SAGRADO
Universidad del Sagrado Corazón

SCHOOL OF HEALTH AND SCIENCES

SYLLABUS

TITLE:	Microbiology
CODE:	BIO 206
PREREQUISITE	BIO 112
CORREQUISITE	BIO 206L
CREDITS:	4 credits | 45 contact hours | 45 lab hours | 1 term

DESCRIPTION

Theoretical course on the study of microorganisms with emphasis on bacteria and their role in Biology. It discusses the structure and function of the prokaryotic and eukaryotic cell, nutrition, metabolism, genetics, and fundamentals of Immunology. This course is aimed at students from the different areas of biology in the School of Health and Sciences. At the end of the course, the student will have a general notion of Microbiology, experimental techniques, and the importance of microorganisms in the environment and in clinical sciences. This course is offered in face-to-face or hybrid mode.

JUSTIFICATION

Students preparing for a career in the field of natural sciences should have fundamental knowledge of Microbiology. The information derived from this discipline has allowed us to obtain great advances in the field of health, as it allows us to identify and treat the causes of infectious diseases and the creation of treatments for them. The study of microorganisms has made it possible to understand many biochemical processes in higher organisms, such as the functioning of genes, the control of the cell, and the role played by microorganisms in biotechnology for the creation of many important medicines and products for the community. It is important to link the course with practice for students to develop skills such as problem solving, teamwork, ethical sense, and practical knowledge in the field of Microbiology.

COMPETENCES

The course develops the following competences in students:

- **Critical questioning**
- **Research and exploration**
- **Problem solving**

OBJECTIVES

After completion of the course, students will be able to:

1. Recognize the importance of Microbiology in the environment, its disciplines, history, and classification of microorganisms.
2. Understand the different techniques and procedures currently used for the study of Microbiology.
3. Understand prokaryotic cells and viruses and establish their differences and mechanisms of action.
4. Learn about nutrition, growth phases, and bacterial metabolism.
5. Have a general understanding of microbial genetics, molecular models, and their importance in the study of other disciplines such as genetics and biotechnology.
6. Develop a general understanding about the study of viruses and their importance in life as etiological agents, classification, major structures, infection cycles, pathogenesis, reproduction, and epidemiology.
7. Identify the main agents for the control of microorganisms.
8. Know the different applications of Microbiology such as air, water, and food.
9. Understand general concepts and mechanisms of infection of the different types of microorganisms and their epidemiology.
10. Know the fundamentals of Immunology and its importance in public health.
11. Understand the basic concepts of Epidemiology and its relationship with population health and its implications for society in general.

CONTENTS

I. Introduction
   A. Definition
   B. Practical uses of Microbiology
   C. History
      1. Antoni van Leeuwenhoek
      2. Theory of Spontaneous Generation

a. Francesco Redi
b. Lazzaro Spallanzani
c. Louis Pasteur
d. Joseph Lister
e. Robert Koch

D. Classification of bacteria (Taxonomy) – criteria
E. Divisions of Microbiology
    1. Medical Microbiology
    2. Environmental Microbiology
    3. Industrial Microbiology
    4. Veterinary, Space Microbiology

II. Laboratory Equipment and Procedures for the Study of Microbes
A. The Microscope
    1. Light
    2. Ultraviolet (UV)
    3. Dark Field
    4. Phase Contrast
    5. Fluorescence
    6. Digital
    7. Tracking
B. Studies of bacteria (Techniques and procedures)

III. The Bacterial Cell
A. Morphology (cocci, bacilli, coils, and vibrio)
B. Bacterial arrangement: streptococcus, staphylococci, diplo, tetrads, and sarcinae
C. Structures of prokaryotic cells
    1. Bacterial wall
    2. Bacterial membrane
    3. Microbial inclusions
    4. Cilia
    5. Pilli
    6. Plasmids
    7. Bacterial ribosome compared to eukaryotic ribosome

8. Flagella
9. Capsules and slime layers

IV. Bacterial Nutrition and Metabolism
   A. Enzymes, energy storage, metabolic pathways (catabolic and anabolic reactions)
   B. Nutrition of bacteria
   C. Bacterial growth
   D. Photosynthesis

V. Bacterial Genetics
   A. DNA molecule replication
   B. Protein synthesis process
   C. Mutations
   D. Conjugation
   E. Transformation
   F. Transduction
   G. Plasmids
   H. Recombinant DNA technique: Role of microbes in Genetic Engineering

