

**UNIVERSITY OF MUMBAI**



**Syllabus for the F.Y.B.Sc.**

**Program: B.Sc.**

**Course : Microbiology**

(Credit Based Semester and Grading System with  
effect from the academic year 2011–2012)

**F.Y.B.Sc. Microbiology Syllabus**  
**Restructured for Credit Based and Grading System**  
**To be implemented from the Academic year 2011-2012**

**Semester I**

Course Code	Title	Credits
<b>USMB101</b>	<b>FUNDAMENTALS OF MICROBIOLOGY</b>	<b>2 Credits (45 lectures )</b>
<b>Unit I</b> <b>Introduction to Microbiology and prokaryotic cell structure and function.</b> 1.1 History and scope of Microbiology 1.2 Prokaryotic cell membranes – plasma membranes and internal membrane systems 1.3 Cytoplasmic matrix – Inclusion bodies, ribosome. 1.4 Bacterial chromosome and plasmids – source of information 1.5 Cell Wall 1.6 Components external to cell wall – Capsule, Slime Layer, S Layer, Pili, Fimbriae, Flagella 1.7 Bacterial endospores and their formation.		<b>15 Lectures</b>
<b>Unit II</b> <b>Eukaryotic cell structure and function.</b> 2.1 Overview of Eucaryotic cell structure and Function. 2.2 The cytoplasmic matrix, microfilaments, Intermediate filaments and microtubules 2.3 Endoplasmic reticulum and Golgi apparatus 2.4 Lysosomes and Endocytosis 2.5 Eucaryotic ribosomes, Mitochondria and Chloroplasts 2.6 Nucleus, Nucleolus, Cell division, Mitosis and eiosis 2.7 External cell coverings 2.8 Comparision between Procaryotic and Eucaryotic cell		<b>15 Lectures</b>
<b>Unit III</b> <b>Microbial Nutrition, cultivation, isolation and preservation.</b> 3.1 Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors. 3.2 Nutritional types of microorganisms 3.3 Nutrient uptake mechanisms 3.4 Types of Culture media with examples 3.5 Isolation of microorganisms and pure culture techniques. 3.6 Preservation of microorganisms		<b>15 Lectures</b>

Course Code	Title	Credits
<b>USMB102</b>	<b>APPLIED MICROBIOLOGY</b>	<b>2 Credits (45 lectures )</b>
<p><b>Unit I : Microscopy.</b></p> <p>1.1 Concepts</p> <p>1.2 Lenses &amp; bending of light</p> <p>1.3 The Light Microscope</p> <p>    a) Bright Field Microscope</p> <p>    b) Resolution of the Microscope</p> <p>1.4 The Electron Microscope</p> <p>    a) The Transmission Electron Microscope</p> <p>    b) The Scanning Electron Microscope</p> <p>1.5 Newer Techniques in Microscopy</p> <p>    a) Confocal Microscopy</p> <p>    b) Scanning Tunneling Microscope Eg. The Scanning Tunneling Microscope.</p> <p>        The Atomic Force Microscope</p>		<b>15 Lectures</b>
<p><b>Unit II : Contrast Enhancement techniques.</b></p> <p>2.1 The Dark Field Microscope</p> <p>2.2 The Phase Contrast Microscope</p> <p>2.3 The Differential Inerference Contrast Microscope</p> <p>2.4 The Fluorescence Microscope</p> <p>2.5 Staining of specimens</p> <p>    a) Flaxation</p> <p>    b) Dyes &amp; simple staining</p> <p>    c) Differential staining</p> <p>    d) Staining of specific structures</p> <p>2.6 Specimen preparation in TEM Staining,Shadowing with metals, Freeze Etching</p>		<b>15 Lectures</b>
<p><b>Unit III : Control of Microorganisms.</b></p> <p>3.1 Definitions of frequently used terms</p> <p>3.2 Pattern / Rate of Microbial Death</p> <p>3.3 Conditions influencing the effectiveness of Antimicrobial Agents</p> <p>3.4 Physical methods of Microbial Control</p> <p>    a) Heat : Moist &amp; Dry    b) Low temperature</p> <p>    c) Filtration                d) High pressure</p> <p>    e) Desiccation              F) Osmotic pressure    g) Radiations</p> <p>3.5 Chemical methods of Microbial Control</p> <p>    a) Phenolics    b) Biguanides- Chlorohexidine</p> <p>    c) Alcohols    d) Halogens</p> <p>    e) Heavy Metals    f) Quaternary ammonium compounds</p> <p>    g) Surface active agents    h) Aldehydes</p> <p>    i) Sterilising gases    j) Peroxygens    k) Chemotherapeutic agents</p> <p>3.6 Evaluation of effectiveness of Antimicrobial agent.</p>		<b>15 Lectures</b>

