Annexure – 10

PERIYAR UNIVERISTY

SALEM – 11

PERIYAR INSTITUTE OF DISTANCE EDUCATION (PRIDE)

SYLLABUS

NON-SEMESTER PATTERN

M.Sc., Microbiology

(Candidates admitted from 2007-2008)

PERIYAR INSTITUTE OF DISTANCE EDUCATION

SALEM – 11

Non-Semester Pattern

M.Sc., MICROBIOLOGY

(Candidates admitted from 2007-2008)

REGULATIONS

1. Condition for Admission

A candidate who has passed a Bachelor degree in Science with **Microbiology / Botany / Zoology / Environmental Science / Biotechnology / Biochemistry / Chemistry / Home Science / Nutrition and Dietetics / B.Sc., MLT / Genetics / Bio-informatics / Marine Biology or a Bachelor degree in Agriculture / Animal Science / Medicine or Veterinary Science / Pharmacy and including Indian Forms of Medicines and Homeopathy degree** of this University or any of the above degree of any other university accepted by the Syndicate as equivalent thereto, subject to such conditions as may be prescribed thereto shall be permitted to appear and qualify for the **M.Sc., Microbiology** degree examination of this University after a course of study of two academic years.

2. Duration of the Course

The course for the degree of Master of Applied Microbiology shall consist of two academic years.

3. Course of Study

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time.

I – Year

Main Paper 1	-	General Microbiology
Main Paper 2	-	Microbial Genetics and Immunology
Main Paper 3	-	Applied Microbiology
Main Paper 4	-	Biostatistics and Bioinstrumentation
		Main Practical – I

II – Year

Main Paper 5	-	Medical Microbiology
Main Paper 6	-	Soil and Environmental Microbiology
Main Paper 7	-	Biotechnology
		Main Practical – II
		Project Work

4. Examinations

The theory examination shall be three hours duration to each paper at the end of the each year. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examinations. The practical examinations for PG course should be conducted at the end of the year.

At the end of the second year viva-voce will be conducted on the basis of the Dissertation / Project work submitted by the student. The viva – voce will be conducted by one internal and one external examiner jointly.

5. Scheme of Examinations

S. No.	Paper	Title of the Paper	Exam Duration	Max. Marks
		I Year		
1	Main Paper 1	General Microbiology	3 hrs	100
2	Main Paper 2	Microbial Genetics and Immunology	3 hrs	100
3	Main Paper 3	Applied Microbiology	3 hrs	100
4	Main paper 4	Biostatistics and Bioinstrumentation	3 hrs	100
		Main Practical – I	8 hrs / day, two consecutive days	100
		II Year		
5	Main paper 5	Medical Microbiology	3 hrs	100
6	Main paper 6	Soil and Environmental Microbiology	3 hrs	100
7	Main paper 7	Biotechnology	3 hrs	100
		Main Practical – II	8 hrs / day, two consecutive days	100
		Project Work		100
			Total	**1000**

6. Question paper model for theory and practical

M.Sc., MICROBIOLOGY

Question Paper Pattern (Non-semester)

(Theory Paper)

Time 3 Hours Max. Marks : 100

Part – A **5x5=25**

Answer all questions
(Two Questions from each unit with internal choice)

Part – B **5x15=75**

Answer all questions
(Two Questions from each unit with internal choice)

QUESTION MODEL FOR PRACTICALS
(Non-semester pattern)

Time 8 Hours / Day
2 Consecutive days Max. Marks : 100

3 Major questions, each carry 25 marks (3x 25 = 75 marks)
For both year **Record 25 marks**

Project work	(100 Marks)
Project Report	(075 Marks)
Viva – voce	(025 Marks)

7. Format to be followed in dissertation

The formats / certificate for dissertation to be submitted by the students are given below.

