



Learning Outcomes based Curriculum Framework (LOCF) Undergraduate Programme 2023

Bachelor of Sciences : Microbiology (Second Year) Majors

Course Learning Outcomes & Contents of the Courses

Semester Three

The course includes two theoretical papers and one related to practicals

Course learning objectives: By the completion of this course, the objectives served for the stakeholders are:

1. To develop a fairly good knowledge and understanding of different types of environments and habitats where microorganisms grow
2. To enable to identify the important role microorganisms play in maintaining healthy environment by degradation of solid/liquid wastes; how these activities of microorganisms are used in sewage treatment plants, production of activated sludge and functioning of septic tanks
3. To make them understand the significance of BOD/COD and various tests involving use of enumerating fecal *E.coli* for assessing quality of water.
4. To develop the practical skills for conducting experiments to assess the BOD/COD of wastewaters and their interpretation; practically assess the portability of drinking water by the use of standard microbiological tests
5. To develop skills for testing the milk and different foods for the presence of microorganisms
6. To enable them, to describe the role of microorganisms in the production of food, its spoilage, including their role in homemade fermented foods.



7. To enable them to identify the role of microorganisms in the causation of the diseases and how to protect against food-borne pathogens

Course learning outcomes: By the completion of this course, the students -

Outcome 1. Have developed a fairly good knowledge and understanding of different types of environments and habitats where microorganisms grow

Outcome 2. Are able to identify the important role microorganisms play in maintaining healthy environment by degradation of solid/liquid wastes; how these activities of microorganisms are used in sewage treatment plants, production of activated sludge and functioning of septic tanks

Outcome 3. Have understood the significance of BOD/COD and various tests involving use of enumerating fecal *E.coli* for assessing quality of water.

Outcome 4. Have developed the practical skills for conducting experiments to assess the BOD/COD of wastewaters and their interpretation; practically assess the portability of drinking water by the use of standard microbiological tests.

Outcome 5. Developed experimental skills for testing the milk and different foods for the presence of microorganisms

Outcome 6. Are able to describe the role of microorganisms in the production of food, its spoilage, including their role in homemade fermented foods.

Outcome 7. Are able to identify the role of microorganisms in the causation of the diseases and how to protect against food-borne pathogens.



BS23MJ3MB1

Environmental Microbiology and Microbial Ecology

credit 4

Unit 1

15 lectures

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1. Terrestrial Environment

- a) Soil profile and soil microflora: association with vascular plants- phyllosphere, Rhizobium, Rhizoplane
- b) Biological Interaction: Microbe–Microbe Interactions:- Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation
- c) Methods of studying soil micro flora: Direct microscopic method, agar plate technique, and buried slide method
- d) Use of Winogradsky column in studying microbial diversity in soil

2. Aquatic Environment:

- a) Microflora of fresh water and marine habitats
- b) Sources of Water contamination
- c) Nuisance organisms in water:

3. Atmosphere:

- a) Source of Aeromicroflora,
- b) Control of air microflora
- c) Dispersal of pathogens through air.

4. **Extreme Habitats:** Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels

Unit 2: Solid, liquid and sewage Waste management:

15 lectures

1. Sources and types of waste water



2. Pollution problems due to disposal of untreated wastewater
3. Composition and strength of sewage (BOD and COD)
4. Microbial indicators of faecal pollution: Coliforms as indicator
5. Methods of differentiation: IMViC test and Elevated temperature test
6. Microbial indicators other than coliforms
7. Liquid waste management & sewage treatment: Primary, secondary and tertiary
8. Methods of solid waste disposal: landfill, compost, vermicompost

Unit 3: Microbiology analysis of water/aquatic microbiology

15 lectures

1. Treatment and safety of drinking (potable) water: Municipal and individual
2. Water Sampling methods
3. Methods to detect potability of water by Standard qualitative procedure
 - a) Standard plate count,
 - b) MPN test,
 - c) Detection of faecal coliforms: presumptive test/confirmed and completed tests for faecal coliforms
 - d) Membrane filter technique and
 - e) Presence/absence tests
 - f) Eijkman test

Unit 4: Biogeochemical cycles

15 lectures

1. Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin
2. Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate Reduction
3. Phosphorus cycle: Phosphate immobilization and solubilisation.
4. Sulphur cycle: Microbes involved in sulphur cycle
5. Iron and manganese cycle