Course Code	Title	Credits
<b>USMBP1</b>	<b>PRACTICALS</b>	<b>2 Credits</b>
<p><b>SECTION – I</b></p> <p><b>FUNDAMENTALS OF MICROBIOLOGY</b></p> <p><b>Unit I : Safety in Laboratory</b> Assignment : Contribution of a Scientist in the field of Microbiology</p> <p><b>Unit II : Procaryotic &amp; Eucaryotic cell structures-</b></p> <ul style="list-style-type: none"> <li>a) Monochrome Staining</li> <li>b) Negative Staining</li> <li>c) Staining of specific structures: Cell wall, Capsule, Endospores, Metachromatic Granules, Lipids, Flagella, Spirocheates</li> <li>d) Permanent slides of Algae &amp; Protozoa</li> </ul> <p><b>Unit III : Preparation of Culture Media</b></p> <ul style="list-style-type: none"> <li>a) Liquid medium (Nutrient Broth)</li> <li>b) Solid Media (Nutrient agar, Sabourauds agar)</li> <li>c) Preparation of slant, butts &amp; plates</li> </ul> <p><b>Inoculation techniques and Study of Growth</b></p> <ul style="list-style-type: none"> <li>a) Inoculation of Liquid Medium</li> <li>b) Inoculation of Solid Media (Slants, Butts and Plates)</li> <li>c) Study of Colony Characteristics of Bacteria</li> <li>d) Study of Motility (Hanging Drop Preparation)</li> <li>e) Use of <b>Differential, Selective and Enriched Media Superimposed Blood Agar, Determination of Optimum growth conditions</b></li> </ul> <ul style="list-style-type: none"> <li>a) Temp.</li> <li>b) Ph</li> </ul>		
<p><b>SECTION - II</b></p> <p><b>APPLIED MICROBIOLOGY</b></p> <p><b>Unit I : Care of Microscope</b> Study of Compound Light /Phase Contrast/Binocular Microscope Study of Bright Field &amp; Darkfield Microscopy</p> <p><b>Unit II : Differential Staining- Gram Staining</b></p> <p><b>Unit III : Physical Method of control of microorganisms:</b></p> <ul style="list-style-type: none"> <li>a) Heat: Autoclaving, Fractional Sterilization, Dry heat</li> <li>b) Bacteria Proof Filtration (Demonstration of membrane filtration)</li> <li>c) Effect of UV rays</li> <li>d) Effect of Dessication</li> <li>e) Effect of high osmotic pressure</li> </ul> <p><b>Chemical methods of control of microorganisms:</b></p> <ul style="list-style-type: none"> <li>a) Effect of Phenolics (Disc Method)</li> <li>b) Oligodynamic action</li> <li>c) Effect of Surfactant ( Tween 80)</li> <li>d) Dyes – Disc Method</li> <li>e) Chemotherapeutic agent</li> </ul>		

## Semester II

Course Code	Title	Credits
<b>USMB201</b>	<b>FUNDAMENTALS OF MICROBIOLOGY.</b>	<b>2 Credits (45 lectures )</b>
<b>Unit I</b> <b>Microbial growth.</b> 1.1 Definition of growth, Mathematical Expression, Growth curve 1.2 Measurement of growth a) Direct microscopic count – Breed’s Petroff – Hausser counting chamber, Hacmocytmeter. b) Viable count – Spread plate and Pour plate technique c) Measurements of cell consituents. d) Turbidity measurements – Nephelometer and spectrophotometer techniques e) Measurements of cell constituents 1.3 Synchronous growth, Continuous growth (Chemostat and Turbidostat) 1.4 Growth yeild 1.5 Influence of environmental factors on growth. 1.6 Microbial growth in natural environment. 1.7 Counting viable non-culturable organisms-Quorum sensing techniques.		<b>15 Lectures</b>
<b>Unit II</b> <b>Study of Yeast, Molds, Algae and Protozoa.</b> 2.1 Classification, Morphological characteristics, cultivation, reproduction and significance. a) Yeast and molds b) Algae c) Protozoa		<b>15 Lectures</b>
<b>Unit III</b> <b>Study of viruses, Rickettsia, Chlamydia, Actinomycetes and Archaeobacteria.</b> 3.1 Viruses : Classification of viruses, General characteristics, Structure of T4 phage, viral Cultivation, inclusion bodies and their significance, Life cycle of coliphages, lytic cycle and lysogeny. 3.2 Rickettsia : General characteristics, Diseases and vectors 3.3 Chlamydia : General characteristics 3.4 Actinomycetes L General properties, cell wall type, whole cell sugar patterns. Characteristics as per new classification and significance. 3.5 Archaea : Characteristics of major archaeal groups.		<b>15 Lectures</b>



