

**DEPARTMENT OF MICROBIOLOGY, OSMANIA UNIVERSITY**  
**M.Sc. (Previous) MICROBIOLOGY (Semester System)**  
**Syllabus, Scheme of Instruction and Examination**

**Semester I (15 Weeks)**

Paper No.	Sub.Code	Subject/Paper Title	Instruction Hrs/Wk	Exam Time Hrs	Max Marks
THEORY					
I	MB 101	General Microbiology	4	3	100
II	MB 102	Virology	4	3	100
III	MB 103	Biometry and Computers	4	3	100
IV	MB 104	Biochemistry	4	3	100
PRACTICALS					
I	MB 151	General Microbiology	4	a	-
II	MB 152	Virology	4	b	-
III	MB 153	Biometry and Computers	4	c	-
IV	MB 154	Biochemistry	4	d	-
	MB 199	Seminar	4	-	-
Total ....			32+4		400

**Semester II (15 Weeks)**

Paper No.	Sub.Code	Subject/Paper Title	Instruction Hrs/Wk	Exam Time Hrs	Max Marks
THEORY					
I	MB 201	Microbial Physiology	4	3	100
II	MB 202	Immunology	4	3	100
III	MB 203	Antimicrobial Agents and Chemotherapy	4	3	100
IV	MB 204	Enzymology and Biochemical Techniques	4	3	100
PRACTICALS					
I	MB 251	Microbial Physiology	4	6(a)	100
II	MB 252	Immunology	4	6(b)	100
III	MB 253	Antimicrobial Agents and Chemotherapy	4	6(c)	100
IV	MB 254	Enzymology and Biochemical Techniques	4	6(d)	100
	MB 299	Seminar	4	-	-
Total ....			32+4		400

Note: (a) The examination includes both MB 151 and MB 251 syllabi  
 (b) The examination includes both MB 152 and MB 252 syllabi  
 (c) The examination includes both MB 153 and MB 253 syllabi  
 (d) The examination includes both MB 154 and MB 254 syllabi

**M.Sc. (Previous) I Semester**  
**Paper I MB 101 General Microbiology (4 Units x 15 Hrs = 60 Hrs teaching)**

**Unit I**

History of Microbiology. Microscopy. Structure of microbial cells: Spontaneous generation and germ theory of disease, Contributions of Antony van Leeuwenhock, Louis Pasteur, Robert Koch, Edward Jenner, Winogradsky, Beijerinck, Alexander Flemming, Waksman. Developments in modern biology.

Principles and working of bright field microscope, fluorescent microscope, phase contrast microscope, electron microscope. Application and importance of above microscopes. Measurement of microscopic objects. Prokaryotic cell, Eukaryotic cell, Organization and function of cellular organells

Cell wall of bacteria, cell membranes, flagella, pili, capsule structure, chemical structure of peptidoglycan, protoplasts, spheroplasts, microsomes and ribosomal RNAs, Nuclear material/nucleus.

**Unit II**

Methods of sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration methods, chemical methods and their application. Concept of containment facility, sterilization at industrial level

Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development.

Preservation and Maintenance of Microbial cultures: Repeated subculturing, preservation at low temperature, sterile soil preservation, mineral oil preservation, deep freezing and liquid nitrogen preservation, freeze-drying (lyophilization). Advantages and disadvantages of each method.

**Unit III**

Identification methods and classification of bacteria: - Microscopic identification characteristics, staining methods – simple staining, differential staining, structural staining and special staining methods.

Ecological identification methods, Nutritional (cultural) identification characters, chemical identification characters, biochemical identification methods, immunological characteristics, pathogenic properties identification, genetic characteristics identification.

Principles of bacterial taxonomy and classification: - Numerical taxonomy, Bergy's manual and its importance, general properties of bacterial groups. Rickettsiae-General characters and their importance; Mycoplasma – general characters; Chlamydiae – TRIC agents and LGV

#### **Unit IV**

Algae, Fungi and their characters:

Distribution of algae, thallus organization, products of algae and their importance.

Reproduction, Biochemical classification of algae.

Vegetative body of fungi, Reproduction, fruiting bodies and dispersal of fungal propagules. Nutritional groups and habitat relationships of fungi. Economic importance of fungi. Classification of fungi.

#### **I Semester MB 151 General Microbiology (Practicals)**

General instructions, Microbiology laboratory and its discipline

Handling of microscopes, Calibration and measurement of microscopic objects

Staining techniques for bacteria – simple, differential and special stainings

Preparation of media and reagents/stains

Sterilization procedures/methods

Isolation and cultivation of pure cultures

Identification methods of bacteria

Isolation and culturing of fungi (yeasts and molds) and algae

Observation of specimen and permanent slides

#### **Recommended books**

Text book of Microbiology by M. Burrows

General Microbiology by Stainier, Deudroff and Adelberg

Review of medical microbiology by Jawitz, melnick and Adelberg

Bacterial and Mycotic infections of man. Ed. Dubos and Hirst Lipincott

Principles of Microbiology and Immunology by Davis, Dulbecco, Eison, Ginsberg and Wood.

Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.

Structure and Reproduction of Algae, Vol. I & II by Fritsch, F.E.

Introduction to Algae by Morris, I.

Products and Properties of Algae by Zizac.

Fresh water algae of the United States by Smith, GM.

Introductory Mycology, by Alexopolus, C.J.