VI. Viruses
   A. Definition
   B. Classification
   C. Structures and reproduction
   D. Infection cycles
   E. Pathogenesis
   F. Viral epidemiology

VII. Control of Microorganisms
   A. Heat
      1. Dry
      2. Humid
   B. Pasteurization
   C. Desiccation (dehydration)
   D. Radiation
   E. Filtration
   F. Chemical agents

1. Disinfectants and germicides
2. Aseptic techniques

G. Chemotherapy and antibiotics

H. Mode of action:

1. Inhibitors of bacterial cell wall synthesis
2. Protein synthesis inhibitors
    a. Bacterial ribosome subunit 50s blockers
    b. Bacterial ribosome subunit 30s blockers
3. Cell membrane rupture inducers
4. Nucleic acid inhibitors (DNA, RNA)
5. Purine inhibitors
6. Those who act by competitive inhibition

VIII. Antibiotic Susceptibility Testing

A. Kirby – Bauer

B. MIC

IX. Microbiology and its Applications

A. Air Microbiology

X. Microbiology of Water

A. Drinking water and polluted water

B. Water potability tests

1. Presumptive evidence
2. Confirmed test
3. Completed test

XI. Milk Microbiology

A. Normal milk flora

B. Diseases transmitted through milk

C. Methods and tests for determining the degree

1. Phosphatase test
2. Colony count on plates
3. Reductase test
4. Coliform testing
5. Pathogen testing

XII. Microbiology of Food

A. Pathogenic and toxic infections of food
    1. Causative agents
        a. Staphylococcus
        b. Clostridium
        c. Salmonella
        d. Toxins

XIII. Introduction to Clinical Microbiology
A. Introduction and definitions
    1. Illness
    2. Contagious disease
    3. Endemic
    4. Epidemic
    5. Pandemic
    6. Acute and chronic infections
    7. Local and systemic infections
    8. Primary and secondary infections
    9. Bacteremia
    10. Viremia
    11. Septicemia
B. Introduction to Epidemiology
C. Resistance of the body's defenses
    1. Molecular mechanisms
    2. Innate immunity:
        a. Cells and associated mechanisms
    3. Antigenic presentation
    4. Learned immunity
        a. Antigen – antibody
        b. Antibody synthesis
D. Measurement of antibodies (serology)
E. Allergies and hypersensitivity
F. Antisera and vaccines
    1. Types of vaccines and mechanisms of action

LABORATORY EXPERIENCES

- Introduction and safety rules
- Use, handling, and care of the microscope. Cell observation.
- Hand washing and aseptic techniques
- Techniques for preparing microbial cultures and isolates
- Staining techniques 1: Gram staining
- Staining techniques 2: Special stains
    - Malachite green bacterial spores
    - Bacterial capsules (negative staining)
- Unknown 1: Theory and delivery of unknown and Gram staining of unknown microorganism
- Unknown 2: Seeding of microorganisms in the corresponding media according to the results of the Gram stain
- Unknown 3: Extra tests for the identification of the unknown microorganism. Kirby Bauer Test.
- Unknown 4: Submission of a report on an unknown microorganism and its examination.
- Epidemiology Exercise
- Final Laboratory Exam

METHODOLOGY

The following strategies from the active learning methodology are recommended:

- Lectures
- Discussion of topics in the classroom
- Study of online material
- Critical analysis of peer-reviewed articles
- Laboratory practices
- Teamwork and cooperative learning
- Presentations
- Use of the computer for study of online activities and virtual references

EVALUATION

Partial assignments	30%
Immersion experience	30%
Oral presentation	10%
Composition	10%
Final project or exam	20%
Total	**100%**

LEARNING ASSESSMENT

The institutional assessment rubric is applied to the course's core activity.

BIBLIOGRAPHY

TEXTBOOK

Tórtora, G. J., Funke, B., Case, C. L., Weber, D., & Bair, W. (2019). *Microbiology an Introduction* (13th ed.). Pearson.

LABORATORY MANUAL

Cappuccino, J., Sherman, N. (2014) *Microbiology: A laboratory Manual*. (10th ed.) Pearson.

REFERENCES

Balasubramaniam, M., Pandhare, J., & Dash, C. (2019). Immune Control of HIV. *Journal of life sciences, 1*(1), 4–37.

Bauman, R. (2020). *Microbiology with Diseases by Taxonomy* (6th ed.). Pearson.