Course Code	Title	Credits
<b>USMBP2</b>	<b>PRACTICALS</b>	<b>2 Credits</b>
<p style="text-align: center;"><b>SECTION – I</b></p> <p style="text-align: center;"><b>FUNDAMENTALS OF MICROBIOLOGY</b></p> <p><b>Unit I : Measurement of Microbial Growth :</b></p> <p>a)Haemocytometer  b)Opacity Tubes  c)Viable Count  d)Growth Curve of <i>E. coli</i>  Measurement of cell dimensions-Micrometry</p> <p><b>Unit II : Cultivation of Yeast &amp; Molds:</b></p> <p>a) Cultivation on Sabourauds agar  b) Static &amp; Shaker Cultures  c) Fungal Wet mounts &amp;  Study of Morphological Characteristics. Mucor, Rhizopus,Aspergillus,  Penicillium,</p> <p><b>Unit III : Slide Culture technique ( Actinomycetes)</b></p>		
<p style="text-align: center;"><b>SECTION - II</b></p> <p style="text-align: center;"><b>APPLIED MICROBIOLOGY</b></p> <p><b>Unit I :</b> Study of air Microflora and Determination of Sedimentation Rate  Study of Soil Microflora (Bacteria, Yeast and Molds, Actinomycetes)  Winogradsky Column-Demonstration of Sulphur Cycle  Study of Azotobacter  Study of Rhizobia  Crowded Plate Technique</p> <p><b>Unit II :</b> Bacteriological Analysis of Water, Study of Raw Sewage</p> <p><b>Unit III :</b> Normal Flora of: a)Skin b)Intestine</p>		

**References :**

**List of books for USMB – 101, 102, 201 & 202.**

1. Prescott ,Hurley.Klein-Microbiology, 5<sup>th</sup> & 6<sup>th</sup> edition, International edition 2002 & 2006, McGraw Hill.
2. Kathleen Park Talaro & Arthur Talaro - Foundations in Microbiology International edition 2002| McGraw Hill.
3. Michael T.Madigan & J.M.Martin,Brock ,Biology of Microorganisms 11<sup>th</sup> Ed. International edition 2006 Pearson Prentice Hall.
4. A.J.Salle,Fundamental Principles of Bacteriology.
5. Stanier.Ingraham et al ,General Microbiology 4<sup>th</sup> & 5<sup>th</sup> Ed. 1987, Macmillan Education Ltd.

**Allocation of Time per Credit :- 1 Credit = 30 to 40 hours**

**Total contact Hrs :- 468 Hrs. per Semester i.e. 936 Hrs. per year.**

**Ratio of Instruction : Self Study :- (i) Theory – 1:1, (ii) Practicals – 4:1**

The time duration per credit is divided into two parts:

Approximately fifty percent of the time will be spent on class room instructions including practical as prescribed by the University.

Rest of the time spent as notional hours.-30-40 hrs/credit

Notional Hours: Module to be selected as per the department requirements.

- Training for Assignment writing ,extra coaching for vernacular students, Journal writing
- Student seminars or group discussion
- Organize lectures or talks on the related subject.
- Organize open day in the department with the participation of FY students for junior college students
- Discuss career opportunities
- Counseling Lecture
- Industrial Visit, relevant to the subject
- CD Shows/Film shows
- E- book learning
- Visit to an NGO, Science exhibition
- Training for participation in extra -curricular activities.
- Interaction with parents.
- Attending seminars, workshop,& conferences
- Group activity/Self Study/Quiz.