Dispersal in Fungi by Ingold, CT

Microbial Physiology by Moat,

Microbes in Action by Seoley HW and Van-Demark, PJ

Laboratory Experiments in Microbiology by Gopal Reddy et al

Brock's Biology of microorganisms by Madigan, MT et al

**M.Sc. (Previous) I Semester**  
**Paper II MB 102 Virology (4 units x 15 hrs = 60 hrs teaching)**

**Unit I**

Classification of viruses, Methods of cultivation, detection, quantitation. Propagation and maintenance of viruses (bacterial, plant and animal viruses). Structure and replication of plant viruses (a) TMV (b) Cauliflower mosaic virus

**Unit II**

Structure and replication of bacteriophages: Lytic ds linear DNA viruses (T2, T7); Lysogenic ds linear DNA virus (Lambda); ss Circular DNA virus (ϕ X 174); Male specific filamentous ss RNA virus (F17 and M13)

**Unit III**

Recombination in phage, multiplicity reactivation and phenotypic mixing. Structure and replication of animal viruses (Adenovirus (eg. Type 2)

**Unit IV**

Structure and replication of Myxoviruses (eg. Influenza); Pox virus (eg. Vaccinia); Hepatitis virus. Effect of animal virus infection on host cell; Viral interference and interferon; Tumor viruses (DNA and RNA)

**I Semester Paper II MB 152 Virology (Practicals)**

Isolation of phage from soil.  
Cultivation and preservation of phages  
Quantitation of phages  
Growth phases of phage and burst size  
Isolation of plaque type and host range mutants  
Phage induction  
Lysogeny-Transduction  
Propagation of animal viruses in egg allantoic, amniotic and CAM  
Propagation of viruses in tissue culture  
Plaque titration and neutralization  
Quantitation of virus by HA, Pock titration, plaque titration  
Identification of virus – HAI  
Demonstration of cytopathological changes  
Symptomatic observations of plant viral infections  
Chloroplast agglutination of plant viruses

### **Recommended Books**

General Virology by Luria and Darnel  
Virology and Immunology by Jokli  
Text book of Virology by Rhodes and Van Royen  
Plant Virology by Smith  
Genetics of bacteria and their viruses by W. Hayes  
Molecular Biology of the gene by Watson, Roberts, Staitz and Weiner  
A laboratory guide in virology by Charles H. Lunningham  
Basic lab procedures in diagnostic virology by Marty Cristensen

### **M.Sc. (Previous) I Semester Paper III MB 103 Biometry and Computers (4 units x 15 hrs = 60 hrs teaching)**

#### **Unit I**

Introduction to statistics and biometry  
Population, samples and sampling procedures, variables, variations and frequency distributions, measures of averages and dispersion, element of probability, gaussian or normal distribution, binomial distribution, poisson distribution, 't' distribution, 'F' distribution and Chi-square distribution, correlation and linear regression with a special reference to applications in biology

#### **Unit II**

Tests of inference and concepts  
Small sample tests and large sample tests: Normal curve test, 't' test, 'F' test, ANOVA, analysis of covariance, Chi-square test, and confidence intervals  
Methods of collection of data, experimental designs and sampling procedures  
Growth curves – exponential and linear growth curves  
Example oriented syllabus with applications to biology and microbiology

#### **Unit III**

Introduction to Computers  
Basic concepts (input, output, CPU, ALU etc.), what is Hardware and software, brief introduction on input output devices (Disks, Printers, CD-ROMS and other storage media etc.)  
Introduction to disk operating systems (DOS): Sample commands, DIR-CD-RD-DEL-COPY-MOVE-REN-TYPE-EDIT (Editor) CE-DATE and TIME.  
Introduction to Windows 95: Icons, Desktop, Files and Folders.  
Simple operations like creation, deletion, moving, copying of Files or folders using windows explorer. Searching files and folders. Creating shortcuts and other simple operations.

#### **Unit IV**

Word Processing: Opening, creating and saving documents – Typing, navigating and selecting – editing and sorting-checking spelling and grammar – formatting – changing appearance of your page – importing graphics – working with tables – working with land documents – Printing

Electronic Spread Sheet: Creating, opening and saving files – working with worksheets and work books – entering data and selecting cells – editing worksheets – printing, creating formulae – working with charts – Summarize data in lists and tables – Analyzing data with Pivot tables – Analyzing sample statistical data – Validating cells.

#### **I Semester Paper III MB 153 Biometry and Computers (Practicals)**

Formation of frequency distribution, graphical presentation and calculation of descriptive measures

Fitting of distribution – Binomial, Poisson and Normal distribution

Chi-square test, goodness of fit, contingency and heterogeneity

Small and large sample tests, sample means and properties

Problems on correlation and regression

ANOVA – One way and two way classifications

Creating documents using word processor

Exercising the features of word processor

Creating spread sheets

Usage of spread sheet to biological applications

#### **Recommended Books**

Introduction to the theory of statistics by Alexander, M Mood and Franklin

Fundamentals of Biometry by L.N.Balam

Statistical methods by Snedecor and Cochran

Introduction to computer and its application by Chae C.Chien

Basic Programming language by Bajaraman

Biostatistics – A manual of statistical methods for use in Health, Nutrition and

Anthropology by K. Vishveshwar Rao

**M.Sc. (Previous) I Semester**  
**Paper IV MB 104 Biochemistry (4 units x 15 hrs = 60 hrs teaching)**

**Unit I**

pH and its biological relevance  
Determination of pH, preparation of buffers  
Concept of entropy, free-energy, free energy changes, high energy compounds.  
Equilibrium constants, Redox potentials, Biological redox systems

**Unit II**

Biological oxidation, Biological redox carriers, biological membranes, electron transport, oxidative phosphorylation and mechanism. Bacterial photosynthesis, photosynthetic electron transport

**Unit III**

Lipids classification: Bacterial lipids, prostaglandins, structure, function, Major steroids of biological importance.  
Nucleic acids: Structure and properties of purines, pyrimidines, nucleosides and nucleotides  
Metabolism of purines and pyrimidines - Biosynthesis and degradation

**Unit IV**

Proteins and amino acids: Properties of amino acids, structure, confirmation and properties of proteins, metabolism of amino acids, biosynthesis and degradation – an overview; Urea cycle

**I Semester Paper IV MB 154 Biochemistry (Practicals)**

Preparation of buffers and adjustment of pH  
Qualitative tests for carbohydrates and analysis of unknowns  
Qualitative tests for amino acids and analysis of unknowns  
Tests for lipids (qualitative)  
Quantitative estimation of glucose and fructose

**Recommended Books**

Biochemistry by Lehninger  
Outlines of Biochemistry by Cohn and Stumph  
Biochemistry of Nucleic acids by Davidson  
Biological Chemistry by Muller and Cards  
Biochemistry by White, Handler and Smith  
Methods in Enzymology series  
The Cell – Brach and Mirsky series  
Laboratory experiments in Microbiology by Gopal Reddy et al  
Biochemistry lab manual by Jayaraman

## **M.Sc. (Previous) II Semester**

### **Paper I MB 201 Microbial Physiology (4 units x 15 hrs = 60 hrs teaching)**

#### **Unit I**

Microbial nutrition – Elemental nutrient requirements of microbes, nutritional groups of bacteria. The autotrophy – Photoautotrophy and bacterial photosynthesis  
Chemoautotrophy and autotrophic metabolism.