Format for the preparation of project work

a) Title Page
b) Bonafide certificate
c) Acknowledgement
d) Table of Contents

CONTENTS

Chapter No.	Title	Page No.
1	Introduction	
2	Review of Literature	
3	Materials and Methods	
4	Results	
5	Discussion	
6	Summary	
7	Reference	

Format of the Certificate

CERTIFICATE

This is to certify that the dissertation entitle _____ (**title of the dissertation**) _____ submitted in part fulfillment of the requirement of the degree of Master of Science in Microbiology to the Periyar University, Salem is a record of bonafide research work carried out by_____ (**name of the candidate**)___ under my supervision and guidance and that no part of the dissertation has been submitted for the award of any degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part of full in any scientific or popular journals or magazines.

Signature of the Co-ordinator Signature of the Guide

Examiner(s)

1.

2.

8. Passing Minimum

The candidate shall be declared to have passed the examination if the candidate secures not less than 50 marks in the University examination in each theory paper.

For the Practical paper, a minimum of 50 marks out of 100 marks in the University examination and the record notebook taken together. There is no passing minimum for record note book. However submission of a record note book is a must.

For the project work and viva-voce the candidate should secure 50% of the marks for pass. The candidate should compulsorily attend viva-voce examination to secure pass in that paper.

Candidate who does not obtain the required minimum marks for a pass in a paper / project report shall be required to appear and pass the same at a subsequent appearance.

9. Classification or successful Candidates

Candidates who secure not less than **60%** of the aggregate marks in the whole examination shall be declared to have passed the examination in **First Class**.

All other successful candidates shall be declared to have passed in the **Second Class**.

Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in **First Class with Distinction** provided they pass all the examinations prescribed of the course at the first appearance.

Candidates who pass all the examinations prescribed for the course in the first instance and within a period of two academic years from the year of admission to the course only are eligible for **University Ranking**.

10. Maximum Duration for the completion of the PG Programme

The maximum duration for completion of the PG programme shall not exceed 4 years. Thereafter, candidate will be permitted to appear for the examination only under the regulations then in force.

MAIN PAPER I – GENERAL MICROBIOLOGY

Unit I – **Origin and Evolution of Microbiology** – Contributions of Early Microbiologists – Classification of Microorganisms – Hackel's three kingdom concepts – Whittaker's five kingdom concepts – Classification and Salient features of bacteria according to the Bergey's manual of determinative bacteriology – Cyanobacteria.

Unit II – Microscopy – Simple – compound, Dark – field, Phase contrast, Fluorescent and Electron microscopes – SEM, TEM, Freeze fraction confocal microscopy and their applications – Stains and Staining reactions – Simple, Differential and special staining techniques.

Unit III – Bacterial Anatomy – Structure – properties and biosynthesis of cellular components of Bacteria. Culture media and Culture methods – Aerobic and Anaerobic – Preservation methods, sporulation and its mechanism.

Unit IV – Bacterial Physiology – Growth – factors – nutritional requirements for bacterial growth. Bacterial metabolism – Respiration – Fermentation – Photosynthesis.

Unit V – Microbial pathogenicity – Toxins – Characterization – mode of action – Antimicrobial chemotherapy – Antibiotics – Classification – Mode of action – drug resistance – Sensitivity tests – sterilization and disinfection – methods and Quality Control.

Text Books

1. Dubey RC & Maheswari DK (2005). A text book of Microbiology, Revised Multicolour Edition, Published by S. Chand & Company Limited, New Delhi Rs.415/-.
2. Purohit SS (2005). Microbiology – Fundamentals and Applications. Reprinted & Published by Student Edition, Behind Nasrani Cinema, Chopasani Road, Jodhpur, Rs.330/-

3. Pelczar TR, Chan ECS & Kreig NR (2006) Microbiology. 5th Edition, Tata McGraw – Hill, New Delhi. Rs.395/-.
4. Powar CB & Daginawala HF (2005). General Microbiology – Volume I & II. 8th Edition, himalaya Publishing House, Mumbai.
5. Salle AJ (2001). Fundamentals & Principles of Bacteriology. 7th Edition. Tata McGraw – Hill, New Delhi. Rs.475/-
6. Hans G Schlegel (2003). General Microbiology. Low Price 7th Edition, Cambridge University Press Rs.250/-
7. Meenakumari S (2006) Microbiology Physiology. 1st Edition, MJP Publishers, A unit of Tamil Nadu Book House, Chennai Rs.220/-.

