



# **GONDWANA UNIVERSITY**

**GADCHIROLI**

**CHOICE BASE CREDIT SYSTEM**

**(CBCS)**

**SYLLABUS FOR**

**B.Sc. I Sem I & II**

**THREE-YEARS DEGREE COURSE**

**IN**

# **MICROBIOLOGY**

**From**

**Academic Year**

**2017-2018**

**GONDWANA UNIVERSITY, GADCHIROLI**  
**CHOICE BASED CREDIT SYSTEM**

**FOR B.Sc. PROGRAM**  
MICROBIOLOGY  
**B.Sc.I (Sem I &II)**

- There shall be two semesters in B.Sc. Part I. Each semester comprise of two theory papers, practical and internal assessment.
- The syllabus is based on six theory periods and six practical periods per week.
- Each theory paper divided into four units.
- **Scheme of examination:** It is divided into two parts- Internal assessment (college assessment) and external assessment (semester end examination conducted by university).

The internal assessment marks assigned to each theory paper shall be awarded on the basis of Based on Assignment, Seminar, Unit Test & overall attendance and performance of the student

- **The Semester End Examination for Microbiology course will be as follows:**  
50 marks Paper I + 50 marks Paper II (External assessment- University examination)  
10 marks Paper I + 10 marks Paper II (Internal assessment/College Assessment)  
Total - 120 Marks Theory.
- One practical course: 30 marks
- Duration of examination for each theory paper will be 3 hours.
- The practical examination shall be of 6 hours duration for 2 days.
- Question paper will consist of five questions and each question will be of 10 marks.
- All questions will be compulsory and with internal choice.
- Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.
- Practical examination for odd semester will be at college level and for even semester at university level with external examiner.

- The marks will be given for all examinations and they will be converted into grade points. The final grade card will have marks, credits, grades, grade points, SGPA& CGPA

**Scheme of Teaching and Examination: B.Sc. Microbiology CBCS ( Sem. I & II)**

<i>Semester</i>	<i>Paper No</i>	<i>Paper code</i>	<i>Title of Paper</i>	<i>Periods/week</i>	<i>Max Marks</i>		<i>Total Marks</i>	<i>Credit</i>	<i>Total: Th+Pract</i>
					<i>External(U.A.)</i>	<i>Internal(C.A.)</i>			
<b>I</b>	I	<b>USMBT01</b>	Fundamentals of Microbiology	03	50	10	60	2	150
	II	<b>USMBT02</b>	Microbial Techniques	03	50	10	60	2	
	Practical	<b>USMBP01</b>		06	30	-	30	2	
<b>II</b>	I	<b>USMBT03</b>	General Biochemistry	03	50	10	60	2	150
	II	<b>USMBT04</b>	Applied Microbiology	03	50	10	60	2	
	Practical	<b>USMBP02</b>		06	30	-	30	2	

# QUESTION PAPER PATTERN

## F.Y. B.Sc. Semester I&II

### MICROBIOLOGY

**Time: 3 Hours**

**Max. Marks: 50**

**Note: All questions are compulsory and carry equal marks Draw well labeled diagrams wherever necessary**

Q 1 Long answer type question from Unit I 10 Marks

OR

- a) Short answer type question from Unit I 2½ Marks each
- b) Short answer type question from Unit I
- c) Short answer type question from Unit I
- d) Short answer type question from Unit I

Q 2 Long answer type question from Unit II 10 Marks

OR

- a) Short answer type question from Unit II 2½ Marks each
- b) Short answer type question from Unit II
- c) Short answer type question from Unit II
- d) Short answer type question from Unit II

Q 3 Long answer type question from Unit III 10 Marks

OR

- a) Short answer type question from Unit III 2½ Marks each
- b) Short answer type question from Unit III
- c) Short answer type question from Unit III
- d) Short answer type question from Unit III

Q 4 Long answer type question from Unit IV 10 Marks

OR

- a) Short answer type question from Unit IV 2½ Marks each
- b) Short answer type question from Unit IV
- c) Short answer type question from Unit IV
- d) Short answer type question from Unit IV