Concept of heterotrophy – Photoheterotrophy and chemoheterotrophy. Heterotrophic metabolism in bacteria. Respiration (Aerobic and anaerobic) and fermentation

#### **Unit II**

Microbiological media and culturing and cultivation of microorganisms - Autotrophic media, defined synthetic mineral media, heterotrophic media. The concept of prototrophs and auxotrophs, prototrophic (minimal) media (defined media), complex media (undefined media), Basal medium, enriched media, enrichment media, selective media, biochemical media, differential media, maintenance media, transport media.

Media for cultivation of fungi, and algae

Cultivation methods of bacteria, slant culturing, stab culturing, agar plate culturing, rolled tube/bottle culturing, tube cultures, flask culturing.

Aerobic culturing methods, anaerobic culturing methods

Environmental requirements of growth

#### **Unit III**

Microbial growth: The concept of growth and definition, formation of protoplasm, building of macromolecules from elemental nutrients, supramolecules, organelles of cell and cellular components. Cell cycle in microbes and generation time

Growth phases of bacteria – Lag phase, exponential (logarithmic) phase, stationary (ideo) phase, decline and survival of microbial cells. Importance of each growth phase.

Synchronous cultures – methods of synchronous culturing

Continuous culturing methods, factors effecting growth. Methods of growth measurement.

#### **Unit IV**

Nature and properties of spores: Bacterial endospore structure, phenomenon of sporulation, biochemistry and genetics of sporulation. Induction of sporulation phenomenon. Germination of spores

The concept of disease: Infectious disease, pathogenic microbes, properties of pathogenic microbes, Infection, pathogenesis and virulence. Virulence factors – Capsular materials, bacterial toxins – exotoxins, toxoids, endotoxins, enterotoxins.

Physiology of toxin production. Extracellular enzymes of pathogenic bacteria.

Application of toxins and toxic enzymes, laboratory testing methods for bacterial virulence properties

## **II Semester Paper I MB 251 Microbial Physiology (Practicals)**

Preparation of microbiological media. Autotrophic media, minimal media, basic media, enriched media, enrichment media, differential media.

Isolation and cultivation of autotrophic microbes

Culturing methods of microbes – slant and stab cultures, tube culture, flask cultures, shake flask cultures

Anaerobic culturing methods – anaerobic jar and its use, pyrogallol method, thioglycollate media culturing, anaerobic glove box and its application

Microbial growth experiments – Viable count of growing cultures and generation time determination

Determination of microbial growth by turbidometric methods

Study of bacterial growth curve

Factors effecting the microbial growth

Tests for microbial toxins – determination of LD50

Testing for extracellular microbial enzymes

### **Recommended Books**

Text book of Microbiology by M. Burrows

General Microbiology by Stainier, Deudroff and Adelberg

Review of medical microbiology by Jawitz, melnick and Adelberg

Bacterial and Mycotic infections of man. Ed. Dubos and Hirst Lipincott

Principles of Microbiology and Immunology by Davis, Dulbecco, Eison, Ginsberg and Wood.

Text book of Microbiology by Ananthanarayanan

Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.

Microbial Physiology by Moat,

Brock's Biology of microorganisms by Madigan, MT et al

Biochemistry of bacterial growth by Mandelstam, Mc Quillon and Dawes

Bacterial Metabolism by Dwelllely

Photosynthesis by Dewlin and Barker

Laboratory Experiments in Microbiology by Gopal Reddy et al

Microbes in Action by Seoley HW and Van-Demark, PJ

## **M.Sc .(Previous) II Semester**

### **Paper II MB 202 Immunology (4 units X 15 hrs=60 hrs teaching)**

#### **Unit I**

Brief history of immunology; Antigens – isoantigens, alloantigens, haptens; Antibodies – structures, genes; Structural variants, classes, and subclasses of antibodies; Immune system – cells, vessels, organs; Immune response – antigen recognition; T-cell interactions; B-cell interactions.

#### **Unit II**

Immune response; Types of immunity – innate, specific, acquired, prophylaxis; Vaccines – whole cell, subunit, recombinant protein-based, DNA-based; Production of vaccines; QA and QC of vaccines; Accepted pharmacopeial techniques; Future of vaccines – bacterial and viral vaccines in market; Advantages and disadvantages of vaccines; Approaches of vaccine design; Acquired and natural tolerance; Mechanism of tolerance; Properties of interferon; Production and assay of interferons.

#### **Unit III**

MHC Complex; Immunoglobulin superfamily; Self and non-self recognition; Genetics of tissue transplantation; Genetic control of immune response; Macrophage restriction; Structure of MHC; MHC products and cell surface; MHC and tissue transplantation; Human MHC and disease association; Autoimmunity and HLA; Examples of autoimmunity and treatment; Inflammation and anaphylactic reactions; Immune reaction of infection, reactions to infectious agents.

#### **Unit IV**

Antigen-antibody reactions; Polyfunctional antibodies; Cross reactivity; Primary antigen-antibody reactions *in vivo*; Secondary antigen-antibody reactions *in vivo*; Sensitivity of antigen-antibody reactions; Immunological methods – agglutination, precipitation, complement fixation, radioactive and enzyme-mediated amplification for detection of antigen-antibody reactions; Immunization – adjuvants, lymphokines; Alternate pathway for complement fixation; Protective immunity to infection; Role of immune mechanism in protection against infection; Immune effector mechanisms in specific infections; Evasion of immune defenses; Tumor immunity – host-tumor relationship, tumor immunity in humans; Tumor antigens; Mechanism of tumor destruction by the immune system; Tumor surveillance; Immuno-diagnosis of cancers; Immuno-prophylaxis of cancer; Immuno-therapy of cancer.