Reference Book

1. Prescott M (2005) Microbiology. 6th Edition, Tata McGraw – Hill, New Delhi Rs. 1729/-.
2. Albert G Moat & John W Foster (2004). Microbial Physiology. 4th Edition, John Wiley & Sons, New York.
3. Edward Alcamo (2001). Fundamentals of Microbiology. 6th Edition, Jones & Bartlett Publishers, New York.
4. Robert F Boyd (1984). General Microbiology. Times Mirror / Mosby College Publishers.

MAIN PAPER II – MICROBIAL GENETICS AND IMMUNOLOGY

Unit – I – DNA – Evidences to prove DNA as genetic material – structure, Chemical composition and different forms of DNA. RNA – Evidences to prove RNA as genetic material – Structure and types of RNA. Gene transfer mechanisms – Transformation, Conjugation, Transduction and Transfection. DNA Recombination – Holiday model.

Unit – II – DNA replication – Types – Mechanism – Enzymes involved in replication – Models of replication. Genetic code. Gene expression – Transcription – Translation. Gene regulation in bacteria – *lac* and *trp* operons. Mutation – Types – Mutagens – Detection of mutation and isolation of mutants. DNA repair – Mechanism and types.

Unit – III – Immunity – Innate immunity and Acquired immunity – Humoral and cell mediated immunity. Organs and cells of the immune system. Cytokines – Structure and functions. Antigens – Types of properties. Immunoglobulin – Structure, Function and Classes of Ig. Monoclonal antibodies – Production and Applications.

Unit – IV – Antigen and antibody reactions – Agglutination, Precipitation, complement fixation, Immunofluorescence, ELISA, and RIA. Complement activation – Classical and Alternative pathways – Regulation and biological consequences of activation of complement. Structure and functions of Class I and Class II MHC molecules. Transplantation immunology – Mechanism of graft rejection, Clinical manifestation, HLA tissue typing and immunosuppressive therapy.

Unit – V – Hypersensitivity Reaction – Type I, II, III and IV. Auto immune diseases – Organ specific and systemic autoimmune diseases – Mechanism – Treatment. Tumor immunology – Tumor antigens, Tumor evasion of the immune system and Cancer immunotherapy. Vaccines – Types – immunization schedule. Immunohaematology – Major and minor blood groups – ABO & Rh incompatibility.

Text Books

1. David Frifielder (2005). Molecular Biology. 2nd Edition. Narosa Publishers, New Delhi Rs.465/-
2. Robert H Tamarin (2004). Principles of Genetics. 7th Edition. Tata McGraw – Hill Publishing House, New Delhi. Rs.325/-.
3. Benjamin Lewin (2004). Genes VIII. Pearson Prentice Hall, USA. Rs. 1494/-
4. Brown TA (2003). Essential of Molecular Biology Freeman Publishing House. Rs.2645/-
5. Peter J Russel (2002). Genetics. Benjamin Cummings.
6. Richard A Goldsby, Thomas J. Kindt, Barbara A Osborne & Janis Kuby (2004). Immunology. 5th Edition, W.H. Freeman and Company, New York. Rs.3511/-.
7. Ivan Roitt, Jonathan Brostolf & David Male (2004). Immunology, 6th Edition, reprinted, Mosby Publications, Edinburgh.
8. Tizard K (1983). Immunology – An introduction. Published by Saunders College, Philadelphia Rs.3102.

MAIN PAPER III – APPLIED MICROBIOLOGY

Food & Diary Microbiology

Unit – I – Food as substrate for microorganisms – Molds – Yeasts & Bacteria. Factors influencing microbial growth in food. Food preservation – Asepsis – removal of microbes – chemical preservatives and food additives – Canning. Contamination of food and spoilage – spoilage of canned foods – Detection of spoilage and characterization.

Unit – II – Food – borne infections and intoxications – Bacterial and non – bacterial with examples of infective and toxic types – Laboratory testing procedures – Preventive measures – Food control agencies and its regulations fermented dairy products – cheese, butter other fermented products – Fermented vegetables, oriental fermented foods.

