

**NORTH MAHARASHTRA UNIVERSITY,  
JALGAON**



'A' Grade  
NAAC Re-Accredited  
(3<sup>rd</sup> Cycle)

**SYLLABUS FOR  
S.Y.B. Sc. MICROBIOLOGY**

**(With effect from JUNE, 2016)**

**North Maharashtra University, Jalgaon**  
**Syllabus for S. Y. B. Sc. Microbiology**  
**[With effect from June, 2016]**

**Aims and Objectives:**

This syllabus is designed to impart fundamental knowledge of Microbiology to undergraduate students at second year of three years of B.Sc. degree course. In view of the demand for trained manpower in the area of Microbiology and microbial biotechnology, this course is broad based, expands the previous year knowledge and focus basic aspects of microbiology with emphasis on practical training to the students. Each unit of the syllabus is well defined, taking into consideration the level and capacity of student. The detailed syllabus for each paper is appended with a list of suggested readings.

**Course structure:**

Subject code	Title of the paper	Periods	Internal marks	External marks	Max. Marks	Credits
<b>First Semester</b>						
<b>Theory courses</b>						
MB-231	Fundamental Biochemistry	60	40	60	100	3
MB-232	Microscopy and Microbial Ecology	60	40	60	100	3
<b>Laboratory course</b>						
MB-234	Practical Course in Microbiology- I	60	40	60	100	1.5
<b>Second Semester</b>						
<b>Theory courses</b>						
MB-241	Genetics and Immunology	60	40	60	100	3
MB-242	Basic Microbial Biotechnology	60	40	60	100	3
<b>Laboratory course</b>						
MB-244	Practical Course in Microbiology II	60	40	60	100	1.5

**Instructions:**

1. Each theory course has to be completed in 60 periods of 45 minutes in each semester.
2. Each theory course will be of 100 marks (40 marks internal and 60 marks external examination).
3. Practical course will be of 100 marks (40 marks internal and 60 marks external examination).
4. Practical examination of laboratory course shall be conducted on two consecutive days for 3 hours per day per batch of the practical examination at the end of each semester.
5. A Study tour of minimum one day to visit at least one place of microbiological interest (pharmaceutical/ industry/ dairy/ research institute etc.) is suggested and students should submit tour report at the time of practical examination.

## First Semester

<b>MB 231: Fundamental Biochemistry</b>	
<b>Unit 1.1</b>	<b>Biomolecules (20 Lectures; 20 marks)</b>
	<ul style="list-style-type: none"> <li>• Chemistry of Carbohydrates               <ul style="list-style-type: none"> <li>➤ Concept and classification (Anomeric carbon, Mutarotation)</li> <li>➤ Structure and biological significance - Glucose (Reducing &amp; Non-reducing), Lactose, Starch and peptidoglycan</li> </ul> </li> <li>• Chemistry of Lipids               <ul style="list-style-type: none"> <li>➤ Concept, classification</li> <li>➤ Structure and biological significance of Glycerol, Phospholipid, Oleic acid, Ergosterol</li> </ul> </li> <li>• Chemistry of Proteins               <ul style="list-style-type: none"> <li>➤ Concept and General properties</li> <li>➤ Basic structure of amino acid and classification</li> <li>➤ Classification of protein (based on solubility and chemical nature)</li> <li>➤ Structural levels of protein organization: Primary, Secondary, super-secondary, tertiary and quartnary</li> </ul> </li> <li>• Chemistry of Nucleic acids               <ul style="list-style-type: none"> <li>➤ Concept of nucleic acid, nucleoside, nucleotide and polynucleotide</li> <li>➤ Structure of basic constituents of Nucleic acids (DNA and RNA)</li> <li>➤ Watson-Crick model of DNA</li> <li>➤ Structure (primary, secondary, tertiary) and functional properties of RNA: (mRNA, rRNA , tRNA, hnRNA)</li> <li>➤ A, B and Z Forms of DNA (structure and differences) and unusual structures of DNA</li> </ul> </li> </ul>
<b>Unit 1.2</b>	<b>Microbial Enzymes (20 Lectures; 20 marks)</b>
	<ul style="list-style-type: none"> <li>• Concept and general properties of enzymes</li> <li>• Enzyme classification (IUB) and nomenclature</li> <li>• Mechanism of enzyme action:               <ul style="list-style-type: none"> <li>➤ Activation energy and transition state</li> <li>➤ Lock and key model</li> <li>➤ Induced fit model</li> </ul> </li> <li>• Factors affecting enzyme activity               <ul style="list-style-type: none"> <li>➤ Substrate concentration, Temperature, pH, Activators, Inhibitors</li> <li>➤ Allosteric enzymes</li> </ul> </li> </ul>
<b>Unit 1.3</b>	<b>Microbial Metabolism (20 Lectures; 20 marks)</b>
	<ul style="list-style-type: none"> <li>• Concept of metabolism (Anabolism and Catabolism)</li> <li>• Metabolic Pathways in bacteria with sequence of reactions and their energetics               <ul style="list-style-type: none"> <li>➤ Glycolysis and Gluconeogenesis</li> <li>➤ Kreb's cycle</li> <li>➤ Glyoxylate cycle</li> </ul> </li> <li>• Electron transport chain in <i>E.coli</i></li> </ul>