Q 5 Solve any 10 out of 12 questions (3 questions from each unit) 10 Marks

<b>Microbiology B. Sc. I Semester-I (CBCS)</b>		
<b>Course Code – USMBT01</b>		<b>Paper – I</b>
<b>Marks – 50</b>		<b>Marks –</b>
<b>Credit : 2</b>		<b>Total Hours :</b>
<b>48</b>		
<b>FUNDAMENTALS OF MICROBIOLOGY</b>		
<b>Unit No.</b>	<b>Content</b>	<b>Hrs.</b>
<b>1</b>	<b>History and Development of Microbiology</b>	<b>09</b>
	Development of microbiology as a discipline with special reference to the work of following scientists: Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Martinus W Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Elie Metchnikoff, A. M. Chakraborty, H.G. Khorana, M.S. Swaminathan.	
	<b>Theory of Abiogenesis and Biogenesis:</b> Aristotle's notion about spontaneous generation; Experiments of F. Redi, John Needham, Spallanzani, Schwann & Schultze, Louis Pasteur, Schroder and von Dusch, and John Tyndall	
	<b>Germ theory of disease – Koch's postulates &amp; River's postulates</b>	
	Scope of Microbiology: Branches of Microbiology, Impact of Microbiology and the future.	
<b>2</b>	<b>Study of Prokaryotic Cell</b>	<b>13</b>
	Difference between Eukaryotic and Prokaryotic cell. <b>Structure and functions of bacterial cell components:</b> (a) Cell wall (b) Cytoplasmic membrane (c) Capsule & Slime layer (d) Flagella (e) Nuclear material (f) Reserve Food Materials (g) Plasmids (i) Mesosome j) 70 S Ribosome k) Gas Vacuoles. <b>Spore:</b> Structure, Stages in sporulation	
<b>3</b>	<b>Microbial Taxonomy</b>	<b>12</b>
	<b>Aim, Principles and Parts of Taxonomy :</b> General Criteria used for bacterial classification, concept of taxa, Genus, Species, Strain, Family, Order, Division, Kingdom; <b>Various approaches of bacterial taxonomy:</b> (Artificial, Natural & Evolutionary) Two (Linnean), Three (Haeckel), four (Stainer-Von Neil) and Five kingdom (Whittaker) concept. <b>Methods of classification of bacteria:</b> Intuitive method, Numerical taxonomy and Genetic relatedness (DNA base composition, DNA homology, r-RNA homology & sequencing) methods. Bergy's Manual of Determinative and Systematic bacteriology.	
<b>4</b>	<b>Viruses, Archaeobacteria and Fungi</b>	<b>14</b>
	<b>Viruses -</b> 1. History and General characteristics of viruses. 2. Structure of viruses. 3. Lytic Cycle of T4 Phage. 4. Lysogenic cycle of Lambda phage 5. Classification of Viruses: LHT classification. 6. Methods of cultivation of animal viruses.	
	<b>Archaeobacteria:</b> General characteristics, Unique characters. Groups of Archaeobacteria (Methanogens, Halophiles, Thermophiles). Evolutionary and Economic importance of Archaea.	
	<b>Fungi:</b> General characteristics, Methods of reproduction and economic importance of Molds and Yeasts.	

