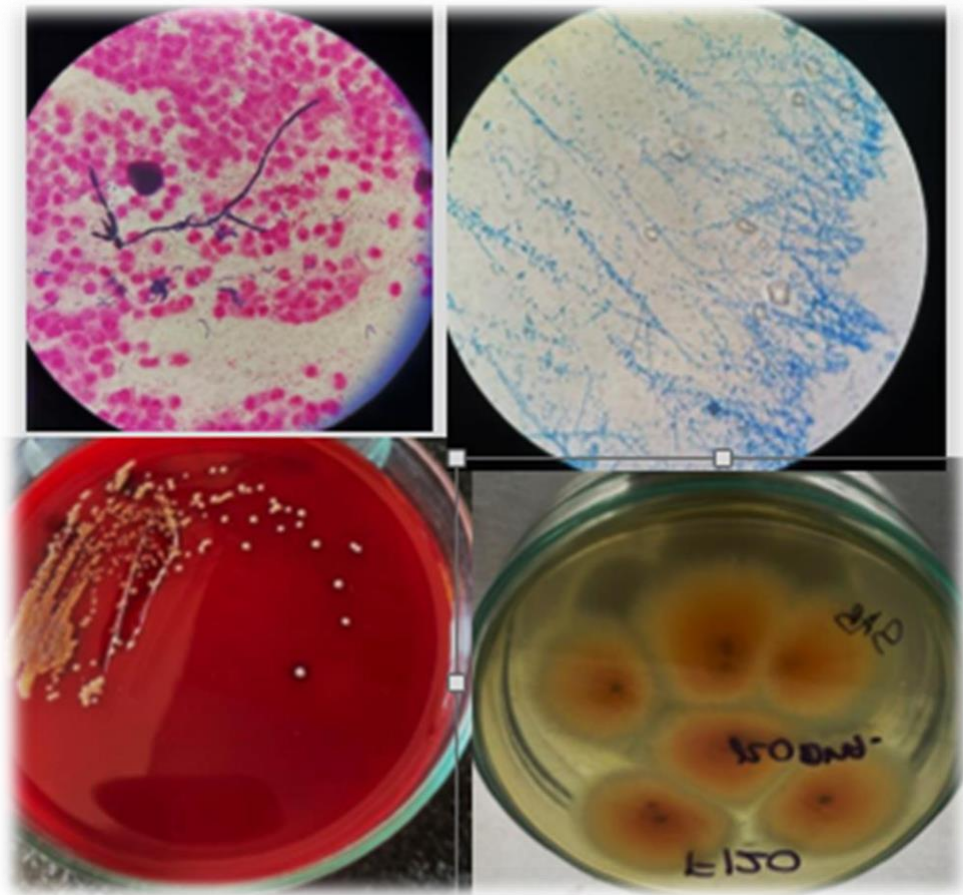




Faculty of Medicine
Sabaragamuwa University of Sri Lanka



**Handbook in
Medical Microbiology & Immunology
for Medical Students**



**Faculty of Medicine
Sabaragamuwa University of
Sri Lanka**

NOVEMBER 2025

CONTENTS

Page No.

- Introduction 2
- The staff in the department 2
- The timetable 3
- Academic programme 4
- Intended Learning Outcomes (ILO) of the course 4
- ILOs of course units, 7 – 11
 - General microbiology
 - Immunology
 - Systematic bacteriology
 - Systematic virology
 - Mycology
 - Antibiotics
 - Clinical microbiology
- The teaching learning methods 12
 - Lectures
 - Practical sessions and demonstrations
 - Small group discussions
 - Flipped classroom method (FCM)
- Assessments 13-14
 - Continuous assessments
 - Final assessment in microbiology and immunology
- Recommended reading 14
- Appendices 15
 - 1. Gram Stain
 - 2. Acid Fast stain

Introduction

Welcome to the Department of Microbiology and to the course in Medical Microbiology.

Medical Microbiology begins with a review of the immune system, focusing on the body's response to invading microorganisms. Study of bacteria are next, with the general concepts of bacterial microbiology and then detailing the major bacterial pathogens of humans. Similarly, virology and mycology are dealt with. The mechanisms of infection characteristic of that type of microorganism are stressed providing the student with a framework to understand the pathogenesis and management of Infectious Diseases of the systems providing the student a transition for clinical considerations.

Learning microbiology should go hand in hand with your clinical work in the wards. It's good if you relate the knowledge you learn in microbiology to cases of infectious diseases that you see and discuss in the wards. Thus, the subject becomes more interesting and relevant to your clinical work. The knowledge you gain by completing this course will guide you to arrive at a diagnosis and advice on management and prevention of infectious diseases as a medical doctor.