### **II Semester Paper II MB 252 Immunology (Practicals)**

Agglutination reactions – Widal, VDRL, HA, Blood group/typing

Precipitation test: Ring interphase, single radial diffusion, Ouchterlony, immunoelectrophoresis

Neutralization test – Plaque neutralization, Haeme absorption test

Raising of antisera

Separation of serum, WBC, RBC, Plasma, CBP and differential blood picture

Lymphoblast transformation, Jerne plaque test, T-cell migration.

Separation of serum proteins

Blot transfer and detection of protein on blot by staining

Lymphocyte viability test

ELIS, Indirect agglutination (a) Hepatitis (b) Pregnancy hCG Ag  
Raising of polyclonal Ab and Monoclonal Ab

### **Recommended Books**

Immunology and immunopathology by Stewart Sell  
Cellular and molecular immunology by Abul K. Abbas et al  
Immunology by Herman N. Eosen  
Text book of Immunology by Barret  
Molecular basis of immunology by Constantin Bena  
Immunology – The science of self-non self discrimination by Jan Klein  
Essential Immunology by Roitt, IM  
Immunology by Kuby, J.

### **M.Sc. (Previous) II Semester Paper III MB 203 Antimicrobial Agents and Chemotherapy (4 units x 15 hrs = 60 hrs teaching)**

#### **Unit I**

History of chemotherapy. Types of antimicrobial agents, Plants and arsenicals as therapeutic agents, Paul Ehrlich and his contributions to chemotherapy. Development of synthetic drugs, development of antibiotics,  
Chemical non-medicinal antimicrobials- sanitizers, disinfectants, antiseptics.  
Selective toxicity and target sites of drug action.  
Synthetic medicinal agents (drugs)- sulphonamides, antitubercular compounds, nitrofurans, nalidixic acid, metronidazoles,  
Antibiotics – Definition of antibiotics, types (chemical) of antibiotics, cell wall inhibitors, membrane inhibitors, inhibitors of macromolecular synthesis, antimetabolites.

#### **Unit II**

Bactericidal and bacteriostatic agents, Factors affecting static and cidal activity, phenols and phenolic compounds, alcohols, halogens, heavy metals, dyes, detergents, aldehydes  
Non-medical uses of antibiotics.  
Assay methods of antimicrobial agents – Phenol coefficient, qualitative assay of drugs (drug sensitivity testing), quantitative assays – liquid tube assay (MIC), agar tube assay. Agar plate assay.

#### **Unit III**

Principles of chemotherapy and Drug Resistance

The physical and lab diagnosis, tests for sensitivity, choice drug determination, dosage, route of administration, combined drug therapy. Policies of antibiotic usage. Antiviral agents – Biological antiviral agents- interferon and its action, chemical antiviral agents. Phenomenon of drug resistance, basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance. Control of drug resistant bacteria

#### **Unit IV**

Mode of action of important drugs – Cell wall inhibitors (betalactam drugs), membrane inhibitors (polymyxin), Ribosomal inhibitors (aminoglycosides – streptomycin), folic acid inhibitors (sulfa drugs), antifungal drugs (nystatin).

### **II Semester Paper III MB 253 Antimicrobial agents and Chemotherapy (Practicals)**

Testing for drug sensitivity  
Determination of MIC values (tube dilution method)  
Determination of phenol coefficient (Reidel Walker coefficient, RWC)  
Study for antimicrobial spectrum of antimicrobials  
Determination of cidal and static activity  
Screening for antibiotic producing microbes  
Chemical assay methods for antimicrobial drugs  
Microbiological assays of antimicrobial drugs

#### **Recommended books**

Disinfection, sterilization and preservation Ed. Block, SS.  
Microbial contamination control facilities Ed. Runkle, RS and Philips, GB  
Principles and methods of sterilization in health science by Perkins John, J.  
Inhibition and destruction of the microbial cell Ed. Hugo  
Biochemistry of antimicrobial action by Franklin, TJ and Snow, L.  
The Molecular basis of antibiotic action by Gale et al  
Antibiotics and chemotherapy by Gerrod et al  
Pharmaceutical microbiology by Hugo Russell  
Microbiological assays by Hewitt  
Antiviral drugs by S.Karger  
Burgers' medicinal chemistry (all volumes) Ed. Manfield E. World.  
Antibiotic interactions by Williams  
The control of antibiotic resistant bacteria by Harris and Harris

**M.Sc. (Previous) II Semester Paper IV MB 204 Enzymology and Biochemical Techniques (4 units x 15 hrs = 60 hrs teaching)**

**Unit I**

Enzymes nomenclature, classification methods for determination of enzyme activity. Isolation and purification of enzymes. Enzyme kinetics: Effect of pH, substrate concentration, temperature and inhibitors. Isoenzymes. Competitive and non-competitive inhibition

**Unit II**

Mechanism of enzyme action – Action of Ribonuclease, chymotrypsin, and trypsin. Coenzyme catalysis. Mechanism of PAXPO and thiamine pyrophosphate enzymes. Control of enzymes. Regulation of enzyme activity: allosteric enzymes and feed back mechanisms. Metabolic compartmentalization in relation to enzyme, enzymes and secondary metabolites

**Unit III**

Optical methods: Elementary treatment of biochemical methods, colourimetry and spectrophotometry, flurometry, optical rotation, fluorescence  
Separation methods: Chromatographic techniques – paper, thin layer, ion exchange, gel filtration and affinity chromatography. Diffusion, dialysis, cell disruption methods, centrifugation techniques, cell free extracts and their use in metabolic studies.