<b>MB-232: Microscopy and Microbial Ecology</b>	
<b>Unit: 2.1</b>	<p style="text-align: right;"><b>Microscopy (20 Lectures; 20 marks)</b></p> <ul style="list-style-type: none"> <li>• Principle, working, ray diagram and applications of:               <ul style="list-style-type: none"> <li>➤ Phase Contrast Microscope</li> <li>➤ Fluorescence Microscope</li> <li>➤ Transmission Electron Microscope (TEM)</li> <li>➤ Scanning Electron Microscope (SEM)</li> <li>➤ Specimen preparation for electron microscopy</li> </ul> </li> </ul>
<b>Unit: 2.2</b>	<p style="text-align: right;"><b>Microbial Interactions (20 Lectures; 20 marks)</b></p> <ul style="list-style-type: none"> <li>• Concept of microbial ecology and types of microbial interactions (positive and negative)</li> <li>• Establishment of symbiosis : Direct and Reinfection</li> <li>• Microbial interactions:               <ul style="list-style-type: none"> <li>➤ Legume-rhizobium</li> <li>➤ Mycorrhiza</li> <li>➤ Lichen</li> <li>➤ Ruminant symbiosis</li> <li>➤ Bacterial bioluminescence</li> </ul> </li> </ul>
<b>Unit: 2.3</b>	<p style="text-align: right;"><b>Environmental Microbiology (20 Lectures; 20 marks)</b></p> <ul style="list-style-type: none"> <li>• Air Microbiology               <ul style="list-style-type: none"> <li>➤ Microflora of air</li> <li>➤ Concept of aerosols and droplet nuclei</li> <li>➤ Enumeration of bacteria in air</li> </ul> </li> <li>• Water Microbiology               <ul style="list-style-type: none"> <li>➤ Microflora of water</li> <li>➤ Microbial indicators of water pollution.</li> <li>➤ Bacteriological examination of potable water</li> </ul> </li> <li>• Soil Microbiology               <ul style="list-style-type: none"> <li>➤ Types of soils, soil horizon and Rhizosphere Microflora</li> <li>➤ Enumeration of soil microflora</li> <li>➤ Biogeochemical cycles: C, N, S and P</li> </ul> </li> </ul>

<b>MB-233: Practical Course in Microbiology - I</b>	
1.	Handling and calibration of pipette, micropipette and volumetric flask
2.	Verification of Beer's and Lambert's law using colorimeter/spectrophotometer
3.	Cell wall staining (Ringers OR Chance's method)
4.	Flagella staining (Bailey's OR Loeffler's method)
5.	Detection of microbial enzymes: Amylase, catalase, coagulase, gelatinase, lipase, protease, urease, nitrate reductase
6.	Determination of potability of water by MPN
7.	Determination of microflora of air or soil
8.	Preparation of buffers and determination of pKa value of amino acid
9.	Qualitative tests for carbohydrates, protein, nucleic acid (any one method for each)
10.	Microscopic observation of Rhizobacteria from root nodules/mycorrhizal spores from soil