Antimicrobial resistance (AMR) occurs when microbes evolve mechanisms that protect them from antimicrobials. This resistance affects all classes of microbes, Together, these adaptations fall under the AMR umbrella, posing significant challenges to healthcare worldwide. The burden of AMR is immense, with nearly 5 million annual deaths associated with resistant infections. Infections from AMR microbes are more challenging to treat and often require costly alternative therapies that may have more severe side effects. Preventive measures, such as using narrow-spectrum antibiotics and improving hygiene practices, aim to reduce the spread of resistance.

Academic staff in the department

Senior Lecturers

Dr. Vindya Perera [BVSc Hons. (Pera), PhD (Col.)]- Head, Department of Microbiology

Dr. Geetha Nanayakara [MBBS (Ruhuna)] Dip Med. Micro (Col.), MD Med. Microbiology (Col.)

Lecturer

Dr. Manushi Sucharitharathne [MBBS (Ruhuna)] Dip Med. Micro (Col.) –on study leave

The Time Table

You will be learning Microbiology during the 4th and 5th semesters in the medical curriculum. Each student will learn microbiology during 3 to 4 hours of contact time per week with the staff in our department in these semesters. During these hours you will participate in various teaching learning activities, which are described in detail below.

This does not mean that you have to limit yourself to learning Microbiology during these hours. The contact time you have with us is for the purpose of directing your learning and to facilitate your learning process. Therefore, you will need to devote many more hours for self learning or learning in groups.

The approximate number of hours that are set aside for Microbiology in a week are as follows:

Semester 4

2 to 3 hours - Lectures in General Microbiology, Immunology, Bacteriology,
Mycology and Antibiotics

2 hours - Practical sessions & demonstrations, Small group discussions

Semester 5

2 to 3 hours - Lectures in Virology & Clinical Microbiology

2 hours- Small group discussions & Case studies

Academic programme

Semester	Subject area	No. of hours allocated for Teaching/Learning methods		
		Lectures	Tutorials/SGD	Practical
4	General Microbiology	6	5	2
	Immunology	6	2	
	Bacteriology		8	2
	Mycology	2	2	
	Antibiotics		2	
5	Virology		6	2
	Clinical Microbiology	14	6	2

INTENDED LEARNING OUTCOMES (ILO) OF THE COURSE IN MEDICAL MICROBIOLOGY

At the completion of this course, the students should be able to:

1. identify bacteria, viruses and fungi which frequently cause disease in humans;
2. describe the clinical features and the pathogenesis of infectious diseases;
3. explain measures to prevent and control such infections including infection control practices and vaccines;
4. select relevant microbiological tests, advise on collection and transport of specimens to diagnose infectious diseases and interpret laboratory reports;
5. select antimicrobial agents effective for treatment and prophylaxis of infections;
6. justify the appropriate use of antibiotics in the healthcare setting;
7. describe the immunological mechanisms that come into play when a human host is exposed to antigens;
8. select appropriate immunological tests for diagnosis of immune mediated disorders and interpret their results

ILOs in General Microbiology

At the end of each session of teaching – learning on general microbiology, the students should be able to:

- List the generic names of common microorganisms (Bacteria, Viruses & Fungi), which cause disease in humans.
- Recognize the basic microscopic features of the common bacterial pathogens and fungi and identify them in direct mounts, Gram and acid-fast smears.
- Describe the habitat, routes of transmission and pathogenesis of infections caused by microbes that are prevalent in this country
- List laboratory tests to identify infectious agents (Bacteria, Viruses & Fungi) in the clinical microbiology lab.
- Identify antiseptics, disinfectants and sterilising agents, explain their mode of action and select the appropriate ones for patient care and in the laboratory.
- Define the terminology used in Bacterial genetics
- Describe different types of genetic mutation and major mechanisms of genetic transfer and recombination among bacteria
- Identify the resident and transient flora of humans
- Explain the benefits and harmful effects of microbial flora on humans
- Define the human microbiome and identify how human physiology or the environment can influence the microbiome, or vice versa
- Explain the effects of microbial biofilms and their role in pathogenesis

Topics

- Introduction to bacteriology
- Classification & Structure of bacteria
- Pathogenesis & virulence of bacteria
- Detection, Culture & identification of Bacteria
- Normal microbial flora & microbiome
- Disinfection & Sterilization
- Bacterial genetics

ILOs in Immunology

At the end of each session of teaching – learning on Immunology, the students should be able to:

- List cells & tissues of the immune system and describe their function.
- List the physiological mechanisms of the immune system. ie. Complement system, its pathways & activation, and cytokines & their function
- Define the term "innate immunity"
- Describe the innate immune mechanisms found in the body: cells and molecules define "acquired immunity" and describe how it differs from innate immunity
- List the types of acquired immunity, define the term "antigen"
- List the antigen-presenting cells (APCs) and explain how APCs present the antigens on their cell surfaces
- Identify the sites of location of lymphocytes
- Define the terms "cell-mediated immunity" and "humoral immunity" and state the type of lymphocyte that promotes each of them
- Explain how antigens are presented to the T and B lymphocytes
- Explain the difference between the primary & secondary antibody response state the different types of immunoglobulins and describe their functions
- Describe the events taking place when a T lymphocyte is exposed to an appropriate antigen
- List the types of T cells and describe the functions of each of them
- Describe the immune mechanisms that control different types of microbial infections Ie. Extra & intracellular bacterial, fungal, viral and parasitic
- List the causes (both primary & secondary), and describe diagnosis, clinical features and complications of immunodeficiency diseases
- Explain the immune regulatory mechanisms in natural & artificial situations.
- List the different types of vaccines used in Sri Lanka.
- Explain the National Programme of Immunization and the schedule of NPI vaccines
- Explain how the immune system can damage the host tissues.
- Identify the types of hypersensitivity
- Explain the disease mechanism of each type of hypersensitivity
- Explain mechanisms on how the immune system can react on host tissue and cause disease

- Explain the principles of immunological diagnostic techniques and interpretation of immunological test results

Topics

- Introduction to Immunology, Immune system,
- Innate immunity - Humoral aspects including complement.
- Adaptive immunity, Immunoglobulins & Humoral immunity.
- Cell mediated immunity & Hypersensitivity.
- Methods of acquiring specific immunity.
- Auto immunity & Immune tolerance.
- Immune deficiency & Transplantation.
- Immunity to bacterial, viral & fungal infections.
- Immunization.
-

ILOs in Systematic Bacteriology

At the end of each session of teaching – learning on Systematic Bacteriology, the students should be able to:

- List the bacterial species that cause important and common infectious diseases.
- Identify the characteristics of the genera to which these bacteria belong.
- Identify their natural source and habitat.
- Identify them by their microscopic morphology in stained clinical specimens
- List the infections or clinical syndromes they cause in humans.
- Explain the pathogenesis of infections they cause.
- Advise staff and patients regarding collection and transport of clinical specimens for the microbiological diagnosis of infective diseases.
- Interpret reports of microbiological investigations done in these infectious diseases
- List front line and second line antibiotics effective against major pathogenic bacteria and select appropriate antibacterial agents for the empiric and definitive treatment of infections caused by them.
- Explain the epidemiology of such infections and the current incidence and prevalence of infective diseases in the community.
- Identify methods to prevent and control infections in the community and in the hospital, caused by the bacteria based on their habitat and modes of spread.

Topics

- Staphylococci/ Streptococci / enterococci.
- Gram +ve bacilli - Corynebacteria & Bacillus sp.
- Gram - ve cocci – Neisseria/Moraxella
- Small Gram -ve bacilli - Haemophilus etc.
- Enterobacteriaceae- E.coli/ Klebsiella/ Salmonella/ Shigella
- Pseudomonas/ vibrio / Aeromonas / Plesiomonas
- Anaerobes - Clostridia / Bacteroides.
- Campylobacter/ Helicobacter.
- Mycoplasma/ Rickettsiae/Chlamydiae.
- Mycobacteria / Norcardia / Actinomycetes.
- Spirochaetes.

ILOs in Mycology

At the end of each session of teaching – learning on Mycology, the students should be able to:

- List the aetiological agents, identify the clinical features and describe the pathogenesis of common superficial, subcutaneous and systemic fungal infections. Eg. Taenia, kerion, pityriasis versicolor, piedra, onychomycosis, candidiasis, chromomycosis, mycetoma, aspergillosis, talaromycosis and cryptococcosis. and rhinosporidiosis
- Advice on collection and transport of specimens for their laboratory diagnosis.
- Advice on specific antifungal treatment and prevention of superficial fungal infections.

