



**LEADING THE WAY**  
KHALIFAH • AMĀNAH • IQRA' • RAHMATAN LIL-ĀLAMĪN  
**LEADING THE WORLD**



AN INTERNATIONAL AWARD-WINNING INSTITUTION FOR SUSTAINABILITY

**DEPARTMENT OF BASIC MEDICAL SCIENCES**  
**KULLIYAH OF MEDICINE**  
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

# MICROBIOLOGY STUDY GUIDE

*Academic Session 2023/2024*

MASTER OF MEDICAL SCIENCES,  
MASTER OF HEALTH SCIENCES  
&  
PhD IN HEALTH SCIENCES

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Any absence due to sickness or any unforeseen circumstances must be notified to the course coordinators as soon as possible and must be supported by suitable documentation e.g. sick certification

# MICROBIOLOGY

## Directory of Course Instructors

No.	Name	Email	Department
1.	Prof. Dr. Mohamed Imad Al-Deen Mustafa Mahmoud	imad@iium.edu.my	Basic Medical Sciences, KOM
2.	Assoc. Prof. Dr. Hairul Aini Hamzah	hairulaini@iium.edu.my	Basic Medical Sciences, KOM
3.	Asst. Prof Dr. Hanan Hamimi Wahid	hananwahid@iium.edu.my	Basic Medical Sciences, KOM
4.	Asst. Prof. Dr Mohd Asyraf Abdull Jalil	mohdasyraf@iium.edu.my	Basic Medical Sciences, KOM

## List of Courses

	Course Title	Course Code	Course Classification	Credit Hours
1.	Introduction to Medical Microbiology	MMBI 7241	Special Req	2
2.	Medical Mycology	MMBI 7141	Core	1
3.	Clinical Microbiology Diagnostic Laboratory Practice	MMBI 7242	Core	2
4.	Basic & Clinical Immunology	MMBI 7243	Core	2
5.	Medical Virology	MMBI 7341	Core	3
6.	Medical Bacteriology	MMBI 7441	Core	4

# **MMBI 7141: Medical Mycology**

Course Coordinator: Asst. Prof Dr. Aniza Pakeer

## **Section 1: Course Synopsis**

This course covers all the important communicable diseases caused by moulds (filamentous fungi) and yeasts and their increasing clinical importance will be highlighted.

## **Section 2: Learning Outcome**

1. Describe, classify, compare and contrast the different species of fungi.
2. Compare and contrast the diseases caused by the different species of fungi.
3. Evaluate the principles of antimicrobial drug actions and point out the treatment of fungal infections.
4. Appraise the current and latest mycology laboratory techniques in research.

## **Section 3: Teaching Format and Guidelines**

1. Lecture
2. Assignment / Tutorial / Report
3. Discussion
4. Journal Critique
5. Self-directed learning

## **Section 4: Course Assessment**

Assignment / Tutorial / Report	20%
Journal Critique Presentation	20%
Examination	50%
Participation/Attendance	10%

## Section 5: Course Content

No.	Topic
1.	Introduction: <ul style="list-style-type: none"><li>• Overview of Clinical Mycology</li><li>• General Features of Fungi</li><li>• Taxonomy and Practical Classification of Fungi</li><li>• Virulence Factors of Medically Important Fungi</li></ul>
2.	Superficial Mycosis: Dermatophytosis
3.	Superficial Candidosis, Pityriasis (Tinea) Versicolor and Other Superficial Infections
4.	Assignment Discussion
5.	Subcutaneous Mycosis : Mycetoma and Chromoblastomycosis
6.	Subcutaneous Mycosis: Sporotrichosis and Other Subcutaneous Mycoses
7.	Systemic Mycosis – Primary Infections: Coccidioidomycosis and Histoplasmosis
8.	Systemic Mycosis – Opportunistic Infections: Aspergillosis
9.	Systemic Mycosis – Opportunistic Infections: Cryptococcosis.
10.	Systemic Mycosis – Opportunistic Infections: Pneumocystosis, Zygomycosis and Other Opportunistic Fungal Infections.
11.	General Considerations for Identification of Moulds and Yeasts. Clinical Laboratory Diagnosis of Fungal Infections.
12.	Antimicrobial Susceptibility Testing and Treatment of Clinically Important Fungal Infections
13.	Journal Critique

## Section 6: Learning Resources

### Required Textbook

1. E. Reiss, H. Jean Shadomy & G.M. Lyon. (2012). Fundamental Medical Mycology. New Jersey: Wiley-Blackwell.
2. Patrick R. Murray, Ken S. Rosenthal & Michael A. Pfaller. (2021). Medical Microbiology. (9th Ed). Elsevier.
3. Stefan Riedel, Hobden JA, Carroll, Miller S, Morse SA, Mietzner TA, et al (2019). Jawetz, Melnick, & Adelberg's Medical Microbiology (28th Ed). McGraw-Hill.

