

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**



**Syllabus for**

# **T.Y.B.Sc. Microbiology**

**(With effect from JUNE-2017)**

**North Maharashtra University, Jalgaon**  
**Class:-T.Y.B.Sc. (Semester Pattern)**  
**(w.e.f. June 2017)**

**MB YSC** [Y for year, S for semester and C for course number].

The course structure and title of the courses for T.Y.B.Sc. (Microbiology) are as given below:

**Theory Courses (Semester V)**

Course	Title	Semester	Periods
MB 351	Microbial Genetics	I	60
MB 352	Fermentation Technology	I	60
MB 353	Microbial Metabolism	I	60
MB 354	Medical Microbiology	I	60
MB 355	Immunology	I	60
MB 356	Applied Microbiology	I	60

**Theory Courses (Semester VI)**

Course	Title	Semester	Periods
MB 361	Molecular Biology	II	60
MB 362	Pharmaceutical Microbiology	II	60
MB 363	Enzymology	II	60
MB 364	Clinical Microbiology	II	60
MB 365	Diagnostic Immunology	II	60
MB 366	Environmental Microbiology	II	60

**Practical Courses (Semester-V)**

Course	Title
MB 357	Techniques in Diagnostic Microbiology-I
MB 358	Techniques in Industrial Microbiology-I
MB 359	Techniques in Applied Microbiology-I

**Practical Courses (Semester-VI)**

Course	Title
MB 367	Techniques in Diagnostic Microbiology-II
MB 368	Techniques in Industrial Microbiology-II
MB 369	Techniques in Applied Microbiology-II

Note:-

- A study tour is compulsory for the T.Y.B. Sc. students. The students should submit their tour reports at the time of practical examination.
- Each theory course is having weightage of 4 periods of 45 min per week OR 3 periods of 60 min per week.
- Each Practical course is having weightage of 4 periods of 45 min per week.
- Examination of practical course shall be conducted at each semester.

**MB-351: Microbial Genetics**

<b>Unit I: Central Dogma</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Introduction to concept of central dogma</li> <li>➤ Meselson and Stahl experiment</li> <li>➤ Hershey and Chase experiment</li> <li>➤ Mechanism of DNA replication (Initiation, Elongation and Termination)</li> <li>➤ Mechanism of Transcription (Initiation, Elongation and Termination)</li> <li>➤ Mechanism of Translation (Initiation, Elongation and Termination)</li> </ul>	
<b>Unit II: Viral Genetics</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Types of viral genome</li> <li>➤ Unusual features of viral genome</li> <li>➤ Structure of T4 and <math>\lambda</math> phage</li> <li>➤ One step growth experiment</li> <li>➤ Lysogenic cycle</li> <li>➤ Lytic cycle</li> <li>➤ Phage mutants (Conditionally lethal, Host range and Rapid lysis mutants)</li> </ul>	
<b>Unit III: Genetic Recombination and Repair</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Transformation - Mechanism in Gram positive and Gram negative bacteria</li> <li>➤ Conjugation - Mechanism, F plasmid, (Hfr, F<sup>+</sup> and F' cells)</li> <li>➤ Transduction - Mechanism of Generalized, Specialized &amp; Abortive transduction, Phage conversion</li> <li>➤ Transposable elements - (IS elements, Tn3, Composite, Transposable phages)</li> <li>➤ DNA repair mechanisms - Photoreactivation, Nucleotide excision, Mismatch repair, SOS repair</li> </ul>	

**MB-361: Molecular Biology**

<b>Unit I: Gene Regulation</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Modes and Mechanism of regulation - Induction and Repression</li> <li>➤ Diauxic growth phenomenon</li> <li>➤ Lac operon -Positive and Negative regulation</li> <li>➤ Lac mutants</li> <li>➤ Tryptophan operon</li> </ul>	
<b>Unit II: Molecular Techniques</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Principle and applications of <ul style="list-style-type: none"> <li>1. Blotting techniques - Southern, Northern and Western</li> <li>2. Autoradiography</li> <li>3. Gene sequencing - Sanger, Maxam-Gilbert and Ribotyping</li> <li>4. Polymerase Chain Reaction (PCR)</li> </ul> </li> <li>➤ Gene library and cDNA library</li> <li>➤ Gene mapping - Co-transformation and interrupted mating experiment</li> </ul>	
<b>Unit III: r-DNA Technology</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Concept and Methodology</li> <li>➤ Restriction endonuclease and DNA ligase</li> <li>➤ Vectors - Plasmid, Cosmid, Phage, YAC</li> <li>➤ Applications of r-DNA Technology in <ul style="list-style-type: none"> <li>1. Health and Medicine: Insulin, Interferon, Hepatitis vaccine</li> <li>2. Agriculture: BT, Herbicide resistance</li> </ul> </li> </ul>	