Beceiro, A., Tomás, M., & Bou, G. (2013). Antimicrobial resistance and virulence: a successful or deleterious association in the bacterial world?. *Clinical microbiology reviews, 26*(2), 185–230. https://doi.org/10.1128/CMR.00059-12

Cohan, F. M. (1996). The role of the genetic exchange in bacterial evolution. *Fundamental and Frontiers* 2nd ed. *62*(12), *63*(1-3). ASM Press.

Dash, P. K., Kevadiya, B. D., Su, H., Banoub, M. G., & Gendelman, H. E. (2020). Pathways towards human immunodeficiency virus elimination. *EBioMedicine*, 53, 102667.

Domingo, E. (2020). Introduction to virus origins and their role in biological evolution. *Virus as Populations*, 1–33.

Eichenberger, E. M., & Thaden, J. T. (2019). Epidemiology and Mechanisms of

Resistance of Extensively Drug Resistant Gram-Negative Bacteria. *Antibiotics, 8*(2), 37.

Ghanchi, N. K., Jamil, B., Khan, E., Ansar, Z., Samreen, A., Zafar, A., & Hasan, Z. (2017). Case Series of Naegleria fowleri Primary Ameobic Meningoencephalitis from Karachi, Pakistan. *The American Journal of Tropical Medicine And Hygiene, 97*(5), 1600–1602.

Kashfi, R., Kelsey, C., Gang, D. J., Call, D. R., & Gang, D. R. (2020). Metabolomic Diversity and Identification of Antibacterial Activities of Bacteria Isolated from Marine Sediments in Hawaii & Puerto Rico. *Frontiers in molecular biosciences, 7*,(23).

Madigan, M., Martinko, J., Bender, K., Buckley, D., & Brock, T. (2017). *Brock Biology of Microorganisms.* (14th ed.). Prentice Hall.

Mahon, C., Lehman, D. (2018). *Textbook of Diagnostic Microbiology*. (6th ed.). Elsevier Saunders.

Prest, E. I., Hammes, F., van Loosdrecht, M. C., & Vrouwenvelder, J. S. (2016). Biological Stability of Drinking Water: Controlling Factors, Methods, and Challenges. *Frontiers in microbiology, 7*, 45.

Van Helwoort, T. (1996). When did virology start? *ASM News, 62*(3): 142-145.

Nature Publishing Group (2011). Why basic microbiology still matters. *Microbiology, 9*(7), 480-480.

Windels, E. M., Van den Bergh, B., & Michiels, J. (2020). Bacteria under antibiotic attack: Different strategies for evolutionary adaptation. *PLOS Pathogens 16*(5): e1008431.

ELECTRONIC REFERENCES

https://www.ncbi.nlm.nih.gov/books

https://www.asm.org/

https://www.nih.gov/

https://openstax.org/

https://icolc.net/consortia/337

For more information resources related to the course's topics, access the library's webpage http://biblioteca.sagrado.edu/

REASONABLE ACCOMMODATION

For detailed information on the process and required documentation you should visit the corresponding office. To ensure equal conditions, in compliance with the ADA Act (1990) and the Rehabilitation Act (1973), as amended, any student in need of reasonable accommodation or special assistance must complete the process established by the Vice Presidency for Student Affairs.

- Students participating in the Student Support Program (PAE, in Spanish) shall request their reasonable accommodation in PAE's offices.
- Students who do not participate in PAE shall request their reasonable accommodation at the Integral Wellness Center (*Centro de Bienestar Integral*, in Spanish).

ACADEMIC INTEGRITY

This policy applies to all students enrolled at Universidad del Sagrado Corazón to take courses with or without academic credit. A lack of academic integrity is any act or omission that does not demonstrate the honesty, transparency, and responsibility that should characterize all academic activity. Any student who fails to comply with the Honesty, Fraud, and Plagiarism Policy is exposed to the following sanctions: receive a grade of zero in the evaluation and / or repetition of the assignment in the seminar, a grade of F (*) in the seminar, suspension, or expulsion as established in the Academic Integrity Policy effective in November 2022.

RESEARCH COURSES

This course may require students to practice tasks related to the research process, such as taking informed consent or assent, administering instruments, conducting interviews, observations, or focus groups, among others. These assignments are part of an academic exercise and the information collected will not be used to share with third parties or disclose it in settings other than the classroom with the professor teaching the course. Every student, as well as their professor, who will interact with human subjects as part of their research practice must be certified in ethics with human subjects in research by the Collaborative Institutional Training Initiative (CITI Program).