### Recommended Textbook

1. Karen C. Carroll, Michael A. Pfaller, James A Karlowsky, Marie Louse Landry, et al (2023), Manual of Clinical Microbiology, (13th Ed). ASM Press

# **MMBI 7241: Introduction to Medical Microbiology**

Course Coordinator: Asst. Prof Dr. Hanan Hamimi Wahid

## **Section 1: Course Synopsis**

The course describes the basic groups of microorganisms through the study of their characteristics including their functional anatomy; survey of the physiology, metabolism, growth and genetics of microorganisms and the practical relationship of these areas to cultivation, identification, and control of microorganisms. Students will be also kept abreast with the current news of medical microbiology through journals.

## **Section 2: Learning Outcome**

1. Point out and identify the important milestones in the history of microbiology.
2. Point out and compare the different classification of microorganisms.
3. Evaluate, integrate and organize the pathogenesis, and immunopathogenesis of microbial infections.
4. Compare and contrast the general characteristics of infections caused by microorganisms and integrate the knowledge with principles of their diagnosis and treatment.

## **Section 3: Teaching Format and Guidelines**

1. Lecture
2. Seminar
3. Viva
4. Self-directed learning

## **Section 4: Course Assessment**

Viva	60%
Seminar Presentation	20%
Participation/Attendance	10%

## Section 5: Course Content

No.	Topic
1.	Introduction: <ul style="list-style-type: none"><li>• Structure and Composition of Bacteria and Viruses.</li><li>• Classification and Nomenclature of Bacteria</li></ul>
2.	Bacterial Replication, Genetics, Evolution and Virulence Factors Gram-positive and Gram-negative Bacteria Overview
3.	Virus Replication
4.	<ul style="list-style-type: none"><li>• Host immune response to bacterial infections</li><li>• Genetic determinants of host resistance</li><li>• Physiological factors affecting host resistance</li></ul>
5.	Mechanisms of Disease Production and Immunopathology
6.	<ul style="list-style-type: none"><li>• Immunization Against Bacterial Diseases</li><li>• Live Vaccines, Inactivated Vaccines, Bacterial Subunit Vaccines, Synthetic Vaccines</li></ul>
7.	<ul style="list-style-type: none"><li>• Chemotherapy of Bacterial Diseases</li><li>• Epidemiology, Prevention and Control of Bacterial Diseases</li></ul>
8.	The Principles of Aseptic Technique in Microbiological Practice, Species Identification and Laboratory Technique Used in Virology

## Section 6: Learning Resources

### Required Textbook

1. Patrick R. Murray, Ken S. Rosenthal & Michael A. Pfaller. (2021). Medical Microbiology. (9th Ed). Elsevier.
2. Stefan Riedel, Hobden JA, Carroll, Miller S, Morse SA, Mietzner TA, et al (2019). Jawetz, Melnick, & Adelberg's Medical Microbiology (28th Ed). McGraw-Hill.



# **MMBI 7242: Clinical Microbiology Diagnostic Laboratory Practice**

Course Coordinator: Asst. Prof Dr. Norhidayah Kamarudin

## **Section 1: Course Synopsis**

This course covers the theoretical aspects as well as laboratory training in clinical microbiology. It will be conducted either at the Hospital Tengku Ampuan Afzan (HTAA) or Pathology and Laboratory Medicine Department of IIUM Medical Centre (IIUMMC) in addition to other specialist laboratories as required.

## **Section 2: Learning Outcome**

1. Evaluate the requirements and functions of a clinical microbiology diagnostic laboratory in a clinical setting.
2. Point out and compare the appropriate diagnostic procedure and method for microbiological infections.
3. Demonstrate skills in diagnostic clinical microbiology and integrate the knowledge and skills acquired in research.

