



# **PERIYAR UNIVERSITY**

**PERIYAR PALKALAI NAGAR**

**SALEM – 636011**

**DEGREE OF MASTER OF SCIENCE  
CHOICE BASED CREDIT SYSTEM**

**SYLLABUS FOR  
M.SC - APPLIED MICROBIOLOGY  
( SEMESTER PATTERN )**

**( For Candidates admitted in the Colleges affiliated to  
Periyar University from 2017-2018 onwards )**



## REGULATIONS

### 1. CONDITIONS FOR ADMISSION

#### A. ELIGIBILITY CONDITIONS FOR ADMISSION

Candidate who has passed the B.Sc. degree in any Life Sciences [ Microbiology / Applied Microbiology / Industrial Microbiology / Botany / Plant Sciences and Plant Biotechnology / Zoology / Animal Science / Applied Animal Science and Animal Biotechnology / Biochemistry / Bioinformatics / Biology / Food Science & Nutrition / BSMS/BAMS/BUMS/BHMS / Chemistry with Botany / Zoology] as Allied Subjects of this University or an Examination of any other University accepted by the Syndicate as equivalent there to shall be eligible for admission to M.Sc. Degree Course in Applied Microbiology.

Candidate shall be admitted to the examination only if he/she has taken the qualifying degree in Science / Medical subjects as mentioned after having completed the prescribed courses consisting of twelve years of study and has passed the qualifying examination.

#### B. METHOD OF SELECTION

Candidates have to appear for an entrance examination in the respective subjects to be conducted by the respective departments and thereafter an interview. The date, venue and time of the entrance examination and interview will be notified to the applicants separately as soon as it is fixed.

### 2. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be eligible for the award of the degree only if he / she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than two academic years, passed the examination of all the four semesters prescribed earning 90 credits (plus 2 credits for Human Rights) and fulfilled such conditions as have been prescribed therefore.

### 3. DURATION OF THE COURSE

The duration of the course is for two academic years consisting of four semesters.

### 4. EXAMINATIONS

There shall be four semester examinations: first semester examinations at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and the end of the second academic year, respectively.

## 5. COURSE OF STUDY AND SCHEME OF EXAMINATIONS

### NAME OF THE COURSES

- Semester – I
  - ❖ Core – I - General Microbiology
  - ❖ Core – II - Immunology and Immuno technology
  - ❖ Core – III - Cell and Molecular Biology
  - ❖ Elective – I
  - ❖ Practical – I & II
- Semester – II
  - ❖ Core – IV - Medical Bacteriology and Mycology
  - ❖ Core – V - Industrial and Pharmaceutical Microbiology
  - ❖ Core –VI - Genetic engineering and Advances in Biotechnology
  - ❖ EDC
  - ❖ Practical – III & IV
- Semester – III
  - ❖ Core – VII - Medical Virology and Parasitology
  - ❖ Core – VIII - Food, Dairy and Environmental Microbiology
  - ❖ Core – IX - Soil, Agricultural Microbiology and Bio degradation
  - ❖ Elective – II
  - ❖ Practical – V & VI
- Semester – IV
  - ❖ Core – IX - Research Methodology, Bio statistics and Bio informatics
  - ❖ Elective – III
  - ❖ Project

### Elective Courses – Major (Choose Any Three)

1. Plant Physiology and Plant Tissue Culture
2. Bio instrumentation and Biological Techniques
3. Human Anatomy and Physiology
4. Nanotechnology
5. Organic Farming
6. Basics of Phytochemistry

### EDC (Extra Disciplinary Courses) for other department

1. Entrepreneurial Microbiology
2. Microbial Nanotechnology
3. Basics of Microbiology
4. Human Infectious Diseases and Diagnostics

**SCHEME OF EXAMINATIONS**

The scheme of examinations for different semesters shall be as follows:

**THEORY:**

Time - 3 hrs.      Maximum marks – 75 Marks:

- Part A – 25 Marks (5 Questions) and
  - Part B – 50 Marks (5 Questions)
- |                  |   |      |
|------------------|---|------|
| ❖ Internal marks | - | 25   |
| ❖ External marks | - | 75   |
| ❖ Total marks    | - | 100. |

The following procedure will be followed for Internal Marks:  
Internal Marks

**Theory Papers:**

- |                           |   |          |
|---------------------------|---|----------|
| ❖ Best Two tests out of 3 | - | 10 marks |
| ❖ Attendance              | - | 5 marks  |
| ❖ Seminar                 | - | 5 marks  |
| ❖ Assignment              | - | 5 marks  |
|                           |   | 25 marks |
|                           |   | -----    |

**Practical:**

- |                                  |   |          |
|----------------------------------|---|----------|
| ❖ Attendance                     | - | 5 marks  |
| ❖ Practical Test Best 2 out of 3 | - | 30 marks |
| ❖ Record                         | - | 5 marks  |
|                                  |   | 40 marks |
|                                  |   | -----    |

**Project:**

- |                                |   |          |
|--------------------------------|---|----------|
| ❖ Internal Marks presentations | - | 40 marks |
| ❖ Viva                         | - | 10 marks |
| ❖ Project Report               | - | 50 marks |

**Break – up Details for Attendance**

- |               |   |          |
|---------------|---|----------|
| ❖ Below 60 %  | - | No marks |
| ❖ 60% to 75%  | - | 3 marks  |
| ❖ 76% to 90%  | - | 4 marks  |
| ❖ 91% to 100% | - | 5 marks  |

### **IMPORTANT POINTS**

1. The each practical examination should be conducted for 6 hrs / day, 2 consecutive days. The fee for the practicals is double the amount of the normal 6 hours practicals (ie. If the practical fee is Rs. 210 for 6 hrs practical's, for these Applied Microbiology students, the fee will be Rs. 420/- practical). Similarly, the practical examiners also should be paid with double the remuneration (i.e. Rs. 100/- practical)
2. Elective papers can be selected by the concerned College Departments based on the student's interest.
3. For EDC papers, students should choose the other department EDC papers.

**COURSE OF STUDY AND SCHEME OF EXAMINATION**

Course	Subject Title	Hrs/Week	Credit	University Examination		Total Marks
				Internal (25%)	External (75%)	
<b>I SEMESTER</b>						
Core - I	General Microbiology	6	5	25	75	100
Core - II	Immunology and Immunotechnology	6	5	25	75	100
Core - III	Cell and Molecular Biology	6	5	25	75	100
Elective - I		6	5	25	75	100
Practical I	General Microbiology and Immunology	6	4	25	75	100
Practical II	Immunology	6	4	25	75	100
<b>II SEMESTER</b>						
Core - IV	Medical Bacteriology and Mycology	5	5	25	75	100
Core - V	Industrial and Pharmaceutical Microbiology	5	5	25	75	100
Core - VI	Genetic Engineering and Advances in Biotechnology	5	5	25	75	100
EDC		4	3	25	75	100
Common Paper	Human Rights	2	2	25	75	100
Practical III	Medical Bacteriology and Mycology	6	4	40	60	100
Practical IV	Genetic Engineering and Industrial Microbiology	6	4	40	60	100

Course	Subject Title	Hrs/Week	Credit	University Examination		Total Marks
				Internal (25%)	External (75%)	
<b>III SEMESTER</b>						
Core - VII	Medical Virology and Parasitology	5	5	25	75	100
Core - VIII	Food, Dairy and Environmental Microbiology	5	5	25	75	100
Core - IX	Soil, Agricultural Microbiology Bio Degradation	5	5	25	75	100
Elective - II		4	3	25	75	100
Practical V	Medical Virology and Parasitology	6	4	40	40	100
Practical VI	Food, Dairy, Environmental and Agricultural Microbiology	6	4	40	40	100
<b>IV SEMESTER</b>						
Core - X	Research Methodology, Bio statistics and Bioinformatics	5	5	25	75	100
Elective III		4	3	25	75	100
Core - XI		21	4	40	60	100
Project						
	<b>Total</b>		<b>92</b>			<b>2200</b>

No. of Core Papers : 16  
 Elective – Major : 03 (Choose any 3 out of 6)  
 Supportive course – EDC : 01  
**\*(Choose from other department EDC papers)**



**6. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS:**

- (i) Candidates shall register their names for the First semester examination after the admission in the PG courses.
- (ii) Candidates shall be permitted to proceed from the First Semester up to the Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subject) Semester subjects.
- (iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time.

Provided in case of candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorized Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the University from time to time.

**7. PASSING MINIMUM**

- a) There shall be no Passing Minimum for Internal.
- b) For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
- c) In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
- d) Grading shall be based on overall marks obtained (internal + external).

**8. CLASSIFICATION OF SUCCESSFUL CANDIDATES:**

Candidates who secured not less than 60% of aggregate marks (Internal + External) in the whole examination shall be declared to have passed the examination in the First Class. All other successful candidates shall be declared to have passed in Second Class. Candidates who obtain 75% of the marks in the aggregate (Internal + External) shall be deemed to have passed the examination in First Class with Distinction, provided they pass all the examinations (theory papers, practicals, project and viva-voce) prescribed for the course in the First appearance.

**9. GRADING SYSTEM:**

The term grading system indicates a Seven (7) Point Scale of evaluation of the performances of students in terms of marks obtained in the Internal and External Examination, grade points and letter grade.

**SEVEN POINT SCALE (As per UGC notification 1998)**

<b>GRADE</b>	<b>GRADE POINT</b>	<b>PERCENTAGE OF EQUIVALENT</b>
'O' = Outstanding	5.50 – 6.00	75– 100
'A' = Very Good	4.50 – 5.49	65 – 74
'B' = Good	3.50 – 4.49	55 – 64
'C' = Average	3.00 – 3.49	50 – 54
'D' = Below Average	1.50 – 2.99	35 – 49
'E' = Poor	0.50 – 1.49	25 – 34
'F' = Fail	0.00 – 0.49	0 – 24

**10. RANKING**

Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction.

Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the First Appearance due to the reasons as furnished in the Regulations under “Requirements for Proceeding to subsequent Semester” are only eligible for Classification.

**11. PATTERN OF QUESTION PAPER**

PART – A (200 words)      Answer all 5 Questions either or type      5x5=25 marks

PART – B (500 words)      Answer all 5 Questions either or type      5x10=50 marks

**12. APPEARANCE FOR IMPROVEMENT**

Candidates who have passed in a theory paper / papers are allowed to appear again for theory paper / papers only once in order to improve his / her marks, by paying the fee prescribed from time to time. Such candidates are allowed to improve within a maximum period of 10 semesters counting from his / her first semester of his/her admission. If candidate improve his marks, then his improved marks will be taken into consideration for the award of Classification only. Such improved marks will not be counted for the award of Prizes / Medals, Rank and Distinction. If the candidate does not show improvement in the marks, his previous marks will be taken into consideration. Candidate will be allowed to improve marks in the Practicals, Project, Viva-voce, Field work.

### **13. TRANSITORY PROVISION**

Candidates who have undergone the course of study prior to the academic year 2008-2009 will be permitted to appear for the examinations under those Regulations for a period of three years i.e., up to and inclusive of April / May 2012 Examinations. Thereafter, they will be permitted to appear for the examination only under the Regulations then in force.

## **M.Sc. APPLIED MICROBIOLOGY**

### **SEMESTER - I**

#### **CORE I : GENERAL MICROBIOLOGY**

##### **UNIT I History and Classification**

Development, Scope and Future of Microbiology. Classification of microorganisms - Haeckel's three Kingdom concepts, Whittaker's five kingdom concepts. Microbial taxonomy, Numerical taxonomy, Taxonomic ranks. Classification and salient features of bacteria according to Bergey's manual of bacteriology. Microbial type culture collections.