Industrial and pharmaceutical microbiology

Unit – III – Industrially important microorganisms – Screening techniques – strain improvements – mutation and recombination DNA techniques for strain development. Development of inoculum for various fermentation processes. Media for industrial fermentation – formulation – sterilization. Fermentation types and cultures – Down stream processing – recovery and purification of industrial products.

Unit – IV – Fermentor – components – types of fermentors, body construction and temperature control – aeration and agitation systems – sterilization of fermentor and air supply, aseptic inoculation methods. Stirring and mixing agents, control of pH and foam pressure – computer in fermentation technology.

Unit – V – Industrial production of Wine, Ethanol. Organic acid – Citric acid – Antibiotic – Penicillin – Vitamin B_{12} – Enzyme - α - Amylase. Microbial production of Vaccines – BCG – Toxoid – Tetanus – Preparation of antisera and their standardization – Biotransformations.

Text Books

1. Adams MR & MO Moss (2005). Food Microbiology. 1st Edition. Reprinted, Published by New Age International (P) Limited. Publishers, New Delhi Rs. 195/-.
2. James M Jay (2004). Modern Food Microbiology. 4th Edition, CBS Publishers & Distributors, New Delhi Rs.260/-
3. Banwart GJ (2004) Basic Food Microbiology. 2nd Edition, CBS Publishers & Distributors, New Delhi. Rs.275/-.
4. Frazier WC & Westhoff DC (1997). Food Microbiology 4th Edition, Tata McGraw – Hill Publishing Company Limited – New Delhi Rs.175/-.
5. Agarwal AK & Pradeep Parihar (2006). Industrial Microbiology. Published by Student Edition, Behind Nasrani Cinema, Chopasani Road, Jodhpur. Rs.330/-.
6. Patel AH (2005). Industrial Microbiology. Published by Macmillan India Ltd., New Delhi. Rs.246/-.
7. Peppler HJ & D Perlman (2004). Microbial Technology – Fermentation Technology. 2nd Edition, Published by Academic Press (An imprint of Elsvier). Volume I and II.
8. Purohit SS, AK Saluja, HN Kakrani (2004). Pharmaceutical Biotechnology. Ist Edition, Agrobios (India) Rs.990/-.

MAIN PAPER IV - BIOSTATISTICS & BIOINSTRUMENTATION

Unit – I – Biostatistics – Meaning, Principle and importance, collection, classification, Presentation of data – graphs, diagrams and tables. Analysis of data. Averages, dispersion, correlation, Regression. Tool vibration – population, samples & sampling techniques. Point of interval estimation. Testing of hypothesis using t-test, chi-square test and test for ANOVA.

Unit – II – Research methodology – Research- classification of research – planning of research – selection of research problem – formulation of research design – review of literature – review and synopsis presentation. Research process, research designs – preparation of research report. Guide lines for preparing an article. Computer in biological research.

Unit – III – Centrifugation techniques. Centrifugal force and principle of sedimentation. Types of centrifuges and their uses. Separation methods – Differential centrifugation, Density gradient centrifugation. Electrochemical technique – pH – electrode.

Unit – IV – Chromatographic techniques – Paper, Thin layer Chromatography, GLC, HPLC, Electrophoresis – Principle, Components, Medium, Buffers, Paper electrophoresis. Gel electrophoresis and application of electrophoresis. Blotting techniques and its applications – PCR and its applications.

Unit - V – Spectroscopic techniques : Beer – Lambert's law – spectrophotometry analysis – Atomic absorption spectroscopy – NMR. Radioisotope techniques – Types of radio active decay. Half life, Measurement of radioactivity and biological applications of radioisotope techniques.

REFERENCES

Biostatistics

1. Wayne W Daniel (2001). Biostatistics. A foundation for analysis in the health sciences. 7th edition, John Wileys Sons (ASIA) Pvt. Ltd.
2. SUNDAR RAO PSS & Richard J. (2004). An Introduction to Biostatistics 3rd Edition, Prentice Hall Publication.
3. Kothari CR (2005) Research Methodology 2nd Edition New Age International Publishers (P) Ltd., New Delhi.
4. Mahajan BK (2005) Methods in Biostatistics. 6th Edition, Jaypee Brothers, medical Publishers.

