

Rs. 10/-

**NORTH MAHARASHTRA UNIVERSITY
JALGAON - 425 001**

SYLLABUS

FOR

**M.Sc. [MICROBIOLOGY]
(From JUNE - 1996)**

SEMESTER I TO IV

**DEPARTMENT OF MICROBIOLOGY
SCHOOL OF LIFE SCIENCES**

Semester I

- MB 101 : Ultrastructure and Taxonomy of Micro-organisms.
- MB 102 : Growth, Nutrition and evolution of Bacteria.
- MB 103 : Basic Biochemistry & Biostatistics.
- MB 104 : Isolation and characterisation Techniques
(Practical Course I)
- MB 105 : Basic Biochemical Techniques
(Practical Course II)

Semester II

- MB 201 : Agricultural Microbiology and Computer Applications
- MB 202 : Microbial Metabolism
- MB 203 : Biochemical Techniques and Methods in Microbiology
- MB 204 : Agricultural Microbiology and Computer Applications
(Practical Course-I)
- MB 205 : Laboratory Techniques in Bio-Chemistry -
(Practical Course-II)

Semester III

- MB 301 : Immunology
- MB 302 : Genetics and Industrial Microbiology
- MB 303 : Applied Microbiology
- MB 304 : Methods in Immunology & Microbiology
(Practical Course-I)
- MB 305 : Methods in Microbiology
(Practical Course-II)

Semester IV

Industrial Microbiology

- MB 401 : Principles of Microbial Fermentations.
- MB 402 : Classical Fermentations
- MB 403 : Novel Fermentations
- MB 404 : Dissertation
(Practical Course-1)
- MB 405 : Microbial Fermentations
(Practical Course-II)

Syllabus for M.Sc. Courses in Microbiology
(Semester I, II, III, IV)
First Semester

MB 101 Ultrastructure and Taxonomy of Microorganisms No. of Lecturers

1. Microscopy: 10
 - (a) Electron Microscopy - TEM and SEM.
 - (b) Interference Microscopy.
 - (c) Preparative techniques for microscopy - Cryostat sectioning ultramicrotomy etc.
2. Ultrastructure of Microorganisms : 15
 - (a) Ultrastructure of Bacterial cell.
 - (b) Cytology of Yeast and Molds.
 - (c) Structure of Plant, animal and bacterial viruses.
3. Recent advances in taxonomy of bacteria, Viruses, yeast Molds and Actinomycetes : 10
4. Criteria used for identification of Yeast and Molds : 9

MB 102 Growth, Nutrition and Evolution of Bacteria

No. of Lecturers

1. Kinetics of Bacterial Growth and Death and Maintenance. 8
2. Continuous & synchronous growth methods and applications. 5
3. Methods of estimation of bacterial growth. 5
4. Morphogenesis in Bacteria. 5
5. Growth factor requirements. 5
6. Transport of nutrients into and out of bacterial cell. 5
7. Autotrophy in Bacteria. 4
8. Growth of bacteria under extreme conditions. 5
9. Evolution of Bacteria. 4

MB 103 Basic Biochemistry and Biostatistics

No. of Lecturers

1. Properties of water, pH, buffers and solubility. 4
2. Chemical properties and structure of Proteins, Amino acids, Carbohydrates, Lipids and Nucleic acids. 20
3. Biostatistics and its application in Microbiology: 22
 - (a) Graphical representation of data.
 - (b) Frequency distributions.
 - (c) Analysis of frequencies.
 - (d) Hypothesis testing.
 - (e) Regression and correlation.
 - (f) Applications of above in genetics ecology and bioassay etc.

SEMESTER - II

201 Agricultural Microbiology & Computer Application

1. Agricultural Microbiology : 20
 - (a) Principles of plant pathology
 - (b) Plant diseases - wheat rust, head smut of Jowar, udhatta diseases of paddy, powdery mildew of grapes, Papaya and potato mosaic, Citrus canker and scab of potato.
2. Computer Applications
Overview of computers, microcomputers, VDU and printer
What is programming? algorithms,
INPUT, PRINT and END statements, arithmetic expressions etc.
GOTO, DO UNTIL, ELSE etc.
Handling arrays, Procedures
Color, sound and graphics
Use of standard packages.

MB 202 Microbial Metabolism

1. Biochemistry of microbial enzymes : 15
 - (a) Kinetics of Enzyme action.
 - (b) Vitamins and Coenzymes.
 - (c) Control and Regulation of enzyme activity.
2. Bioenergetics: 15
 - (a) Principles of Thermodynamics.
 - (b) Energetics of degradative metabolic pathways.
 - (c) Energetics of Chemolithotrophs.
 - (d) Energetics of bacterial photosynthesis.
 - (e) Energetics of anaerobic bacteria.
3. Microbial degradation of aromatic and aliphatic hydrocarbon, Detergents and Pesticides.
4. Metabolic Pathways and their integration in Microorganisms. 4

MB 203 Biochemical Techniques & Methods in Microbiology

1. Chromatography - adsorption, affinity, partition (gas- liquid-gas, HPLC, TLC, RPC, etc). Immobilized cells (4 L)
2. Electrophoresis colloidal solutions of biopolymers and their electrochemical properties, different methods of electrophoresis for proteins, nucleic acids, small W.W. compounds immunoprecipitates etc. (4 L)
3. Peptide mapping and combination of electrofocussing and SDS-PAGE (O/Farrell).