## References

1. David Clark and Nanette J. Pazdernik(2012) Molecular Biology, Academic Press,USA
2. Malacinski G. M. (2006) Essentials of Molecular biology, Narosa Publishing House, Delhi
3. Trun N. and Trempy J. (2004) Fundamentals of molecular biology, Blackwell Science Ltd, UK
4. Benjamin, L., (2000), Genes VIII, Oxford University Press Inc., New York.
5. Dale, J. W., (1994), Molecular Genetics of Bacteria, John Wiley and Sons Inc., New York.
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7. Gardner (1994), Principles of Genetics, 8th Ed., John Wiley and Sons Inc., New York.
8. Glazer, A. N., (1995), Microbial Biotechnology, Academic Press, London.
9. Stanier RY, Ingraham JL, Wheelis ML, Painter PR (1995). General Microbiology, 5th Edition, MacMillan Press Ltd. London.

### MB-352: Fermentation Technology

<b>Unit I: Bioreactor Engineering</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Types of bioreactor (Air-lift fermenter, Tower fermenter, Fluidized bed reactor)</li> <li>➤ Fermenter accessories: Impeller, Sparger and Baffle arrangements etc.</li> <li>➤ Probes &amp; Control: O<sub>2</sub>, pH, temperature &amp; foam</li> <li>➤ On-line, In-situ, Measurements within fermenters</li> </ul>	
<b>Unit II: Industrial Sterilization and Strain Improvement</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Need of aseptic conditions in fermentation process</li> <li>➤ Fermentation media sterilization - Batch and Continuous</li> <li>➤ Sterilization of air by Filtration</li> <li>➤ Methods of strain improvement based on               <ol style="list-style-type: none"> <li>1. Modification of permeability</li> <li>2. Mutation</li> <li>3. r-DNA technology</li> </ol> </li> </ul>	
<b>Unit III: Scale Up and Large Scale Production</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Criteria for scale up</li> <li>➤ Scale up of industrial process</li> <li>➤ Large scale production:               <ol style="list-style-type: none"> <li>1. Beer</li> <li>2. Wine</li> <li>3. Vinegar</li> </ol> </li> </ul>	

### MB-362: Pharmaceutical Microbiology

<b>Unit I: Quality Control and Quality Assurance</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Concept of quality control and quality assurance</li> <li>➤ Raw material</li> <li>➤ Finished product</li> <li>➤ Packaging</li> <li>➤ Documentation</li> <li>➤ Regulations and Introduction to IP, BP, USP and EP</li> <li>➤ Concept of GMP and GLP</li> <li>➤ Pharmaceutical audit</li> </ul>	

- Pharmaceutical testing
    1. Ames test
    2. Sterility test
    3. Toxicity test
  - Microbial assay (Antibiotic)
- Unit II: Microbiological Aspects of Pharmaceuticals** **20**
- General organization of pharmaceutical industry
  - Microbiological environmental monitoring
    1. Sterile manufacturing unit
    2. Biosafety level
    3. Validation of LAF, Autoclave, Balance, pH meter and Centrifuge
- Unit III: Large-Scale Production of the following with respect to organisms involved, inoculum preparation, fermentation media, fermentation process, flow chart, recovery** **20**
- Antibiotics: Streptomycin and Penicillin
  - Enzyme: Amylase
  - Vitamin: Cyanocobalamine
  - Organic acids: Citric acid and Lactic acid
  - Organic solvent: Ethanol
  - Amino acids: L- Lysine and L- Glutamic acid
  - Large scale production of vaccine /immune sera - seed lot system

## References

1. Stanbury, P. F., Whitaker, A., Hall, S. J, (1997), Principles of fermentation Technology, Aditya Book Pvt. Ltd., New Delhi.
2. Demanin Arnold L. and Davies Julian E., (1999) Manual of Industrial Microbiology and Biotechnology, 2nd ed. Panima, ASM Press.
3. Bu'lock, J. and Kristiansen, B, (1987), Basic Biotechnology, Academic Press, London
4. Rehm, li J. and Reed, G, (1983), Biotechnology vol.111, Verlag Chenuue, Florida
5. Vyas, S. P. and Dixit, V. K., (1998), Phamaceutical Biotechnology, CBS Publisher, New Delhi.
6. Casida, L. E., (1991), Industrial Microbiology, Wiley Eastern, New Delhi
7. Peppler, H. J., Perlman, D., (1979), Microbial Technology, vol. I & II, Academic Press.
8. Prescott, S. C. And Dunn, C. G, (1987), Industrial Microbiology, 3rd Ed., McGraw Hill, New York.
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12. Crueger W and Crueger A., (2000) Biotechnology: A text book of Industrial microbiology, 2nd ed. Panima Publishing corporation, New Delhi
13. Jogdand S. N. (2006) Industrial Biotechnology, Himalaya Publishing House, Mumbai.