Reference Books

1. Madigan, M.T., Martinko, J. M. and Parker, J. Brock Biology of Microorganisms.
Pearson Education Inc. , New York
2. Alexander, M John. Microbial ecology. Wiley & Sons, Inc., New York.
3. Alexander, M John. Introduction to soil microbiology. Wiley & Sons Inc., New York.
4. Barker, KH, and Herson, D.S. Bioremediation. Mc Craw Hill Inc., New York.
5. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.
Willey, Sherwood, Woolverton. Prescott, Harley, and Klein's Microbiology McGraw-Hill
publication
6. Tortora, Funke, Case. Microbiology. Pearson Benjamin Cummings.
7. Jacquelyn G. Black. Microbiology Principles and explorations. JOHN WILEY & SONS,
INC.
8. Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson
9. Tom Besty, D.C Jim Koegh. Microbiology Demystified McGRAW-HILL.
10. Pepper, Ian L., and Scot E. Dowd. "Aeromicrobiology." Environmental Microbiology.
N.p.: Academic Press, 2009. 83-101. Print
11. Fundamentals of Microbiology, **Frobisher, Martin; etc.**, Published by W.B.
Saunders Company



BS23MJ3MB2

Food and Dairy Microbiology

credit 4

Unit 1: Food spoilage and preservation

15 lectures

- Intrinsic and extrinsic factors that affect growth and survival of microbes in foods
- Natural flora and source of contamination of foods in general.
- Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.
- Principles of food preservation: temperature, canning, drying, irradiation, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO₂, citrates, benzoates, nitrite and nitrates etc.

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Unit 2 : Fermented dairy & food products

15 lectures

- Dairy starter cultures
- Fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese
- Other fermented foods: dosa, sauerkraut, soy sauce and tampeh
- Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.
- Utilization and disposal of dairy by-product – whey.
- Microbes as food

Unit 3. Food borne diseases: etiologic, symptoms, prevention, cure, diagnosis 15 lectures

- Bacterial food borne diseases
- Viral food borne diseases
- Bacterial Food poisoning/intoxication



d) Toxins in food

Unit 4

15 lectures

a) Introduction to HACCP

b) Cultural and rapid detection methods of food borne pathogens

c) Genetically modified foods

d) Introduction to Nutraceuticals

e) Biosensors in food

f) Applications of microbial enzymes in dairy industry [Protease, Lipases].

Reference

1. Banwart, GJ. Basic Food Microbiology. CBS Publishers and Distributors, Delhi. (1989).
2. Hobbs BC and Roberts D. Food poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton) London.
3. Joshi. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2.
4. John Garbult. Essentials of Food Microbiology. Arnold International.
5. John C. Ayres. J. Orwin Mundt, William E. Sandinee. Microbiology of Foods. W.H. Freeman and Co.
6. Photis Papademas. Dairy Microbiology: A Practical Approach. CRC Press
7. Rao M.K.. Food and Dairy Microbiology. Manglam Publishers
8. William Frazier. Food Microbiology. McGraw Hill Education
9. Jay, James M., Loessner, Martin J., Golden, David A. Modern Food Microbiology. Springer



10. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.

Wiley, Sherwood, Woolverton. Prescott, Harley, and Klein's Microbiology McGraw-Hill publication

11. Tortora, Funke, Case. Microbiology. Pearson Benjamin Cummings.

12. Jacquelyn G. Black. Microbiology Principles and explorations. JOHN WILEY & SONS, INC.

13. Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson

BS23MJ3MBP

Microbiology Practical

credit 4

Environmental Microbiology

1. Isolation of bacteria from soil (28°C & 45°C).
2. Assessment of microbiological quality of water by standard qualitative procedure: Standard plate count
3. Assessment of microbiological quality of water by standard qualitative procedure MPN test
4. Assessment of microbiological quality of water by standard qualitative procedure :Detection of faecal coliforms: presumptive test/confirmed and completed tests for faecal coliforms
5. Study the presence of microbial activity by detecting (qualitatively) enzymes: amylase, urease in soil.
6. Isolation of *Rhizobium* from root nodules.
7. Micrometry

Food and Dairy Microbiology



8. MBRT of milk samples and their standard plate count.
9. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
10. Isolation of any foodborne bacteria from food products.
11. Isolation of spoilage microorganisms from spoiled vegetables/fruits.