MB 104 Isolation & Characterization techniques: Practical Course I 21

1. Isolation and characterization of groups of Microorganisms
 - (a) Anaerobic bacteria - Clostridia groups
 - (b) Chemolithotrops.
 - (c) Lactic culture.
 - (d) Yeasts.
 - (e) Actinomycetes.
 - (f) Bacteriophage.
 - (g) Halophiles.
 - (h) Acidophiles.
 - (i) Thermophile.

Using the techniques like phase contrast microscopy, Dark ground microscopy, Millipore filter, Higher speed centrifuge, Slide culture and anaerobe cultivation.

2. Construction of growth curve and estimation of generation time of *E. coli* and *B. subtilis*. *C. albicans* and molds.
3. Diauxic growth curve of *E. coli*.

MB 105 Basic Bio-chemical Techniques - Practical Course II

1. Estimation of reducing sugars and Polysaccharides
2. Estimation of nitrogen by Microkjeldahl method
3. Estimation of protein.
4. Estimation of ascorbic-acid.
5. Determination of protein, lipids and carbohydrate content of microorganisms.
6. Preparation and standardization of buffers, molar solutions.
7. Determination of pK value of glycine.

4. Structure of biomembranes and their electrochemical properties, membrane potential, action potential and propagation of impulses (3 L)
5. Principles and application of a) Spectroscopic methods, (UV, VIS, IR, Photoacoustic, Fluorescence, ORD, CD, Mossbauer) to biological systems (15 L)
6. Use of radioactive and stable isotopes and their detection in biological systems (1 L)
7. Automatic analysers for amino acids, protein sequenator, peptide synthesizer, nucleic acid synthesizer (2L)
8. Theory of lyophilization and its applications to biological systems (1 L)
9. Manometric methods and their applications in biological systems (1 L)
10. Theory of centrifugation and application to biological systems. Rotors angle/ swing out/ vertical/ zonal continuous flow. Buoyant density centrifugation. (4 L)
11. PCR & Flow Cytometry.

MB 204 Agricultural Microbiology and Computer Application

Practical Course I

1. Isolation and identification of plant pathogens - species of Bacterial and fungal Pathogen Establishment of etiology of any one Pathogen.
2. Preparation of biofertilizers with special reference to Azotobacter Sp. Rhizobium sp and Blue green algae.
3. Study of Microecosystem - Estimation of bacterial species diversity.
4. Enrichment culture methods for degradation of Detergents Pesticide.
5. Determination of B.O.D. and C.O.D.
6. Preparation of Fungicide.
7. Computer Applications.

MB 205 Methods in Microbiology (Practical Course-II)

1. Quantitative assay of antibiotic, MIC, MBC.
2. Chemical estimation of penicillin and streptomycin.
3. Purification and estimation of amylase, invertase and penicillinase.
4. Isolation and estimation of bacterial DNA.
5. Paper and Gel electrophoresis.
6. Detection of microbial metabolites by using paper and Thin layer chromatography techniques.

SEMESTER THIRD

No. of Lectures

301-IMMUNOLOGY

1. Cellular basis of immunity: immunological memory specificity, diversity, discrimination between self and nonself, primary & secondary lymphoid organs, cell mediated and humoral immune responses. T and B lymphocytes, autoimmune reactions.
2. Antigen and antibody : antigen, antigenic determinant, immunopotency, Structure of antibody; constant and variable regions, Fab, F(ab)₂ & Fc fragments, different classes of antibodies and their functions. Fine structure of antibodies: X-ray diffraction studies, isotypes, allotypes and idiotypes.
3. Measurement of antigen-antibody interaction -diffusion, immunodiffusion, immunoelectrophoresis, radioimmunoassay, immunofluorescence, ELISA, Western blotting.
4. Clonal selection theory of antibody production, Monoclonal and polyclonal antibodies.
5. Complement system : classical and alternate pathway.
6. T lymphocytes and cell mediated immunity, T cell subpopulations, immune response genes. MHC gene complex polymorphism, graft rejection, graft versus host response.
7. Hypersensitivity, immunodeficiency diseases.
8. Vaccines, interferon, AIDS.
9. Blood antigens : blood group substances and Rh factor.
10. Introduction to Tumor Immunology.
11. CMI Reactions - DTH, MI, ADCC & LT.
12. Immuno modulations.