**MB-353: Microbial Metabolism**

<b>Unit I: Bioenergetics</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Laws of thermodynamics</li> <li>➤ Concept of free energy, entropy and enthalpy</li> <li>➤ High energy compounds</li> <li>➤ Redox potential</li> <li>➤ Electron transport chain (ETC)</li> <li>➤ Inhibitors of electron transport chain</li> <li>➤ Shuttle pathways (Malate aspartate and Glycerol phosphate shuttles)</li> <li>➤ Microbial ATP synthase complex</li> <li>➤ Reverse electron transport chain (RETC)</li> </ul>	
<b>Unit II: Anabolism</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Polysaccharides: Glycogen and Peptidoglycan biosynthesis</li> <li>➤ Fatty acid biosynthesis</li> <li>➤ Purine and Pyrimidine nucleotide biosynthesis (de Novo and Salvage pathway)</li> <li>➤ Bacterial Photosynthesis (Light reaction and Dark reaction- Calvin cycle)</li> </ul>	
<b>Unit III: Catabolism</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Catabolism of Polysaccharides: Starch and glycogen</li> <li>➤ Beta oxidation of fatty acids</li> <li>➤ Overview of catabolism of proteins</li> <li>➤ Transamination</li> <li>➤ Deamination (Oxidative and Non-oxidative)</li> </ul>	

**MB-363: Enzymology**

<b>Unit I: Bioenergetics</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Role of cofactor in metabolism</li> <li>➤ Structure and biochemical functions of the following:             <ol style="list-style-type: none"> <li>1. Nicotinic acid</li> <li>2. Riboflavin</li> <li>3. Thiamine</li> <li>4. Biotin</li> <li>5. Pantothenic acid</li> <li>6. Folic acid</li> </ol> </li> </ul>	
<b>Unit II: Enzyme Regulation</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Allosteric enzyme: ATCase</li> <li>➤ Isoenzyme: LDH</li> <li>➤ Definition and significance of <math>K_M</math> and <math>V_{Max}</math></li> <li>➤ Reversible inhibition (Competitive, Uncompetitive and Noncompetitive)</li> <li>➤ Irreversible inhibition</li> <li>➤ Covalent modification</li> <li>➤ Proteolytic modification</li> </ul>	
<b>Unit III: Enzyme Technology</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Methods of enzyme purification             <ol style="list-style-type: none"> <li>1. Molecular size: Gel exclusion chromatography</li> <li>2. Solubility difference: Isoelectric precipitation, salt precipitation</li> <li>3. Electric charge: Electrophoresis (SDS-PAGE)</li> <li>4. Adsorption – Affinity chromatography</li> </ol> </li> <li>➤ Enzyme assay technique (Spectrophotometric assay)</li> </ul>	

- Immobilization: Concept, Methods and Applications
- Enzyme engineering : Objectives, Principle and Methodology

### References

1. Lehninger, A I., (1982), Principles of Biochemistry, Butterworth Publishers, New York.
2. Moat, A., Foster, J., (1988), Microbial Physiology, 2nd Ed., Wiley Interscience Publications, New York.
3. Palmer T., (1985). Understanding Enzymes. 2nd Ed., Ellis Horwood Ltd., Chichester
4. Price, N. C, Stevens, L, (1989), Fundamentals of Enzymology, 2"d Ed.,Oxford Sci. Publ., Oxford
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7. Stryer, L., (1988), Biochemistry, W H Freeman and Co., New York.
8. Satyanarayan U., (1999), Biochemistry, Books and Allied (P) Ltd. Calcutta

### MB-354: Medical Microbiology

<b>Unit I: Concepts in Medical Microbiology</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Normal flora of human body</li> <li>➤ Concept of Human microbiome</li> <li>➤ Portal of entry of pathogen</li> <li>➤ Stages of infectious diseases</li> <li>➤ Virulence factors: Invasiveness and Toxigenicity</li> <li>➤ Pattern of disease: Chronic and Acute</li> <li>➤ Signs, symptoms and syndrome</li> <li>➤ Laboratory diagnosis</li> <li>➤ Prophylaxis</li> <li>➤ Treatment</li> <li>➤ Epidemiology</li> <li>➤ Introduction to CDC and WHO; their efforts in various epidemics and diagnosis and control of community infection</li> </ul>	
<b>Unit II: Anatomy of Human System</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Brief with illustrations of following:               <ol style="list-style-type: none"> <li>1. Skin</li> <li>2. Digestive system</li> <li>3. Respiratory system</li> <li>4. Nervous system (Peripheral and Central)</li> <li>5. Reproductive system</li> <li>6. Excretory system</li> </ol> </li> </ul>	
<b>Unit III: Chemotherapeutic agents</b>	<b>20</b>
<ul style="list-style-type: none"> <li>➤ Criteria for evaluation of chemotherapeutic agents</li> <li>➤ Antimicrobial spectrum of activity</li> <li>➤ Mechanism of drug resistance</li> <li>➤ Mode of action of antimicrobial agents               <ol style="list-style-type: none"> <li>1. Penicillin, Cephalosporin, Tetracycline and Chloramphenicol</li> <li>2. Polyenes and Griseofulvin</li> <li>3. Amantadine and Zidovudine</li> <li>4. Sulphonamides and Quinones</li> </ol> </li> </ul>	