Bioinstrumentation

1. John G. Webster (2004) Bioinstrumentation, Student Edition. John Wiley & Sons Ltd.
2. Keith Wilson & John Walker (2003) Practical Biochemistry Principles and Techniques. 5th Edition, Cambridge University Press.
3. Asokan P (2001) Analytical Biochemistry (Biochemical Techniques). 1st Edition. 2nd Reprint. Published by Chinna Publications. Melvisharam. Vellor, Tamil Nadu.
4. Palanivelu P. (2001). Analytical Biochemistry and Separation Techniques. A Laboratory Manual 2nd Edition. Published by Tulsi Book Centre Madurai, Tamil Nadu.
5. Gurumani N. (2006) Research Methodology for Biological Sciences. Ist Edition. MJP Publishers, Chennai.
6. Jognand SN (2004) Gene Biotechnology, Published by Himalaya Publishing House. Mumbai.

MAIN PAPER V – MEDICAL MICROBIOLOGY

Unit – I – Collection and transport of clinical specimens for microbiological examinations. Virulence factors of bacteria causing human infections - Normal flora of human body. Laboratory diagnosis of bacteria, fungi, parasites & viruses.

Unit – II – Bacteriology – Morphology, Culture, biochemical, pathogenicity, Lab diagnosis and prevention of bacterial diseases – *Staphylococcus aureus, Streptococcus pyogenes, Neisseriae, Mycobacterium tuberculosis, Corynebacterium diphtheriae, Bacillus anthracis – Salmonella typhi, Shigella dysentriae, Vibrio cholerae, Escherichia coli* – Spirocheates.

Unit – III – Mycology – Superficial Mycosis – Pityriacis versicolor, cutaneous mycosis – dermatophytosis, subcutaneous mycosis – sporotrichosis, systemic mycosis – Histoplasmosis, opportunistic mycosis. Candidosis, Cryptococcosis – Antifungal agents – Mycotoxins – Parasitology – *Entamoeba histolytica, Trichomonas vaginalis, Leishmania donovani, Plasmodium vivax, Toxoplasma gondii, Taenia solium, Ancylostoma dudenale, Ascaris lumbricoides* and *Wuchereria bancrofti*.

Unit - IV – Medical virology – DNA viruses – Pox, Herpes, Hepatitis Viruses – RNA viruses – Picorna, Arbo viruses – Rhabdo, HIV and oncogenic viruses.

Unit – V – General diagnosis of meningitis, Acute respiratory tract infections, Urinary tract infection, Gastroenteritis, Pyrexia of Unknown origin, Hospital acquired infection, Sexually transmitted diseases and Aids.

Text Books

1. Satish Gupte (2006). The Short Text books of Medical Microbiology. 9th Edition, Jaype Brothers, Medical Publishers (P) Ltd., New Delhi. Rs.295/-.
2. Ananthanarayan R & CK Jayaram Paniker (2005). Text Book of Microbiology. 7th Edition, Orient Longman Private Limited. Rs.395/-.
3. Monica Cheesbrough (2003). District laboratory Practice in Tropical Countries. Part 1 & 2. Low – Price Edition, Cambridge University Press.
4. Rajesh Bhatia & Rattan Lal Ichhpujani (2004) Essentials of Medical Microbiology. 3rd Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi. Rs.425/-.
5. Subhash Chandra Parija (2004). Text book of Medical Parasitology – Protozoology and Helminthology. 2nd Edition, Published by All India Publishers & Distributors, Medical Books Publishers, New Delhi. Rs.299/-.
6. Mehrotra Rs & KR Aneja (2006). An Introduction to Mycology. Reprinted and Published by New Age International (P) Limited, Publishers, New Delhi. Rs.250/-.