##### **UNIT II Microscopy**

Working principle, instrumentation and applications of Bright field microscope, Phase contrast microscope, Dark field microscope, Fluorescent microscope and Electron microscopes (SEM and TEM). Staining Methods – Simple, Gram, Acid-fast, Spore, Granular, Capsular, Flagellar and Fat bodies.

##### **UNIT III Bacterial anatomy and Growth**

Bacterial size, shape and arrangement. Ultra Structure and functions of glycocalyx, flagella, fimbriae, pili - cell wall and plasma membranes – Gram Positive, Gram Negative and Archaea. Outer membrane. cytoplasmic inclusions. ribosome, endospore – Mechanism of sporulation. Physical conditions required for bacterial growth. Growth curve. Generation time. Culture medium – types. Pure culture techniques. Maintenance and preservation of cultures. Anaerobic cultivation.

##### **UNIT IV Bacterial Metabolism**

Aerobic Respiration - Nutritional requirements of bacteria. Nutritional types. Glycolysis, ED, TCA, Oxidative, Substrate level phosphorylation and ETC. Fermentation – Lactic acid, ethanol and mixed acid, anaerobic respiration. Photosynthesis – Phototrophy, oxygenic and anoxygenic photosynthesis. Biosynthesis – Glyoxylate pathway, gluconeogenesis, peptidoglycan, purines and pyrimidines.

##### **UNIT V Control of Microorganisms**

Sterilization – Types – Mode of action – Applications. Disinfectants. Sterility control of autoclave, hot air oven and laminar air flow. Antimicrobial chemotherapy – Antibiotics (Anti bacterial and antifungal) – Classification (Based on chemistry and mode of action) – Sensitivity tests and drug resistance mechanism.

**REFERENCE BOOKS**

1. Prescott LM, Harley JP and Klein DA (2003) Microbiology (10th edition) McGraw Hill, New York.
2. Pelczar Jr, M.J. Chan, E.C.S and Krei N.R (1993) Microbiology McGraw Hill, New York.
3. Michael Madigan, John Martinko, David Stahl and David Clark (1997) Brock Biology of Microorganisms (Thirteenth Edition) Pearson International edition .
4. Holt, J S., Kreig N R., Sneath P. H. A and Williams ST Bergey's Manual of Determinative Bacteriology (9th edition) Williams and Wilkins, Baltimore.
5. Jeffrey C Pommerville (2004) Alcamo's Fundamentals of Microbiology (Seventh edition) - Jones and Bartlett Publishers
6. Gerard J. Tortora Berdell R. Funke , Christine L. Case - Microbiology an Introduction, Pearson International edition (12th edition).
7. Albert G. Moat, John W. Foster and Michael P. Spector - Microbial Physiology, (4th edition), John Wiley & Sons, INC., Publication.
8. Ananthanarayan and Paniker's Text book of Microbiology (1978) Universities Press (9th edition), Hyderabad.
9. Hans G Schlegel (2003). General Microbiology. Low Price 7th Edition, Cambridge University Press.
10. Meenakumari S (2006) Microbiology Physiology. 1st Edition, MJP Publishers, A unit of Tamil Nadu Book House, Chennai.

## **M.Sc. APPLIED MICROBIOLOGY**

### **SEMESTER - I**

#### **CORE II : IMMUNOLOGY AND IMMUNOTECHNOLOGY**

##### **UNIT I The Cells of Immune System**

The Cells of Immune System - An overview of the immunology- Classification of the immune response. Cells and tissues of the immune system. Haematopoiesis: Origin and differentiation of Lymphocytes and phagocytic cells. Primary and secondary lymphoid organs. Immunogens and antigens- haptens, adjuvants.

##### **UNIT II Humoral Immunity**

Development, maturation, activation and differentiation of B-lymphocytes; Antibody: structure, classes and subclasses; antibody diversity- Antigen and antibody interaction. Complement – Classical, alternate and lectin pathways; Hybridoma technology for production of the monoclonal antibody and applications.

##### **UNIT III Cellular Immunity**

Classification and stages of development (T) Lymphocytes - T cell receptor - Major histocompatibility complex –structure, classification and genetic organization of MHC; mechanism of phagocytosis- ADCC- cell biology of antigen processing and presentation- cytokines; immunosuppression, tolerance.

##### **UNIT IV Hypersensitivity, Transplantation, Immunology of Tumors**

Injury and inflammation; allergy and hypersensitivity-types; Transplantation: types, immunological mechanisms of graft rejection- immunological strategies to prevent graft rejection-Tumors: Immune response to tumors- type of tumor antigens.

##### **UNIT V Autoimmunity Immunopathology and Techniques in Immunotechnology**

Autoimmunity: Diseases & mechanisms - Preparation and storage of tissues - identification of various cell types and antigens in tissues. Immunocytochemistry- immuno fluorescence, immuno enzymatic and immuno ferritin techniques and immunoelectron microscopy; Isolation of pure antibody, assays of circulating immune complexes; Isolation of lymphocyte populations. Vaccine Types- Preparation of vaccines.

**TEXT BOOKS**

1. Owen, J., Punt, J and Strandford, S. “Kuby Immunology”, 7th Ed., W. H. Freeman Publication, New York, USA, 2012.
2. Abbas, K. A., Litchman, A. H. and Pober, J. S. “Cellular and Molecular Immunology”, 4th Ed., W. B.Saunders Co., Pennsylvania, USA, 2005.
3. Talwar, G. P. and Gupta S. K. A “Hand book of practical and clinical immunology” Vol. I & II. CSB Publications, New Delhi, 1992.

**REFERENCE BOOKS**

1. Roitt, I., Brostoff, J. and David, M. “Immunology”, 6th Ed., Mosby publishers Ltd., New York, USA, 2001.
2. Tizard, R.I. “Immunology”, 4 th Ed., Saunders college publishing, Chennai Microprint Pvt. Ltd., Chennai, 2004.

## **M.Sc. APPLIED MICROBIOLOGY**

### **SEMESTER - I**

#### **CORE III : CELL AND MOLECULAR BIOLOGY**

##### **UNIT I Cell Structure Permeability and Transport**

Prokaryotes, Development of multicellular organisms, Cell wall structure of bacteria and eukaryotes, Plasma membrane structure and models, cell organelles; cell permeability- concentration gradient and partition coefficient, transport of small molecules- active, passive, ion channels, facilitated diffusions.

##### **UNIT – II Cell division, Cell signaling and protein localization**

Cell cycle and its regulation, Bacterial cell division, Eukaryotic cell division, mechanics of cell division-mitosis and meiosis; Cell signaling – signaling molecules, G protein coupled receptors, Ion-channel receptors, enzyme linked receptors, protein sorting, nuclear localization, mitochondria and chloroplast import and export mechanism.

##### **UNIT – III Molecular structures of genes and chromosomes**

Structure of DNA - DNA melting and reannealing, base composition and sequence, size, shape, super twisting; molecular events of prokaryotic and eukaryotic chromosome organization, exon; intron- DNA mutation and repair mechanism.

##### **UNIT IV Replication and Transcription**

Basic rules of replication- genes and enzymology of replication, processivity and fidelity of replication, rolling circle replication, termination of replication, importance of telomerase in eukaryotic replication- gene transfer mechanism in bacteria; Molecular events of Prokaryotic and Eukaryotic Transcription; initiation, elongation and termination.

##### **UNIT V Gene expression and regulation**

Genetic code, Ribosome of prokaryote and eukaryote and its evolutionary importance; mechanism of translation- initiation, elongation and termination. Inhibitors of Translation. Post translational modification. Regulation of gene expression – lac operon, trp operon, ara operon.



**TEXT BOOKS**

1. Lodish, H., Berk, A., Zipurursky, S. L., Matsudaria, P., Baltimore D, and Darnell, J, “Molecular Cell Biology”, W. H. Free Man and Company, England, 2000.
2. Benjamin Lewin, “Gene IX”, OxfordUniversity Press, New Delhi, India, 2000.

**REFERENCE BOOKS**

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P, ”Molecular Biology of the Cell”, Garland Science., New York, 2002.
2. Watson, J.D, Hopkins, W.H, Roberts, J.W, Steitz, J.A, Weiner, A.M. “Molecular Biology of the Gene”, 1987.

**M.Sc. APPLIED MICROBIOLOGY**

**SEMESTER - I**

**PRACTICAL – I**

**GENERAL MICROBIOLOGY AND IMMUNOLOGY**

**Practical Exam : 6 Hrs / Day; 2 Consecutive Days**

**GENERAL MICROBIOLOGY**

1. Measurement of microorganisms – Micrometry
2. Staining methods – Simple, Gram's, Acid fast, Spore, Granular, Capsule (Positive and Negative) and Fat stain (Sudan Black Method)
3. Motility Determination – Hanging drop method and Soft agar
4. Media preparation and Cultural Characters of bacteria on

**Agar Plate**

- ❖ Size and Pigmentation
- ❖ Form – Circular, Irregular and Rhizoid,
- ❖ Margin – Entire, Lobate, Undulate, Serrate and Filamentous,
- ❖ Elevation – Flat, Raised, Convex and Umbonate

**Agar Slant**

- ❖ Abundance of growth, Pigmentation, Optical Characteristics
- ❖ Form – Filiform, Echinulate, Beaded, Effuse, Arborescent and Rhizoid

**Broth**

- ❖ Uniform turbidity, Flocculent, Pellicle and Sediment

**Types of Media**

- ❖ Enriched, Selective, Differential, Enrichment and Transport media

**5. Pure culture techniques**

- ❖ Streak plate, Pour plate and Spread plate

**6. Bacterial Growth**

- ❖ Total Count – Neubauer chamber
- ❖ Growth curve – Turbidity method – Spectrophotometer / Colorimetry

**7. Effect of various factors on growth of bacteria**

- ❖ Temperature, pH and Osmotic pressure

**8. Anaerobic cultivation**

- ❖ Anaerobic gas pack method (Demo)

**9. Study on bacterial extra cellular enzymes**

- ❖ Starch, Casein, Gelatin and Lipid hydrolysis

**10. Biochemical Tests for identification of bacteria**

- ❖ Oxidase test
- ❖ Catalase test
- ❖ Coagulase test
- ❖ Nitrate reduction test
- ❖ Carbohydrate fermentation test
- ❖ IMViC test
- ❖ TSI test
- ❖ Urease test
- ❖ Amino acid decarboxylation test

**11. Antibiotic sensitivity methods – Kirby-Bauer method and Stokes method****REFERENCE BOOKS**

1. Sundaraj T, Aswathy Sundarraj (2002), Microbiology Laboratory Manual (First edition), Chennai.
2. Dubey, R.C and Maheshwari, O.K (2005) Practical Microbiology, S Chand and Co. Ltd., (First edition), New Delhi.
3. James G. Cappuccino and Natalie Sherman (2014) Microbiology: A Laboratory Manual (10th Edition), Pearson.
4. Aneja, K.R (2003) Experiments in Microbiology, Plant Pathology and Biotechnology (4th edition), New age international, New Delhi.
5. Rajan S., R. Selvi Christy (2010), Experimental procedures in Life Sciences, (3rd reprint) Anjanaa Book House, Chennai.