- Vaccines- Classification, General instruction for vaccination, Vaccination for high-risk individuals
- Antitoxin and Interferon as therapeutic drugs

### MB-364: Clinical Microbiology

- Unit I: Viral Infections and Diseases** **20**
- Study of disease - causative agent, infectious dose, portal of entry, virulence, epidemiology, laboratory diagnosis, prophylaxis and treatment of the following:
    1. AIDS
    2. Polio
    3. Rabies
    4. Hepatitis
    5. Newly emerging diseases: Dengue and Ebola
- Unit II: Bacterial Infections and Diseases** **20**
- Study of disease - causative agent, infectious dose, portal of entry, virulence, epidemiology, laboratory diagnosis, prophylaxis and treatment of the following:
    1. Tuberculosis
    2. Typhoid
    3. Cholera
    4. Tetanus
    5. Syphilis
    6. Gastroenteritis caused by *E. coli*
- Unit III: Fungal and Protozoal Diseases** **20**
- Study of disease-Causative agent, portal of entry, pathogenicity, laboratory diagnosis and treatment of the following:
    1. Dermatophytosis
    2. Malaria
    3. Amoebic dysentery

### References

1. Anantnarayan, P., Paniker, C. K. J., (2009), Ed 8th Textbook of Microbiology, Universities press, Hyderabad
2. Atlas, R. M. (1995), Microorganisms in our world, Mosby Year Book Inc.
3. Chakraborty P (2013) A text book of Microbiology, New Central Book Agency, Delhi
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**MB-355: Immunology**

<b>Unit I: Cells and Organs of Immune System</b>	<b>20</b>
➤ Blood cells: Morphology, formation and function, regulation of hematopoiesis	
➤ Primary lymphoid organs (Structure and function of Thymus and Bone marrow)	
➤ Secondary lymphoid organs (Structure and function of Spleen and Lymph node)	
<b>Unit II: Immune Mechanism</b>	<b>20</b>
➤ Primary and secondary immune response	
➤ Antigen processing and presentation: Need of antigen presentation, APC's, Pathways (Endogenous and Exogenous)	
➤ Inflammatory response: Role of lymphocytes in inflammation	
➤ Cell Mediated Immunity (T cell types, T cell activation, mechanism)	
➤ Humoral immunity ( B- cell Proliferation, Differentiation)	
➤ Cytokines: Properties and role with examples	
➤ Complement system: Classical and Alternative pathway, Complement deficiency, Biological activities of complement activation	
<b>Unit III: Immunological Disorders</b>	<b>20</b>
➤ Hypersensitivity: Types and mechanism in detail (Type I to IV)	
Autoimmune diseases:	
1. Anemia	
2. Rheumatoid arthritis	
3. Diabetes	
4. Myasthenia gravis	
➤ Immunodeficiency: Concept, Disorders and example of each class	

**MB-365: Diagnostic Immunology**

<b>Unit I: Antigen and Antibody Reaction</b>	<b>20</b>
➤ Concept of antibody avidity and affinity	
➤ Antibody specificity - cross reactivity and Prozone effect	
➤ Precipitation	
➤ Agglutination	
<b>Unit II: Immunological Technique</b>	<b>20</b>
➤ Radio-Immuno Assay (RIA)	
➤ Enzyme Linked Immuno Sorbent Assay (ELISA)	
➤ Immunofluorescence	
➤ Immunoelectrophoresis	
➤ Complement fixation	
➤ Western blot	
➤ Immunodiffusion	
<b>Unit III: Transplantation and Tumor Immunology</b>	<b>20</b>
➤ HLA: Structure, Role and Types	
➤ Transplantation: Graft and its types, Graft rejection (1 <sup>st</sup> and 2 <sup>nd</sup> set of reaction)	
➤ Tumor immunology: Definition and concept of tumor	
➤ Types of tumor: Benign and Malignant tumors, Metastasis	
➤ Immune mechanisms against tumors	

**References**

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7. Roitt, E. M., (1988), Essential Immunology, ELBS, Blackwell Sci. Publ., Oxford
8. Vyas, S. P. and Dixit, V. K. (1998), Pharmaceutical Biotechnology, CBS Publisher, New Delhi.
9. Weir, D. M., (1991), Immunology, Livingstone, ELBS and Churchill