## Second Semester

<b>MB-241: Genetics and Immunology</b>	
<b>Unit 1.1</b>	<p style="text-align: right;"><b>Genes and chromosomes (20 Lectures; 20 marks)</b></p> <ul style="list-style-type: none"> <li>• Concept of allele, gene, genome, genotype, phenotype, recon, muton, cistron, intron and exon</li> <li>• Typical structure of prokaryotic chromosome</li> <li>• Structural organization of prokaryotic chromosome</li> <li>• Concept of Chromosome variation (Euploidy, Non-disjunction, Aneuploidy, Polyploidy)</li> <li>• Extrachromosomal Plasmid : concept, types and properties</li> <li>• Genetic code and its properties</li> </ul>
<b>Unit 1.2</b>	<p style="text-align: right;"><b>Mutations (20 Lectures; 20 marks)</b></p> <ul style="list-style-type: none"> <li>• Concept and significance of mutation</li> <li>• Types of mutation (Base pair substitutions, frame shift , missense, nonsense, neutral, silent , pleiotropic and suppressor mutations): spontaneous and induced</li> <li>• Mechanism of Spontaneous mutations</li> <li>• Mechanism of induced mutations: Physical (UV, gamma, X rays), Chemical (Base analogues, deaminating agents, alkylating agent, intercalating agent)</li> <li>• Methods to study mutation               <ul style="list-style-type: none"> <li>➤ Fluctuation test</li> <li>➤ Replica plate technique</li> </ul> </li> </ul>
<b>Unit 1.3</b>	<p style="text-align: right;"><b>Elementary Immunology (20 Lectures; 20 marks)</b></p> <ul style="list-style-type: none"> <li>• Infection : Types and mode of transmissions</li> <li>• Immunity: concept, types (Innate, acquired) and components of immune system</li> <li>• Non-specific immune response</li> <li>• Specific immune response (Humoral and cell mediated): Primary and secondary</li> <li>• Antigen: Concept of hapten, adjuvants, Immunogen: Eptiope and Paratope               <ul style="list-style-type: none"> <li>➤ Types and properties of antigen</li> </ul> </li> <li>• Antibody: Types, structure and properties of each antibody</li> </ul>

<b>MB- 242: Basic Microbial Biotechnology</b>	
<b>Unit 2.1</b>	<p style="text-align: right;"><b>Basics of fermentation technology (20 Lectures; 20 marks)</b></p> <ul style="list-style-type: none"> <li>• Characteristics of industrial strain</li> <li>• Screening of industrially important microbes: Primary and Secondary</li> <li>• Fermentation media: Composition, Raw materials, criteria and screening of media</li> <li>• Inoculum - stock, working culture and its criteria</li> <li>• Inoculum development</li> <li>• Preservation of industrially important microbes</li> </ul>
<b>Unit 2.2</b>	<p style="text-align: right;"><b>Fermentation Process (20 Lectures; 20 marks)</b></p> <ul style="list-style-type: none"> <li>• Fermenter and its components</li> <li>• Criteria for fermenter design</li> </ul>

	<ul style="list-style-type: none"> <li>• Batch fermentation</li> <li>• Fed batch fermentation</li> <li>• Continuous fermentation (CSTR)</li> <li>• Continuous (Chemostat and Turbidostat) and Synchronous culture cultivation and its applications</li> </ul>
<b>Unit 2.3</b>	<b>Downstream Processing (20 Lectures; 20 marks)</b>
	<ul style="list-style-type: none"> <li>• Recovery and purification of fermentation products : <ul style="list-style-type: none"> <li>➤ Cell removal: Precipitation, filtration and centrifugation</li> <li>➤ Cell disruption : Physical and chemical method</li> </ul> </li> <li>• Solvent recovery process</li> <li>• Chromatography: Types and recovery of fermentation product</li> <li>• Ultrafiltration, Drying, lyophilization and crystallization</li> </ul>

### MB-243: Practical Course in Microbiology – II

1.	Nucleus staining (Fuelgen staining)
2.	Endospore Staining (Dorner's OR Schaeffer-Fulton's method)
3.	Capsule Staining (Hiss OR Maneval's method)
4.	Volutin granules (Albert's OR Neisser's method)
5.	Isolation of spontaneous mutants using Replica plate technique
6.	Screening of microbes: Crowded plate technique and Indicator dye method
7.	Estimation of acetic acid from vinegar by titrimetric method
8.	Determination of blood group and cross matching of blood
9.	Demonstration of a typical fermenter
10.	Recovery of organic acid from fermentation broth and detection using Paper/ Thin layer chromatography