<b>Microbiology B. Sc. I Semester-I (CBCS)</b>		
<b>Credits: 2</b>		<b>Total Hours :48</b>
<b>Course Code - USMBT02</b>	<b>Paper - II</b>	<b>Marks -</b>
<b>50</b>		
<b>Credit : 2</b>		<b>Total Hours :</b>
<b>48</b>		
<b>MICROBIAL TECHNIQUES</b>		
<b>Unit No.</b>	<b>Content</b>	<b>Hrs</b>
<b>1</b>	<b>Microscopy:</b> Definition of Magnification, Resolving power, Focal length, Focal Point, Angular Aperture and Numerical Aperture, resolving Power. Objectives lenses (Low, High, Oil immersion), Ocular Lens and Function. Condensers: Abbes, Cardioids, Parabolic and their function. Principle, Construction, Working and applications of Bright field microscopy, Dark Field microscopy, Phase Contrast microscopy and Electron microscopy (TEM and SEM).	<b>12</b>
<b>2</b>	<b>Stains and Staining Techniques</b>	<b>10</b>
	Definition of stain and dye, auxochrome, chromophores, Acidic and Basic dyes; Indicator Dyes; Classification of stains, Theories of staining, Mechanism, procedure and applications of Gram staining, Acid fast staining, Negative staining, Capsule staining, Flagella staining and Endospore staining.	
<b>3</b>	<b>Cultivation of bacteria</b>	<b>12</b>
	<b>Microbial Nutrition:</b> Basic nutritional requirements, nutritional categories of microorganism based on carbon and energy source. <b>Culture media:</b> Components of media, types of media based on physical nature: liquid, semisolid and solid with example, natural and synthetic media, chemically defined media, complex media, selective, differential, enriched and enrichment media. <b>Methods of isolation of pure culture:</b> Streak plate, Pour plate and Spread plate methods, Spiral plate method, Cultivation of anaerobic bacteria. <b>Methods of preservation of pure cultures:</b> Agar slant, Lyophilization (Freeze drying) Oil Sealing. Systemic study of pure culture, Stock culture collection centers in India and abroad	
<b>4</b>	<b>Sterilization &amp; Disinfection</b>	<b>13</b>
	Definitions: - Sterilization, Disinfection, Antiseptic, Germicide, Microbiostatic, Microbicidal Sanitization	
	<b>Physical agents</b> - (a) Temperature - Dry heat, moist heat, Incineration (b) Radiation - Ionizing and Non Ionizing. (c) Filtration and Types of Filters.	
	<b>Chemical agents-</b> (a) Phenol & Phenolic compounds. (b) Alcohols. (c) Halogens (d) Heavy metals and their compounds (e) Aldehydes (f) Gaseous agents (g) Quaternary ammonium compounds. (h) Detergents. Characteristics of an ideal disinfectant, phenol Coefficient Experiment, Checking of Efficacy of Sterilization.	

**Practicals B. Sc. I (USMBP01) Semester –I {Based on Paper -I & II}**

**TOTAL HOURS: 48**

**CREDITS: 2**

**Marks: 30**

1. Microbiology Good Laboratory Practices and Biosafety.
2. \*Preparation of Cotton Plug, Cleaning of Glasswares.
3. \* Study of principle and applications of important instruments,  
(Anaerobic Jar, Autoclave, Incubator, Hot air oven, Microscope, Colony counter,  
Membrane filter assembly, pH meter, Laminar Air Flow, Spectrophotometer).
4. Staining Techniques
  - \*(a) Monochrome / Simple staining
  - (b) Negative Staining
  - \*(c) Gram Staining
  - (d) Flagella Staining
5. Special Staining Procedures
  - (a) Cell Wall Staining (Chance's Method)
  - \*(b) Endospore staining
6. Preparation of Culture Media: Saline, Peptone Water, Nutrient Broth, Nutrient agar, McConkey's agar, Starch Agar, Milk agar, PD - agar, Baired-Parker Agar.
7. \*Demonstration of presence of Microbes and their colony characters present in Air, Skin, Soil, Teeth, and Water.
8. \*Isolation of pure culture by Streak plate and Spread plate methods.
9. \*Enumeration of bacteria by standard plate count method.
10. \*Study of Motility by Hanging Drop technique
11. Cultivation and Staining of Fungi.
12. \*Antibiotic sensitivity test by Kirby-Bauer disc diffusion method
13. Oligodynamic action of heavy metals.

- Note:** i) Minimum 4 major and 4 minor experiments are compulsory  
ii) Underlined experiments are considered to be major experiments  
iii) Experiments with asterisks are compulsory  
iv) Duration of practical examination will be 8 hours i.e. 4 hours each for two consecutive days

**Distribution of marks for practical examination:**

One major experiment .....	08 Marks
Two minor experiments 4 × 2 =	08 Marks
Spotting	04 Marks
Viva-Voce	05 Marks
Practical Record	05 Marks

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**Total .....**                      **30 marks**