## **M.Sc. APPLIED MICROBIOLOGY**

### **SEMESTER - I**

### **PRACTICAL – I**

### **IMMUNOLOGY**

#### **1. ABO Blood grouping – Rh typing and cross matching**

#### **2. Agglutination tests**

- ❖ WIDAL
- ❖ RA
- ❖ ASO
- ❖ CRP
- ❖ Beta-HCG

#### **3. Precipitation**

- ❖ Ouchterlony's Double Immuno - diffusion test
- ❖ Counter Immuno electrophoresis
- ❖ Rocket Immuno electrophoresis
- ❖ Radial Immuno electrophoresis

#### **4. Rapid plasma reagin test (RPR)**

#### **5. ELISA (HIV & Hbs)**

#### **REFERENCES:**

1. Aneja KR (2005). Experiments in Microbiology, Plant pathology and Biotechnology. Fourth edition, New Age International Publishers, Chennai.
2. Dubey RC and Maheswari DK (2004). Practical Microbiology First edition, S Chand and Company Ltd., New Delhi.
3. Kannan N (2003). Handbook of laboratory culture media, Reagents, Stains and buffers. Panima Publishing Corporation, New Delhi.
4. Kannan N (1996). Laboratory Manual in General Microbiology. First edition, Palani Paramount Publications, Palani. Tamil Nadu.
5. Horold J Benson (1998). Microbiological Applications - Laboratory Manual in General Microbiology. Seventh International edition, Mc Grew-Hill, Boston.
6. Myer's and Koshy's manual of diagnostic procedures in medical microbiology and immunology/serology. Published by department of clinical microbiology, CMC and Hospital, Vellore, Tamil Nadu.
7. The HiMedia Manual (2003). For microbiology and Cell Culture Laboratory Practice. Published by HiMedia Laboratories (P) Ltd., Mumbai.
8. Mukherjee, L. (1997). Medical Laboratory Technology. Volume I & II. Tata McGrew – Hill Publishing Company Limited, New Delhi.

**M.Sc. APPLIED MICROBIOLOGY**  
**SEMESTER - I**  
**PRACTICAL – II**  
**(CELL AND MOLECULAR BIOLOGY)**

1. Identification of different stages of mitosis in *Allium cepa* (Onion) by staining
2. Isolation of genomic DNA from bacterial cells.
3. Extraction of genomic DNA from yeast cells.
4. Isolation of genomic DNA from blood by high salt method.
5. Isolation of genomic DNA from plants by CTAB method.
6. Extraction of plasmid DNA from bacterial cells.
7. Isolation of total RNA from prokaryotes.
8. Quantification of DNA by UV spectrometer.
9. Isolation of drug resistant mutants by gradient plate technique.
10. Size determination of DNA agarose gel electrophoresis.
11. Ames test.
12. Bacterial conjugation.
13. Bacterial transformation.
14. Isolation of Bacteriophage from sewage.

**REFERENCES**

1. Sambrook, J., Russel, D.W., 'Molecular cloning – A laboratory manual', Third edition, Cold spring Harbor Laboratory Press, Cold spring Harbor, New York, USA, 2001.
2. Ansubel, F.M., Brent, R., Kingston, R.e., and Moore , D.D., 'Current protocols in Molecular Biology', Geone publication associates, New York, USA, 2001.

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3. Rajan S and Selvi Christy (2011). Experimental procedures in life sciences. Anjana Book House, publishers and distributors, Chennai.
4. Aneja KR (2005). Experiments in Microbiology, Plant pathology and Biotechnology. Fourth edition, New Age International Publishers, Chennai.
5. Dubey RC and Maheswari DK (2004). Practical microbiology First edition, S Chand and Company Ltd., New Delhi.
6. James G Cappuccino and Natalie Sherman (2004). Microbiology: A laboratory manual. Sixth edition, Published by Pearson Education.
7. Kannan N (2003). Handbook of laboratory culture media, Reagents, Stains and buffers. Panima Publishing Corporation, New Delhi.
8. Kannan N (1996). Laboratory Manual in General Microbiology. First edition, Palani Paramount Publications, Palani. Tamil Nadu.
9. Horold J Benson (1998). Microbiological Applications - Laboratory Manual in General Microbiology. Seventh International edition, Mc Grew-Hill, Boston.
10. The HiMedia Manual (2003). For microbiology and Cell Culture Laboratory Practice. Published by HiMedia Laboratories (P) Ltd., Mumbai.

**M.Sc. APPLIED MICROBIOLOGY****SEMESTER - II****CORE IV - MEDICAL BACTERIOLOGY AND MYCOLOGY****UNIT I Bacteriology**

Indigenous normal microbial flora of human body. General attributes and virulence factors of bacteria causing infections. Host Parasite relationships – Nonspecific host immune mechanisms. Ground rules for collection and dispatch of clinical specimens for microbiological diagnosis and discarding of clinical Specimens.

**UNIT II**

Morphology, classification, cultural characteristics, pathogenicity, pathology, laboratory diagnosis and prevention – Control and treatment of diseases caused by the following organisms: Staphylococci, Streptococci, Pneumococci, Neisseriae (Gonococci & Meningococci), Corynebacterium diphtheriae, Mycobacterium tuberculosis, M. leprae, Clostridium tetani, Cl. botulinum and Bacillus anthracis.

**UNIT III**

Morphology, classification, cultural characteristics, pathogenicity, pathology, Laboratory diagnosis and prevention – Salmonella, Shigella dysenteriae, Vibrio cholerae, E. coli, Brucella abortus, Spirochetes, Rickettsiae rickettsi, Chlamydiae trachomatis, Mycoplasmas, Zoonotic diseases and their control – Hospital acquired infections – Hospital Infection control committee – functions – Hospital waste disposal – Ethical committee – functions.

**UNIT IV Mycology**

Classification of medically important Fungi (Morphology, Infection & Reproduction), Immunity to Fungal Infections. Culture Media and Stains in Mycology, Normal fungal flora of human beings, Specimen collection, preservation, Transportation & Identification of Mycological Agent. Biochemical tests for fungal identification, Anti fungal agents- sensitivity test

**UNIT V Superficial Mycosis**

Pityriasis versicolor, White piedra, Black piedra, Tinea nigra, Cutaneous mycosis - Dermatophytes. Subcutaneous Mycosis – Mycetoma, Sporotrichosis, Chromoblastomycosis, Systemic Mycosis- Histoplasmosis, Blastomycosis, Coccidioidomycosis, Opportunistic Mycosis – Candidiasis, Aspergillosis, Miscellaneous Mycosis- Otomycosis. Fungal infections in eyes. Mycotoxins. Allergic Fungal diseases - Mycetismus.

**REFERENCE BOOKS**

1. Alexopoulos CJ and C. W. Mims (1993) *Introductory Mycology* (3rd edition) Wiley Eastern Ltd. New Delhi.
2. Elizabeth Moore Landecker (1996) *Fundamentals of the Fungi* (4th edition) Prentice Hall International Inc, London.
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4. Jegadish Chander, 1996. *A Text Book of Medical Mycology*. Interprint, New Delhi.
5. [D. R. Arora](#) (2014) *Medical Mycology*, CBS Publishers & Distributors; 1st edition.
6. Greenwood, D., Slack, R.B. and Peutherer, J.F. (2002) *Medical Microbiology*, 16th Edn. Churchill Livingstone, London.
7. Topley and Wilson (1995) *Principles of Bacteriology Virology and Immunity*. 9th Edn. Vol I, Edward Arnold, London.
8. Chakraborty, P., 2003. *A Text Book of Microbiology*. 2nd edition, Published by New Central Agency (P) Ltd., Kolkatta.
9. Dey, N.C., Dey, T.K. and Sinha, D., 1999. *Medical Bacteriology including Medical Mycology and AIDS*. 17th edition, New Central Book agency. Kolkatta.
10. Ananthanarayan and Paniker's *Text book of Microbiology* (1978) Universities Press (9th edition), Hyderabad.
11. Jawetz, Melnick, & Adelberg's. (2013). *Medical Microbiology*. 26th Edition. McGraw-Hill.



**M.Sc. APPLIED MICROBIOLOGY**  
**SEMESTER - II**  
**CORE V - INDUSTRIAL AND PHARMACEUTICAL**  
**MICROBIOLOGY**

**UNIT I**

Introduction to fermentation – the range of fermentation process. The chronological development of the fermentation industry. The component parts of a fermentation process. Industrially important organisms – Isolation, preservation and strain improvement.

**UNIT II**

Development of inoculum - Scale up (Pilot study) – Upstream processing – media for industrial fermentation – formulation – sterilization – Microbial growth kinetics. Fermentation – types. Downstream processing. Fermentor – parts, design – types – Instrumentation and control.

**UNIT III**

Microbial production of organic acids (Citric acid, Acetic acid, Lactic acid and Itaconic acid), Amino acids (L - Glutamic acid and L - Lysine), Antibiotics (Penicillin, Semi synthetic penicillins, Streptomycin, Tetracyclines and Griseofulvin), enzymes (Amylases, Proteases and Pectinases), vitamins (B12, B2 and C), alcoholic beverages. Microbial transformations – steroids, sterols, antibiotics and pesticides

**UNIT IV**

Production of vaccines, toxoid, antisera and their standardization. Antiseptics, disinfectants and their standardization. Types of water (DM/Purified water/water for injection) used in pharmaceutical industry. Environmental monitoring. Growth promotion test

**UNIT V**

Sub culturing and culture suspension preparation. Microbial assay of antibiotics and vitamins. Sterility testing. Bacterial Endotoxin Test (BET). Microbial limit test. Validation of instruments (Laminar air flow, autoclave and Hot air oven). Good Documentation Practice (GDP) – SOP – GLP. Failure investigation.

**REFERENCE BOOKS**

1. Stanbury, P.F., Whittaker, A and Hall, S.J., (1995) Principles of fermentation technology, Elsevier; 3rd edition.
2. Crueger and Crueger, A., Biotechnology: A text book of Industrial Microbiology, Sinavos association, Ino Sundeland; 2nd edition.
3. Cassida, J.E., (1968). Industrial Microbiology, New Age International (2007).
4. Prescott and Dunn, S., (1982) Industrial Microbiology. The AVI Publishing Company Inc., USA; 4th edition.
5. Pepler, H. J. and Pearlman, D. (1979). Microbial Technology, Vol 1 and 2, Academic press.
6. Demain, A. L. and Soloman INA, (1986). Manual of Industrial Microbiology and Biotechnology, American society for Microbiology, Washington DC.
7. Chisti, Y., Fermentation, Biocatalysis and bioseparation, Encyclopedia of Bioprocess Technology, Vol. 5, John Wiley and Sons, N. Y.
8. Belter, P.A., Cussler, E.L. and Hu, W.S., Bioseparation: Downstream processing for Biotechnology, John Wiley and Sons, N.Y.
9. Agarwal AK & Pradeep Parihar (2006). Industrial Microbiology. Published by Student Edition, Behind Nasrani Cinema, Chopasani Road, Jodhpur.
10. Patel A H (2005). Industrial Microbiology. Laxmi Publications, New Delhi; Second edition
11. <https://www.scribd.com/document/322795616/Free-Download-Indian-Pharmacopoeia-2010-PDF>

**M.Sc. APPLIED MICROBIOLOGY**  
**SEMESTER - II**  
**CORE VI - GENETIC ENGINEERING AND ADVANCES IN**  
**BIOTECHNOLOGY**

**UNIT I**

Introduction to Genetic Engineering – Definitions, Historical perspectives. Enzymes in rDNA technology - Restriction enzymes – types – nomenclature – Properties of type II restriction endonucleases. DNA ligase. DNA modifying enzymes – alkaline phosphatase, poly nucleotide kinase and terminal transferase.

