

SYLLABUS

FOR

B.Sc. SEMESTER PATTERN IN

MICROBIOLOGY

SEMESTER I & II

GONDWANA UNIVERSITY

GADCHIROLI

INDIA

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Gondwana University, Gadchiroli
Teaching & Examination Scheme
Bachelor of Science
Three Year (SIX SEMESTER) Degree course

MICROBIOLOGY

1. There shall be total six Semesters. Total 3000 Marks.
2. The Division / Grade of the student shall be calculated on the basis of Science subjects as per the previous yearly pattern.
3. Each semester shall comprise of 90 teaching days.
4. Semester I and II shall be of 600 Marks
5. Semester III to VI shall be of 450 Marks
6. Microbiology subject in each semester will comprise of
 - a. Two theory papers – 50 Marks each
 - b. One internal assessment based on two theory papers for 10 Marks each. Total 20 Marks.
 - c. One practical / Laboratory work – Total 30 marks
7. In addition to above Semester I and II will have
 - a. One compulsory English paper of 60 marks with 15 marks internal assessment.
 - b. One second language paper (Supp Eng / Hindi / Marathi / Urdu / etc) of 60 Marks with 15 marks internal assessment.
8. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects.
9. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
10. The pattern of Internal assessment and guidelines for the same shall be prepared by the respective subject Board of Studies
11. All Theory papers shall be divided into four units. Each unit shall be covered in 7.5 hours.
12. The theory question papers shall be of 3 hours duration and comprise of 5 questions with internal choice and with equal weightage to all units. (as per the previous pattern)
13. Practical exam shall be of 10 hours duration , 5hrs each for two consecutive days.
14. Table of teaching and examination scheme attached.

Teaching & Examination Scheme
Bachelor of Science (Microbiology)
Three Year (SIX SEMESTER) DEGREE COURSE
B. Sc. Part I (Semester I and II)

S. No.	Subject	Teaching scheme			Examination scheme										
		Th + Tu (Periods)	Pr (Periods)	Total Periods	Theory							Practical			Total Marks / credits (Th, Pr, IA)
					Duration Hrs	Max Marks Th paper	Min Passing Marks Th	Max Marks Int Assessment	Min Passing IA	Total	Min passing Marks	Duration Hrs	Max marks practical	Min passing marks	
1	Compulsory English	4+1	-	4+1	3	60	21	15	6	75	27	-	-	-	75
2	Second Language	3	-	3	3	60	21	15	6	75	27	-	-	-	75
3	Semester-I Microbiology Paper I- General Microbiology	3+@	-	6+@	3	50	18	10	4	120	22	-	-	-	150
4		Microbiology Paper II- Microscopy and Microbial Techniques	3+@		-	3	50	18	10		4	22	-	-	
5		Practical	-	6	6	-	-	-	-	-	-	-	10*	30	
6	Semester-II Microbiology Paper I- Microbial Chemistry and Physiology	3+@	-	6+@	3	50	18	10	4	120	22	-	-	-	150
7		Microbiology Paper II- Microbial Taxonomy, Ecology and Diversity	3+@		-	3	50	18	10		4	22	-	-	
8		Practical	-	6	6	-	-	-	-	-	-	-	10*	30	
Grand Total of Semester I & II: 450 + 150 each semester = TOTAL – 600 Marks per semester															

Note: Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment; @ = Tutorials wherever applicable; * = If required, for two days.

MICROBIOLOGY

B.Sc. Semester I

Paper I :General Microbiology

Unit I: History And Development of Microbiology

- a. Scope of Microbiology
- b. Basic and Applied Branches of Microbiology, Concept of Medical, Industrial, Food, Exobiology, Geomicrobiology, Biotechnology, Agricultural Microbiology
- c. Discovery of Microorganism
- d. Contribution of Scientists to the field of Microbiology: Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner, Paul Ehrlich, Metchnikoff, Beijerinck, Winogradsky, Waksman, Alexander Flemming, Knoll and Ruska, H.G. Khorana, Anand M. Chakraborty, M. S. Swaminathan
- e. Controversy Over Spontaneous Generation : Contribution of Aristotle, Redi, Needham, Spallanzani, Schulze and Schwann, Schroder and Von Dusch, Louis Pasteur, John Tyndall

Unit II : Study of Bacteria and Morphology.