## Microbiology B. Sc. I Semester-II (CBCS)

Course Code - USMBT03

Paper - I

Marks - 50

Credits: 2

Total Hours :48

### GENERAL BIOCHEMISTRY

**Objective:** To make the students to understand the fundamentals of Chemical Microbiology.

Unit No.	Content	Hrs.
1	<b>Biochemical principles</b>	12
	I. Concepts of Atom, Molecule, pH, Acids, Bases, Buffer, Solvent, Solute, Types of solutions ( hypotonic, hypertonic, isotonic) and redox potential <b>II. Types of Isomers and their importance in biology.</b> III. Types of bonds and their importance: Electrovalent, covalent, non-covalent, Ester, Phospho-diester, Thio-ester, Peptide, Glycosides.	
2	<b>Amino Acids &amp; Proteins</b>	12
	<b>Amino Acids:</b> Definition, General structure and features of amino acids, amphoteric nature, List of 20 amino acids with structure. <b>Classification of amino acids:</b> based on R-group, Uncommon amino acids and their functions. <b>Proteins:</b> Definition. Classification of Proteins, Primary, secondary, tertiary, quaternary structures of proteins (outline). Biological significance of proteins.	
3	<b>Carbohydrates &amp; Lipids</b>	12
	<b>Carbohydrates:</b> a] Definition and Classification. b] Monosaccharides, Triose, Tetrose, Pentose, Hexose (Examples and structures). c] Disaccharides: Glycoside Linkage (Lactose, Maltose and Sucrose). d] Oligosaccharides: Trisaccharides (Structure of raffinose). <b>e] Polysaccharides:</b> Homo and Heteropolysaccharides, structure of (Starch, Cellulose, Hyaluronic acid). Biological significance of carbohydrates. <b>Lipids:</b> Definition and Classification. Types of Lipids: Simple lipids-Triglycerides. Conjugated Lipids- Phospholipids, Phosphatidic acid, and Cholesterol. Biological importance of Lipids.	
4	<b>Nucleic Acids</b> Nitrogenous base composition of nucleic acids, Structure of Purines, Pyrimidines, Pentose sugars (Ribose, Deoxyribose), Phosphodiester bond, Nucleosides and Nucleotides, Nomenclature of Nucleosides and nucleotides. Basic Structure of DNA (Watson-Crick model). <b>RNA :</b> Structure of m-RNA, t-RNA, r-RNA	12



## Microbiology B. Sc. I Semester-II (CBCS)

Course Code - USMBT04

Paper - II

Marks - 50

Credits: 2

Total Hours :48

### APPLIED MICROBIOLOGY

**Objective:** To make the students to understand and aware the fundamentals of National Mission on Environmental cleanliness, health and hygiene.

Unit No.	Content	Hrs.
1	<p><b>Air Microbiology:</b> a. Definition and composition of air. b. Sources of microorganisms in air. c. Enumeration of microorganisms in air: Solid and liquid impingement technique (Lemon sampler, Anderson sampler)</p> <p>d. control of microorganisms in air, Room sterilization techniques (radiation, fumigation, laminar air flow)</p> <p>e. droplet, aerosol, droplet nuclei and droplet infection, air borne diseases( list with causative organisms)</p>	12
2	<p><b>Water Microbiology:</b></p> <p>a. Definition, Types of water sources, Types of waters, b. Sources and types of microorganisms in water</p> <p>b. Significance of microorganisms in water, Pure (safe/potable) &amp; polluted water</p> <p>c. Indicators of excretal pollution.</p> <p>d. Collection and handling of water sample for analysis</p> <p>e. Bacteriological analysis of water for coliforms(MTDT, MPN)</p> <p>f. Identification of faecal and non-faecal coliforms by (IMViC and Eijkmann test)</p> <p>g. Water treatment using RSF</p> <p>h. Chlorination of water (mechanism), different methods</p> <p>i. Water borne diseases(List with causative organisms)</p>	12
3	<p><b>Sewage Microbiology</b></p> <p>a. Definition and types of sewage, composition and strength of sewage (BOD, COD, ThOD),</p> <p>b. Microbiology of sewage,</p> <p>c. General municipal sewage treatment method,</p> <p>d. Preliminary, Primary and Secondary sewage treatment methods.</p> <p>e. Water reclamation.</p>	12
4	<p><b>Milk Microbiology</b></p> <p>a. Definition and composition of milk, sources of contamination of milk.</p> <p>b. Desirable and undesirable changes in milk.</p> <p>c. Milk borne diseases (List with causative organisms).</p> <p>d. Bacteriological examination of milk by SPC, DMC, Reductase test (MBRT), checking of pasteurization of milk by phosphatase test.</p> <p>e. Milk products- Cheese, yoghurt ( production)</p>	12