**UNIT II**

Cloning Vectors – Bacterial Plasmid vectors- pBR322 & pUC vectors, Bacteriophages,  $\lambda$ , M13. Hybrid vectors – Cosmids, Phasmids, Yeast vectors- YEP, YIP, YRP, YCP & YAC. Shuttle vector, Expression vector.

**UNIT III**

Cloning Strategies. Construction of genomic libraries, cDNA library construction. Gene transfer methods– transformation, electroporation, particle bombardment and microinjection. Screening and selection of clones.

**UNIT IV**

Transgenic animals: Animal vectors – SV 40, Retroviral vector. Production and applications of transgenic mice. Agrobacterium mediated transformation: Crown gall disease, Ti plasmids, T-DNA transfer, Ti plasmid derivatives- co-integrate vectors, binary vectors. Gene transfer to plants-development of pesticide, insecticide and stress resistant plants . Plant tissue culture and its types. Biomarkers.

**UNIT V**

Techniques in Biotechnology – Blotting techniques – Southern, Northern and Western blotting. PCR amplification and its application. RFLP and RAPD analysis and its applications. DNA sequencing methods – dideoxy, chemical and Next Generation Sequencing (NGS). Chromosomal walking, chromosome jumping, site directed mutagenesis, Protein engineering.

### **TEXT BOOKS**

1. Brown, T.A. 1995. Gene Cloning – An Introduction. [Third Edition]. Chapman and Hall, UK. [Units I, II & III]
2. Glick, B.K. and Pasternik, J.J. 1998. Molecular Biotechnology. Principles and applications of recombinant DNA. [Second Edition]. ASM Press. [Units IV & V].
3. Mitra (2005). Genetic engineering. Published by Macmillan India Ltd., Chennai.
4. Jogdand SN (2005). Gene biotechnology. Himalaya Publishing House, Mumbai.
5. Satyanarayana (2005). Biotechnology. First edition, Books and Allied (P) Ltd., Kolkata.
6. Preeti Joshi (2002). Genetic engineering and its application. First edition, Agrobios (India).
7. Dubey RC (2005). A Text of Biotechnology. Multicolor Illustrative edition, S.Chand and Company Ltd., New Delhi.
8. Bernad R Glick (2003). Molecular Biotechnology - Principles and Applications of Recombinant DNA. Third edition, ASM Press, Washington, D.C.
9. Ramawat K and Shaily Goyal (2010). Molecular Biology and Biotechnology. First edition, S.Chand and company Ltd., New Delhi.

### **REFERENCE BOOKS**

1. Old, R.M. and Primrose, S.B. 1995. Principles of Gene Manipulation. [Sixth Edition]. Blackwell Scientific Publication, London.
2. Winnacker, E.L. 1987. From Genes to Clones. Introduction to Gene technology. [First Edition]. Panima Publishing Corporation, New Delhi.

**M.Sc. APPLIED MICROBIOLOGY**  
**SEMESTER - II**  
**PRACTICAL – III**

**MEDICAL BACTERIOLOGY AND MYCOLOGY**

1. Preparation of cotton swab and sterile container for clinical sample collection.
2. Collection of clinical specimens (Throat swab, pus sample, sputum, urine and stool sample).
3. Microscopic examination of wet film (*V.cholerae*).
4. Preparation of Stains for bacterial and fungal observation.
5. Staining methods
  - a) Gram staining
  - b) AFB staining
  - c) Capsule staining
  - d) Spore staining
  - e) Granular staining
6. Biochemical reactions for identification of pathogenic bacteria
  - a) *S. aureus*,
  - b) *E. coli*,
  - c) *K. pneumoniae*,
  - d) *P. aeruginosa*
  - e) *S. typhi*,
  - f) *Shigella dysenteriae*,
  - g) *Proteus vulgaris*,
  - h) *V. cholerae*
7. Kirby Bauer (AST) antibiotic sensitivity test.
8. KOH/LPCB preparation of Skin/hair/nail for fungal observation.
9. Microscopic identification of (*Penicillium*, *Aspergillus*, *Mucor*, *Rhizopus*, *Trichophyton*, *Microsporum* and *Epidermophyton*) fungi.
10. Slide culture method.
11. Cultivation of Yeast (*Candida* & *Cryptococcus*).
12. Germ tube technique.
13. Capsule staining.
14. Antibiotic sensitivity test for fungi.

**REFERENCE BOOKS:**

1. Dubey, R.C. and Maheshwari, D.K. (2002) Practical Microbiology, 1st Edn. S. Chand & Co. Ltd., New Delhi.
2. Cappuccino, J. and Sherman, N. (2002) Microbiology: A Laboratory Manual, 6th Edn. Pearson Education Publication, New Delhi.
3. Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996) Mackie and McCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London.
4. Cowan and Steel (1995) Manual for Identification of Medical Bacteria, 4th Edn. Cambridge University Press, London.
5. Murray, P.R., Baron, E.J., Jorgensen, J.H., Tenover, M.C. and Tenover, R.H. (2003) Manual of Clinical Microbiology, 8th Edn. Vol 1&2, ASM Press, Washington, D.C.
6. Balows, A., Hausler, W.J., Tenover, M.C. and Tenover, R.H. (Eds) (1988) Laboratory Diagnosis of Infectious Diseases: Principles and Practice, Vol 1 Springer Verlag, New York.
7. Holt, J.S., Krieg, N.R., Sneath, P.H.A. and Williams, S.S.T. (1994) Bergey's Manual of Determinative Bacteriology, 9th Edn. Williams & Wilkins, Baltimore.
8. Gerhardt, P., Murray, R.G., Wood, W.A. and Krieg, N.R. (Eds) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.
9. Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edn. C.V. Mosby Company, St. Louis.
10. Sundararaj, T (2005). Microbiology Laboratory Manual, Perungudi, Chennai - 96.

**M.Sc. APPLIED MICROBIOLOGY**

**SEMESTER - II**

**PRACTICAL - IV**

**(GENETIC ENGINEERING AND INDUSTRIAL MICROBIOLOGY)**

**GENETIC ENGINEERING**

1. Isolation of chromosomal DNA from bacteria.
2. Isolation of plasmid DNA.
3. Restriction digestion of  $\lambda$  DNA (EcoR1 and BamH1) and ligation.
4. Bacterial transformation, competence cell preparation.
5. SDS - PAGE.
6. Protein estimation by Lowry et al method
7. Western blotting.
8. Southern blotting.
9. Separation of biomolecules by paper, thin layer and column chromatography.
10. Polymerase chain reaction.
11. Plant tissue culture – Explant preparation, Callus formation in MS media.

**REFERENCES BOOKS:**

1. Rajan S and Selvi Christy (2011). Experimental procedures in life sciences. Anjana Book House, publishers and distributors, Chennai.
2. Aneja KR (2005). Experiments in Microbiology, Plant pathology and Biotechnology. Fourth edition, New Age International Publishers, Chennai.
3. Dubey RC and Maheswari DK (2004). Practical microbiology First edition, S Chand and Company Ltd., New Delhi.
4. James G Cappuccino and Natalie Sherman (2004). Microbiology: A laboratory manual. Sixth edition, Published by Pearson Education.
5. Kannan N (2003). Handbook of laboratory culture media, Reagents, Stains and buffers. Panima Publishing Corporation, New Delhi.
6. Kannan N (1996). Laboratory Manual in General Microbiology. First edition, Palani Paramount Publications, Palani. Tamil Nadu.
7. Horold J Benson (1998). Microbiological Applications - Laboratory Manual in General Microbiology. Seventh International edition, Mc Grew-Hill, Boston.
8. The HiMedia Manual (2003). For microbiology and Cell Culture Laboratory Practice. Published by HiMedia Laboratories (P) Ltd., Mumbai.

## **M.Sc. APPLIED MICROBIOLOGY**

### **SEMESTER - II**

#### **PRACTICAL IV - INDUSTRIAL MICROBIOLOGY**

1. Screening of antibiotics producing microbes from soil.
2. Production of microbial enzymes
  - a). Solid state fermentation (Any one enzyme)
  - b). Submerged fermentation (Any one enzyme)
3. Assay of enzymes
  - a). Amylase
  - b). Protease
  - c). Lipase
4. Immobilization of cells and enzymes
5. Microbial production of wine
6. Citric acid production using *Aspergillus niger*.
7. Minimal inhibitory concentration (MIC) determination of antibiotics – Broth Dilution
8. Minimal inhibitory concentration (MIC) determination of antibiotics – Filter paper disc assay
9. Evaluation of disinfectants – Filter paper disc assay
10. Phenol co – efficient test
11. Vitamin assay (B12/Nicotinic acid)
12. Sterility testing of pharmaceutical products (Membrane filter assay – Fluid thiglycollate medium) (Demo)
13. Bacterial Endotoxin Test – Limulus Amoebocyte Lysate (LAL) assay (Demo).

#### **REFERENCE BOOKS:**

1. Stanbury, P.F., Whittaker, A and Hall, S.J., (1995) Principles of fermentation technology, Elsevier; 3rd edition.
2. Crueger and Crueger, A., Biotechnology : A text book of Industrial Microbiology, Sinavos association, Ino Sundeland; 2nd edition.
3. Cassida, J.E., (1968). Industrial Microbiology, New Age International (2007).
4. Presscott and Dunn, S., (1982) Industrial Microbiology. The AVI Publishing Company Inc., USA; 4th edition.
5. Demain, A. L. and Soloman INA, (1986). Manual of Industrial Microbiology and Biotechnology, American society for Microbiology, Washington DC.
6. Chisti, Y., Fermentation, Biocatalysis and bioseparation, Encyclopaedia of Bioprocess Technology, Vol. 5, John Wiley and Sons, N, Y.
7. Patel A H (2005). Industrial Microbiology. Laxmi Publications, New Delhi; Second edition.



**M.Sc. APPLIED MICROBIOLOGY****SEMESTER - III****CORE VII - MEDICAL VIROLOGY AND PARASITOLOGY****UNIT I**

Brief outline on discovery of Viruses, nomenclature, ICTV classification of Viruses, Distinctive properties of Viruses, Morphology & ultra structure. General methods of diagnosis and serology, virioids, prions, satellite RNAs and virusoids. Anti viral agents – Viral vaccines, Interferon.

**UNIT II**

Epidemiology, life cycle, pathogenicity, diagnosis, prevention and treatment of DNA Viruses. Pox virus – Variola, Vaccinia, Herpes Simplex Virus – Varicella Zooster virus, Adeno virus, Hepatitis virus – A, B & C, Cytomegalo virus, Epstein Barr virus, Oncogenic virus – Papilloma virus , Polyoma virus.

**UNIT III**

Epidemiology, life cycle, pathogenicity, diagnosis, prevention and treatment of RNA Viruses. Picorna viruses – Polio virus, Orthomyxo virus – Influenza virus (H1N1), Paramyxo viruses – Mumps virus, Measles virus, Rhabdo viruses - Rabies virus, Retro virus – HIV, Arbo viruses – Yellow fever virus, Dengue virus, Japanese B Encephalitis virus. Newly emerging viral disease –Ebola & Zika virus.