12. Isolation of spoilage microorganisms from bread.
13. Preparation of Yogurt/Dahi.
14. Assessment of microbiological quality of food by standard qualitative procedure MPN test.
15. Assessment of microbiological quality of food by standard qualitative procedure :Detection of faecal coliforms: presumptive test/confirmed and completed tests for faecal coliforms

SCHEME OF PRACTICAL EXAMINATION SEMESTER THREE

First day:

1. Environmental Microbiology
2. Food/milk microbial analysis
3. Journal /slides

Second day

4. Spotting

Third day

5. Viva

Total marks

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Bachelor of Sciences : Microbiology (Second Year) Majors Semester Four

Course Learning Outcomes & Contents of the Courses

Course learning outcomes: By the conclusion of this course, the students-

Outcome 1. Acquired detailed knowledge of antimicrobial agents, their chemical nature, and mechanism of action and basis of resistance of microbes to these antimicrobials, formulations involving different antimicrobials, stabilization of formulations.

Outcome 2. Developed understanding of different types of disinfectants/antiseptics and their specific uses, and evaluation of their bactericidal and bacteriostatic actions; basic knowledge of cell cultures.

Outcome 3. Developed practical skills for testing pharmaceutical products for sterility testing and pyrogenicity testing using different methods

Outcome 4. Developed practical skills for potency testing pharmaceutical products

Outcome 5. Has acquired a fairly good understanding of normal microflora of human body,

Outcome 6. Understood the basic components of the immune system and how this system serve to protect the host against disease-causing microbes.

Outcome 7. Has acquired skills of handling microorganisms in the laboratory and study their characteristics.

Semester Four

BS23MJ4MB1: BASICS OF PHARMACEUTICAL MICROBIOLOGY

Unit 1. Chemotherapeutic agents

15 lectures

- General Characteristics of ideal Antimicrobial Drugs
- Antibacterial Drugs Inhibitors of cell wall synthesis; protein synthesis inhibitors, metabolic antagonistic, nucleic acid synthesis inhibitors,
- Introduction to Antifungal Drugs
- Antiviral Drugs
- Antiprotozoan Drugs

Unit 2: Mechanisms of action of antibiotics drug resistance and evaluation 15 lectures

- Mode of action of: antibiotic and non antibiotic drugs
- Development of drug resistance in microbes,
- Causes of development of drug resistance and their problems
- Principles and methods of different microbiological assay: gradient plates, ditch - plate and cup – plate techniques, disc diffusion , MIC, MBC testing, and E - tests



- e) Pyrogenicity
- f) Toxicological evaluation of drug: LD50, ID50

Unit 3. Sterility control and sterility assurance

15 lectures

Sterility control

- a) Designing of aseptic area
- b) Study of different sources of contamination in an aseptic area
- c) Methods of prevention of contamination of area and product
- d) Good manufacturing practice

Sterility assurance by

- e) Bioburden determinations
- f) Environmental monitoring
- g) Validation and in - process monitoring of sterilization procedures
- h) Sterility testing

Unit 4. Sterile Pharmaceutical products

15 lectures

- a) Types of sterile product Injections
- b) Non - injectable sterile fluids
- c) Ophthalmic preparations
- d) Contact lens solutions
- e) Dressings
- f) Implants
- g) Surgical ligatures and sutures
- h) Instruments and equipment
- i) Vaccines
- j) Recombinant pharmaceutical products

Reference Books



1. A Textbook of Pharmaceutical Microbiology Paperback (2018) by Pulak Mujumder, Sameer Rajan Sahoo Everest Publishing
2. A Textbook of Pharmaceutical Microbiology (2015) Mehra Prahlad Singh IK International Publishing
3. Pharmaceutical Microbiology (2015) by Sheth Z. PCBS Publisher
4. .Nidhi Goel .Pharmaceutical Microbiology: A Textbook .Alpha Science Intl Ltd .2012
5. Prahlad Singh Mehra .A Textbook of Pharmaceutical Microbiology .IK International Publications
6. Hugo and Russell's Pharmaceutical microbiology

