



# **Savitribai Phule Pune University**

*(Formerly University of Pune)*

**Three Year B.Sc. Degree Program in Microbiology**

**(Faculty of Science & Technology)**

**F.Y.B.Sc. (Microbiology)**

**Choice Based Credit System Syllabus**

**To be implemented from Academic Year 2019-2020**

## Title of the Course: B. Sc Microbiology

### Structure of The Syllabus :

#### F.Y.B.Sc. Microbiology

Semester	PaperCo	Paper	Papertitle	credits	Lectures/Week			Evaluation		
					Th.	Tut.	Pr.	CA	UE	Total
<b>I</b>	<b>MB 111</b>	<b>I</b>	Introduction to Microbial World	<b>2</b>	<b>2</b>			<b>15</b>	<b>35</b>	<b>50</b>
	<b>MB 112</b>	<b>II</b>	Basic Techniques in Microbiology	<b>2</b>	<b>2</b>			<b>15</b>	<b>35</b>	<b>50</b>
	<b>MB113</b>	<b>III</b>	Practical Course based on theory paper I and II	<b>1.5</b>			<b>3</b>	<b>15</b>	<b>35</b>	<b>50</b>
<b>II</b>	<b>MB121</b>	<b>I</b>	Bacterial Cell and Biochemistry	<b>2</b>	<b>2</b>			<b>15</b>	<b>35</b>	<b>50</b>
	<b>MB122</b>	<b>II</b>	Microbial cultivation and growth	<b>2</b>	<b>2</b>			<b>15</b>	<b>35</b>	<b>50</b>
	<b>MB123</b>	<b>III</b>	Practical Course based on theory paper I and II	<b>1.5</b>			<b>3</b>	<b>15</b>	<b>35</b>	<b>50</b>

#### S. Y. B. Sc. Microbiology

Semester	PaperCo	Paper	Papertitle	credits	Lectures/Week			Evaluation		
					Th	Tut	Pr.	CA	UE	Total
<b>III</b>	<b>MB 211</b>	<b>I</b>	Bacterial Systematics and Physiology	<b>2</b>	<b>2</b>			<b>15</b>	<b>35</b>	<b>50</b>
	<b>MB 212</b>	<b>II</b>	Industrial Microbiology	<b>2</b>	<b>2</b>			<b>15</b>	<b>35</b>	<b>50</b>
	<b>MB213</b>	<b>III</b>	Practical based on MB211 & MB 212	<b>2</b>			<b>4</b>	<b>15</b>	<b>35</b>	<b>50</b>
<b>IV</b>	<b>MB221</b>	<b>I</b>	Bacterial Genetics	<b>2</b>	<b>2</b>			<b>15</b>	<b>35</b>	<b>50</b>
	<b>MB222</b>	<b>II</b>	Air Water & Soil Microbiology	<b>2</b>	<b>2</b>			<b>15</b>	<b>35</b>	<b>50</b>
	<b>MB223</b>	<b>III</b>	Practical based on MB211 & MB 212	<b>2</b>			<b>4</b>	<b>15</b>	<b>35</b>	<b>50</b>

**T. Y. B. Sc. Microbiology Proposed Structure**

	Paper	Paper Title	Marks	Lecture
Semester V	MB 331 TC	Medical Microbiology I	50	2 Credits /per TC
	MB 332 TC	Genetics and Molecular Biology I	50	
	MB 333 TC	Enzymology	50	
	MB 334 TC	Immunology I	50	
	MB 335 TC	Fermentation technology I	50	
	MB 336 Elective Course TE	Applied Microbiology I (Elective Course)	50	2 Credits /TE
	TE 1	Dairy Microbiology		
	TE 2	Agricultural Microbiology		
	TE 3	Marine Microbiology		
	TE 4	Space Microbiology		
	MB 337 PC	Practical Course I	50	2 Credits /per PC
	MB 338 PC	Practical Course II	50	
	MB 339 PC	Practical Course III	50	
Semester VI	MB 341 TC	Medical Microbiology II	50	2 Credits /per TC
	MB 342 TC	Genetics and Molecular Biology II	50	
	MB 343 TC	Metabolism	50	
	MB 344 TC	Immunology II	50	
	MB 345 TC	Fermentation technology II	50	
	MB 346 Elective Course TE	Applied Microbiology II (Elective Course)	50	2 Credits /TE
	TE 5	Food Microbiology		
	TE 6	Geomicrobiology		
	TE 7	Nanobiotechnology		
	TE 8	Waste Management		
	MB 347 PC	Practical Course I	50	2 Credits /per PC
	MB 348 PC	Practical Course II	50	
	MB 349 PC	Practical Course III	50	