**MB-356: Applied Microbiology****Unit I: Milk Microbiology**

20

- Milk - Definition, Composition and Types
- Pasteurization of Milk : Principle and Types
- Microbiological examination of milk
  1. Standard plate count
  2. Breed count
  3. Test for mastitis
  4. MBRT test
  5. Resazurin test
  6. Brucella ring test
- Spoilage of milk
  1. Succession of microorganisms in milk
  2. Colour and flavour defects
  3. Sweet curdling
  4. Stormy fermentation ropiness
- Milk products: Fermented milk - Dahi / Yoghurt
- Milk products: Cheese (Types, General production process, Ripening and defects).
- Concept of Probiotics and Prebiotics

**Unit II: Food Microbiology**

20

- Food fermentations
  1. Bread
  2. Idli
- Food preservation : Principles and methods
- Microbial Food poisoning with respect to toxins, their effects, properties of toxins and treatment
  1. *Staphylococcus aureus*
  2. *Bacillus cereus*
  3. *Clostridium botulinum*

- Food infection: Sources and prevention
    1. *Salmonella*
    2. *Vibrio parahaemolyticus*
  - Aflatoxins: Structure, detection, mode of action and detoxification
- Unit III: Geomicrobiology and Nanotechnology** **20**
- Microbial leaching (Concept, laboratory and field methods)
  - Copper and manganese leaching
  - Nanotechnology- Scope, Microbial synthesis of silver nanoparticles

**MB-366: Environmental Microbiology**

- Unit I: Plant pathology** **20**
- Classification of plant diseases based on symptoms
  - General methods of plant disease control
  - Study of plant diseases with respect to causative agent, host, symptom and control:
    1. Wilt of cotton
    2. Citrus canker
    3. Downy mildew of grapes
    4. Whip smut of sugarcane
    5. Tikka disease of groundnut
    6. BBTV-Banana Bunchy Top Viral disease
- Unit II: Soil Microbiology** **20**
- Soil (Types, Composition and Soil microbes)
  - Rhizosphere
  - Biogeochemical cycles: C, N, S and P
  - Concepts - Bioremediation, Bioaugmentation and Biostimulation
  - Xenobiotics biodegradation e.g. Pesticide
  - Degradation of Cellulose and Lignin
- Unit III: Microbial Waste Treatment Methods** **20**
- Waste (Types and management)
  - Liquid waste (Aerobic and anaerobic methods)
  - Solid waste (Composting)
  - Role of microbes in greenhouse effect
  - Biogas and Bioenergy

**References**

1. Adams, M. R., Moss, M. O, (1995), Food Microbiology, New Age International, New Delhi.
2. Banwart, G. J., (1987), Basic Food Microbiology, CBS Publ., New Delhi.
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13. Sayyed R Z and Patil, A S, (2009) Biotechnology: Emerging Trends, Scientific Publishers Jodhpur.

### Practical courses (Semester Pattern)

#### MB-357: Techniques in Diagnostic Microbiology-I

1. Isolation and identification of *Proteus* from urine sample
2. Isolation and identification of *E. coli* from stool sample
3. Isolation and identification of *Salmonella* from blood sample
4. Determination of Minimum Inhibitory Concentration (MIC) of an antibiotic
5. Demonstration of Koch's postulates
6. ELISA test by suitable kit
7. Demonstration of precipitation reaction based on Immuno-diffusion test
8. Cultivation of anaerobic bacteria using anaerobic jar / any suitable method
9. Demonstration of permanent slides : *Plasmodium*, *Entamoeba histolytica*
10. Detection of Malarial parasite by suitable kit

#### MB-367: Techniques in Diagnostic Microbiology-II

1. Isolation and identification of *Staphylococcus* from pus sample
2. Isolation and identification of *Pseudomonas* from blue pus sample
3. Isolation and identification of *Candida albicans* from skin
4. Antibiotic resistance/sensitivity testing
5. Widal test using slide test (Qualitative & Quantitative)
6. VDRL test for syphilis by antigen- antibody reaction
7. Demonstration of DNA / Protein separation by gel electrophoresis
8. Isolation of microflora from human skin
9. Demonstration of universal precautions for handling of blood and other body fluids
10. **Activity:** Visit to blood bank/Diagnostic Pathology Lab

#### MB-358: Techniques in Industrial Microbiology-I

1. Preparation of alcoholic beverage from fruit juice
2. Separation and identification of sugar/ amino acid by Thin Layer Chromatography (TLC)
3. Measurement of fungal growth by biomass (mycelia dry weight) method
4. Total fungal spore count using Neubauer's chamber
5. Standardization of given disinfectant by using Phenol coefficient test (Rideal Walker test)
6. Sterility testing by membrane filter technique
7. Isolation of Probiotic/Lactic acid bacteria
8. Determine Thermal Death Point (TDP) of given microorganism