## **Section 3: Teaching Format and Guidelines**

1. Practical
2. Report
3. Self-directed learning

## **Section 4: Course Assessment**

Laboratory Practical Report	40%
Examination	50%
Participation/Attendance	10%

## Section 5: Course Content

No.	Topic
1.	Practical: <ul style="list-style-type: none"><li>• Specimen Collection and Transport.</li><li>• Safety Regulations, Classes Of Substances, Labeling Packages, Documentation, Personnel Training.</li></ul>
2.	Practical: <ul style="list-style-type: none"><li>• Blood Cultures, Urine Culture, Sputum Culture, Throat Swabs, Swabs from Skin Lesions etc.</li></ul>
3.	Practical: <ul style="list-style-type: none"><li>• Antimicrobials and Antimicrobial Susceptibility Testing:<ul style="list-style-type: none"><li>– Qualitative disc diffusion methods</li><li>– Quantitative MIC/MBC and E tests.</li></ul></li></ul>
4.	Practical: <ul style="list-style-type: none"><li>• Lab. Physical Design, QC and Infection Control.</li></ul>
5.	Practical: <ul style="list-style-type: none"><li>• Hospital-acquired Infections:</li><li>• Sources, Monitoring, Tracing and Control.</li></ul>
6.	Practical: <ul style="list-style-type: none"><li>• Molecular Diagnosis of Microbial Infections:<ul style="list-style-type: none"><li>– conventional and real-time PCR; others.</li></ul></li></ul>
7.	Practical: <ul style="list-style-type: none"><li>• Serological and Immunochemical Diagnosis of Microbial Infections.</li></ul>

## Section 6: Learning Resources

### Required Textbook

1. P.M. Tille. (2022). Bailey & Scott's Diagnostic Microbiology, (15th Ed). Elsevier.
2. M.D. Delost (2022). Introduction to Diagnostic Microbiology for the Laboratory Sciences. MA: Jones & Bartlett Learning.
3. C. R. Mahon, D. C. Lehman, G. Manuselis Jr. (2022). Textbook of Diagnostic Microbiology. (7th Ed). Saunders Elsevier. E. Reiss, H. Jean Shadomy & G.M. Lyon. (2012). Fundamental Medical Mycology. Elsevier.

# **MMBI 7243: Basic and Clinical Immunology**

Course Coordinator: Asst. Prof Dr. Hanan Hamimi Wahid

## **Section 1: Course Synopsis**

The course is intended to expose the students to the intricacies of the interplay between the various components of the immune system in response to infections, as well as the immunological disorders that would affect the host should one or more of these components go awry. This would form the basis in the understanding of the various pathologies observed in medical microbiology.

## **Section 2: Learning Outcome**

1. Point out the various components of immune systems and describe the immune response.
2. Differentiate system specific immunological diseases.
3. Demonstrate skills in basic immunology laboratory techniques and integrate the knowledge and skills acquired in research.

## **Section 3: Teaching Format and Guidelines**

1. Lecture
2. Tutorial / Seminar
3. Practical
4. Report
5. Self-directed learning

## **Section 4: Course Assessment**

Seminar presentation/ Tutorials	20%
Laboratory Practical Report	20%
Examination	50%
Participation/Attendance	10%

## Section 5: Course Content

No.	Topic
1.	Introduction: Historical Perspective Antigens, Immunogens, Haptens and Adjuvants
2.	The Anatomy, Histology and Cytology of the Immune System
3.	Innate Immunity: Humoral and Cellular Mechanisms
4.	The Human Leucocyte Antigen (HLA) System  Seminar
5.	Cellular Immune Responses: Antigen Presentation - The Interplay Between Dendritic Cells, Macrophages, B lymphocytes, T lymphocytes
6.	Hypersensitivity Reactions and Clinical Allergy  Practical: Immunodiffusion
7.	The Immune Response to Microbes: Viruses, Bacteria, Fungi, Parasites.  Practical: Immunoagglutination
8.	Immunodeficiency.  Practical: Immunofluorescence
9.	Mechanisms of immunotolerance and autoimmunity.  Practical: Enzyme immunoassay
10.	Rheumatological and dermatological diseases.  Seminar
11.	Cardiovascular, Pulmonary, Gastrointestinal and Liver Diseases.
12.	Hematological and Endocrinological Diseases
13.	Diseases of the Central Nervous System and the Eye
14.	Immune-based Therapies Including Immunization

## Section 6: Learning Resources

### Required Textbook

1. Strandford S, Owen J, Punt J & Patricia J (2023). Kuby immunology (8th. Ed). Macmillian
2. Abul Abbas Andrew H. Lichtman Shiv (2021) Cellular and Molecular Immunology (10th Ed). Elsevier
3. M. Peakman & D. Vergani. (2009). Basic and clinical immunology (2nd Ed). Elsevier.
4. V. Kumar, A. K. Abbas, N. Fausto & J. C. Aster (2010). Robbins and Cotran pathologic basis of diseases (8th. Ed.). Saunders Elsevier.