**Equivalence of Previous Syllabus: F. Y. B. Sc. Microbiology**

<b>Sem</b>	<b>Old Course(2013 Pattern)</b>	<b>New Course(2019 Pattern)</b>
<b>I</b>	Introduction to Microbiology	Introduction to Microbial World
	Basic Techniques in Microbiology	Basic Techniques in Microbiology
	Practical Course	Practical Course based on theory paper I and II
<b>II</b>	Introduction to Microbiology	Bacterial Cell and Biochemistry
	Basic Techniques in Microbiology	Microbial cultivation and growth
	Practical Course	Practical Course based on theory paper I and II

## Semester I

### Paper I: Introduction to Microbial World

Sr. No.	Topic	No. of Hours
<b>Credit One</b>	<b>Amazing world of Microbiology</b>	<b>(15)</b>
	<b>Development of microbiology as a discipline</b> -Discovery of microscope and Microorganisms (Anton von Leeuwenhoek and Robert Hooke), Abiogenesis v/s biogenesis (Aristotle's notion about spontaneous generation, Francesco Redi's experiment, Louis Pasteur's & Tyndall's experiments)	<b>4</b>
	<b>Golden Era of Microbiology</b> Contributions of - Louis Pasteur (Fermentation, Rabies and Pasteurization) Robert Koch (Germ theory of disease, Tuberculosis and Cholera) Ferdinand Cohn (Endospore discovery), Discovery of viruses, River's Postulates	<b>3</b>
	Contribution of Joseph Lister (antiseptic surgery), Paul Ehrlich (Chemotherapy), Elie Metchnikoff (Phagocytosis), Edward Jenner (Vaccination) and Alexander Fleming (Penicillin) in establishment of fields of medical microbiology and immunology, Discovery of Streptomycin by Walksman	<b>3</b>
	Contribution of Martinus W. Beijerinck (Enrichment culture technique, Rhizobium), Sergei N. Winogradsky (Nitrogen fixation and Chemo-lithotrophy) in the development of the field of soil microbiology	<b>2</b>
	<b>Modern Era of Microbiology</b> (Carl Woese and Ananda Chakrabarty) Human Microbiome, Nanobiotechnology, Space Microbiology	<b>1</b>
	<b>Nobel laureates in Life Sciences of 21<sup>st</sup> Century</b>	<b>1</b>
	<b>Project Based Learning</b>	<b>1</b>
<b>Credit Two</b>	<b>Types of Microorganism and their differentiating characters</b>	<b>(15)</b>
	--Bacteria (Eubacteria and Archaeobacteria)	<b>1</b>
	--Protozoa	<b>1</b>
	--Fungi	<b>1</b>
	--Algae	<b>1</b>
	--Viruses, Viroids and Prions	<b>1</b>
	--Actinomycetes	<b>1</b>
	<b>Benefit and nuisances caused by microorganisms</b>	<b>1</b>
	<b>Medical Microbiology</b> (Enlist diseases caused by various microorganisms and their cure)	<b>2</b>
	<b>Environmental Microbiology</b> (Eutrophication, red tide, Sewage treatment,	

	bioremediation)	<b>1</b>
	<b>Food and Dairy Microbiology</b> (Food spoilage, food borne diseases, Probiotics and fermented food)	<b>2</b>
	<b>Agriculture Microbiology</b> (Plant diseases and Biofertilizers and Biocontrol agents)	<b>2</b>
	<b>Industrial Microbiology</b> (Production of antibiotics, enzymes, solvents, contaminants producing undesirable product, reducing yield)	<b>1</b>
	<b>Immunology</b> (Normal flora, Three lines of defence)	

## Semester II

### Paper I: Bacterial Cell and Biochemistry

Sr. No.	Topic	No. of Hours
<b>Credit One</b>	<b>Bacterial Cytology</b> - Microbial cell size, shape and arrangements <b>Structure, chemical composition and functions of the following components in bacterial cell:</b> --Cell wall (Gram positive, Gram negative, Mycoplasma, Spheroplast, protoplast, L-form) <b>3</b> --Cell membrane <b>1</b> --Endospore (spore formation and stages of sporulation) <b>1</b> --Capsule <b>1</b> --Flagella <b>1</b> --Fimbriae and Pili <b>1</b> --Ribosomes <b>1</b> --Chromosomal & extra-chromosomal material <b>1</b> --Cell inclusions (Gas vesicles, carboxysomes, PHB granules, metachromatic granules, glycogen bodies, starch granules, magnetosomes, sulfur granules, chlorosomes) <b>5</b>	<b>15</b>
<b>Credit Two</b>	<b>Chemical Basis of Microbiology</b> Atom, Biomolecules, types of bonds (covalent, co-ordinate bond, non-covalent) and linkages (ester, phospho-diester, peptide, glycosidic) <b>2</b>  <b>Chemistry of Biomolecules: Structure, organization and functions</b> <b>Carbohydrates: Definition, classification</b>  i. Monosaccharides: Classification based on aldehyde and ketone groups; structure of Ribose, Deoxyribose, Glucose, Galactose and Fructose. <b>1</b> ii. Disaccharides: Glycosidic bond, structure of lactose and sucrose. <b>1</b> iii. Polysaccharides: Structure and types <b>2</b> Examples-Starch, glycogen, Peptidoglycan, chitin <b>Lipids: Definition, classification</b> i. Simple lipids – Triglycerides, Fats and oils, waxes. <b>1</b>	<b>15</b>