**Unit IV**

General method of study of intermediary metabolism  
Electrophoretic techniques and application, counter current distribution  
Radio isotopes – detection and measurement of radioactivity – scintillation counters, autoradiography, stable isotopes and their use. Uses of mutants in study of metabolism

**II Semester Paper IV MB 254 Enzymology and Biochemical Techniques (Practicals)**

Determination of saponification value and iodine number of fats  
Quantitative estimation of inorganic and organic phosphate  
Partial purification of enzymes (B-amylase, urease, pyrophosphatase and catalase)  
Effect of substrate concentration, pH, time and temperature on enzyme activity  
Calculation of  $K_m$  for partially purified enzyme  
Inhibition of enzyme activity

**Recommended books**

Biochemistry by Lehninger

Outlines of Biochemistry by Cohn and Stumph

Biochemistry of Nucleic acids by Davidson

Biological Chemistry by Mullar and Cards

Biochemistry by White, Handler and Smith

Methods in Enzymology series

The Cell – Bratch and Mirsky series

Laboratory experiments in Microbiology by Gopal Reddy et al

Biochemistry lab manual by Jayaraman

**DEPARTMENT OF MICROBIOLOGY, OSMANIA UNIVERSITY**  
**M.Sc. (Final) MICROBIOLOGY (Semester System)**  
**Syllabus, Scheme of Instruction and Examination**

**Semester III (15 Weeks)**

Paper No.	Sub.Code	Subject/Paper Title	Instruction Hrs/Wk	Exam Time Hrs	Max Marks
THEORY					
I	MB 301	Molecular Biology and Microbial Genetics	4	3	100
II	MB 302	Industrial Microbiology	4	3	100
III	MB 303	Soil Microbiology	4	3	100
IV	MB 304	Medical Bacteriology	4	3	100
PRACTICALS					
I	MB 351	Molecular Biology and Microbial Genetics	4	a	-
II	MB 352	Industrial Microbiology	4	b	-
III	MB 353	Soil Microbiology	4	c	-
IV	MB 354	Medical Bacteriology	4	d	-
	MB 399	Seminar	4	-	-
Total ....			32+4		400

**Semester IV (15 Weeks)**

Paper No.	Sub.Code	Subject/Paper Title	Instruction Hrs/Wk	Exam Time Hrs	Max Marks
THEORY					
I	MB 401	Molecular Biotechnology	4	3	100
II	MB 402	Microbial Biotechnology	4	3	100
III	MB 403	Microbiology of Food and Environment	4	3	100
IV	MB 404	Medical Virology and Parasitology	4	3	100
PRACTICALS					
I	MB 451	Molecular Biotechnology	4	6(a)	100
II	MB 452	Microbial Biotechnology	4	6(b)	100
III	MB 453	Microbiology of Food and Environment	4	6(c)	100
IV	MB 454	Medical Virology and Parasitology	4	6(d)	100
	MB 499	Seminar	4	-	-
Total ....			32+4		400

**Note** The students of M.Sc Final Microbiology have to undergo an educational tour/training/visit to subject based industries/institutions and submit a report as part of their academic curriculum.

- (a) The examination includes both MB 351 and MB 451 syllabi
- (b) The examination includes both MB 352 and MB 452 syllabi
- (c) The examination includes both MB 353 and MB 453 syllabi
- (d) The examination includes both MB 354 and MB 454 syllabi

**M.Sc. (Final) III Semester Microbiology**  
**Paper I MB 301 Molecular Biology and Microbial Genetics**  
**(4 units x 15 hrs = 60 hrs teaching)**

**Unit I**

Structure of DNA and its biosynthesis – Detailed structure of DNA , variation from Watson and Crick model, Z-DNA, A & B DNA, denaturation and melting curves.  
Genome organization in prokaryotes and eukaryotes  
Enzymes involved in replication, step by step process, heteroduplexes,  
Modes of DNA replication- Semiconservative and conservative  
Mechanisms of DNA replication in E.coli (bi-directional), Mitochondrial (D-loop), Viral DNA (ROLLING CIRCLE), Single stranded DNA phages (  $\phi$  X 174),  
Eukaryotic telomere and its replication. Selfish DNA, Alu sequences

**Unit II**

RNA structure and biosynthesis : m-RNA, r-RNA t-RNA structures  
Transcription apparatus and proteins involved in transcription  
Prokaryotic and eukaryotic transcription. Processing of t-RNA, r-RNA, m-RNA splicing  
Concept of ribozyme  
Genetic code and Wobble hypothesis  
Protein synthesis – Translation in Prokaryotes and eukaryotes  
Post translational modifications

**Unit III**

Mutagenesis- Types of mutagens, molecular basis of mutations, analysis of mutations, site directed mutagenesis and reverse genetics  
DNA damage and repair mechanisms. Mutagenicity testing using microbial systems  
Concept of gene – Benzer's fine structure analysis, introns and exons.  
Complementation and functional allelism

**Unit IV**

Bacterial transformation and recombination- Discovery, detection, molecular mechanisms of transformation, transformation methods  
Bacterial conjugation – Sex factor in bacteria, F and HFR transfer, mechanism of transfer, linkage mapping, Mechanism of recombination  
Bacterial transduction – transduction phenomenon, methods of transduction, co-transduction, generalized, specialized and abortive transduction, sex-ductions, and their applications  
Genetics of eukaryotic viruses

### **Paper I MB 351 Molecular Biology and Microbial Genetics (Practicals)**

Extraction/Isolation of DNA (Plasmid DNA AND genomic DNA) (Mini preparation and large preparation)  
Estimation of DNA, RNA and Protein (colourimetry)  
Determination of molecular weight of DNA, resolved on agarose gel electrophoresis  
Determination of molecular weight of protein by PAGE  
Induction of mutations by physical/chemical mutagens, screening and isolation of mutants, Replica plating technique  
Transformation in bacteria  
Conjugation in bacteria  
Complementation tests in bacteria  
Protoplast preparation and regeneration

#### **Recommended books**

Molecular biology by David and Freifelder  
Microbial genetics by David and Freifelder  
Genetics of bacteria and their viruses by William Hayes  
Molecular biology of the gene by Watson et al  
The Biochemistry of nucleic acids by Davidson JN  
Molecular biotechnology by Primerose  
Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak  
DNA Microarrays Ed. M. Schena

### **M.Sc. (Final) III Semester Microbiology**

#### **Paper II MB 302 Industrial Microbiology (4 units x 15 hrs = 60 hrs teaching)**

##### **Unit I**

Introduction to industrial microbiology. Definition, scope, history, microorganisms, properties and industrial products  
Screening for microbes of industrial importance. Primary screening, screening for amylase, organic acid, antibiotic, amino acid and vitamin producing microorganisms.  
Secondary screening. Further evaluation of primary isolates  
Detection and assay of fermentation products. Physico-chemical methods and biological assays. Fermentation equipment and its use. Design of fermentor, type of fermentor, agitation, aeration, antifoam, pH and temperature control.