Reference Book

1. Baron EJ, Peterson LR and Finegold SM (1994). Bailey and Scott's – Diagnostic Microbiology. 9th Edition, Mosby Publications.
2. Topley & Wilsons (1995). Principles of Bacteriology, Virology and Immunology, Edward Arnold, London.
3. Morag C 7 MC Timbury (1994). Medical virology. 10th Edition, Churchill Livingstone, London.
4. Patric R Murray (1990). Medical Microbiology. Mosby Publications.

MAIN PAPER VI – SOIL AND ENVIRONMENTAL MICROBIOLOGY

Unit – I – Properties of soil – Structure, texture and formation. Role of microbes in soil fertility – Influence of soil and environmental factors on microflora. Methods of studying ecology of soil microorganisms.

Unit – II – Biological nitrogen fixation – Diazotrophs – Symbiotic and Non – Symbiotic bacteria and cyanobacteria – Biochemistry of nitrogen fixation – Nitrogenase – Mechanism of nitrogenase – Protection of nitrogenase from oxygen – Hydrogenase. Biochemistry and physiology of fixed nitrogen in legume symbiotic system.

Unit – III- Microbial interaction between microbes, interaction of microbes with plants – Rhizoplane, Rhizosphere, Pyllosphere, Spermosphere, Mycorrhiza. Biofertilizer and Biocontrol agents – *Rhizobium, Azotobacter, Azospirillum* – Mass multiplication, field application and crop response. Biopesticide (Bacterial, fungal and viral) – Biological control (*Trichoderma viridae*, *Pseudomonas fluorescens*) – Mode of action, formulation and application methods.

Unit – IV – Microbiology of air – Microbial contamination of air – Enumeration of bacteria in air – Air sampling devices – Air sanitation. Microbiology of water – water pollution and water borne pathogens – Indicator organisms – Bacteriological examination of water. Microbiology of sewage – Chemical and biochemical characters – Sewage treatment and disposal of wastes – Pollution problems and their control. Organic waste pollution (solid & liquid) – BOD – COD and treatment.

Unit – V – Positive role of microbes in environment – Degradation – Microbial conversion of solid waste to food (Mushroom, SCP), fuels (Biogas, Ethanol), Bioleaching of ores, Biodegradation – Lignin – Pesticide – Recalcitrant – Bioremediation – types and its application. Negative roles of microbes in environment – Biodeterioration of paper – wood – paint. Metal corrosion – GMO and their impact.

Text Books

1. Subba Rao NS (2004). Soil Microbiology. 4th Edition, Oxford & IBH Pubilshing Co. Pvt. Ltd., New Delhi. Rs.295/-.
2. Rangaswami G & Mahadevan A (2002). Diseases of Crop Plants in India. 4th Edition, Prentice – Half of India Pvt. Ltd., New Delhi.
3. Subba Rao NS (1995). Biofertilizers in Agriculture and Forestry. 3rd Edition, Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
4. Robert L Tate (1995). Soil Microbiology. 1st Edition, John Wiley & Sons, Inc. New York.
5. Atlas RN & Bartha R (1998). Microbial Ecology, 4th Edition, Benjamin Cummings.
6. Jogdand SN (2004). Environmental Biotechnology. Reprinted & Published by Himalaya Publishing House, Mumbai Rs.180/-.
7. Singh DP & SK Dwivedi (2005). Environmental Microbiology and Biotechnology. 1st Edition, New Age International (P) Ltd., Publishers, New Delhi.
8. Mitchell R (1974) Introduction to Environmental Microbiology. Prentice Hall. Inc. Englewood Cliffs, New Jersy.

MAIN PAPER VII – BIOTECHNOLOGY

Unit – I – Scope of genetic engineering, Milestones in Genetic Engineering, DNA Sequencing, Synthesis and mutation, detection and separation, cloning, gene expression, Genetic engineering guidelines. Molecular tools and their applications. Restriction enzymes, modification enzymes. Nucleic acid purification.

Unit – II – Gene cloning vectors – Plasmids, bacteriophages, phagemids, cosmids, artifical chromosomes, restriction mapping of DNA fragments. cDNA synthesis.

Unit – III – PCR Methods and application. DNA sequencing methods – dideoxy and chemical methods. Sequencing assembly. Automated sequencing. Genomic sequencing and physical mapping of genomes.