**UNIT IV**

Introduction and classification of parasites - Laboratory diagnostic techniques in parasitology - Examination of faeces, cultivation, Direct and concentration methods - Intestinal amoebae - Entamoeba histolytica, Entamoeba coli. Free living amoebae - Naegleria fowleri, Acanthamoeba spp. Intestinal and genital flagellates - Giardia, Trichomonas. Blood and tissue flagellates - Leishmania donovani, Trypanosoma cruzi. Haemosporina - Malarial parasites. Coccidian - Toxoplasma, Cryptosporium.

**UNIT V**

Helminthic Infections - Taenia solium, T. Saginata, Echinococcus granulosus, Fasciola hepatica, Paragonimus westermani and Schistosomes, Ascaris lumbricoids, Ancylostoma duodenale, Trichuris triuchura, Enterobius vermicularis and Wuchereria bancrofti. Blood smear examination - Serology and Molecular diagnosis - PCR. Emerging parasitic infection.

### REFERENCE BOOKS

1. Topley and Wilson (1995) Principles of Bacteriology Virology and Immunity. 9th Edn. Vol I, Edward Arnold, London.
2. Morag, C. and Timbury, M.C. (1994) Medical Virology, 10th Edn. Churchill Livingstone, London.
3. Dimmock, N.J. and Pimrose, S.B. (1994) Introduction to Modern Virology, 4th Edn. Blackwell Scientific Publications, Oxford.
4. Conrat, H.F., Kimball, P.C. and Levy, J.A. (1994) Virology, 3rd Edn, Prentice Hall, New Jersey.
5. Chakraborty, P., 2003. A Text Book of Microbiology. 2nd edition, Published by New Central Agency (P) Ltd., Kolkatta.
6. Monica Cheesbrough, 2003. District Laboratory Practice in Tropical Countries. Part 1 and 2. Cambridge University Press.
7. Dey, N.C., Dey, T.K. and Sinha, D., 1999. Medical Bacteriology including Medical Mycology and AIDS. 17th edition, New Central Book agency. Kolkatta.
8. Subhash Chandra Parija, 2004. Text book of Medical Parasitology – Protozoology and Helminthology. 2nd edition, published by All India Publishers and Distributors, Medical book publisher, New Delhi.
9. Chatterjee, 1986. Medical Parasitology. Tata McGraw Hill, New Delhi.
10. Karyakarte, R.P. and Damle, A.S., 2005. Medical Parasitolog. Revised edition. Published by Books and Allied (P) Ltd., Kolkatta.
11. Jeyaram Paniker, 2004. Text book of Medical Parasitology. 5th edition, JAYPEE brothers, Medical Publishers (P) Ltd, New Delhi.
12. Ichpujani, R.L. and Rajesh Bhatia, 2003. Medical Parasitology. 3rd edition, JAYPEE brothers, Medical publishers (P) Ltd, New Delhi.
13. Patrick R. Murray PhD (Author), Ken S. Rosenthal PhD (Author), Michael A. Pfaller MD (Author). Medical Microbiology, 8e 8th Edition.
4. Ananthanarayan R and Jayaram Paniker CK (2005) Text Book of Microbiology. Seventh edition, Orient Longman Limited, Hyderabad.
5. Jawetz, Melnick, & Adelberg's. (2013). Medical Microbiology. 26th Edition. McGraw-Hill.

### WEB REFERENCES:

1. <http://dmoz.org/Science/Biology/Microbiology/>
2. <http://microbiology.mtsinai.on.ca/manual/default.asp>
3. <http://cal.vet.upenn.edu/parasite/links.html>
4. <http://www.suite101.com/links.cfm/microbiology>
5. <http://www.biosci.ohio-state.edu/-zoology/parasite/home.html>

**M.Sc. APPLIED MICROBIOLOGY**  
**SEMESTER - III**  
**CORE VIII - FOOD, DAIRY AND ENVIRONMENTAL**  
**MICROBIOLOGY**

**UNIT I Food Microbiology**

Food as a substrate for microbes. Microorganisms important in food microbiology. Factors influencing microbial growth in food. Extrinsic and Intrinsic factors. Sources of food contamination.

**UNIT II**

Principles of food preservation, Contamination, preservation and spoilage of fruits, vegetables, meat, poultry, eggs, fish and other sea foods. Canning - Methods - Types - Spoilage of canned foods. Food borne diseases, food intoxication and their control measures.

**UNIT III**

Dairy Microbiology: Micro flora of milk. Sources of milk contamination. Preservation and spoilage of milk and milk products. Fermented foods - Fermented vegetables and dairy products. Food sanitation. Food control agencies and their regulations.

**UNIT IV**

Environmental Microbiology: Microbiology of air - composition of air, number and types of organisms in air. Distribution and sources of air borne organisms. Enumeration of bacteria in air - Air sampling devices. Air sanitation. Air borne diseases and their control. Microbiology of water- Indicator organisms. Assessment of water quality. Water sanitation. Water borne diseases. ISI and BIS Regulations for packaged drinking water.

**UNIT V**

Waste treatment - Types of wastes - Characterization of solid and liquid wastes. Effluent treatment - Primary, secondary (aerobic and anaerobic) and tertiary Methods - Disinfection - SCP and Biogas production. Definition of DO, BOD, COD and their limits in treated industrial effluents. Solid waste management - Composting, vermicomposting, silage, pyrolysis saccharifications and Mushroom cultivation.

**REREFENCES**

1. Adams MR & MO Moss (2005). Food Microbiology, New Age International (P) Limited. Publishers; 1st Edition, New Delhi.
2. James M Jay (2004). Modern Food Microbiology, CBS Publishers & Distributors; 4th Edition, New Delhi.
3. Patel A H (2005). Industrial Microbiology. Published Laxmi Publications; Second edition.
4. Rita Narayanan B. Dhanalakshmi (2013) Food Microbiology: Basic and Applied with Laboratory - New India Publishing Agency.
5. A. Bohra P. Bohra (2011) Food Microbiology, Agrobios.
6. William Frazier and Dennis Westhoff (2008) - Food Microbiology McGraw Hill Education; 4 edition.
7. Purohit SS, AK Saluja, HN Kakrani (2004). Pharmaceutical Biotechnology, Agrobios (India); Ist Edition.
8. Ian L. Pepper Professor, Charles P. Gerba and Terry J. Gentry (2014), Environmental Microbiology, Academic Press; 3 edition.
9. Buckley R G (2016) Environmental Microbiology – CBS; 1 edition.
10. Ralph Mitchell and Ji-Dong Gu (2009) Environmental Microbiology, Wiley-Blackwell.
11. Singh DP & SK Dwivedi (2005). Environmental Microbiology and Biotechnology, New Age International Publishers (P) Ltd; 1st Edition, New Delhi.
12. Vijaya Ramesh K (2004). Environmental Microbiology, MJP Publishers; 1st Edition, Chennai.
13. Joseph C Daniel (1999) Environment Aspects of Microbiology, Bright sun Publications; 1st Edition, Chennai.
14. 1M.S. Bhatt and Asheref Illiyan (2012), Solid Waste Management: An Indian Perspective, Synergy Books India, New Delhi.

**M.Sc. APPLIED MICROBIOLOGY**  
**SEMESTER - III**  
**CORE IX - SOIL, AGRICULTURAL MICROBIOLOGY AND**  
**BIODEGRADATION**

**UNIT I**

Discoveries in soil Microbiology; distribution of microorganisms in soil, Autochthonous, Allochthonous and Zymogenous microbes, quantitative estimation of microorganisms in soil, role of microorganisms in soil fertility; influence of soil and environmental factors on micro flora, moisture, pH, temperature, organic matter, agronomic practices.

**UNIT II**

Biogeochemical cycles, Carbon cycle, organic matter decomposition, humus formation, Nitrogen cycle - nitrogen fixation, ammonification, nitrification, denitrification, reactions – organisms involved. Nitrogen fixation – symbiotic - root nodulation, non symbiotic, associative organisms, nitrogenase, hydrogenase, nif gene, nod gene. Microbial transformation of phosphorus, solubilization by phosphobacteria and P- mobilization by mycorrhizal fungi, Microbial transformation of sulphur - sulphur toxicity and sulphur bacteria.

**UNIT III**

Interaction between soil microbes–Neutralism, Commensalism, Symbiosis, Synergism, Amensalism, Parasitism, Predation and Competition. Interrelationships between soil microbes and plants, Rhizosphere concept, R:S ratio, rhizoplane; spermosphere; phyllosphere, Mycorrhizae-types, Rumen flora, Insects microbial interactions.

**UNIT IV**

Phytopathology – Classification of plant diseases, signs, and related terminology. Bacterial disease – Citrus canker, Blight of paddy, Fungal Disease- Red rot of sugarcane, Black stem rust of wheat, Tikka leaf spot, Wilt of cotton, Viral Disease – TMV, Vein clearing disease. Principles and methods of plant disease management, integrated plant disease management.

**UNIT V**

Biofertilizers – Rhizobium, Azotobacter, Cyanobacteria, Azolla, and VAM. Biopesticides – Bacillus thuringiensis, Pseudomonas fluorescens - 84, Trichoderma viridae, Bavaria bassiana, Nuclear Polyheadrosis Virus. Biodegradation – Cellulose, Lignin. Biodeterioration – Wool, Leather. Bioleaching- Copper, Uranium. Biomagnification, Bioremediation – Degradation of DDT, Atrazine (Xenobiotic Compounds) and Cleanup oil spills – P. putida.

**REFERENCE BOOKS:**

1. Subba Rao NS (2004). Soil Microbiology. Fourth edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Mishra RR (2004). Soil Microbiology. First edition, CBS Publishers and distributors, New Delhi.
3. Rangaswami G and Mahadevan A (2002). Disease of Crop Plants in India. Fourth edition, PHI Learning (P) Ltd., New Delhi.
4. Rangaswami G and Bagyaraj DJ (2002). Agricultural Microbiology. Second edition, PHI Learning (P) Ltd., New Delhi.
5. Robert, L Tate (1995). Soil Microbiology. First edition, John Wiley and Sons, Inc. New York.
6. R, M, Atlas and Richard Bartha (2000). Microbial Ecology, Fourth edition, An imprint of Addison Wesley Longman, Inc, New York.

**M.Sc. APPLIED MICROBIOLOGY****SEMESTER - III****PRACTICAL V - MEDICAL VIROLOGY AND PARASITOLOGY**

1. Examination of parasites in clinical specimens - ova/cysts in faeces.
2. Direct and concentration: methods - Formal Ether and Zinc sulphate methods - Saturated salt solution method.
3. Blood smear examination for malarial parasites.
4. Thin smear by Leishman's stain.
5. Isolation and characterization of bacteriophage from natural sources – phage titration-T4.
6. Study of virus infected plants - chick embryo isolation- fibroblast culture preparation (demonstration).
7. Spotters of viral inclusions and CPE - stained smears. Viral serology- HAI -ELISA kits, Western Blotting.

**REFERENCE BOOKS:**

1. Dubey, R.C. and Maheshwari, D.K. (2002) Practical Microbiology, 1st Edn. S. Chand & Co. Ltd., New Delhi.
2. Cappuccino, J. and Sherman, N. (2002) Microbiology: A Laboratory Manual, 6th Edn. Pearson Education Publication, New Delhi.
3. Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996) Mackie and McCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London.
4. Cowan and Steel (1995) Manual for Identification of Medical Bacteria, 4th Edn. Cambridge University Press, London.
5. Murray, P.R., Baron, E.J., Jorgensen, J.H., Tenover, M.C. and Tenover, R.H. (2003) Manual of Clinical Microbiology, 8th Edn. Vol 1&2, ASM Press, Washington, D.C.
6. Balows, A., Hausler, W.J., Tenover, M.C. and Tenover, R.H. (Eds) (1988) Laboratory Diagnosis of Infectious Diseases: Principles and Practice, Vol 1 Springer-Verlag, New York.
7. Holt, J.S., Krieg, N.R., Tenover, P.H.A. and Williams, S.S.T. (1994) Bergey's Manual of Determinative Bacteriology, 9th Edn. Williams & Wilkins, Baltimore.
8. Gerhardt, P., Murray, R.G., Wood, W.A. and Tenover, N.R. (Eds) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.
9. Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edn. C.V. Mosby Company, St. Louis.