# **MMBI 7341: Medical Virology**

Course Coordinator: Assoc. Prof Dr. Hairul Aini Hamzah

## **Section 1: Course Synopsis**

This course presents the students with the structural and biological properties of different families of viruses relevant to medicine. For each virus or group of viruses the following aspects of important viral properties, pathogenesis and immunity, clinical features, laboratory diagnosis, epidemiology as well as treatment and control are covered.

## **Section 2: Learning Outcome**

1. Differentiate medically important viruses and point out their properties.
2. Describe, classify, compare and contrast the different diseases caused by different species of viruses.
3. Point out diagnostic approach to the diseases, appropriate therapy and control measures.
4. Appraise the current and latest virology laboratory techniques in research.

## **Section 3: Teaching Format and Guidelines**

1. Lecture
2. Assignment
3. Journal Critique
4. Self-directed learning

## **Section 4: Course Assessment**

Assignment	20%
Journal Critique Presentation	20%
Examination	50%
Participation/Attendance	10%

## Section 5: Course Content

No.	Topic
1.	<ul style="list-style-type: none"> <li>• Introduction               <ul style="list-style-type: none"> <li>– Structure and composition of viruses</li> <li>– Physical methods for studying viruses</li> <li>– Chemical composition of virions</li> </ul> </li> <li>• Classification and Nomenclature of Viruses               <ul style="list-style-type: none"> <li>– Criteria for classification and nomenclature</li> <li>– Families of DNA and RNA viruses</li> </ul> </li> </ul>
2.	<ul style="list-style-type: none"> <li>• Viral Replication of RNA viruses</li> <li>• Viral replication of DNA viruses</li> </ul>
3.	<ul style="list-style-type: none"> <li>• Virus-cell interactions               <ul style="list-style-type: none"> <li>– Cytopathic effects</li> <li>– Mechanisms of cell damage</li> <li>– Noncytotoxic infections</li> <li>– Interferons</li> </ul> </li> <li>• Virus-Host Interaction               <ul style="list-style-type: none"> <li>– Determinants of viral virulence and host resistance</li> <li>– Genetic determinants of viral virulence</li> <li>– Genetic determinants of host resistance</li> <li>– Physiological factors affecting host resistance</li> <li>– Immune response to viral infections</li> </ul> </li> </ul>
4.	<ul style="list-style-type: none"> <li>• Mechanisms of disease production and Immunopathology</li> <li>• Virus-Host Interaction               <ul style="list-style-type: none"> <li>– Persistent viral infections</li> <li>– Latent, chronic and slow infections</li> </ul> </li> <li>• Assignment discussion 1</li> </ul>
5.	<ul style="list-style-type: none"> <li>• Mechanisms of viral oncogenesis               <ul style="list-style-type: none"> <li>– Oncogenesis by RNA viruses</li> <li>– Oncogenesis by DNA viruses</li> </ul> </li> <li>• Immunization against viral diseases               <ul style="list-style-type: none"> <li>– Live vaccines, inactivated vaccines, virus subunit vaccines, synthetic vaccines, DNA vaccines and other vaccines</li> </ul> </li> </ul>
6.	<ul style="list-style-type: none"> <li>• Chemotherapy of Viral Diseases</li> <li>• Epidemiology, Prevention and Control of Viral Diseases</li> </ul>
7.	<ul style="list-style-type: none"> <li>• Introduction: Overview of DNA and RNA viruses</li> <li>• Parvoviridae               <ul style="list-style-type: none"> <li>– Parvovirus B19</li> <li>– Other parvoviruses</li> </ul> </li> <li>• Papillomaviridae               <ul style="list-style-type: none"> <li>– Human papillomaviruses</li> </ul> </li> </ul>
8.	Assignment Discussion 2
9.	Adenoviridae: Human adenoviruses Polyomaviridae: Human polyomaviruses
10.	<ul style="list-style-type: none"> <li>• Herpesviridae</li> </ul>