- a. Concept of Prokaryotes and Eukaryotes, Comparison
- b. Typical Bacterial Cell
- c. Size , Shape and Cell Arrangements in Bacteria
- d. Cell Wall Structure, Difference between Gram positive and Gram negative bacterial cell wall
- e. Cell Membrane Structure (fluid mosaic model) and functions
- f. Capsule and Slime Layer
- g. Flagella: Arrangements, Gram positive and Gram negative flagella

Unit III : Structure and Functions of Bacterial Sub-Cellular Organs.

- a. Ribosome, 70s Ribosome, Comparison with 80s Ribosome
- b. Mesosome
- c. Plasmids, Types
- d. Pili, Sex Pili
- e. Nucleoid
- f. Inclusion Bodies
- g. Endospore, Sporulation

Unit IV: Viruses

- a. General Characters, Discovery of viruses
- b. Structure of viruses (Icosahedral, helical and complex symmetry).
- c. Classification of viruses (LHT system)
- d. Replication of viruses- lytic cycle of virus, lysogenic cycle (λ)
- e. Cultivation of animal viruses: Chick embryo inoculation, Animal Inoculation and Tissue culture.
- f. Detection of viral growth: CPE, FAT, Haemagglutination
- g. Viroid and Prions

MICROBIOLOGY
B.Sc. Semester I

Paper II :Microscopy and Microbial Techniques

Unit I : Microscopy

A .

- a) History of Microscope
- b. Simple and Compound Microscope, Types of Compound Microscope
- c. Mechanical and Optical Parts of Compound Microscope and Their Functions
- d. Working Mechanism of Bright Field Microscope, Resolving Power, Numerical Aperture, Refractive Index
- e. Use of Oil Immersion Objective Lens

B. Construction, working mechanism (ray diagram) and applications of

- a. Dark Field Microscope
- b. Phase Contrast Microscope
- c. Fluorescent Microscope
- d. Electron Microscope (SEM & TEM)

Unit II : Stain and Staining Techniques

- a. Definition of Dye and Stain, Chemical nature, chromophore, auxochrome, chromogen,
- b. Classification of Stain:- Acid, Basic and Neutral.
- c. Physical and chemical theories of staining
- d. Principle and Procedure of Simple Staining , Gram Staining, Acid Fast Staining, Endospore Staining, Negative Staining, Flagella Staining
- e. Staining of Fungi (Mould)

Unit III: Pure Culture and Isolation Techniques

- a. Definition: Mixed culture, Pure Culture, Axenic Culture
- b. Methods of Isolation of Pure Culture:
 - i. Streak Plate
 - ii. Spread Plate
 - iii. Serial Dilution
 - iv. Pour Plate
 - v. Enrichment Culture,
 - vi. Use of Selective And Differential Media,
 - vii. Single Cell Isolation
- c. Pure Culture Characteristics
- d. Maintenance and Preservation of Pure Culture (Agar Slant, Saline Suspension, Overlaying With Oil, Freeze Drying)
- e. Stock Culture Collection Centre: Their Role and Names of Some International and National Centers

Unit IV: Microbial Control

- a. Definition of Sterilization, Disinfection, Antiseptics, Sanitizer, Microbiostatic and Microbicidal Agents,
- b. Characteristics of Ideal Disinfectants
- c. Mechanism of Cell Injury

- d. Microbial Control by Physical Agent: Temperature, Desiccation, Osmotic Pressure, Radiation, Filtration
- e. Microbial Control By Chemical Agents: Mode of action of Alcohol, Phenol and Phenolic Compounds, Halogens, Heavy Metals, Gaseous Sterilization (Formaldehyde, Ethylene oxide, Beta propiolactone)
- f. Modes of Action of Antibiotic : Penicillin, Tetracycline
- g. Evaluation of Disinfectant (Phenol Coefficient)

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Practical Course for Microbiology B.Sc. Semester I

Marks: 30

(Based on theory paper I & II)

1. Safety measures in Microbiology Laboratory.
2. Cleaning and sterilization of glassware
3. Use and care of Microscope
4. To study the principle and applications of important laboratory instruments- Autoclave, Hot air Oven, Bacteriological Incubator, pH meter, colorimeter, Laminar air flow, Membrane filter assembly, Anaerobic jar)
5. Preparation of cotton plugs and culture media: nutrient broth, nutrient agar, potato dextrose agar
6. *Demonstration of presence and study of colony characteristics of microorganism from skin, teeth, soil, water and air
7. *Isolation of pure culture on solid media by streak plate method.
8. *Enumeration of bacteria by pour plate technique from soil (SPC)
9. Estimation of CFU count by spread plate method
10. Staining of bacteria:
 - a. Simple staining
 - b.* Gram staining
 - c. Acid fast staining
 - d. Negative staining
 - e. *Endospore staining
11. *Cultivation (slide culture technique) and staining of Fungi
12. *Hanging drop method to demonstrate motility in bacteria
13. Measurement of size of microorganisms (Micrometry)
14. Demonstration of Oligodynamic action of heavy metals against bacteria
15. *Determination of antibiotic resistance of bacteria by Kirby- Bauer method (paper disc)
16. Determination of phenol coefficient of a disinfectant.