**M.Sc. APPLIED MICROBIOLOGY**  
**SEMESTER - III**  
**PRACTICAL VI - (FOOD, DIARY, ENVIRONMENTAL AND**  
**AGRICULTURAL MICROBIOLOGY)**  
**FOOD, DIARY, ENVIRONMENTAL MICROBIOLOGY**

1. Microbiological (Bacteria and Fungi) examination of spoiled foods
  - ❖ Vegetables
  - ❖ Fruits
  - ❖ Dairy products
2. Examination of microbial load in
  - ❖ Fruit pulp
  - ❖ Carbonated beverages
  - ❖ Ice creams
3. Assessment of milk quality by
  - ❖ Breeds count
  - ❖ Standard Plate Count (SPC) method
  - ❖ Methylene Blue Reduction Test (MBRT)
  - ❖ Resazurin Test
4. Litmus milk test
5. Quantification of microbes in air by
  - ❖ Settle plate method
  - ❖ Air sampler
6. Examination of potability of drinking water by
  - ❖ Membrane filter technique
  - ❖ Standard Plate Count (SPC) method
  - ❖ Most Probable Number Test (MPN)
7. Physico- chemical assessment of treated water by
  - ❖ DO
  - ❖ COD
  - ❖ BOD



**REFERENCE BOOKS:**

1. Dubey, R.C and Maheshwari, O.K (2005) Practical Microbiology, S Chand and Co. Ltd., (First edition), New Delhi.
2. [James G. Cappuccino](#) and Natalie Sherman (2014) Microbiology: A Laboratory Manual (10th Edition), Pearson.
3. Aneja, K.R (2003) Experiments in Microbiology, Plant Pathology and Biotechnology (4th edition), New age international, New Delhi.
4. Rajan S., R. Selvi Christy (2010), Experimental procedures in Life Sciences, (3rd reprint) Anjanaa Book House, Chennai. 2000) Diagnostic Microbiology, 10th Edn. C.V. Mosby Company, St. Louis.

**M.Sc. APPLIED MICROBIOLOGY**  
**SEMESTER - III**  
**PRACTICAL VI - AGRICULTURAL MICROBIOLOGY AND**  
**BIODEGRADATION**

1. Enumeration of Heterotrophic microbes from soil
2. Isolation of Rhizobium from root nodules
3. Isolation of Azotobacter from soil
4. Isolation of Azospirillum from root
5. Isolation of Phosphate Solubilizers
6. Estimation of R:S ratio of rhizosphere
7. Isolation of Antagonistic microorganism from soil
8. Isolation and identification of plant pathogens
  - ❖ Citrus canker - *Xanthomonas citri*
  - ❖ Blight of paddy - *Xanthomonas oryzae*
  - ❖ Tikka leaf spot - *Cercospora* sp.
  - ❖ Wilt of cotton - *Fusarium oxysporum*
  - ❖ Red rot of sugarcane – *Colletotricum falcatum*
9. Study of Cyanobacteria
  - ❖ Anabaena
  - ❖ Nostoc
  - ❖ Oscillatoria
  - ❖ Lyngbya
10. Isolation and identification of *Trichoderma* sp.
11. Isolation of Cellulose degrading bacteria.
12. Isolation of Xenobiotic (pesticide) degrading bacteria.
13. Isolation and Microscopic observation of Mycorrhizae/spore.
14. Microscopic observation of *Bacteria* sp.

**REFERENCES:**

1. Subba Rao NS (2004). Soil Microbiology. Fourth edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Mishra RR (2004). Soil Microbiology. First edition, CBS Publishers and distributors, New Delhi.
3. Rangaswami G and Mahadevan A (2002). Disease of Crop Plants in India. Fourth edition, PHI Learning (P) Ltd., New Delhi.
4. Rangaswami G and Bagyaraj DJ (2002). Agricultural Microbiology. Second edition, PHI Learning (P) Ltd., New Delhi.
5. Robert, L Tate (1995). Soil Microbiology. First edition, John Wiley and Sons, Inc. New York.
6. R,M, Atlas and Richard Bartha (2000). Microbial Ecology, Fourth edition, An imprint of Addison Wesley Longman, Inc, New York.

**M.Sc. APPLIED MICROBIOLOGY****SEMESTER - IV****CORE X - RESEARCH METHODOLOGY, BIostatISTICS AND BIOINFORMATICS****UNIT I**

Research Methodology - Meaning and importance. Statement, Constraints, Review of literature - Review and synopsis presentation. Types of research, Research tools, Qualities of a good researcher. Research process, Research designs - Experimental and non-experimental. Preparation of research report. Guidelines for preparing an article. Computers in biological research.

**UNIT II**

Data collection, source of data, types of classification of data, Tabulation of data – Diagrammatic representation of data (line, bar diagram, pie diagram, pictogram and cartogram) - Graphical representation of data. Measures of central tendency – mean, median, mode - Standard deviation. Correlation – coefficient of correlation (Karl Pearson method, group bi-variable data). Coefficient of variation. Probability.

**UNIT III**

ANOVA (one way and two way), Chi square test –Student's T test – testing of hypothesis-null hypothesis- level of significance-standard error. F Test Web Resources for Microbiology – Use of Digital Library.

**UNIT IV**

Bioinformatics - Introduction and skills for a bioinformatician. Biological databases- Database searching, Sequence analysis, Pair alignment, Visualizing protein structures, Predicting structure and function of protein using sequences, Tools for genomics and proteomics.

**UNIT V**

Bioinstrumentation - Principles and applications of pH meter, Centrifuge . Electrophoresis, Chromatography -Thin layer, Column, Gas and high pressure liquid chromatography, spectrophotometry, NMR, Atomic absorption spectrophotometer, Microbial Identification System, Autoanalyser - ELISA Reader.

**REFERENCES:**

1. Balagurusamy. E, 1992, Programming in ANSIC, Tata Mcgraw Hill.
2. Bernard Rosner, 1999, Fundamentals of Biostatistics ,Duxbury Press.
3. Attwood T.K. and D.J. Parry-Smith, 2001. Introduction to Bioinformatics, Pearson Education Asia.
4. Jeffrey A. Witmer Myra L. Samuels, 2002. Prentice Hall Statistics for the Life Sciences (3rd Edition).
5. Gurumani. N., 2006. Research methodology for biological sciences. 1st edition, MJP Publishers. A unit of Tamil nadu Book House, Chennai.
6. Wayne W. Daniel, 2006. Biostatistics- A foundation for analysis in the Health Sciences. 7TH edition. Wiley India publication.
7. Rastogi. S. C, N. Mendiratta and P. Rastogi, 2008. Bioinformatics- Methods and Applications Genomics, Proteomics and Drug Discovery 3rd edition.
8. Harvey Motulsky, 1995, Intuitive Biostatistics, Oxford University Press.
9. Marcello Pagano Kimberlee Gauvreau, 2000. Principles of Biostatistics , 2nd Edition, Brooks Cole.
10. Higinns. D and W. Taylor (Eds.) 2000. Bioinformatics. Sequence, Structure and databanks- A Practical Approach by Oxford University Press.
11. Baxevanis A.D and B.F. Francis Ouellette (Eds.) Wiley-Interscience, 2001. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins.
12. Stanton A. Glantz, 2001. Primer of Biostatistics McGraw-Hill.
13. David W. Mount, Cold Bioinformatics, 2001. Sequence and Genome Analysis, Spring Harbor Laboratory Press.
14. Claverie J-M and C. Notredame, 2003. Bioinformatics for Dummies, Wiley Publishing, Inc.
15. Beth Dawson Robert G. Trapp Beth Dawson Robert Trapp, 2004. Basic and Clinical Biostatistics (LANGE Basic Science), McGraw-Hill.

**M.Sc. APPLIED MICROBIOLOGY**  
**ELECTIVE COURSES**

**PLANT PHYSIOLOGY AND PLANT TISSUE CULTURE**

**UNIT I**

Photosynthesis - light harvesting complexes, structure and function of chlorophylls and other pigments. Mechanism of light absorption – Photo system-I and II. Photophosphorylation. Co<sub>2</sub> fixation – C<sub>3</sub>-C<sub>4</sub> and CAM Pathways. Structure, function and mechanism of phytochromes, Cryptochromes and phototropins.

**UNIT II**

Respiration and photorespiration - Glycolysis, Citric acid cycle, plant mitochondrial electron transport and ATP synthesis. Secondary metabolites – Bio synthesis of Terpenes, Phenols and Nitrogenous compounds and their roles.

**UNIT III**

Nitrogen metabolism - Sources of Nitrogen, Biochemistry and Physiology of Symbiotic Nitrogen fixation in root nodule - Leghaemoglobin. Nitrate and ammonium assimilation, Amino acid biosynthesis. Plant hormones (Auxin, Gibberellin and Cytokinin) physiological effects and mechanism of action.

**UNIT IV**

General Techniques of Micropropagation, Initiation of culture, Multiplication, Rooting – Hardening, callus culture, Embryogenesis. Somaclonal and gametoclonal variation, uses in crop improvement. Synthetic seeds-practical application. PTC medium.

**UNIT V**

Shoot Tip-Meristem culture for virus free plants. Anther culture-production of Haploids. Protoplast culture-protoplast isolation-Purification – culture-regeneration. Somatic hybridization – protoplast fusion techniques. Cryopreservation and Germplasm storage.

**REFERENCES:**

1. S.N. Pandey, B.K. Sinha (2009). Plant physiology. Vikas Publishing House Pvt Limited.
2. Francis H. Witham, Robert M. Devlin (1986). Plant physiology. CBS Publishers & Distributor.
3. V.K. Jain. Fundamentals of plant physiology (2005). S. Chand & Company Ltd.
4. M.K. Razdan. Introduction to plant tissue culture. (2003). Science publishers Inc.
5. NIIR Board of Consultants & Engineers (2005). Handbook on plant and cell tissue culture. Asia Pacific Business Press Inc.,

**M.Sc. APPLIED MICROBIOLOGY  
ELECTIVE COURSES**

**BIOINSTRUMENTATION AND BIOLOGICAL TECHNIQUES**

**UNIT I**

Buffers, molar and normal solutions, pH meter, pH electrodes – calomel and glass electrodes. Incubator, water bath shaker, laminar air flow.

**UNIT II**

Centrifugation: Principle – types of centrifuges – low speed, high speed, ultra centrifuge, and Differential centrifugation – density gradient centrifugation. Conversion of 'G' in to rpm. Applications of centrifuge.

**UNIT III**

Electrophoresis – SDS – PAGE and Agarose gel electrophoresis. Southern blotting – Northern blotting – Western blotting – DOT blotting.

**UNIT IV**

Chromatography – paper, thin layer, column, ion exchange, gas chromatography and HPLC, Colorimetry, spectrometry - FACS - Biosensors.