	<ul style="list-style-type: none"> <li>• Properties and role of Fixatives, Mordants, Decolourisers and Accentuators</li> <li>• Monochrome staining and Negative (Relief) staining</li> <li>• Differential staining - Gram staining and Acid-fast staining</li> <li>• Special staining- Capsule, Cell wall, Spore, Flagella, Lipid granules, metachromatic granules</li> </ul>	1 1 2 2
<b>Credit II</b>	<b>Sterilization and Disinfection</b> <b>1. Sterilization</b> <ul style="list-style-type: none"> <li>• Physical Agents - Heat, Radiation, Filtration</li> <li>• Checking of Efficiency of Sterilization (Dry and Moist) – Biological and Chemical Indicators</li> </ul> <b>2. Disinfection:</b> <ul style="list-style-type: none"> <li>• Chemical agents and their mode of action - Aldehydes, Halogens,</li> <li>• Quaternary ammonium compounds, Phenol and phenolic compounds,</li> <li>• Heavy metals, Alcohol, Dyes, Detergents and Ethylene oxide.</li> <li>• Characteristics of an ideal disinfectant</li> <li>• Checking of Efficiency of Disinfectant - Phenol Coefficient</li> </ul>	15  3 3  2 2 3 1 1

## Semester II

### Paper II: Microbial cultivation and growth

Serial No.	Topic	No. of Hours
<b>Credit One</b>	<b>Cultivation of Microorganisms:</b> 1. Nutritional requirements and nutritional classification 2. Design and preparation of media: Common ingredients of media and types of media 3. Methods for cultivating photosynthetic, extremophilic and chemolithotrophic bacteria, anaerobic bacteria, algae, fungi, actinomycetes and animal viruses 4. Concept of Pure Culture, Isolation of pure culture by streak plate, pour plate, spread plate and their enrichment 5. Maintenance of bacterial and fungal cultures by using different techniques 6. Culture Collection centres and their role 7. Requirements and guidelines of National Biodiversity Authority for culture collection centres	15 2 2 4 2 3 1 1
<b>Credit Two</b>	<b>Bacterial growth:</b> 1. Kinetics of bacterial growth (Logistic growth model) 2. Growth curve and Generation time 3. Diauxic growth 4. Measurement of Bacterial growth- Methods of enumeration: <ul style="list-style-type: none"> <li>• Microscopic methods (Direct microscopic count, counting cells using improved Neubauer, Petroff-Hausser's chamber)</li> <li>• Plate counts (Total viable count)</li> <li>• Turbidometric methods</li> </ul>	(15) 2 2 1 2 2 1



	<ul style="list-style-type: none"> <li>• Estimation of biomass (Dry mass, Packed cell volume)</li> <li>• Chemical methods (Cell carbon and nitrogen estimation)</li> </ul>	<b>1</b>
	5. Factors affecting bacterial growth {pH, Temperature, Solute Concentration (Salt and Sugar)} and Heavy metals	<b>1</b>
		<b>3</b>