##### **Unit II**

Inoculum media, inoculum preparation  
Raw materials Saccharides, starchy and cellulosic materials  
Fermentation media and sterilization.  
Types of fermentations processes – Solid state, surface and submerged fermentations

### **Unit III**

Batch, fed batch and continuous fermentations. Direct, dual or multiple fermentations.

Scaleup of fermentations. Product recovery methods.

Fermentation type reactions, alcoholic, lactic acid, mixed acid, propionic acid, butandiol and acetone-butanol types

### **Unit IV**

Strain development strategies. Environmental factors and genetic factors for improvement. Immobilization methods – Absorption, covalent linkage, entrapment and cross linkage, types of carriers, advantage and disadvantages.

## **Paper II MB 352 Industrial Microbiology (Practicals)**

Screening for amylase producing organisms

Screening for organic acid producing microorganisms

Isolation of antibiotic producing microorganisms by crowded plate technique

Isolation and culturing of yeasts

Seperation of amino acids by chromatography

Estimation of glucose by DNS method

Estimation of ethanol by dichromarte method

Extimation of maltose

Immobilization of microbial cells by entrapment method

### **Recommended Books**

Industrial Microbiology by Casida, LE

Industrial Microbiology by Patel, AH

Industrial Microbiology by Miller, BM and Litsky

Industrial Microbiology by Prescott and Dunn

Microbial Technology by Peppler, JH and Perlman, D.

Biochemistry of Industrial Microorganisms, by Rainbow and Rose

Economic Microbiology by Rose Vol I – V

Microbial Enzymes and Biotechnology by Fogarty WM and Kelly, CT

Comprehensive Biotechnology, All volumes Ed. Murray Moo-Yong

Biotechnology (A text book of industrial Microbiology) Ed. Cruger & Cruger

Advances in Applied Microbiology Ed. Perlman Series of volumes

Laboratory experiments in microbiology by Gopal Reddy et al

**M.Sc. (Final) III Semester Microbiology**  
**Paper III MB 303 Soil Microbiology (4 units x 15 hrs = 60 hrs teaching)**

**Unit I**

The soil as habitat for microorganisms: general description of soil, soil structure, differences among soils and factors of ecological significance  
Soil Microorganisms: Distribution, abundance, methods of estimation, biomass measurement, environmental factors, activity and functions of soil bacteria, fungi, algae, protozoa, blue green algae and soil fertility  
Microbial diversity in soil and its significance

**Unit II**

Organic matter decomposition both native and added organic matter and factors governing the decomposition  
Degradation of carbonaceous materials in soil – cellulose, hemicellulose and lignin decomposition, factors governing the decomposition and biochemistry of decomposition  
Mineralization of nitrogenous organic matter – microbes involved and factors influencing the processes, Soil humus formation

**Unit III**

Nitrification –Microbes involved, factors influencing nitrification, nitrifying bacteria and biochemical mechanism. Denitrification – microbes involved, factors influencing and the mechanism of denitrification and nitrate pollution  
Nitrogen fixation – Asymbiotic and symbiotic nitrogen fixation, microorganisms involved, biochemistry and genetics of nitrogen fixation, measurement of nitrogen fixation, ecological and economic importance of nitrogen fixation.

**Unit IV**

Microbial transformation of phosphorus in soil  
Microbial transformation of sulfur in soil  
Microbial transformation of iron in soil  
Biofertilizers – bacterial fertilizers and production of rhizobial inoculants and blue-green algae, quality control tests

**Paper III MB 353 Soil Microbiology (Practicals)**

Setting of Winogradsky's column  
Estimation of soil composition by sedimentation method  
Enumeration of soil microorganisms (bacteria), actinomycetes, fungi) by standard plate count  
Estimation of soil microbial activity by CO<sub>2</sub> evolution  
Isolation of cellulose decomposing microbes and estimation of cellulose activity  
Estimation of ammonifiers, nitrifiers and denitrifiers in soil by MPN METHOD

Isolation and culturing of Rhizobium sp from root nodules and Azospirillum from grasses (Cyanodon)  
Biological enrichment isolation of Rhizobium from soil by Leonard Jar experiment  
Nodulation testing by tube/jar method  
Solubilization of rock phosphate by microorganisms and estimation  
Testing for mineral leaching by Thiobacillus sp  
Assessment for sulphate reducing bacteria  
Observation and assessment of soil algae/algal biofertilizers  
Bacterial biofertilizers and their use  
Estimation of N<sub>2</sub> fixation (Micro Kjeldahl method/GC method)

### **Recommended Books**

Soil Microbiology by Alexander Martin  
Microbial ecology, Fundamentals and Applications Ed. Benjamin-Cummings  
Soil Biotechnology by JM Lynch  
Microbial Ecology: Organisms, Habitats, Activities by Stolp, H.  
Soil Microbiology and Biochemistry by Paul E. and PE Clank  
Microbial Ecology: Principles, Methods and Applications by Lavin, Seidler, Rogul  
Biological Nitrogen Fixation by Quispel  
Soil Microorganisms and Plant Growth by N.S., SubbaRao.  
Laboratory experiments in microbiology by Gopal Reddy et al

## **M.Sc. (Final) III Semester Microbiology**

### **Paper IV MB 304 Medical Bacteriology (4 units x 15 hrs = 60 hrs teaching)**

#### **Unit I**

Principles of Medical Microbiology:  
Classification of medically important microorganisms. Normal flora of human body –  
Origin of normal flora, role of the resident flora, effect of antimicrobial agents on normal flora, characteristics of normal flora  
Distribution and occurrence of normal flora (Skin, conjunctiva, nose, nasopharynx, sinuses, mouth, upper respiratory tract, intestinal tract, urogenital tract)  
Bacteria in the blood and tissues, factors influencing normal flora.

#### **Unit II**

Properties of pathogenic microorganisms. Factors that influence pathogenicity  
Type of infections, source of infections, different modes/means of infections

Diagnostic microbiology – Types of specimen, specimen collection, transportation of specimen, processing, laboratory investigations, specific lab. Tests, non-specific lab tests, diagnosis and report

Use of lab animals in diagnostic microbiology

### **Unit III**

Systematic bacteriology – Detailed study of morphology, cultural characteristics, antigenic structure, pathogenesis, diagnostic lab test, epidemiology, prevention and

treatment of the following bacterial pathogens.