**Credit Assignment: Semester I :**

Course	Learning Hours(h) Lectures (L)		Credits	
	Theory	Practical	Theory	Practicals
I (USMB101)	45 L = 36 h	-	2	-
I (USMBP101)	-	45 L = 36 h	-	1
II (USMB102)	45 L = 36 h	-	2	-
II (USMBP102)	-	45 L = 36 h	-	1
<b>Total / Semester: 90 L = 72 h</b>			<b>4</b>	<b>2</b>

**Semester II :**

Course	Learning Hours (h) Lectures (L)		Credits	
	Theory	Practical	Theory	Practicals
I (USMB 201)	45 L = 36 h	-	2	-
I (USMBP 201)	-	45 L = 36 h	-	1
II (USMB 202)	45 L = 36 h	-	2	-
II (USMBP 202)	-	45 L = 36 h	-	1
<b>Total / Semester</b>	<b>90 L = 72 h</b>	<b>90 L = 72 h</b>	<b>4</b>	<b>2</b>

<b>Grand Total / Year</b>	<b>180 L = 144 h</b>	<b>180 L = 144 h</b>	<b>8</b>	<b>4</b>
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## Scheme of Examination:

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40% marks in the first part & by conducting the Semester End Examinations with 60% marks in the second part.

The Course having Practical training will have Practical Examination for 50 marks at the end of Semester, out of which 30 marks for the Practical task assigned at the time of examination. The 20 marks are allotted as Internal Assessment.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

**Internal Assessment:** It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the Credit based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

**Semester End Assessment :** It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ written/ Practical examination.

### Modality of Assessment :

**Internal Assessment - 40%** **40 marks.**

#### a) Theory **40 marks**

Sr No	Evaluation type	Marks
1	Two Assignments/Case study/Project	20
2	One class Test (multiple choice questions objective)	10
3	Active participation in routine class instructional deliveries(case studies/ seminars//presentation)	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

#### b) Practicals **20 marks**

Sr No	Evaluation type	Marks
1	Two best practicals	10
2	Journal	05
3	Viva	05

### B ) External examination - 60 %

**Semester End Theory Assessment - 60%** **60 marks**

- i. Duration - These examinations shall be of two hours duration.
- ii. Theory question paper pattern :-
  1. There shall be four questions each of 15 marks. On each unit there will be one question & fourth one will be based on entire syllabus.
  2. All questions shall be compulsory with internal choice within the questions. Each question will be of 20 to 23 marks with options.
  3. Questions may be sub divided into sub questions a, b, c, d & e only & the allocation of marks depends on the weightage of the topic.

**Practical External Assessment**

**30 marks**

**Practical Examination Pattern :****Semester I:**

Course : USMBP- 1	Internal	External	Total
SECTION- I	20 marks	30 marks	50 marks
SECTION - II	20 marks	30 marks	50 marks

**Semester II :**

Course : USMBP- 2	Internal	External	Total
SECTION- I	20 marks	30 marks	50 marks
SECTION - II	20 marks	30 marks	50 marks

**Internal Practical Examination (20 marks)**

<b>Semester I-Internal Practical Examination</b>				
USMBP -1	Journal-Marks	Assignment /Viva Seminar Marks	Pract test-02 Marks	Total
SECTION- I	05	05	10	20
SECTION - II	05	05	10	20
<b>Semester II-Internal Practical Examination</b>				
USMBP -2	Journal-Marks	Assignment /Viva Seminar Marks	Pract test-02 Marks	Total
SECTION- I	05	05	10	20
SECTION - II	05	05	10	20

## External Practical Examination Pattern

<b>External Practical Examination -Semester I</b>	
<b>USMBP - 1</b>	
<b>SECTION- I</b>	
	Marks
Spots/quiz	10
Special Staining	10
Technique –I(Any-1) Isolation on selective media, Preparation of slant/butt/plate, Broth transfer	10
<b>Total</b>	<b>30</b>
<b>SECTION- II</b>	
Technique –II (Any-1) Oligo- dynamic action, Dye Disc method, Chemotherapeutic agent	20
Gram staining	10
<b>Total</b>	<b>30</b>

<b>External Practical Examination- Semester II</b>	
<b>USMBP - 2</b>	
<b>SECTION- I</b>	
	Marks
Technique –I Viable count	20
Slide Culture /Wet mount	10
<b>Total</b>	<b>30</b>
<b>SECTION- II</b>	
Technique –II ( <b>Any-1</b> ) <b>OR Any two (10 Marks each)</b> Isolation of Azotobacter Isolation of Rhizobium /Bacteroid staining Study of soil microflora. Crowded plate technique Normal Flora IMViC Water analysis: MPN,EMB Streaking & BGLB Rate of sedimentation of air	20
Spots/quiz	10
<b>Total</b>	<b>30</b>