edition, Vols - 1, 2, 3). Cold Spring Harbor Laboratory. Cold Spring Harbor Laboratory Press, New York.
8. Surzyeki S (2000). Basic Techniques in Molecular Biology. Springer.
9. Westermeier R. (1993) - Electrophoresis in Practice - VCH - Federal Republic of Germany
10. Willett JE. (1991) Gas Chromatography, John Wiley & Sons.
11. Wilson K and Walker. (1995) Practical Biochemistry Principles.

CORE PRACTICAL IV
(Subjects covering Paper X)

Objectives

To impart practical knowledge on various aspects of research methodology.

1. Analysis of microorganisms using Bright field, Dark field, Phase contrast and Fluorescent microscopy.
2. Microscopic diagram using camera Lucida.
3. Measurement of microbes using micrometry.
4. Preparation of samples for Density gradient.
5. Separation of pigments using paper chromatography.
6. Separation of compounds from crude extracts using TLC.
7. Separation of DNA, proteins using electrophoretic techniques.
8. Molecular weight analysis of DNA and proteins using gel documentation.
9. DNA and plasmid isolation - small scale.
10. RAPD finger printing using PCR.
11. Blotting techniques - Southern and western blotting and hybridization.
12. ELISA test.

ELECTIVE

PAPER IV

BIOREMEDIATION

Objectives

To enable the students to understand the aspects of bioremediation.

UNIT-I

Definition of Bioremediation - Types of pollution - organic, inorganic in soil, water and air - Remediation by bacteria, fungi, microalgae and green plants.

UNIT-II

Bioaccumulation and biomagnification processes - microbial remediation by natural attenuation - biostimulation - bioaugmentation.

UNIT-III

Application of immobilized microbes in soil decontamination - use of genetically engineered microorganism and bioremediation.

UNIT-IV

Biodegradation of organic compounds - humification and polymerization reaction - bio-transformation of metal and metal compounds - phyto-remediation use of microalgae, green plants to remove pollutants.

UNIT-V

Phyto-extraction - Types of phytoextraction - induced phyto-extraction and continuous phyto-extraction - phyto-degradation - rhizofiltration - phyto-stabilisation - phyto-volatilisation of metals - phyto-remediation of organic. Bioavailability and uptake. Biotransformation and compartmentalisation.

Reference Books

1. Moo-Young, M., Anderson, W.A. and Chakrabarty, A.M. 1996. Environmental biotechnology: Principles and applications. Boston, Mass.: Kluwer Academic Publishers.
2. Wainwright, M. 1999. An introduction to environmental biotechnology. Boston, Mass. Klumer Academic Publishers.

ANNEXURE
INFRASTRUCTURE FACILITIES

Building

First year (for a strength of 25 students)

Class room	– 1	(30 feet x 20 feet)
Laboratory (with Exhaust fans)	– 1	(60 feet x 30 feet)
Preparation Room	– 1	(20 feet x 10 feet)
Sterilization Room	– 1	(10 feet x 10 feet)
Culture Room	– 1	(10 feet x 10 feet)
Staff room	– 1	(20 feet x 10 feet)
Department Library	– 1	(20 feet x 20 feet)
Store Room	– 1	(20 feet x 20 feet)

Second year (for a strength of 25 students)

Class room	– 1	(30 feet x 20 feet)
Molecular Biology Laboratory	– 1	(60 feet x 30 feet)

Furniture

Work benches
Tables
Chairs

Equipment required for the Laboratory

S.No.	Equipment	Quantity
1	Compound Microscope with Oil immersion	25
2	Trinocular microscope with Bright field/Dark field/Phase contrast & Fluorescence with photomicrography	1
3	UV- visible spectrophotometer	1
4	Physical balance	2
5	Electronic balance	1
6	Distilled water plant	1
7	pH meter	1
8	Pressure cooker maximum size	1
9	Autoclave	1
10	Hot air oven	1
11	Spectrophotometer	1
12	Refrigerator	1
13	Incubator (20-40°C)	1
14	Clinical centrifuge	1
15	High speed cooling centrifuge	1
16	Electric heater	1
17	Desiccator	1
18	Temperature controlled shaker	1
19	Gas connection with cylinders and burners	
20	Water bath	
21	SDS PAGE apparatus with power pack	1