BS23MJ4MB2: BASICS OF IMMUNOLOGY AND HAEMATOLOGY Credit 4

Unit 1: 15 lectures

- a. Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract
- b. The Relationship between Normal Microbiota and the Host
- c. Types of immunity: Humoral and cell-mediated, innate, adaptive immunity.
- d. Primary and Secondary Immune Response
- e. Immunization

Unit 2. 15 lectures

- a. Antigens : Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity)
- b. Haptens; Epitopes (T & B cell epitopes)
- c. T-dependent and T-independent antigens; adjuvants
- d. Antigens occurring in bacterial cell,
- e. Antibodies: Structure, Types, Functions and Properties of antibodies
- f. Monoclonal antibodies

Unit 3 Basics of haematology 15 lectures

- a. Outline of blood constituents
- b. Structure and function of RBC, haemoglobin
- c. Structure and function of WBC, Phagocytosis
- d. Blood clotting factors and blood coagulation
- e. Blood groups and blood bank
- f. Introduction to Complement factors



Unit 4. Diagnostic application of immunology

15 lectures

- a. Collection of clinical specimens
- b. Antigen antibody interaction
- c. Precipitation immunological reaction
- d. Agglutination immunological reaction
- e. Complement fixation test
- f. ELISA
- g. Immunoelectrophoresis & Immunofluorescence
- h. RIA, RAST

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References :

- 1) Principles Of Microbiology , Atlas R.M.
- 2) Microbiology Marjorie Kelly Cowan
- 3) Microbiology Gerard J. Tortora
- 4) Foundations In Microbiology Kathleen Park Talaro
- 5) General Microbiology , Roger Y. Stanier Macmillan, 1987
- 6) Michael J. Pelczar Jr. Chan Ecs And Krieg Nr (2004) Microbiology , 5th Edition. Tata Mcgraw Hill.
- 7) Prescott's Microbiology, Eighth Edition Reviewed By Joanne J. Dobbins Joanne M. Willey , Linda M. Sherwood , And Christopher J. Woolverton . 2011. Mcgraw-Hill Higher Education, New York, NY.
- 8) Black JG (2008), Microbiology : Principles And Explorations 7th Edition, Prentice Hall.
- 9) Medigan M T And Martinko JM (2014), Brock Biology Of Microorganisms, 14th Edition. Parker J. Prentice Hall International Inc
- 10) <https://www.mooc-list.com/tags/immunology>
- 11) <https://www.mooc-list.com/tags/blood>
- 12) <https://www.mooc-list.com/tags/vaccines>
- 13) <https://www.pasteur.fr/en/e-learning-mooc>
- 14) https://onlinecourses.swayam2.ac.in/cec20_bt05/preview

BS23MJ4MBP

Microbiology Practical

Credit Points 4

a. Pharmaceutical Microbiology

1. Microbial Examination of sterile and Non Sterile Products/Sterility testing
2. LAL Test for pharmaceutical product (demo)



3. Antibiotic Potency Testing by diffusion method of penicillin (Bioassay)
4. Antibiotic Potency Testing by turbidometric method of streptomycin (Minimal inhibitory concentration: MIC)
5. Bioburden estimation for Medical Devices by pour plate method
6. Chemical determination of Streptomycin by sodium nitropruside test

b. Basics Of Immunology And Haematology

1. Methods of blood collection
2. Preparation of serum and plasma and blood anticoagulating agents
3. Disposal of biohazardous waste.
4. Identification of human blood groups.
5. Estimation of Haemoglobin by Sahli's method
6. Total Leukocyte Count
7. Total erythrocytes count.
8. Differential Leukocyte Count of the given blood sample.
9. Estimation of blood sugar by GOD/POD method

SCHEME OF PRACTICAL EXAMINATION SEMESTER FOUR

First day:

1. Pharmaceutical microbiology
2. Journal /slides

Second day

3. Basics of immunology and haematology
4. Spotting

Third day

5. Viva

Total marks

PATTERN OF QUESTION PAPER

SEMESTER END EXAMINATION AS PER UNIVERSITY GUIDELINES

Teaching learning processes:

The teaching learning processes incorporate a variety of modes and a regular use of ICT. These are listed below:

1. **Classroom Teaching** for topics which are intensely information-based. This a very regular feature of all the courses in Microbiology
2. **Power Point slides** for topics which involve information related to intricate biological pathways such as metabolic pathways in bacteria and other microorganisms.