Topics

- Skin and superficial mycoses
- Subcutaneous and systemic mycoses

ILOs in Antimicrobial Agents

At the end of each session of teaching – learning on Antibiotics, the students should be able to:

- Explain the mechanisms of action of antimicrobials.
- Describe the development of antimicrobial drug resistance by microbes and its clinical implications.
- Identify the clinical settings where antimicrobial agents are used for empiric and definitive therapy.
- Identify the clinical conditions where antimicrobials are used for prophylaxis.
- Select appropriate antimicrobials to treat common infectious diseases.
- List the generic names, describe the mechanism of action, spectrum of activity, adverse effects of commonly used antimicrobials in each group e.g. penicillins, aminoglycosides, cephalosporins, azoles etc.
- Identify the drug/s of choice and schedules in the treatment of common infectious diseases such as Tuberculosis, Leprosy, Typhoid, Infective endocarditis, UTI, pneumonia, gastro - enteritis, meningitis and encephalitis, taenia infections, herpes infections etc.
- Outline the tests that are done in the laboratory, to guide clinicians on antimicrobial therapy.
- Interpret antibiotic susceptibility test reports issued by the laboratory.

Topics

- Antimicrobial agents
- Antimicrobial therapy.

ILOs in Systematic Virology.

At the end of each session of teaching – learning on systematic virology, the students should be able to:

- Identify the common characteristics of the family and the genus to which the virus belongs.
- Identify the important and pathogenic serotypes / strains / variants of the genus.
- Explain the morphology and common characteristics of the virus.
- Explain the methods of transmission of the virus to the human host, and the natural hosts and vectors.
- List the common diseases and syndromes caused by the virus.
- Recognize and describe briefly the clinical features of common diseases and syndromes caused by the virus.
- Explain the pathogenesis and outcome of such viral infections.
- Identify the appropriate laboratory diagnostic methods available for detection of viral infections.
- Explain the collection and transport of appropriate clinical specimens for laboratory diagnosis of viral infection.
- Interpret laboratory reports of viral infections.
- Identify appropriate antiviral drugs for such viral infections.
- Describe briefly the epidemiology (i.e. the prevalence, distribution, at risk population etc) of such infections.
- Explain the appropriate methods of prevention and control of viral infections in the community.

Topics

- Introduction to Virology
- Viruses of the Respiratory tract
- Hepatitis
- Herpes group of viruses
- Pox viruses/ parvovirus/ papilloma viruses
- Mumps / Measles/ Rubella
- Rabies
- HIV
- Diarrhoeagenic viruses

- Enteroviruses and Arboviruses

ILOs in Clinical Microbiology

At the end of each session of teaching – learning on clinical microbiology students should be able to:

- List the common infections of the systems and arrive at a tentative diagnosis from the clinical signs and symptoms and relevant microbiology laboratory reports.
- Identify relevant microbiological and other laboratory investigations to aid the definitive diagnosis of such infections
- Advice on collection and transport of relevant microbiological specimens for diagnosis of these infections
- Plan strategies to use effective antimicrobial agents for treatment and prophylaxis
- Explain measures for the prevention and control of infectious diseases.
- Identify healthcare associated infections and infection prevention and control practices to prevent such infections
- Identify emerging infectious diseases in the country and globally

Topic

- Collection & transport of specimens
- Urinary tract infections
- Upper and lower respiratory tract infections
- Bone and joint infections
- Pyrexia of unknown origin (PUO) / Sepsis / Septic shock
- Congenital, perinatal and blood borne infections
- Infections of central nervous system
- Abdominal infections, gastroenteritis and food poisoning
- Healthcare associated infections and infection prevention and control
- Eye and ear Infections
- Sexually transmitted infections
- Skin infections.
- Emerging infectious diseases

The Teaching Learning Activities (TLA)

Lectures

The academic staff of the department will conduct the lectures. Visiting lecturers will be invited when necessary to deliver lectures in their specialty. This is the main TLA in this course where the core knowledge in Microbiology will be learnt. The schedule of lectures together with the dates will be displayed on the notice board at the beginning of semesters 4 & 5 and will be uploaded on VLE as well. It would be good if you can come prepared for these lectures in which case you will be able to follow the lecture very clearly and make this TLA a productive learning exercise. The teachers will use Power Point presentations to facilitate learning during the lecture. Handouts of the slides will be uploaded on to the VLE.

Practical sessions

The practical sessions in semester 4 will train you to be competent in observing and identifying stained bacteria. The Gram stain procedure (appendix 1) and the acid-fast stain (Ziehl Neelson) procedure (appendix 2) will be demonstrated to you during this semester.

Small group discussions

The students will participate in this teaching learning activity during the scheduled time for practical or tutorials in Microbiology. The batch will be divided into small groups of students. The topic to be discussed will be given as questions or clinical scenarios. At the end of the allocated time lecturer/ tutor will facilitate the discussion.

Flipped class room model (FCM)

A flipped classroom is a type of blended learning where you are able to study at home the contents of a lecture accessed via VLE and practice the application of the contents in the classroom. This is the reverse (flipped) of the more common practice of listening to a lecture in the classroom and the application of that lecture is done by you independently at home as homework. During your microbiology course you will be introduced to FCM on several occasions.