- Note: 1. Underlined experiments are treated as major experiments.
2. Students should perform atleast 4 major and 6 minor experiments
3. Practicals with asteric mark are compulsory.

Distribution of marks during practical examination of B.Sc. Semester I

- | | |
|-------------------------|--------|
| 1. One major experiment | 10 |
| 2. Two minor experiment | 2x4= 8 |
| 3. Viva voce | 4 |
| 4. Spotting | 4 |
| 5. Practical Record | 4 |

30

(Duration of Practical exam will be 10 hrs. , 5 hrs. each for two consecutive days)

Books Recommended for Theory & Practical of B.Sc. Semester I Microbiology

1. Ingraham J.L. and Ingraham C.A. Introduction to Microbiology. 3rd Edition. Thomson Books
2. Tortora G.J., Funke B.R., Case C.L. Microbiology: an Introduction. 8th edition. Pearson Education Inc.
3. Prescott L.M., Harley J.P. and Klein D.A. Microbiology 6th edition Macgraw Hill Comp. Inc.
4. Powar and Dagainawala, General Microbiology Vol.I&II (Himalaya Publication)
5. Modi H.A. Elementary Microbiology Vol I & II (EktaPrakashan, Nadiad)
6. Dubey R. C. and Maheshwari D.K., Text Book of Microbiology, S. Chand
7. Pelzar, Chan and Kreig, Microbiology 5th edition TMH
8. Frobisher, Hindsdill, Crabtree, Good Heart : Fundamentals of Microbiology : W.B. Saunders Company, 7th edition USA Topman co. Ltd. Japan
9. Stainer, Roger et.al General Microbiology
10. Luria S.E. General Virology
11. Atlas R.A. Microbiology- Fundamental and Applications, Macmillan
12. Dubey H.C.: A textbook of Fungi and Viruses, Vikas Publishing House Pvt, Ltd. New Delhi
13. Vashishta B R and Sinha A K (2008) Fungi, S. Chand and Company Limited New Delhi
14. Salle A.J. Fundamental Principles of Bacteriology, Tata McGraw-Hill Publishing Company Limited, New Delhi.
15. Brock T.D. and Madigan M.T. Biology of Microorganisms, Prentice Hall of India Private Limited
16. Alcamo Fundamentals of Microbiology
17. Purohit, Microbiology- fundamentals and applications
18. Davis, Dulbecco, Microbiology
19. Textbook of Microbiology- Ananthnarayan and Panikers-University press (8th ed.)
20. Cell Biology- Channarayappa- University Press, Hyderabad
21. Dubey R.C. and Maheshwari D.K. 2004 Practical Microbiology, S. Chand and Co. Delhi
22. Aneja K.R. (1996) Experiments in Microbiology, 3rd edition WishwaPrakashan, New delhi
23. Deshmukh A.M. (1997) 1st edition, Handbook of Media, Stain and Reagents in Microbiology, Pama Publications
24. Goud R.S. and Gupta G.D. Practical Microbiology, NiraliPrakashan, Pune
25. Gunasekaran, Introduction to Microbial Techniques
26. Himedia: Handbook of Microbiological Media
27. Cappucino J and Sherman N. (2010) Microbiology, A Laboratory Manual. 9th edition, Pearson Education Limited.

MICROBIOLOGY

B.Sc. Semester II

Paper I : Microbial Chemistry and Physiology

Unit I: Chemistry of Carbohydrates and Lipids

- a. Definition, classification and biological significance of carbohydrates.
- b. Structure of monosaccharides- glucose, fructose
- c. Structure of disaccharides- lactose, maltose, sucrose
- d. Trisaccharides- raffinose
- e. Polysaccharides- i) Homopolysaccharide- starch, cellulose ii) Heteropolysaccharides- Hyaluronic acid
- f. Definition, classification and significance of lipids
- g. Structure of triglycerides, compound lipids, derived lipids and prostaglandins.