**UNIT V**

Biological Techniques - ELISA - Principles and types. Immunodiffusion techniques - ODD, RIA. Agglutination and its applications - IFT, CFT.

**REFERENCES:**

1. Bajpai PK (2010). Biological Instrumentation and Methodology. Revised edition, S.Chand & Co. Ltd., New Delhi.
2. Palanivelu P (2004). Analytical Biochemistry and Separation techniques. Third edition, MKU Co-op, Press Ltd., Palkalai Nagar, Madurai.
3. Gurumani N (2006). Research Methodology for Biological Sciences. First edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai.
4. Subramanian MA (2005). Biophysics – Principles and Techniques. First edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai.
5. John G Webster (2004). Bioinstrumentation. Student edition. John Wiley and Sons, Ltd.
6. Ravishankar S (2001). A Text Book of Pharmaceutical Analysis. Third edition. Rx Publications, Tirunelveli.
7. Upadhyay & Upadhyay. Biophysical Chemistry, (2010). Himalaya Publishing house.

**M.Sc. APPLIED MICROBIOLOGY**  
**ELECTIVE COURSES**  
**HUMAN ANATOMY AND PHYSIOLOGY**

**UNIT I**

An Introduction to Human body - Overview of level of organization and characteristics - Digestive system - Components of digestive system (GI tract and accessory organs) and their functions.

**UNIT II**

Muscular system - Muscle tissue - types (Skeletal, smooth and cardiac) - functions and properties. Neuro muscular junction.

**UNIT III**

Respiratory system - Anatomy - External and internal respiration. Cardiovascular system - Anatomy of heart, Cardiac cycle and ECG.

**UNIT IV**

Nervous system - CNS and ANS Organization - Neuron - Structure and functions - Neuro transmitters and signal transmission. Anatomy and physiology of endocrine glands - Classification of hormones - General properties and action of pituitary, thyroid, para thyroid, pancreatic hormones and gonads.

**UNIT V**

Urinary system - External and Internal anatomy of kidneys - nephron - parts and functions. Mechanism of urine formation. Reproductive system - Anatomy and physiology of male and female reproductive organs.

**REFERENCES:**

1. Gerard J. Tortora, Bryan H. Derrickson (2014) Principles of anatomy and physiology, John Wiley and sons Inc; 10th Edition.
2. A.C. Guyton (2010) Text Book of Medical physiology, Saunders; 12th edition.
3. K. Sembulingam and Prema Sembulingam (2012) Essentials of medical physiology - Jaypee brothers Medical publishers (P) Ltd; 6th Edition.
4. D U Silverthorn (2015) Human physiology - An integrated approach, Pearson; 7th edition.

**M.Sc. APPLIED MICROBIOLOGY**  
**ELECTIVE COURSES**  
**NANOTECHNOLOGY**

**UNIT I Introduction to nanotechnology**

What is nanotechnology? - What is Nanobiotechnology? - What is nanomaterial? - Classification of nanostructures - Nanospheres, Nanotubes, Nanorods, Nanowires, Nanosheets, Quantum dots - Effects of the nanometre length scale - Changes to the system structure - How nanoscale dimensions affect properties - Nanocomposites - Graphene - Carbon Nanotubes - Fullerenes - Natural Nanomaterials - Bio-inspired nanomaterials.

**UNIT II Synthesis Methods of Nanomaterials**

Physical synthesis - Ball Milling - Electrodeposition - Spray Pyrolysis - Thermal evaporation Chemical synthesis - Sol-Gel Process - Metal Nanocrystals by Reduction - Solvothermal Synthesis - Biological Synthesis - Protein-Based Nanostructure Formation - DNA-Templated Nanostructure Formation - Protein Assembly

**UNIT III Properties of Nanomaterials**

Physical properties - Electrical, Optical, Mechanical, Magnetic, Quantum confinement, Surface Plasmon resonance - Electrochemical Properties of Nanoscale Materials, Intra-molecular bonding, Inter-molecular bonding, Nanocatalysis, Surface energy, Self-assembly - Interaction Between Biomolecules and Nanoparticle Surfaces

**UNIT IV Characterization methods**

X-ray diffraction (XRD) - Dynamic Light Scattering (DLS). Electron microscopes: Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM); Atomic Force Microscope (AFM) -UV - Visible Spectrophotometer - Photoluminescence (PL) Spectrophotometer - Fourier Transform InfraRed Spectrometer (FTIR) - Nuclear Magnetic Resonance (NMR) - Differential scanning calorimeter (DSC) - Thermogravimetric/Differential Thermal Analyzer (TG/DTA)

**UNIT V Applications of Nanoparticles**

Polymeric, Lipid nanoparticles for drug delivery, Micelles in Drug Delivery. Quantum Dots, Gold, silica, silver and magnetic nanoparticles for biomedical applications - Biosensors - Proteins in Nanotechnology Enabled Sensors - Nano-sensors based on Nucleotides and DNA Microarrays - Cell Biochips - in-vitro Characterization - in- vivo Investigations - Use of Nanoparticles in Animals - Nanoparticles for Imaging and Therapy in Humans - Military applications of Nanotechnology - Nanomaterials for food Applications - Toxicity of Nanoparticles - Future Perspectives.



**REFERENCES:**

1. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
2. Nano:The Essentials: Understanding Nanoscience and Nanotechnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
3. Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Guozhong Gao, Imperial College Press, 2004.
4. Encyclopedia of Materials Characterization, C. Richard Brundle, Charles A. Evans Jr., Shaun Wilson, Butterworth-Heinemann Publishers, 1992.
5. Nanotechnology: Basic Science and Emerging Technologies - Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press, 2005.
6. Nanoparticles as Drug carriers, Vladimir P Torchilin, Imperial College Press, USA, 2006.
7. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M.Niemeyer, Chad A.Mirkin, Wiley-VCH, Weinheim, 2004.

**M.Sc. APPLIED MICROBIOLOGY**  
**ELECTIVE COURSES**  
**ORGANIC FARMING**

**UNIT I**

Scope, Definition and concept of organic farming. Components of organic farming and their role in sustainable crop production. Nutrient management in organic farming – Crop rotation. Integrated intensive Farming system (IIFS).

**UNIT II**

Traditional organic farming:- Manures – Bulky organic manures:- Farmyard manure, compost - urban compost, Night-soil. Concentrated organic manures – Oil Cakes, Fishmeal. Green manure – Sesbania sps., Crotalaria juncea. Green leaf manure.

**UNIT III**

Non-Traditional organic farming:- Bio fertilizers, Rhizobium, Azotobacter, Azospirillum, B.G.A., Azolla, Ecto & Endo Mycorrhiza, VAM – Potash mobilizer (Frateuria aurentia)- Liquid biofertilizers - Mass cultivation, Field application, cost effectiveness. Vermi – Compost - Methods. Aquatic weeds.

**UNIT IV**

Biogas technology for organic farming - Composition of biogas slurry- Agronomic importance. Waste water treatment method (sewage) and its uses for organic farming - Macrophyte Treatment. Agricultural waste management – Crop waste - cattle, Poultry and pig waste - Farm waste recycling.

**UNIT V**

Pest and disease management in organic farming – Trichogramma sps., NPV, Beauveria bassiana, Metarhizium anisopliae. Weed management – Living mulch, organic mulches and biological weed control. Organic post harvest technologies. Organic farm inputs techniques: Panchagavya and Dasagavya. Organic certification and accreditation process of organic product.

**REFERENCES:**

1. Subba Rao NS (2004). Soil Microbiology. Fourth edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Rangaswami G and Bagyaraj DJ (2002). Agricultural Microbiology. Second edition, PHI Learning (P) Ltd., New Delhi.
3. Dahama, A.K. (2002). Organic Farming for sustainable agriculture. Agrobios (India).
4. Arun K.Sharma, (2003). Biofertilizers for Sustainable Agriculture. Agrobios (India).
5. Subba Rao NS (1997). Biofertilizer in Agriculture and Forestry, 3rd edition, Oxford & IBU Publications.
6. Dubey RC (2005). A Text of Biotechnology. Multicolor Illustrative edition, S.Chand and Company Ltd., New Delhi.

**Web Sites:**

1. [http://www.agritech.tnau.ac.in/org\\_farm/orgfarm\\_index.html](http://www.agritech.tnau.ac.in/org_farm/orgfarm_index.html)

**M.Sc. APPLIED MICROBIOLOGY**  
**ELECTIVE COURSES**  
**BASICS OF PHYTOCHEMISTRY**

**UNIT I**

Distribution of Indian medicinal plants; Introduction, Important medicinal plants, eco distribution, mapping distribution in different biogeographic zones. Diversity hot spots - Endemism - Rare, endangered and threatened species. Plant genetic resources and their conservation: Medicinal and Aromatic plants – Scope and importance of medicinal plants. Drug discovery from plants – the role of plants in human history- the role of plant derived compounds in drug development.

**UNIT II**

Plant secondary metabolites as drug precursors-Recent developments in drug discovery from plants – Introduction to Phytochemicals - Antioxidants - Alkaloids - Anthocyanins - carotenoids - flavonoids - Hydroxycinnamic acids - Xanthophylls - plants with phytochemicals - Production of Phyto chemicals from medicinal plants - Extraction of phytochemicals - Developing new drugs from Ethnomedicines.

**UNIT III**

Pharmacognosy - Introduction - history - Indian System of medicine – natural sources of Drugs – Crude drugs – Classification of crude drugs – Collection and Processing of crude drugs – Phytoconstituents of therapeutic value – Histochemical tests for phytochemicals – Analytical pharmacognosy – Anatomical features of selected medicinal plants (Senna leaf, Datura leaf, Cinchona bark, Nux Vomica seed).

**UNIT IV**

Separation of bioactive compounds – Extraction methods: distillation, steam and solvent. Phytochemical screening – Phytochemistry – Extraction, isolation , characterization and identification of terpens, alkaloid and flavanoids.

**UNIT V**

An overview of bioinformatics. Molecular docking, drug design and commercial bioinformatics. Computing tools phylogenetics and computational biology. Intellectual property rights, patents, trade secrets, copyrights, trade mark. Patenting transgenic organisms. Plant breeders right.

**REFERENCES:**

1. Goodman Gillmans. The pharmacological basis of therapeutics (2001). Ed. Hardman JG.
2. Limbird LE (Tenth Edition) McGraw Hill press New York.
3. Bajpai, s. Biological instrumentation and methodology.
4. Avinash Upadhyay. Biophysical chemistry, Principle and Techniques.
5. Attwood T.K. and D.J. Parry- smith. Introduction to bioinformatics pearson education.
6. Subbaram , N. Patents. Pharma Book syndicate.
7. Harborne JB (1984) Phytochemical methods: A guide to Modern techniques of plant.
8. Analysis, 2nd edn., Chapman and Hall , New York.
9. Jones WP, Chin YW, Kinghorn AD (2006) Curr Drug Targets 7:247.
10. Drug Discovery from plants. A.A. Salim, Y., M. Chin and A.D. Kinghorn 2008.
11. Webster J.G., Bioinstrumentation.
12. Wilson, K. and J.Walker Practical biochemistry principles and Techniques.
13. Gurumani, N. Research methodology for biological sciences.
14. Rosner, B., Fundamentals of Biostatistics.
15. D.J. Holme and H. Peck, Analytical Biochemistry, Longman Group, 1983.
16. Higgins, D. and W. Taylor. Bioinformatics. Sequence, Structure and Databanks.