9. Determine Thermal Death Time (TDT) of given microorganism
10. Presentation of data in an appropriate form (graphs/ tables using MS Excel)

#### **MB-368: Techniques in Industrial Microbiology-II**

1. Production of citric acid by fermentation
2. Determine protein content of commercial enzyme preparation (e.g. amylase)
3. Determine activity of enzyme (e.g. amylase) and calculation of specific activity
4. UV survival curve
5. Validation of Laminar air flow system / Autoclave validation
6. Microbiological assay of Streptomycin or Penicillin by cup plate/ paper disc method
7. Isolation of antibiotic resistant bacterial population by gradient plate method
8. Detection of invertase in immobilized yeast cells
9. Study of microbial quality of pharmaceutical substance using microbial limit test
10. **Activity:** Visit to Food-Milk Processing/ Pharmaceutical/Fermentation Industry OR Research organization

#### **MB-359: Techniques in Applied Microbiology-I**

1. Measurement of microbial cell size by micrometry
2. Estimation of cellulose
3. Isolation of bacteriophage from sewage
4. Determination of Chemical Oxygen Demand (COD) of sewage water
5. Isolation and identification of *Azotobacter* from rhizospheric soil
6. Isolation of endophytic microorganisms
7. MBRT test for milk sample
8. Isolation and characterization of food fermenting microorganism from idli batter
9. Demonstration of mushroom cultivation
10. Demonstration safety handling of hazards chemicals and awareness of Material Safety Data Sheet (MSDS)

#### **MB-369: Techniques in Applied Microbiology-II**

1. Synthesis of nanoparticles by fungi/ bacteria/ plant
2. Isolation of phosphate solubilizing microorganism from soil
3. Demonstration of Koch's postulates in plants
4. Determination of Biological Oxygen Demand (BOD) of sewage water
5. Detection of antifungal/antibacterial activity of plant extract (e.g. Garlic)
6. Isolation and identification of *Rhizobium* from root nodules
7. Isolation and identification of *Xanthomonas* from infected citrus fruit or leaf
8. Phosphatase test for milk sample
9. Determination of efficacy of biofertilizer *Azotobacter*/ *Rhizobium*/ *Trichoderma*
10. Activity: Exposition activity

#### **Guideline for exposition activity**

Exposition activity should be based on current/relevant topic related to microbiology or allied life science discipline and should have local/global importance. The activity should be submitted as Survey report/PowerPoint

Presentation/MiniReview/Designandexecutionof experiment/Demonstration of sophisticated instruments/Demonstration of microbiological techniques/Practices

**Objectives:**

- To learn team work and co-operative learning
- To enhance the interaction between students and teachers
- To aware students about local problems
- Intellectual thinking and research awareness
- To improve writing/presentation/interview skills
- Effective use of library and online resources

**Procedure:**

- Group of (2-4) students should be assigned the work guided by all interested staff members in the department. The students will be expected to work as a team involving reporting of their activities individually in the form of dissertation Report/ Presentation/Demonstration
- Report of this activity should not exceed 4 Pages (Page size A4, Font used - Times New Roman Font size 12 Double space) OR 10 PowerPoint slides. OR 5- 8 minutes demonstration
- In charge Teacher and head should certify the work completed by the student with note that the opinion/data/result generated in the project has only academic importance and has no legal/ commercial significance.

**Example 1**

**“Emergence of Dengue in 2016 in Dhule District”** (Allotted to 4 students).

All students should work together to collect data by visiting hospitals, health centers online and use library resources. Conclusively each student should submit a separate report.

Student 1: Survey report of Emergence of Dengue in 2016 in Dhule city,

Student 2: Mini review on Dengue,

Student 3: Give demonstration about prophylactic measurements

Student 4: Give Power Point Presentation on Emergence of Dengue in 2016 in Dhule District.

**Example 2**

**“Microbiological quality assessment of drinking water supplied to Shirpur city”**

(Allotted to 3 students)

Students should work together for collection of data, design and execution of experimental work. Finally each student should submit separate report.