Unit II: Chemistry of Proteins and Nucleic acid

- a. Proteins: classification of amino acids , peptide bond theory, structural level of proteins- primary, secondary, tertiary, quaternary.
- b. Nucleic acid : structure of purine and pyrimidine nucleosides, nucleotides, structure of DNA- (Watson and Crick model), structure and types of RNA.

Unit III: Nutrition

- a. Basic nutritional requirements of microorganism
- b. Nutritional classification- based on carbon & energy, electron donor- Autotrophs, heterotrophs, phototrophs, chemotrophs, photoautotrophs, chemolithotrophs, organotrophs, mixiotrophs, paratrophs.
- c. Types of media- synthetic & non-synthetic with example, common ingredients of biologically complex media- peptone, meat extract, yeast extract, NaCl, water, gelatin, agar-agar. Specific media- selective, differential and enriched media.
- d. Determination of nutritional requirements- Auxanography, Replica plating, multipoint inoculation technique.

Unit IV: Microbial Growth

- a. Definition of bacterial growth, Reproduction- binary fission
- b. Growth curve- phases and characteristics
- c. Generation time- mathematical expression of growth, growth rate constant
- d. Continuous culture- definition, methods and application, Synchronous culture- Definition, methods and application
- e. Measurement of bacterial growth- Cell No. / Cell count- Breed's method, proportional count method, Heamocytometer, coulter counter, plate count/ membrane filter count, Cell mass measurement- weight measurement, turbidity measurement
- f. Physical conditions requirement for growth i) temperature ii) oxygen requirement, iii) pH, iv) miscellaneous

MICROBIOLOGY
B.Sc. Semester II

Paper II : Microbial Taxonomy, Ecology and Diversity

Unit I :Classification of Microorganisms

- a. General principles of bacterial taxonomy- Binomial nomenclature
- b. Haeckel and Whitaker's classification- Concept of three domain system (Carl Woese)
- c. Introduction to Bergey's manual of determinative Bacteriology IX edition and systematic bacteriology-II edition (4 division and 33 sections)
- d. Methods of classification- Intuitive, Numerical taxonomy, Genetic relatedness

Unit II

A.General Characteristics and Structure (in brief) of

- a. Mycoplasma
- b. Rickettsia
- c. Chlamydia
- d. Actinomycetes
- e. Cyanobacteria
- f. Archaeobacteria

B. General characters of Algae and Protozoa.

C. Fungi (Yeast and Molds): General characters, Morphology, Reproduction (asexual and sexual methods)

Unit III :Microbial Associations

- a. Definition and examples of positive, negative and neutral association
- b. Types of association- symbiosis, synergism, syntrophism, commensalism, antagonism, parasitism, competition, predation,
- c. Interaction of microbes with plant- Mycorrhizae-types and application
- d. Humus: definition, composition and functions
- e. Compost: definition, aerobic and anaerobic method of composting

Unit IV : Microbial Ecology

- a. Biological Nitrogen Fixation: Nitrogen fixing bacteria, symbiotic and non symbiotic nitrogen fixation, process of nodulation in legume, nitrogenase complex, mechanism of nitrogen fixation (symbiotic and non symbiotic), factors affecting nitrogen fixation, nif gene and rDNA technology in N₂fixation.
- b. Brief account of Biofertilizer and Biopesticides.
- c. Xenobiotics: Definition, reason for recalcitrance, examples of xenobiotics, Bioaugmentation, concept of superbug
- d. Bioaccumulation and Biomagnification: concept with examples

Practical Course for Microbiology Sem. II (Based on theory paper I & II)
Marks: 30

1. Qualitative estimation of carbohydrate.
2. Qualitative estimation of proteins.
3. Qualitative estimation of lipids.
4. * Quantitative estimation of DNA(DPA method)
5. * Quantitative estimation of RNA (orcinol method)
6. * Estimation of protein by Lowry method
6. * Estimation of sugar by DNS / Follin-Wu method.
7. Partial purification of protein by fractional precipitation.
8. Determination of acid value of fat.
9. Measurement of bacterial growth by Breeds method.
10. Effect of pH and salt concentration on bacterial growth.
11. Determination of nutritional requirement by auxanography.
12. Demonstration of antagonism.
13. Demonstration of synergism
14. Anaerobic cultivation of bacteria(gas pack/pyrogallol)
15. * Isolation of Rhizobium from root nodule.
16. Isolation of Azotobacter from soil.
17. Preparation of Biofertilizer.
18. Staining of VAM fungi.