Bacterial air borne infections – B-Haemolytic streptococcus, pneumococci, *Corynebacterium diphtheriae*, *Mycobacterium tuberculosis*, *Mycobacterium leprae*, *Neisseria meningitidis*, *Haemophilus influenzae*.

Sexually transmitted diseases caused by bacteria, *Treponema pallidum*, *Neisseria gonorrhoea*

### **Unit IV**

Systematic bacteriology – Detailed study of morphology, cultural characteristics, antigenic structure, pathogenesis, diagnostic lab tests, epidemiology, prevention and treatment of the following pathogenic bacteria

Water borne infections – *E.coli*, *Salmonella typhi*, *Shigella dysenteriae*, *Vibrio cholerae*. Wound infections – *Staphylococcus aureus*, *Clostridium tetani*, *Clostridium welchi*, *Pseudomonas*.

## **Paper IV MB 354 Medical Bacteriology (Practicals)**

Preparation of different types of culture media/observation. Mannitol salt agar, Blair Parker medium, MacConkey agar, Lowenstein-Jensen medium, Wilson Blair Bismuth sulphite medium, Biochemical media.

Staining techniques – Gram's staining, AFB staining, Albert Staining, Capsular staining  
Isolation and identification of various pathogenic bacteria by microscopic, biochemical, enzymatic and serological tests

Bacteriological examination of urine, pus, throat swab etc from patients for diagnosis

### **Recommended Books**

Review of Medical Microbiology by Jawitz, Melnick and Adelberg

Diagnostic Microbiology by Bailey and Scott

Medical Microbiology by Cruickshank et al Vol I & II

Text book of Microbiology by Ananthanarayanan and Jayaram Paniker

Bacterial diseases by Wilson and Topley

Medical Microbiology by Sherris

Laboratory experiments in microbiology by Gopal Reddy et al

**M.Sc. (Final) IV Semester Microbiology**  
**Paper I MB 401 Molecular Biotechnology (4 units x 15 hrs = 60 hrs teaching)**

**Unit I**

Gene regulation and expression – Lac operon, arabinose and tryptophane operons  
Repressors and activators in lambda, Sigma switch in B.subtilis  
Gene regulation in eukaryotic systems, repetitive DNA, gene rearrangement, promoters, enhancer elements, gene amplification. Signal transduction – Concept of second messenger, cAMP, cGMP, protein kinases, G-proteins  
Steroid/peptide hormone regulation, tissue specific regulation.

**Unit II**

Plasmids – Definition, types of plasmids, identification and classification of plasmids, purification of plasmids, plasmid transfer and its mechanism. Host restriction in transfer.  
Transposable elements – Definition, detection of transposition in bacteria, types of bacterial transposons, mechanisms of transposition and excision, applications of transposons.  
PCR Technology – Principle, designing of primers PCR methodology, RT-PCR, multiplex PCR, identification of PCR products, application of PCR technology.

**Unit III**

Genetic engineering – Cloning vectors, enzymes involved in genetic engineering, restriction mapping, cloning strategies, methods of gene transfer.  
Detection of clones and their expression – Expression of cloned genes in yeast and E.coli, Blot analysis – Southern, Northern and Western blots, DNA methylation, DNA hybridization.  
Genomic and c-DNA library construction and application.  
Hybridoma technology – Principle and application

**Unit IV**

Molecular markers –RFLP, RAPD, AFLP, 16S r-RNA typing.  
Gene chip and microarrays- Assays, applications in disease profiles, drug target, gene discovery, drug action and toxicity  
Molecular biology data bases and bioinformatics – Overview and data mining of sequence data bases. DNA sequencing methodology and software, sequence comparison and alignment. Concept of pharmacogenomics and its application  
IPR and patenting – Concept and overviews

**Paper I MB 451 Molecular Biotechnology (Practicals)**

Restriction mapping  
PCR technique – demonstration  
Plasmid detection and Isolation of Plasmid DNA  
Preparation of competent cells and transformation  
Gene cloning in bacteria – demonstration

Southern transfer – demonstration  
Demonstration of RFLP/AFLP  
Induction of enzymes – Lac operon  
Transposon mutagenesis  
Dialysis and separation of proteins by column chromatography

### **Recommended Books**

Molecular biology by David and Freifelder  
Microbial genetics by David and Freifelder  
Genetics of bacteria and their viruses by William Hayes  
Molecular biology of the gene by Watson et al  
The Biochemistry of nucleic acids by Davidson JN  
Molecular biotechnology by Primerose  
Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak  
DNA Microarrays Ed. M. Schena

## **M.Sc. (Final) IV Semester Microbiology** **Paper II MB 402 Microbial Biotechnology (4 units x 15 hrs = 60 hrs teaching)**

### **Unit I**

Fermentative production of industrial alcohol, uses, raw materials, microorganisms, inoculum preparation, preparation of wort, fermentation and recovery  
Fermentative production of beer – Medium components, malt, malt adjuncts, hops, water. Preparation of wort, mashing, wort boiling, microorganism, inoculum preparation, fermentation, cold storage maturation, carbonation, packing and preservation  
Principles of wine making – Fruit selection, picking, crushing, sulphite addition, processing, fermentation, aging and bottling

### **Unit II**

Fermentative production of citric acid, uses, microorganism, inoculum preparation, medium preparation, fermentation, recovery and mechanism of citric acid production  
Fermentative production of vitamin B12 – Uses, structure of vit.B12, microorganisms, inoculum preparation, medium preparation, fermentation and recovery  
Fermentative production of glutamic acid – Uses, microorganism, inoculum preparation, production medium, fermentation and downstream processing

### **Unit III**

Antibiotics – Commercial production of benzyl penicillin, uses, microorganism, inoculum preparation, production medium, fermentation, recovery and semi-synthetic penicillins

Fermentative production of tetracyclines – uses, chlortetracycline, oxy-tetracycline, tetracycline and semisynthetic tetracyclines, structures, microorganisms, inoculum preparation, production medium, fermentation and recovery methods

#### **Unit IV**

Production and application of microbial enzymes. – Amylases, lipases and proteases, uses, microorganisms, inoculum preparation, production medium, fermentation and recovery

Steroid transformations – Substrates, typical structures, microorganisms, inoculum preparation, 11-hydroxylation, process and recovery.