Assessments in Microbiology

End Semester (Continuous) Assessments

Two **End Semester** (continuous) assessments (ES) will be held. One will be at the end of the semester 4 and the other will be held at the end of semester 5.

Methods of assessment:

End semester 4 (ES4)

Multiple choice questions (MCQ) – 15 questions

Single best answer (SBA) - 5 questions

End semester 5 (ES5)

Objective Structured Practical Examination (OSPE) - 10 questions

A total of 20 marks from the **2, End Semester examinations** (10 marks from each) will be carried over for the 3rd MBBS part 1 examination.

3rd MBBS part 1 examination

This will be held at the end of the 5th semester.

The theory component will consist of 15 MCQs, 3SBAs and 3 EMQs, 6 Structured Essay Questions (SEQs) and 20 Objective Structured Practical Examination (OSPE) questions.

Compilation of the final mark as a percentage:

Method of assessment	Main examination	Duration
15 MTF + 3 SBAs +3 EMQs (each EMQ with 4 scenarios)	25	1hour 30 mins
6 SEQs	25	1hour 30 mins
OSPE 20 projected questions- 3 mins each	30	1 hour
Contribution from continuous assessments	20	
Total	100	

* MCQ= Multiple Choice Questions, MTF = Multiple True False, SBA = Single Best Answer, EMQ= Extended Matching Questions, SEQ= Structured Essay Question

Continuous Assessment marks out of 20, will be considered only for the first attempt at the end of course assessment (3rd MBBS Part 1 Examination). For subsequent attempts the marks out of 80 will be converted to a mark out of 100

The pass mark is 50%. However, students should obtain 45% for the theory components
Students obtaining less than 50% in the total mark has to repeat all components of the examination

To be eligible for distinction a student should obtain cumulative minimum of 60% in the continuous assessments and should pass the Third MBBS examination for MBBS Degree in the first attempt.

Important facts

1. No student can omit both End Semester examinations 4 and 5 under any circumstances.
2. In the final Examination, students should complete all components of the examination within one attempt (in one sitting). If a student fails to do so, the student has to repeat the entire examination (final examination).
3. If a student is unable to attend the total or part of the final examination due to an illness-the student should inform the SAR and the department and submit a valid medical certificate within two weeks of the date of the examination. In such an event the student shall sit the full repeat examination and this will be considered his or her 1st attempt.

Subsequent Examination procedure (Final examination in Microbiology)

1. The first subsequent attempt for the failures will be conducted after a period of 4 weeks from the date of release of results of the main examination
2. The second subsequent attempt will be with the immediate junior batch.

Recommended Reading

- Medical microbiology, 18th Edition 2012.D. Greenwood, R. Slack, J. Peutherer. Churchill Livingstone, London.
- Medical Microbiology, 6th Edition 2018. Mims C. A., Playfair J. H. L., Roitt I., Wakelin D., Williams R., Anderson R. M. Mosby. Elsevier.
- Basic Immunology Functions and Disorders of the Immune System, 5th Edition 2015 Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai. Elsevier.

APPENDICES

APPENDIX 1:

PRESTON & MORELL'S MODIFICATION OF GRAM'S STAIN

1. Apply Ammonium Oxalate-Crystal Violet stain for 1/2 minute.
2. Wash thoroughly with water.
3. Apply Lugol's Iodine solution for 1/2 minute.
4. Wash thoroughly with water.
5. Apply Iodine-Acetone solution for 1/2 minute.
6. Wash thoroughly with water.
7. Counterstain with dilute Carbol Fuchsin for 1/2 minute.
8. Wash thoroughly with water.

APPENDIX 2:

ZIEHL-NEESEN'S METHOD FOR ACID-FAST BACILLI

1. Flood the slide with Strong Carbol Fuchsin and heat, until steam rises. (do not boil). Allow the preparation to stain for 5 minutes, Heat being applied at intervals to keep the stain hot. The stain must not be allowed to evaporate and dry on the slide, if necessary pour more carbol fuchsin to keep the whole slide covered with stain.
2. Wash the slide thoroughly under running water.
3. Decolourize in 3% acid alcohol by pouring the solution onto the smear. Keep till the red colour of the smear is changed to light pink, Wash the slide in water. The object of the washing is to remove the compound acid with stain. The decolourization is finished when, after washing the slide, the film is very faintly pink.
4. Wash the slide well in water.

Copyright:

Department of Microbiology.

Faculty of Medicine, SUSL. 2nd December 2024