- Note:**
1. Underlined experiments are treated as major experiments.
 2. Students should perform atleast 4 major and 6 minor experiments
 3. Practicals with asteric mark are compulsory.

Distribution of marks during Practical examination of B.Sc. Semester II

- | | |
|-------------------------|--------|
| 1. One major experiment | 10 |
| 2. Two minor experiment | 2x4= 8 |
| 3. Viva voce | 4 |
| 4. Spotting | 4 |
| 5. Practical Record | 4 |

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(Duration of Practical examination will be 10 hrs. , 5 hrs. each for two consecutive days)

Books Recommended for Theory & Practical Microbiology B.Sc. Semester II

1. Prescott L.M., Harley J.P. and Klein D.A. (2005) Microbiology 6th ed. Macgraw Hill Companies Inc.
2. Powar and Daginawala General Microbiology Vol.I &II (Himalaya Publication)
3. Modi H.A. Elementary Microbiology Vol.I& II (EktaPrakashanNadiad)
4. Dubey R. C. and Maheshwari D.K. Text Book of Microbiology
5. Frobisher , Hindsdill, Crabtree, Good Heart : Fundamentals of Microbiology : W.B. Saunders Company, 7th edition USA Topman co. Ltd. Japan
6. Atlas R.M. Microbiology- Fundamentals and applications, Macmillan Pub.Company , New York.
7. Pelczar M.J. Chan E.C.S. and Krieg N.R. Microbiology, McGraw Hill BookCompany, New York.
8. Salle A.J. Fundamental Principles of Bacteriology, Tata McGraw-Hill Pub. Co.Ltd, New Delhi.
9. Staner R,Y Ingraham J.L. General Microbiology, Prentice Hall of India Private
10. Satyanarayan , Biochemistry
11. Powar and Chatwal-Biochemistry
12. J.L. Jain-Biochemistry
13. Thimaiah Text book of Biochemistry
14. Zubay – Biochemistry
15. White,Handler, Smith- Principles of Biochemistry 5thedn.
16. Nelson David L and Cox Michael M. Lehninger Principles of Biochemistry,Macmillan Press/Worth Publishers, New Delhi.
17. Voet D and Voet J.G. Biochemistry, John Wiley and Sons, New York.
18. Harpers Biochemistry
19. Agrawal O. P. – Elements of Biochemistry
20. Doelle- Bacterial metabolism
21. Gotschalk -Bacterial metabolism
22. Alexander M. Introduction to Soil Microbiology, Wiley Eastern Limited, New Delhi.
23. Vashistha-Fungi
24. Alexopoulos C.J. and Mims C.W. Introductory Mycology, New Age International,New Delhi
25. Brock T.D. and Madigan M.T. Biology of Microorganisms, Prentice Hall of India Pvt. Limited.
26. Mehrotra R.S. and Anejs K.R. An Introduction to Mycology, New Age International,
27. Subbarao N.S Soil Microorganisms and Plant Growth, Oxford and IBH Publishing Co., New Delhi.
28. Steward W.D.P, Nitrogen Fixation in Plants. The At lone Press, London.
29. West and Todd, Text book of Biochemistry
30. Rangaswamy G. and Bhagyaraj Text book of Agricultural Microbiology
31. Subba Rao , Biofertilizer in Agriculture, Oxford and IBH New Delhi
32. Gene IX - Benjamin Lewin
33. David Frefildder-Microbial Genetics
34. Textbook of Microbiology-Ananthnarayan and Panikers-University press(8th ed.)

35. Cell Biology-Channarayappa- University Press,Hyderabad
36. Aneja K.R. Experiments in Microbiology, Plant pathology &Tissue culture, New Age International, New Delhi.
37. Practical Biochemistry by Plummer
38. Biochemistry by Murugan
39. Biochemistry by J. Jayraman
40. Dubey R.C. and Maheshwari D.K. 2004 Practical microbiology, S.Chand and co. Delhi
41. Cappucino J and Sherman N.(2010) Microbiology, a Laboratory Manual. 9th edition, pearson education limited.
42. Thimaiah, Standard methods of Biochemical Analysis, Kalyani publication.
43. Text book of Microbiology for Sem.-II, Paper- I & II. P.H.Kumbhare & V. U. Thool et al. Rajani Prakashan Nagpur.

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