Unit – IV – Biotechnology – Definitions & History – Enzyme Biotechnology – enzyme population from microbes - applications – enzyme immobilization – products. Microbial algae biotechnology. Biotechnological potentials of micro algae – food, Feed, fuel production – Pharmaceutically Valuable compounds of microalgae.

Unit – V – Biological industrial micro – organisms. *Streptomyces*, Yeasts (*Saccharomyces*, *Hansenela*) *Spirulina* and *Peniciliium*, Microbial products of commercial use – Pencillin, ethanol, vinegar, vitamin B12, Protease, Citric acid and glutamic acid. Commerically useful non – microbial products – Insulin, interferons. B-cell growth factors. Tissue plasmogen activation.

Text Books

1. Satyanarayana U (2005). Biotechnology. 1st Edition, Published by Books and Allied (P) Ltd. Kolkata. Rs.395/-.
2. Dubey RC (2005). A Text Book of biotechnology. Multicolour illustrative Edition, Published by S. Chand & Company Ltd., New Delhi. Rs.280/-
3. Jogdand SN (2005) Gene Biotechnology. Reprinted and Published by Himalaya Publishing House. Mumbai. Rs.180/-
4. Preeti Joshi (2005). Genetic Engineering and Its Applications. 1st Edition & Reprinted. Published by Student Edition, Behind Nasrani Cinema, Chopasani Road, Jodhpur. Rs.150/-.

Reference Books

1. Bernard R Glick (2003). Molecular Biotechnology Principles and Applications of Recombinant DNA. 3rd Edition, ASM Press, Washington, DC.
2. Winnacker EL (2003). From Genes to clones – Introduction to Gene technology. 1st Edition, Indian Reprint, Panima Publishing corporation, New Delhi.
3. Sambrose and Russel (2000) Molecular cloning. 3 volumes, CSH Press.
4. Brown TA (2001). Gene cloning & DNA Analysis Introduction. 4th Edition, Blackwell Science Ltd., London.

MAIN PRACTICAL – I

General Microbiology

- Handling and maintenance of bright field microscopy.
- Micrometry – Measurement of microorganisms
- Motility determination – Hanging drop method.
- Staining – Simple, Gram's, Acid – fast, Spore, Capsule
- Pure culture techniques : Streak plate, pour plate, spread plate.
- Growth curve
    - Non – visual method – Turbidity method – Spectrophotometer.
- Effect of various factors on growth of bacteria
    - Temperature
    - pH
- Biochemical tests for identification of bacteria
- Antibiotic sensitivity test – Kirby – Bauer & Stoke's methods.

Microbial Genetics

- Isolation of mutants by replica plating and gradient plate technique.
- Mutagenesis : Induction and isolation of Auxotrophic / drug resistant mutants of bacteria.
- Bacterial conjugation
- Bacterial transformation
- Phage titration – Induction of lysogeny, lytic cyle – Lambda phage.
- Isolation of phage from sewage.
- Isolation of genomic DNA from blood cells.

Immunology

- ABO Blood grouping – Rh typing and cross matching.
- Agglutination tests.
    - WIDAL – slide and tube test
    - RA test
    - ASO test
    - CRP test
    - TPHA test
- Precipitation reaction
    - Ouchterlony's Double Immunodiffusion test (ODD)
    - Counter immunoelectrophoresis (CIE)
- Rapid plasma reagin test – VDRL test
- Diagnosis of HIV and Hepatitis viruses by ELISA.

Applied Microbiology

Food & Diary Microbiology

- Microbiological analysis of food products
- Detection of bacteria in milk by Standard plate count
- Reductase test for milk – Methylene Blue / Resazurin.
- Isolation of Lactobacilli and Streptococci from curd.
- Microbiological examination of spoiled foods – Bacteria / Fungi
    - Vegetables and fruits
    - Proteinaceous foods
    - Dairy foods
- Examination of microbial load in soft drinks.
- Examination of microbial load in ice – creams.