Student 1: Report on sample collection, methodology and results

Student 2: Mini review on “Quality of drinking Water - microbiologist’s view”

Student 3: Presentation on quality improvement methodology used for Shirpur Municipal Corporation

### References for practical courses

1. Aneja, K. R. (1996) Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, 2nd Ed., WishwaPrakashan, New Delhi (New Age International, Pvt. Ltd.).
2. Harley, J.P. and Prescott, L. M (1996) Laboratory Exercises in Microbiology, 3rd Ed, WCB / McGraw Hill Inc.
3. Jayararnan, I (1981) Laboratory Manual in Biochemistry, Wiley Eastern Ltd., New Delhi.
4. Mackie and McCartney (1989) Practical Medical Microbiology, 13rd \ Collee, J. E., Duguid, J. P., Fraser, A. G, Marmion, B. P., Churchy Livingstone International Student Ed.
5. Plummer, D. T. (1992) An Introduction to Practical Biochemistry, Tata McGraw Hill Publisher, New Delhi.
6. Sharma Kanika, Manual of Microbiology Tools and techniques, 2nd Ed. 2007, Ane's Book India, New Delhi
7. Gunashekharan P, Introduction to microbial techniques,
8. Parija S. C., (2007) Textbook of Practical Microbiology, Ahuja Publishing House New Delhi
9. Dubey R.C. and Maheshwari D.K. (2004), Practical Microbiology, S.Chand and Co. Delhi.
10. Deshmukh A.M. (1997) 1st Edition, Handbook of Media, Stains and reagents in Microbiology Pama Publications.
11. Reddy M. G., Reddy M. N., Saigopal D. V. R. and Mallaiah K. V. (2008) Laboratory experiments in Microbiology, Himalaya Publishing House, Mumbai

### Skills acquired by the students for job prospectus

A relevant emphasis is given on educating the students about the basic and applied knowledge along with fine skills as a good microbiologist. Emphasis has also been given on various opportunities available as microbiologist and how to avail these. Following is the list every student will acquire during his/her graduation programme.

#### Laboratory skills:

**A student successfully completing B.Sc. microbiology will demonstrate ability in using a bright field light microscope to view and interpret slides, including**

- a. Correctly setting up and focusing the microscope
- b. Proper handling, cleaning, and storage of the microscope
- c. Correctly using all lenses
- d. Recording microscopic observations

**Properly preparing slides for microbiological examination, including**

- a. Cleaning and disposing of slides
- b. Preparing smears from solid and liquid cultures
- c. Performing wet mount and/or hanging drop preparations
- d. Performing Gram stains

**Using properly aseptic techniques for the transfer and handling of microorganisms and instruments, including**

- a. Sterilizing and maintaining sterility of transfer instruments
- b. Performing aseptic transfer
- c. Obtaining microbial samples

**Using appropriate microbiological media and test systems, including**

- a. Isolating colonies and/or plaques
- b. Maintaining pure cultures
- c. Using biochemical test media
- d. Recording accurately macroscopic observations

**Estimating the number of microbes in a sample using serial dilution techniques, including**

- a. Choosing and using correctly pipettes and pipetting devices
- b. Spreading correctly diluted samples for counting
- c. Estimating appropriate dilutions
- d. Extrapolating plate counts to obtain the correct CFU or PFU in the starting sample

**Using standard microbiology laboratory equipment correctly, including**

- a. Using the standard metric system for weights, lengths, diameters, and volumes
- b. Lighting and adjusting a laboratory burner
- c. Using an incubator

**Laboratory Thinking Skills:**

**A student successfully completing B.Sc. microbiology will demonstrate increased skill level in Cognitive processes, including**

- a. Formulating a clear, answerable question
- b. Developing a testable hypothesis
- c. Predicting expected results
- d. Following an experimental protocol

**Analytical skills, including**

- a. Collecting and organizing data in a systematic fashion
- b. Presenting data in an appropriate form (graphs, tables, figures /descriptive paragraphs)
- c. Assessing the validity of the data (including integrity and significance)
- d. Drawing appropriate conclusions based on the results

**Communication skills, including**

**Discussing and presenting lab results or findings in the laboratory**

**Interpersonal and citizenry skills, including**

- a. Working effectively in teams or groups so that the task, results, and analysis are shared
- b. Effectively managing time and tasks allowing concurrent and/or overlapping tasks to be done simultaneously, by individuals and within a group
- c. Integrating knowledge about microbiology in everyday life



**Laboratory Safety skills:**

**A student successfully completing B.Sc. microbiology will demonstrate ability to explain and practice safe Microbiological procedures, including**

- a. Reporting all spills and broken glassware to the instructor and receiving instructions for cleanup
- b. Identifying methods of aseptic transfer
- c. Minimizing or containing the production of aerosols and describing the hazards associated with aerosols
- d. Washing hands prior to and following laboratories and at any time contamination is suspected
- e. Using universal precautions with blood and other body fluids
- f. Disinfecting lab benches and equipment prior to and at the conclusion of each lab session, using an appropriate disinfectant and allowing a suitable contact time
- f. Identifying proper disposal of different types of waste
- g. Reading and signing a laboratory safety agreement indicating that the student has read and understands the safety rules of the laboratory
- h. Practicing good lab practices, including returning materials to proper locations, proper care
- i. and handling of equipment and keeping the bench top clear of extraneous materials