Principles of vaccine production and types of vaccines

Microbial biopesticides

Microbial products from genetically modified (cloned) organisms eg. Insulin

#### **Paper II MB 452 Microbial Biotechnology (Practicals)**

Production of ethanol by flask fermentation, recovery of ethanol by distillation and calculation of fermentation efficiency

Preparation of Beer by Microbial fermentation

Preparation of wine from grapes/fruits by fermentation

Production of citric acid by fungal fermentation, recovery and estimation

Production of amino acid (Glutamic acid/lysine) by fermentation

Production of amylase by fermentation, recovery and estimation

Production and estimation of penicillin by flask fermentation

Immobilized bacteria/yeast/enzyme in fermentation

Scale up of fermentation.

#### **Recommended Books**

Industrial Microbiology by Casida, LE

Industrial Microbiology by Patel, AH

Industrial Microbiology by Miller, BM and Litsky

Industrial Microbiology by Prescott and Dunn

Microbial Technology by Peppler, JH and Perlman, D.

Biochemistry of Industrial Microorganisms, by Rainbow and Rose

Economic Microbiology by Rose Vol I – V

Microbial Enzymes and Biotechnology by Fogarty WM and Kelly, CT

Comprehensive Biotechnology, All volumes Ed. Murray Moo-Yong

Biotechnology (A text book of industrial Microbiology) Ed. Cruger & Cruger

Advances in Applied Microbiology Ed. Perlman Series of volumes

Laboratory experiments in microbiology by Gopal Reddy et al

**M.Sc. (Final) IV Semester Microbiology**  
**Paper III MB 403 Microbiology of Food and Environment**  
**(4 units x 15 hrs = 60 hrs teaching)**

**Unit I**

Introduction to fermented foods, Microbial products of milk  
Microbiology of cheese, butter, yogurt, Microbiology of bread, sauerkraut, idlt  
Bacteriological examination of fresh and canned foods  
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Food preservation methods, silage. Food poisoning, Mycotoxins  
Dairy microbiology - Types of microorganisms in milk, significance of microorganisms  
in milk, microbni0ological examination of milk, control of microbial flora of milk

**Unit II**

Microbes and animal interactions – Rumen microbiology, termite microbial communities  
Microbes in the production of energy from agricultural and domestic wastes  
Methanogenesis (Biogas) and microbiology of methogenesis

**Unit III**

Microbial degradation of pesticides and persistence of pesticides  
Degradation of herbicides, fungicides and insecticides.  
Microbes and plant interactions – Rhizosphere, Mycorrhizae, Phyllospheree

**Unit IV**

Microorganisms and water pollution  
Water-borne pathogenic microorganisms and their transmission.  
Sanitary quality of water. Water pollution due to degradation of organic matter  
Aerobic sewage treatment – Oxidation ponds, trickling filters, activated sludge treatment  
Anaerobic sewage treatment – Septic tank  
Microorganisms in air and their importance (brief account)

**Paper III MB 453 Microbiology of Food and Environment (Practicals)**

Microbiological examination of fresh and canned foods and mushrooms  
Microbiological examination of milk and milk products  
Microbiological quality testing dof milk (MBRT test)  
Isolation and cultivation of anaerobic microbes from rumen, and termites  
Isolation and observation for phillosphere microflora  
Isolation and observation for rhizosphere microflora  
Observation for mycorrhizae  
Effect of pesticides on microbial activity  
Estimation of BOD  
Testing for microbial sanitary quality of water (coliform test )

Isolation and analysis of mycotoxins  
Isolation and observation of air microflora

### **Recommended books**

Food Microbiology by Frazier  
Microbial Ecology – A conceptual approach by Lynch and Poole  
Basic food microbiology (Abridged edition) by George J. Banwart  
Waste water microbiology by Bitton, G.  
Waste water treatment – Biological and chemical process by Henze, M.  
Soil Microbiology by Alexander Martin  
Soil Microorganisms and Plant growth by NS Subba Rao  
Laboratory experiments in microbiology by Gopal Reddy et al

## **M.Sc. (Final) IV Semester Microbiology Paper IV MB 404 Medical Virology and Parasitology (4 units x 15 hrs = 60 hrs teaching)**

### **Unit I**

Diagnostic virology – Cultivation of pathogenic viruses in lab animals and tissue culture  
Identification of pathogenic viruses and establishment of viral etiology  
Air borne viral infections (detailed study) – Influenza virus, Rhino virus, Rubella virus, Adeno virus (type 2), Mumps virus and Measles virus

### **Unit II**

Detailed study of viruses transmitted by water - Hepatitis (HAV), Rmk, Polio myelitis  
Detailed study of viruses transmitted by Zoonosis – Rabies, Japanese encephalitis

### **Unit III**

Detailed study of contact and sexually transmitted viral diseases – Small pox, Herpes (Herpes simplex virus), Hepatitis viruses and their diseases  
Acquired immunodeficiency syndrome (AIDS)

### **Unit IV**

Malaria, Amoebiasis, Helminthic infections (Round worms, Hookd worms),  
Medical Mycology – Dermatomycosis, Systemic mycosis

## **IV MB 454 Medical Virology and Parasitology (Practicals)**

Cultivation of viruses - Egg inoculation (CAM, Allantoic, Amniotic route inoculation)  
Tissue culture techniques

Animal inoculation techniques  
Microscopic studies of viruses infected materials  
Examination of pathogenic fungi  
Examination of stool for helminthes and Amoeba  
Examination of blood smear by Leishman stain for medical parasites  
Rota viral RNA (ds RNA) analysis  
Immunodiagnosis - ELISA tests

### **Recommended Books**

Review of medical microbiology by Jawitz et al  
Medical laboratory Manual for tropical countries Vol I & II by Monica Cheesbrough  
Text Book of Microbiology by Ananthanarayanan and Jayaram Paniker  
Viral and Rickettsial infections of Man by Horsfall and Jam  
Text book of Virology by Rhodes and Van Royan  
Virological Procedures by Mitchal hasking  
Virology by Wilson and Topley