### References (Theory courses)

	<b>Title of Book</b>	<b>Author/s and Editor</b>	<b>Publisher</b>	<b>Edition and Year</b>
1.	Foundations in Microbiology ( ISBN 978-0-07-337529-8)	Kathy Talaro and Barry Chess	The McGraw-Hill Companies, Inc., New York.	8th Edition (2012)
2.	Microbiology ISBN 10: 0-321-55007-2;	Tortora, Funke and Case	Brenjamin Cummings Inc. ,California	10 th Edition (2010)
3.	Desk Encyclopedia of Microbiology	Moselio Schaechter	Elsevier	2nd edition (2009)
4.	Microbiology 0-07-282905-2	Prescott, Harley and Klein's	The McGraw-Hill Companies, Inc.,	5th Edition (2002)
5.	General Microbiology Vol.I and II	Pawar and Daginawala	Himalaya Publishing House, Mumbai	First Edition
6.	General Microbiology	Stainer, R. Y., Ingraham, J.L., Wheelis M.L., Painter R.K.	MacMillan Press Ltd. London.	5 <sup>th</sup> Edition (1995),
7.	Fundamental Principles of	Salle, S.J.	Tata McGraw Hill	(1974)

	Bacteriology		Publishing Co. Ltd. New Delhi	
8.	Fundamentals of Microbiology	Frobisher M. Hinsdill, Crabtree and Goodheart	Edition, WB Saunder's Co. USA.	9 <sup>th</sup> Edition (1974)
9.	Microbiology	Pelczar MJ, Chan ECS, Krieg NR	Tata McGraw Hill Publishing Co.Ltd. New Delhi.	5 <sup>th</sup> Edition (1998)
10.	Foundations in Microbiology (ISBN: 976-81-85790-53-4)	Ulhas Patil, JS Kulkarni, AB Chaudhari and SB Chincholkar	Nirali Prakashan, Pune	7th Edition (2011)
11.	Textbook of Microbiology	Ananthanarayanan, R and Jayaram Panicker C.K	University Press (India) Pvt. Ltd, Hydrabad	8 <sup>th</sup> ed. (2009)
12.	Industrial Microbiology	Casida, L.E	New Age International Publishers, New Delhi	1998
13.	Biotechnology: A textbook of Industrial Microbiology	Crueger, W. and Crueger, A.	Panima Publ Co., New Delhi	2nd edn., (2000)
14.	Principles of Fermentation Technology,	Stanbury, P.F., Whitaker, A. and Halt G.	Pergamon Press, New York	2 edn., (1995)
15.	Principles of Biochemistry	Lehninger, A.L	CBS Publ.Pvt Ltd., New Delhi	1994
16.	Elementary Microbiology, Vol 1, and 2	Modi H. A	Ekta Prakashan, Ahemdabad	1995
17.	Industrial Microbiology	Patel A. H.	McMillan Publication, New Delhi	(1996)
18.	Industrial Microbiology	Prescott S.C and Dunn C.G.	McGraw Hill Book Co. Inc., New York.	3rd edn. (1983)

### References (Practical Course in Microbiology I and II)

	Title of Book	Author/s or Editor	Publisher	Edition and Year
1.	Methods in Microbiology Volume 1	J. R. Norris, D. W. Ribbons	Academic Press Inc., London	First Edition (1969)
2.	Laboratory Exercises in Microbiology	John P. Harley, Lansing M. Prescott	The McGraw-Hill Companies, New York	Fifth Edition (2002)
3.	Microbiological Applications Lab Manual	H. Benson	The McGraw-Hill Companies, New York	Eighth Edition (2001)
4.	Experiments in Microbiology	Aneja K.R.	Wishwa Prakashan, New Delhi.	3rd Edition (1996)
5.	Text Book of Practical Microbiology	Parija S.C.	Ahuja Publishing House, New Delhi.	First edition (2005)
6.	Manual of Microbiology Tools and techniques	Sharma Kanika	Ane's Book India, New Delhi	2nd Ed. (2007)
7.	Practical Microbiology	Dubey, R.C. and Maheshwari, D.K.	S. Chand and Co., New Delhi.	(2004)
8.	A laboratory Manual in Biochemistry	Jayraman, J	New Age international publication, New Delhi	(2001)
9.	In introduction to practical Biochemistry	David Plummer	Tata McGraw Hill Ed, New Delhi	(2001)