Reference Books

1. Essentials of immunology (5th Edition) Roit, Blackwell Scientific Publishing, London.
2. Basic and clinical immunology. Lange Medical Publication Maruzen Asia.

MB 302 Genetics and Industrial Microbiology

1. Genetics: 20
 - (a) Principles and mechanism of Mutation
 - (b) Mutation: at Molecular level.
 - (c) Outline of Genetics of Viruses and streptomycetes.
 - (d) Principles of Recombinant DNA Technology.
2. Industrial Microbiology: 24
 - (a) Principles of screening
 - (b) Scale up in detail
 - (c) Recovery of fermentation products (including principle underlying the methods).
 - (d) Theory of growth and product formation, hydrodynamics, mass and heat transfer.
 - (e) Principles and methods of microbial assays.

MB 303 Applied Microbiology

No. of Lectures

1. Food Microbiology 20
 - (a) Microbiological quality control of food products and Microbiological standards.
 - (b) Mycotoxin - sources, toxicity, symptoms, prevention, methods of detection and detoxification.
 - (c) Microbial enzymes and their applications in food industry, Food adjuvants.
2. Biological Nitrogen fixation and soil fertility. 10
3. Geomicrobiology: 10
 - (a) Leaching, beneficiation, and biogeochemical prospecting of important minerals; or microbiological aspects.
4. Industrial waste treatment. 4

MB 304 Laboratory Techniques in Immunology and Microbiology - Practical Course - II

1. Preparation of 'H' and 'O' antigen from Salmonella.
2. Preparation of Blood grouping Sera-Anti A Anti B and Anti AB.
3. Complement fixation test.
4. Animal inoculation using rabbit and mice.
5. Demonstration of chick embryo inoculation.
6. Ouchterlony gel diffusion Technique.
7. Haemagglutinin titer determination.
8. Lac induction in E.coli
9. Restriction digestion/Gel electrophoresis practicals.

10. Screening of antibiotic and acid producing microorganisms.
11. Growth curve of antibiotic producing micro-organisms.
12. Isolation of antibiotic resistant mutants - using U.V. rays and replica plating.

MB 305 Methods in Microbiology II- Practical Course

1. Determination of fat, protein, sugar and water content in milk.
2. Detection of aflatoxin in food.
3. Detection of food poisoning Staphylococci - nuclease test.
4. Comparison of different enumeration methods for bacteria and calculation of standard error and confidence limit.
5. Examination of 'N', 'P' moisture and pH from compost and soil.
6. Determination of 'D', 'F' and 'Z' value of Bacterial culture.
7. Isolation of Iron oxidizing bacteria.

SEMESTER FOURTH

Industrial Microbiology

MB 401 Principles of Microbial Fermentations.

	No. of Lectures
1. Raw material-its availability, treatment and economics	5
2. Culture collection and maintenance of important industrial strains.	8
3. Bioengineering aspects-Design and operation of fermenter, optimization studies with respect to controls of physical parameters.	8
4. Genetics of industrial microorganisms-Methods used for improvement of industrial strains, examples of genetically improved strains.	7
5. Automation in fermentation industry.	8
6. Control of metabolic pathway in fermentation-environmental and genetic controls.	8

MB 402 Classical Fermentations

1. Antibiotics: B lactam antibiotics (Cephalosporin C) Rifamycin, Gentamycin and Nystatin.	9
2. Vitamins: Vit. B12 (including mixed fermentation), Vit. C and Riboflavin.	9
3. Organic acids: Citric, Gluconic, Lactic acid-production at large scale.	9
4. Enzymes: Cellulose, Penicillin acylase, Glucose Oxidase, and Glucose isomerase.	9
5. Nucleotide fermentation: IMP, AMP GMP.	8

MB 403 Novel Fermentations

1. Steroid transformation;	5
2. Biofuel technology - Ethanol, Acetone, Butanol, Biogas and Biochemical fuel cells.	8
3. Technological advances in immobilization of enzymes and cells.	6
4. SCP from carbohydrates & non carbohydrate substrates	8
5. Canning of foods.	5
6. Treatment of industrial effluents and waste water Effluents from: (a) Antibiotics industry (b) Dyestuff industry (c) Textile industry (d) Distillery waste (e) Paper industry (f) Leather industry	8
7. Fermentation of coffee, cocoa and tea.	2
8. Retting of Fibre and Tanning of leather	2

MB 404 Dissertation (Project Work)

MB 405 Microbial Fermentation - Practical Course-II

1. Optimization studies on following fermentation at laboratory level:

- (a) Citric acid fermentation.
- (b) Riboflavin fermentation.
- (c) Penicillin fermentation.
- (d) Streptomycin fermentation
- (e) Neomycin fermentation
- (f) Vit. B12 fermentation.

2. Extraction and estimation of Steroid, RNA and DNA

3. Transformation of Steroid.

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