Industrial & Pharmaceutical Microbiology

- Screening of antibiotic producing organisms from soil.
- Screening of amylase enzyme producing organisms from soil.
- Antibiotic sensitivity test disc preparation
- Antibiotic sensitivity test – Kirby – Bauer, Stoke's
- MIC determination by filter paper disc assay.
- Evaluation of Disinfectant – Phenol co-efficient test.
- Evaluation of disinfectant – filter paper disc assay.

MAIN PRACTICAL – II

Medical Microbiology

Bacteriology

- Collection and transport of clinical specimens from sputum, pus, urine, faeces, blood and CSF.
- Identification of pathogenic bacteria from clinical specimens.
  - *Staphylococcus* spp
  - *Bacillus* spp
  - *Escherichia* spp
  - *Klebsiella* spp
  - *Proteus* spp
  - *Salmonella* spp
  - *Shigella* spp
  - *Vibrio* spp
  - *Pseudomonas* spp
  - *Yersinia* spp

Parasitology

- Examination of parasities in clinical specimens – Ova / cysts in faeces – Direct and concentration methods – formal ether and zinc sulphate methods – Saturated saline – technique.
  - *Entamoeba hitolytica*
  - *Entamoeba coli*
  - *Giardia intestinalis*
  - *T.solium*
  - *Ascaris spp*
  - *Ankylostoma spp*
- Blood smear examination for malarial parasites

Mycology

- Collection and transport of clinical specimens – Direct microscopy – KOH and Lactophenol cotton blue preparations for skin scrapings, for fungi and for scabies mites – Cultivation of fungi – Culture media and their uses in fungal cultivation.
- Isolation and identification of fungal pathogens from clinical specimens, their biochemical and specific identification tests.

Clinical specimens		**Fungi**
i)	Nail / Skin scrapping	- Dermatophytes
ii)	Blood	- *Candida* spp.
iii)	CSF	- *Cryptcoccus* spp.
iv)	Urine	- *Candida* spp.
		- *Histoplasma* spp.
		- *Cryptococcus* spp.
v)	Pus	- *Candida* spp.
		- *Cryptcoccus* spp.

Virology

- Viral cultivation methods
  - Egg inoculation techniques (All routes)
- Serological tests : Serodiagnosis of various viral disease
  - ELISA – HBV, HCV, HIV
  - Haemagglutination (HA) and Haemagglutination inhibition (HI) tests.

Soil & Agricultural Microbiology

- Enumeration of microbial population from soil
  - Bacteria, Fungi, Actinomycetes
- Isolation of free living nitrogen fixing bacteria from soil – *Azotobacter*
- Isolation of symbiotic Nitrogen fixing bacteria from root nodule – *Rhizobium*
- Enumeration of microorganisms from phyllosphere
- Study of cyanobacteria
- Examination of plant diseases

Bacterial Disease	**Fungal Disease**

Blight of rice	Wilt
Citrus canker,	Blast of rice
Brown rot of potato	Red rot of sugarcane
	Tikka leaf spot of ground nut
	Alternaria leaf spot

Environmental Microbiology

- Bacterial examination of water (qualitative)
- Standard plate count (quantitative test)
- Membrane filter technique
- Enumeration of microorganism from air
    - Settle plate technique
    - Air sampling technique
- Estimation of dissolved oxygen
- Estimation of BOD and COD.

Genetic Engineering

- Separation techniques – Paper, Thin layer & Column Chromatography
- Separation of proteins using SDS – PAGE
- Immobilization of microorganisms
- Isolation of plasmid (PUC series plasmids of *E.coli*) separation by Agarose gel electrophoresis.
- Western blotting, PCR (Demonstration)

PRACTICAL REFERENCES

1. The HiMedia Manual (2003). For Microbiology and Cell Culture Laboratory Practice. Published by HiMedia Laboratories Pvt. Ltd., Mumbai.
2. Aneja KR (2005). Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai. Rs.225/-
3. Horold J Benson (1998). Microbiological Applications. Laboratory Manual in General Microbiology. 7th International Edition, WCB McGraw – Hill, Boston.
4. James G Cappuccino & Natalie Sherman (2004) Microbiology : A Laboratory manual. 6th Edition, Published by Pearson Education.
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