22	DNA gel electrophoretic setup with power pack	1
23	Auto pipettes (10, 50, 100, 200 & 1000 µl)	1 set
24	Fermentor	1
25	Deep freezer (-20 °C)	1
26	PCR machine with gel documentation system	1
27	Immuno electrophoretic unit	1
28	ELISA Reader	1
29	Heating mantles (3 & 5 litre)	1 each
30	Vortex mixer	1
31	Magnetic stirrer (2 & 5 litre)	1 each
32	Laminar flow chamber - Horizontal & vertical type	1 each
33	Glass filtration unit with vaccum pump	1
34	Fire extinguisher	2
	<i>Apparatus</i>	
35	Haemocytometer	10
36	Thermometer (different temperature level)	5
37	Micrometer (Stage & Ocular)	5 set
38	Pestle and Morter	15
39	Filter paper ordinary	1 Reem
40	Whatman No.1 filter paper	1 packet
41	Inoculation needle	20
42	Sprit lamp	20
43	Burette stand	20
44	Tripod stand	10
45	Wire gauge	20

46	Burette (50 ml)	25
47	Pipettes (1, 2, 5, & 10 ml)	20 each
48	Watch glass (medium size)	20
49	Cover slips packets	20
50	Cavity slide	20
51	Microscopic slides normal size	20 pockets
52	Funnel (50 mm & 100 mm)	20 each
53	Measuring cylinder (10, 25, 50, 100, 250, 500, 1000 ml)	3 each
54	Conical flask (100, 250 & 500 ml) (1000 ml)	30 each 10
55	Beaker (100 & 250 ml) (500 & 1000 ml)	30 each 10 each
56	Test tube (10 & 20 ml)	500 each
57	Glass rod	30
58	Volumetric flask	5
59	Embryo cup with cover	30
60	Wash bottles (500ml) Petri plates	30 200
61	Distilled water storage canes (5, 10, 50 liters)	
62	Cotton bundle (absorbent)	50
63	Cotton Gauze	25 meters
64	Reagent bottle (100, 250 & 500 ml)	20 each

	<i>Chemicals</i>	
65	Agar Agar	
66	Beef extract powder	
67	Calcium nitrate	
68	Calcium chloride	
69	Copper sulphate	
70	Dextrose	
71	Ferric chloride	
72	Formaldehyde solution	
73	Iodine Resublimed	
74	Hydrogen orthophosphate anhydrous	
75	Potassium chloride	
76	Hydrochloric acid	
77	Sulfuric acid	
78	Nitric acid	
79	Magnesium sulphate	
80	Sodium chloride	
81	Sodium nitrate	
82	Phenol extrapure	
83	Peptone	
84	Sucrose	
85	Potassium dichromate	
86	Sodium hydroxide flakes	
87	Yeast extract powder	
88	Potassium iodide	

89	Ammonium oxalate	
90	Chloroform	
91	Tannic acid	
92	Acetone	
93	Ethyl alcohol	
94	Methyl alcohol	
95	Fuchsin basic	
96	Crystal violet	
97	Cotton blue	
98	Lactic acid	
99	Methylene blue	
100	Malachite green	
101	Safranine	
102	Microbiology media for Bacteria & Fungi	
103	PCR kit	
104	Restriction enzyme	
105	DNA & Protein markers	
106	Agarose	
107	Mutagens	
108	Tris	
109	EDTA	
110	Phenol	
111	Chloroform	
112	Isoamyl alcohol	
113	TEMED	

114	Ammonium persulphate	
115	Amino acid kit	
116	Acrylamide	
117	Bis-Acrylamide	
118	Mercapto ethanol	
119	Bromophenol blue	
120	Urea	
121	Silver nitrate	
122	Potassium acetate	
123	PCR primers	
124	Cloning kit	
125	X-Gal & IPTG	
	<i>Permanent slides</i>	
126	Algae, Fungi, Bacteria, Protozoan, Lichens etc.,	

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