**Protective procedures, including**

- a. Tying long hair back, wearing personal protective equipment (eye protection, coats, gloves, closed shoes; glasses may be preferred to contact lenses), and using such equipment in appropriate situations
- b. Using always appropriate pipetting devices and understanding that mouth pipetting is forbidden
- c. Never eating or drinking in the laboratory
- d. Never applying cosmetics, handling contact lenses, or placing objects (fingers, pencils, etc.) in the mouth or touching the face

**Emergency procedures, including**

- a. Locating and properly using emergency equipment (eye wash stations, first aid kits, fire extinguishers, chemical safety showers, telephones, and emergency numbers)
- b. Reporting all injuries immediately to the instructor

**Following proper steps in the event of an emergency**

- Train faculty, staff, and students in proper waste stream management
- Provide and maintain all necessary safety equipment and information resources
- Train faculty, staff and students in the use of safety equipment and procedures
- Train faculty and staff in use of MSDS

(Reference: ASM's Curriculum Recommendations: Microbiology Majors Program, [www.asm.org](http://www.asm.org))

### Careers in the Field of Microbiology

Microbiological sciences, the study of microorganisms and their relationship to the environment, provide a foundation for a variety of careers. Some scientists conduct basic research to increase the knowledge of these microscopic organisms, while those in applied field use this knowledge to develop new medicines, increase crop yields and improve the environment. Science graduates also work in management or administration, planning programs for food and drug testing, some work as consultants to business firms, sell chemicals or laboratory instruments, or write for technical publications. Even a bachelor's degree is sufficient for advanced technician jobs in the various fields, lab/research assistant positions, or testing and inspection jobs. An advanced degree is required for most other positions in the scientific field. The students can pursue carrier in diverse fields such as Pharmaceutical Microbiology, Industrial Microbiology, Microbial biotechnology, Environmental Biology, Food and Dairy Microbiology, Biofuels and Bioenergy. The research carrier includes the areas in Biomedical Research, Immunology, Proteomics and Genomics, Genetic Engineering and molecular biology. The opportunities are also in some allied fields like Intellectual Property Rights, Forensic Science, Clinical research, Bioinformatics, Nanotechnology etc.

As microbiologist could work for a number of different profit and nonprofit organizations and business or the government. Here is a list of just a few of them:

- Pharmaceutical, Biotech, cosmetic and Chemical Companies
- Public Health Agencies - blood bank, pathology etc.
- State / Government Laboratories and Agencies
- Medical Research Laboratories, Clinics and Hospitals - Cancer, AIDS, TB, Malaria etc.
- Private / Govt. Research Foundations - NCL, NARI, NEERI, CCMB, CDFD, NIV, Reliance, ARI, ICMR, CDRI, TFIR, CSIR, CSRI, etc.
- Agricultural /Dairy / Pesticide Industries
- Food / Beverages Manufacturers and Food & Drug Administration
- Patent / Forensic officials, Forensic Department
- Bio Instrument companies

Currently abundant opportunities are knocking in different areas such as academic institutions, medical schools, the government, and pharmaceutical industry for individuals with training in modern microbiology. Student can work in these settings with a Bachelor's or Master's degree as a technician, lab in charge, manager, junior scientist in R&D lab or as a scientist with a Ph.D.

## Equivalence

Old course No.	Old course title 2014-15	New course No.	New course title June 2017
MB 311	Microbial Genetics	MB 351	Microbial Genetics
MB 312	Fermentation Technology	MB 352	Fermentation Technology
MB 313	Microbial Metabolism	MB 353	Microbial Metabolism
MB 314	Medical Microbiology	MB 354	Medical Microbiology
MB 315	Immunology	MB 355	Immunology
MB 316	Applied Microbiology	MB 356	Applied Microbiology
MB 321	Molecular Biology	MB 361	Molecular Biology
MB 322	Pharmaceutical Microbiology	MB 362	Pharmaceutical Microbiology
MB 323	Enzymology	MB 363	Enzymology
MB 324	Clinical Microbiology	MB 364	Clinical Microbiology
MB 325	Diagnostic Immunology	MB 365	Diagnostic Immunology
MB 326	Environmental Microbiology	MB 366	Environmental Microbiology
MB 307	Techniques in Diagnostic Microbiology	MB 357	Techniques in Diagnostic Microbiology -I
		MB 367	Techniques in Industrial Microbiology -I
MB 308	Techniques in Industrial Microbiology	MB 358	Techniques in Applied Microbiology- I
		MB 368	Techniques in Diagnostic Microbiology-II
MB 309	Techniques in Applied Microbiology	MB 359	Techniques in Industrial Microbiology-II
		MB 369	Techniques in Applied Microbiology-II