**M.Sc. APPLIED MICROBIOLOGY**  
**EDC COURSES - EXTRA DISCIPLINARY COURSES**  
**ENTREPRENEURIAL MICROBIOLOGY**

**UNIT I**

Entrepreneur development, activity, Institutes involved, Government contributions to entrepreneur, risk assessment, Industrial Microbiology, Definition, scope and historical development.

**UNIT II**

Microbial cells as fermentation products – Baker's yeast, food and feed yeasts, bacterial insecticides, legume inoculants, Mushrooms, Algae, Enzymes as fermentation products-bacterial and fungal amylases, proteolytic enzymes.

**UNIT III**

Mushroom cultivation and composting-cultivation of *Agaricus campestris*, *Agaricus bisporous* and *Volvoriell volvaciae*: Preparation of compost, filling tray beds, spawning, maintaining optimal temperature, casing, water harvesting, storage, Biofertilizer-Historical background, chemical fertilizers versus biofertilizers, organic farming. *Rhizobium* sp., *Azospirillum* sp., *Azotobacter* sp., as Biofertilizers

**UNIT IV**

Brewing - Media components, preparation of medium, microorganisms involved, maturation, carbonation, packaging, keeping quality, contamination, by products. Production of industrial alcohol.

**UNIT V**

Patents and secret process, History of patenting, composition, subject matter and characteristics of a patent, inventor, infringement, cost of patent. Patents in India and other countries. Fermentation economics.

**REFERENCES:**

1. Prescott LM, Harley JP and Klein DA (2003) Microbiology (10th edition) McGraw Hill, New York.
2. Pelczar Jr, M.J. Chan, E.C.S and Krei N.R (1993) Microbiology McGraw Hill, New York.
3. Subba Rao NS (1997). Biofertilizer in Agriculture and Forestry, 3rd edition, Oxford & IBU Publications.
4. LE Cassida JR (2005). Industrial Microbiology. New Age International (P) Ltd., New Delhi.
5. Arora. Entrepreneurial Development in India.
6. Aneja, K.R. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, 6th Edition, New age International Publication.

**M.Sc. APPLIED MICROBIOLOGY**  
**EDC COURSES - EXTRA DISCIPLINARY**  
**COURSES MICROBIAL NANOTECHNOLOGY**

**UNIT I**

Definition – Evolution of Nanoscience – Need of Nanotechnology – Hurdles for Nanotechnology development – Factors affecting the manufacturing process of nano materials – Role of physicists, chemists, medical doctors, engineers, biologists and computer scientists in nanotechnology.

**UNIT II**

Spectroscopy and Microscopy – the two most important tools used in nano technology research – Infra red spectroscopy, Raman spectroscopy, Ultra violet-visible spectroscopy. Atomic force microscope – Scanning electron microscope – Transmission electron microscope – Scanning tunneling microscope- Magnetic resonance force microscopy.

**UNIT III**

Nanospectra biosciences. Nanocrystals – Quantum dot as Biological fluorescent tag – Bucky balls for medical imaging – Gadolinium for Magnetic resonance imaging – Dendrimers in molecular imaging. Nanoprobes for nucleic and hybridization detection. Nucleophilic carbenes. Working on the DNA chain gangs. DNA and protein based nanocircuitry.

**UNIT IV**

Nanotechnology for drug development and medical applications. Nanotechnology for drug solubilization and drug delivery. Diagnosis using nanomaterials. Nanotherapy for cancer treatment – Interior artery expansions – Replacing joints with better stuff. - Radioactive tubercule cages in Nuclear medicine.

**UNIT V**

Cleaner environment with Nanotechnology. Cleaning the air with Nanotechnology – Nanotechnology for water treatment. Microbial nanoparticles. Nanocarbon ball as deodorizer in ferment process. Biomotors for engineered devices. Possible harm from Nanomaterials. Nanoscience in India – Nanoscience education abroad – Looking at ethics and society.

**REFERENCES:**

1. Richard Brooker and Earl Boysen (2006). Nanotechnology. Wiley Publishing Inc., India. Pp 361.
2. Paul Dieppe and Paul Calvert. (1983). Crystals and Joint disease, Chapman and Hall Ltd, London.
3. Duckruix, A. and R. Giege, (1992). Crystallization of Nucleic acids and Proteins. A practical approach, Oxford University Press, England.

**M.Sc. APPLIED MICROBIOLOGY**  
**EDC COURSES - EXTRA DISCIPLINARY COURSES**  
**BASICS OF MICROBIOLOGY**

**UNIT I**

History and scope of microbiology – Louis Pasteur – Robert Koch. Microscope and its applications. Importance of staining. Classification of microorganisms.

**UNIT II**

Structure and organization of bacterial cell. Sterilization and Disinfection, Methods of sterilization – Physical and chemical methods.

**UNIT III**

Culture and media preparation, Nutrition – Different phases of growth – Growth curve. Structure and function of DNA and RNA.

**UNIT IV**

Antigen, Antibody – Humoral and Cell - Mediated immunity. Blood grouping– Infections – Source and methods. Definitions – Epidemic, Pandemic, Endemic. Normal flora. Bacteria – *S. aureus*, *E. coli*. Fungi - *Candida*. Virus – Rabies, HIV, Parasite – Malaria.

**UNIT V**

Fermentation and its uses. Production of Penicillin and Streptomycin, Beer, Wine, Yoghurt. Plant - microbial interaction – N<sub>2</sub> fixation in root nodules.

**REFERENCES:**

1. Prescott L M, J P Harley and D A Klein (2005). Microbiology. Sixth edition, International edition, Mc Graw Hill.
2. Pelczar TR M J Chan ECS and Kreig N R (2006). Microbiology. Fifth edition, Tata Mc Graw-Hill INC. New York.
3. Kuby Immunology - Richard A Goldsby, Thomas J Kindt. Barbara A Osborne, (2000). Fourth edition, W H Freeman and company. New York.
4. Jawetz, Melnick, & Adelberg's. (2013). Medical Microbiology. 26th Edition. McGraw-Hill.
5. Patel AH (2005). Industrial microbiology. Published by Mac Millan India Ltd., Chennai.
6. Subba Rao NS (2004). Soil Microbiology. Fourth edition, Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi.

**M.Sc. APPLIED MICROBIOLOGY**  
**EDC COURSES - EXTRA DISCIPLINARY COURSESHUMAN**  
**INFECTIOUS DISEASES AND DIAGNOSTICS**

**UNIT I**

Scope and relevance of Microbiology-Definition and concepts, Type of micro organism, Distribution of Microorganism in nature; Development of Microbiology as a Scientific discipline; General characteristics of microorganisms- General principles, Taxonomy, classification and structural organization of Bacteria, Fungi, Viruses, Algae, Actinomycetes, Mycoplasma, and Rickettsiae; Microscopy- Principles and applications.

**UNIT II**

Fixatives and Fixation of smears, Stains- Definition, Acidic, Basic stains, simple and differential staining, use and significance of stains in microbiology; cultivation of micro organism- Pure culture techniques; cultivation of anaerobes; control of microorganism- sterilization by physical and chemical methods , Antiseptics .

**UNIT III**

Binomial nomenclature; Outline classification of living organisms- Haeckel, Whittaker, and woese system, normal micro flora in human body and their beneficial effects; Lymphoid organs and types of immunity; General principles of diagnostic microbiology- collection, transport, and processing of clinical specimens, General methods of laboratory diagnosis-cultural, biochemical, serological, and molecular methods.

**UNIT IV**

Host pathogen interaction- virulence factors, General account of the following diseases- Causal organisms, pathogenesis, diagnosis, prevention and therapy of Typhoid, cholera, dysentery, whooping cough, tuberculosis, Malaria, small pox, and AIDS. General account of Nosocomial Infections and prevention.

**UNIT V**

Antimicrobial therapy in the diagnosis of diseases; In vitro diagnostic methods- agglutination, precipitation, immunofluorescence, ELISA, Skin test; Vaccines: Principles underlying the preparation of live and attenuated vaccines. Immunization; Automation in Disease diagnosis.



**REFERENCES:**

1. Morag, C. and Timbury, M.C. (1994) Medical Virology, 10th Edn. Churchill Livingstone, London.
2. Dimmock, N.J. and Pimrose, S.B. (1994) Introduction to Modern Virology, 4th Edn. Blackwell Scientific Publications, Oxford.
3. Conrat, H.F., Kimball, P.C. and Levy, J.A. (1994) Virology, 3rd Edn, Prentice Hall, New Jersey.
4. Maloy SR, Cronan Jr. JE, Freifelder D. (1998). Microbial Genetics. Jones and Bartlett publishers.
5. Robert G. Welstar and Allan Garnoll. Encyclopaedia of Virology (1994). Vol. I, II & III Academic Press inc. San Diego, CA 92101. Ed.
6. Greenwood, D., Slack, R.B. and Peutherer, J.F. (2002) Medical Microbiology, 16th Edn. Churchill Livingstone, London.
7. Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edn. C.V. Mosby Company, St. Louis.
8. Ananthanarayanan, R. and Jayaram Panicker C.K. (2004) Text book of Microbiology. Orient Longman, Hyderabad.
9. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Eds) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.
10. Topley and Wilson (1995) Principles of Bacteriology Virology and Immunity. 9th Edn. Vol I, Edward Arnold, London.

**WEB SITES**

1. <http://www.microbiologyonline.org.uk/sgmprac.htm>
2. [http://www.cvm.uiuc.edu/vdl/AppenA\\_man.html](http://www.cvm.uiuc.edu/vdl/AppenA_man.html)
3. [http://www.microbes.info/resources/education\\_and\\_learning](http://www.microbes.info/resources/education_and_learning)
4. <http://infohost.nmt.edu/-nmtlib/subj/boil.html>
5. <http://www.hoflink.com/%7Ehouse/microbio.html>
6. <http://www.Splammo.net/bact102/home102.html>
7. <http://www.pathmicro.med.sc.edu/book/bact-sta.htm>
8. <http://www.textbookofbacteriology.net/>

**QUESTION PAPER PATTERN**

**Theory**

**I/II/III/IV Semester**

**M. Sc. Examination,**

**..MONTH & ...YEAR**

**M.Sc. Applied Microbiology**

**Paper title**

Duration: 3 Hrs

Max Marks:75

**Instruction: Answer all the two Parts.**

**PART – A (Either or Choice)**

(One question from each unit)

**Answer all the questions: 5 X 5 = 25**

1. a). (or) b).
2. a). (or) b).
3. a). (or) b).
4. a). (or) b).
5. a). (or) b).

**PART – B (Either or Choice)**

(One question from each unit)

**Answer all the questions: 5 X 10 = 50**

1. a). (or) b).
2. a). (or) b).
3. a). (or) b).
4. a). (or) b).
5. a). (or) b).

**QUESTION PAPER PATTERN**

**PRACTICAL**

**M.Sc. Applied Microbiology**

**Scheme of Examination**

**I/II/III/ Semester M. Sc. Examination,**

**..MONTH &...YEAR**

**Applied Microbiology Practical Examination**

**Duration: 6 Hrs/ day, 2 days**

**Max. Marks: 60**

Q.1. Major Practical	20 Marks
Q.2. Minor Practical	15 marks
Q.3 Spotters	
Identify and Critical comment on. (Specimens / Spotters)	5 X 3 = 15 Marks
A.	
B.	
C.	
D.	
E.	
Viva-Voce	05 Marks
Record note	05 Marks

**IV Semester M.Sc. Examination Project work (Dissertation)**

Dissertation Thesis	50 Marks
Viva-Voce	10 Marks