## Practical Course

### Title: Practical Course based on theory paper I and II

Semester I		
Expt. No.	Topics	No. of Practicals
1	Safety Measures and Good Laboratory Practices in Microbiology laboratory	1
2	Introduction, operation, precautions and use of common microbiology laboratory instruments: Incubator, Hot Air Oven, Autoclave, Colorimeter, pH Meter, Distillation Unit, Chemical Balance, Laminar air flow hood, Clinical Centrifuge	1
3	Construction (mechanical and optical), working and care of bright field microscope	1
4	Introduction and use of common laboratory glass wares: Test tubes, Culture tubes, suspension tubes, screw capped tubes, Petri plates, pipettes (Mohr and serological) micropipettes, Pasture pipettes, Erlenmeyer flask, volumetric flask, glass spreader, Durhams tube, Cragie's tube and inoculating needles (wire loop, stab needles)	1
5	Learning basic techniques in Microbiology: Wrapping of glassware, Cotton plugging, cleaning and washing of glassware, Inoculation of bacterial culture, Biological waste disposal. Aseptic transfer techniques (slant to slant, broth to broth, broth to agar and Agar to Agar)	1
6	Basic staining techniques: <ol style="list-style-type: none"> <li>Monochrome staining</li> <li>Negative staining</li> <li>Gram staining of bacteria</li> </ol>	3
7	Observation of motility in bacteria using: Hanging drop method and Swarming growth methods	2
8	<ol style="list-style-type: none"> <li>To study the effect of different parameters on growth of <i>E. coli</i>: pH, temperature, sodium chloride concentration</li> <li>Study of Oligodynamic action of heavy metal</li> <li>Detection of above growth using colorimeter</li> </ol>	4
9	Study of normal flora of skin: <ol style="list-style-type: none"> <li>Cultivating and observing different morphoforms of bacteria from skin</li> <li>Study of effect of washing on skin with soap and disinfectant on its microflora</li> </ol>	2

10	Permanent Slide observation: Algae, Fungi and Protozoa Wet Mount slide preparation and its observation for: Bacteria, Algae, Fungi and Protozoa	2
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<b>Semester II</b>		
<b>Expt. No.</b>	<b>Topics</b>	<b>Hours</b>
<b>1</b>	<b>Cultivation of microorganisms:</b> <ol style="list-style-type: none"> <li>Preparation of simple laboratory nutrient media (solid and liquid) and using them to cultivate bacteria.</li> <li>Observation of the growth of cultures and reporting of colony and cultural characteristics (Nutrient agar, MacConkey's agar, Sabouraud's agar)</li> <li>Preparation of Winogradsky's column and observation of different types of microorganisms using bright field microscope.</li> </ol>	<b>3</b>
<b>2</b>	<b>Special staining techniques:</b> <ol style="list-style-type: none"> <li>Endospore staining</li> <li>Capsule staining</li> <li>Metachromatic granules staining</li> </ol>	<b>6</b>
<b>2</b>	Isolation of bacteria by streak plate technique (Colony and cultural characteristics)	<b>1</b>
<b>3</b>	Enumeration of bacteria from fermented food / soil / water by: <ol style="list-style-type: none"> <li>Spread plate method</li> <li>Pour plate method</li> </ol>	<b>2</b>
<b>4</b>	Checking sterilization efficiency of autoclave using a biological indicator ( <i>B. stearothermophilus</i> )	<b>1</b>
<b>5</b>	Demonstration of checking of efficacy of chemical disinfectant: Phenol Coefficient (Rideal-Walker method)	<b>1</b>
<b>6</b>	Preservation of cultures on slants, soil and on grain surfaces; revival of these cultures and lyophilized cultures.	<b>1</b>
<b>7</b>	Visit to Microbiological research Institute OR Culture collection Centre, Agricultural college / Industry	<b>1</b>

**Recommended Books:**

1. Daniel Lim, Microbiology, 2<sup>nd</sup> Edition; McGraw-HillPublication
2. David T. Plummer (1993) An Introduction to Practical Biochemistry, 3<sup>rd</sup> ed., Tata McGraw-Hill Publishing Company Limited, NewDelhi
3. Hans G. Schlegel (1993) General Microbiology, 8<sup>th</sup> ed., Cambridge UniversityPress
4. Harley Prescott, (2002), Laboratory exercises in microbiology, 5<sup>th</sup> ed, The McGraw Hill.
5. Harold B. Benson, (2001), Microbiological applications - laboratory manual on general microbiology, 8<sup>th</sup> Ed, The McGraw Hill.
6. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3<sup>nd</sup> ed. Thomson Brooks /Cole.
7. Jeffrey C. Pommerville, (2011), Alcamo's Fundamentals of Microbiology, 9<sup>th</sup> ed.
8. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11<sup>th</sup> ed. Pearson EducationInc.
9. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5<sup>th</sup> ed., Tata McGraw HillPress.
10. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6<sup>th</sup> ed. McGraw Hill CompaniesInc.
11. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6<sup>th</sup> ed., McGraw Hill HigherEducation
12. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7<sup>th</sup> ed. Tata McGraw Hill PublishingCo.
13. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5<sup>th</sup>ed.. Macmillan PressLtd.
14. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8<sup>th</sup> ed. Pearson EducationInc
15. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8<sup>th</sup> ed., McGraw-Hill HigherEducation
16. Wilson K. and Walker J.M. (2005) Principles and Techniques of Biochemistry and Molecular Biology. 6<sup>th</sup> Edition. Cambridge UniversityPress.