**Practical's B.Sc. I  
(Semester II)**

**USMBP02 {Practical's based on Paper -I & II}**

**Total Hours: 48**

**CREDITS: 2**

**Marks: 30**

1. \*Qualitative estimation of carbohydrate.
2. \*Qualitative estimation of proteins.
3. \*Qualitative estimation of lipids.
4. \*Estimation of protein by Lowry method
5. \*Estimation of sugar by DNS method.
6. \*Estimation of DNA by Diphenylamine method
7. \*Estimation of RNA by Orcinal method
8. Partial purification of protein by fractional precipitation.
9. Determination of acid value of fat.
10. \*Bacteriological examination of water for potability (MTDT)  
i) Presumptive (MPN) test ii) Confirmatory test iii) completed test;
11. \*Identification of Coliforms by IMViC test.
12. \*Determination of quality of Milk by Methylene blue reduction test.
13. \*Checking of Pasteurization of milk by phosphatase test.
14. \*Determination of BOD/DO of water
15. Determination of residual chlorine of water
16. Isolation and study of Air micro flora

**Note:** i) Minimum 4 major and 4 minor experiments are compulsory  
ii) Underlined experiments are considered to be major experiments  
iii) Experiments with asterisks are compulsory  
iv) Duration of practical examination will be 10 hours i.e. 5 hours each for two consecutive days

**Distribution of marks for practical examination:**

One major experiment .....	8 marks
Two minor experiments $4 \times 2 =$	8 marks
Spotting	4 marks
Viva-Voce	5 marks
Practical Record	5 marks

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**Total ..... 30 marks**

### **Books Recommended for Theory & Practical of B.Sc. I SEM I & II**

1. General Microbiology by Hans G. Schlegel.
2. General Microbiology by R.Y. Stayner.
3. Fundamentals of Microbiology by Crabtree, & Martin Frobisher.
4. Fundamentals of Bacteriology by A.J. Salle
5. A text of Microbiology by Dubey RC and Maheswari DK (2012).
6. Geeta Sumbali and Mehrotra RS (2009). Principles of Microbiology.
7. General Microbiology volume 1 and 2 by Powar CB and Dagainawala H F.
8. Microbiology by Pelczar TR M J Chan ECS and Kreig N R.
9. Robert F Boyd (1984). General microbiology.
10. Microbiology by Prescott L M, J P Harley and D A Klein.
11. Introduction to Microbiology by Ingraham J.L. and Ingraham C.A
12. History of Microbiology & Microbiological Methods by A.B. Solunke, V.S. Hamde, R.S. Awasthi & P.R. Thorat,.
13. General Microbiology by Hans G. Schlegel.
14. Air Microbiology An environment & Health Prospective by S.C. Aithal, P.S. Wakte & A.V. Manwar.
15. Water Microbiology by S.C. Aithal, & N. Kulkarni.
16. General Microbiology by R.Y. Stayner.
17. A text of Microbiology by Dubey RC and Maheswari DK.
18. Manual of Methods for Pure Culture Study by A.B. Solunke, V.S. Hamde, R.S. Awasthi & P.S. Wakte.
19. Text Book of Microbial Chemistry and Physiology by P.H.Kumbhare & U.V.Thool Rajani Prakashan, Nagpur.
20. Text Book of Applied Microbiology by P.H.Kumbhare & U. V.Thool, Rajani Prakashan, Nagpur.
21. General Virology by Luria S.E.
22. A textbook of Fungi and Viruses by Dubey H.C.
23. Alcamo Fundamentals of Microbiology
24. Experiments in Microbiology by Aneja K.R.
25. Introduction to Microbial Techniques by Gunasekaran,
26. Elementary Microbiology by Modi H.A.
27. Handbook of Media, Stain and Reagents in Microbiology by Deshmukh A.M.,
28. Biology of Microorganisms by Brock T.D. and Madigan M.T.
29. Biochemistry by J.L. Jain
30. Biochemistry by Zubay
31. Principles of Biochemistry by Nelson David L and Cox Michael M. Lehninger.
32. Disinfectants and Disinfection by A.G. Young
33. Filtration by F.E. Vey
34. Biological Stains By H.J. Conn.