Use of Power Point presentations are also made whenever the lectures are to be summarized in a crisp and pointwise manner to highlight salient / important conclusions from the topics.

3. **Classroom Discussions** are a regular feature while teaching. The students are drawn into impromptu discussions by the teacher during the process of teaching.

4. **Video Displaying**, both real-time and animations, are used for topics which require 3D dimensional viewing of the biological mechanisms to drive the point home. These have proved to be very helpful while teaching concepts of molecular biology like DNA replication, transcription and translation. These are also used to convey complexities of antigen-antibody interactions and generation of antibody diversity during the teaching of Immunology.

5. **Model Making** is also used especially for understanding and building a perception of the students for the structures of viruses which cannot be seen by a light microscope and can be seen only under expensive equipment like electron microscopes.

6. **Laboratory Practical** are an integral part of every course included in UG programme in Microbiology. The is also a daily affair for UG students of Microbiology.

7. **Problem Solving** is encouraged during the laboratory work.

8. **Group Activity** as well as discussions with the laboratory supervisor/ among the students themselves/ Mentor is also encouraged during laboratory work.

9. **Project Work** is included in the programme where students work individually or in groups to design experiments to solve/answer a problem suggested by the Mentor or identified by the students in consultation with the Mentor. The students are mentored regularly during the duration the project is in progress.

10. **Presentations by the Students** are regularly done. The students are mentored in presentation of data, interpretation of data and articulation with the students/teachers/Research Scholars during their presentation.

11. **Presentation by Experts** in different specialties of Microbiology are arranged to broaden the horizons of the students.

12. **Interaction with Experts** is also encouraged during/after presentations to satisfy/ignite curiosities of the students related to developments in the different ares of Microbiology.

13. **Visit to Industries/Laboratories** related to Microbiology like fermentation, food, diagnostics etc. are organized to acquaint the students with real-life working environments of the professional microbiologists with a view to broaden their perspective of the subject of Microbiology



Shri Govind Guru University

(Established Vide Gujarat Act. No. 24/2015)



SHRI GOVIND GURU UNIVERSITY, GODHRA

B.Sc. Biotechnology Semester-III

(Multidisciplinary paper)

BT: Instrumentation and Techniques

Total credit: 4 (Theory and Practical)

UNIT-1: POTENTIOMETRY AND SEPARATION TECHNIQUE

- 1.1 pH Electrode: Reference electrode, Glass electrode, Combine electrode
- 1.2 Construction, operation and use of pH meter
- 1.3 Classification of chromatography & general principles
- 1.4 Principles of Paper chromatography and Thin Layer Chromatography
- 1.5 Development methods
- 1.6 Detection, measurement and use of radioactivity in Biology

UNIT-2: CENTRIFUGATION

- 2.1 Basic principles of sedimentation, Types of centrifuges and rotors
- 2.2 Separation methods in preparative ultracentrifuges:
 - 2.2.1 Differential centrifugation
 - 2.2.2 Density gradient centrifugation
- 2.3 Application of analytical ultracentrifuge
 - 2.3.1 Determination of relative molecular mass
 - 2.3.2 Estimation of purity of macromolecules

BT Practical

1. Study of Binocular Microscope and cell count by Haemocytometer.
2. To study the working of Centrifuge
3. Paper chromatography for separation of amino acids
4. Preparation of working solutions as well as different buffers and calibration of pH meter.

REFERENCES:

1. Keith Wilson & John Walker (ED) (2000): Practical biochemistry-principle & Techniques. Cambridge university press.
2. Skoog, Holler and Nieman, Industrial analysis-Saunders college publication
3. Skoog, West and Holler, fundamentals of analytical chemistry- Saunders college publication
4. James S. Fritz & George H. Schenk, Jr. (1969): Quantitative analytical chemistry (2nd edition). Allyn & Bacon, Inc., Boston.
5. Brown S.B (1980): An Introduction to spectroscopy for biochemists. Academic press London.