	<ul style="list-style-type: none"> <li>– Herpes simplex viruses</li> <li>– Varicella-Zoster Virus</li> <li>– Cytomegalovirus</li> <li>– Epstein-Barr Virus</li> <li>– Other Human Herpesviruses</li> <li>• Hepatitis Viruses: Hepatitis A-E viruses</li> </ul>
11.	<ul style="list-style-type: none"> <li>• Picornaviridae</li> <li>• Rhinoviruses</li> <li>• Enteroviruses</li> <li>• Polioviruses</li> <li>• Other Enteroviruses</li> </ul>
12.	<ul style="list-style-type: none"> <li>• Orthomyxoviridae <ul style="list-style-type: none"> <li>– Influenza A and B viruses</li> <li>– Others</li> </ul> </li> <li>• Paramyxoviridae <ul style="list-style-type: none"> <li>– Paramyxovirus: Parainfluenza 1, 3</li> <li>– Rubulavirus: Mumps, Parainfluenza 2, 4</li> </ul> </li> </ul>
13.	<ul style="list-style-type: none"> <li>• Morbillivirus: Measles (Other Exanthematous Viral Infections will be discussed at this stage: Rubella, HHV6, Parvovirus B19)</li> <li>• Pneumovirus: Respiratory Syncytial Viruses</li> <li>• Reoviridae</li> <li>• Rotaviruses</li> <li>• Other diarrheal viruses</li> </ul>
14.	Journal Critique

## Section 6: Learning Resources

### Required Textbook

1. P.M. Howley & D.M. Knipe. (2021). Fields Virology. (8th Ed). Wolters Kluwer.
2. Patrick R. Murray, Ken S. Rosenthal & Michael A. Pfaller. (2021). Medical Microbiology. (9th Ed). Elsevier.
3. Stefan Riedel, Hobden JA, Carroll, Miller S, Morse SA, Mietzner TA, et al (2019). Jawetz, Melnick, & Adelberg's Medical Microbiology (28th Ed). McGraw-Hill.

### Recommended Textbook

2. Karen C. Carroll, Michael A. Pfaller, James A Karlowsky, Marie Louse Landry, et al (2023), Manual of Clinical Microbiology, (13th Ed). ASM Press

# **MMBI 7441: Medical Bacteriology**

Course Coordinator: Asst. Prof Dr. Hanan Hamimi Wahid

## **Section 1: Course Synopsis**

The course is intended to expose the students to the fundamental of bacteriology including classification, metabolism and growth, and bacterial genetics. The course emphasizes on the epidemiology, mechanisms of bacteria pathogen causing harms to human, the current approaches to diagnosis of infections and infection control in hospitals and healthcare. An overview on the principles management and treatments are also covered for each bacterial family, genus and species.

## **Section 2: Learning Outcome**

1. Describe, classify, compare and contrast the different species of bacteria, their virulence factors and pathogenicity.
2. Describe, compare and contrast the different diseases caused by different species of bacteria.
3. Evaluate the principles of antimicrobial drug actions and relate their mechanisms of resistance.
4. Appraise the current and latest bacteriology laboratory techniques in research.

## **Section 3: Teaching Format and Guidelines**

1. Lecture
2. Assignment
3. Journal Critique
4. Self-directed learning

## **Section 4: Course Assessment**

Assignment	20%
Journal Critique Presentation	20%
Examination	50%
Participation/Attendance	10%



## Section 5: Course Content

No.	Topic
1.	Introduction to the Course: Learning objectives; course format; evaluation, testing, and grading, policies; expectations; etc.
2.	<ul style="list-style-type: none"> <li>Bacterial Classification, Morphology &amp; Cell Structure: Medically important groups of microorganisms Classification (taxonomy) of bacteria Morphology (cell shapes, Gram stain)</li> <li>Ultrastructural features (cytoplasm, cell envelope, external features)</li> <li>Bacterial spores.</li> </ul>
3.	Bacterial Metabolism & Growth: <ul style="list-style-type: none"> <li>Nutrient requirements of bacteria</li> <li>Overview of metabolism</li> <li>Aerobic respiration</li> <li>Anaerobic respiration</li> <li>Fermentation</li> <li>Biosynthesis</li> <li>Bacterial growth</li> </ul>
4.	Bacterial Genetics iV I Basic Concepts & Gene Expression: <ul style="list-style-type: none"> <li>The bacterial genome (chromosome, extrachromosomal elements, bacteriophages)</li> <li>Gene organization (operons, cistrons)</li> <li>DNA replication (binary fission, replication rules &amp; fidelity)</li> <li>Polymerase chain reaction</li> </ul> <p>Assignment discussion 1</p>
5.	Bacterial Genetics iV II Genes, Maintenance & Exchange: <ul style="list-style-type: none"> <li>Mutation &amp; repair (types of mutations, mutagens, DNA repair processes)</li> <li>Gene transfer (transposons, extrachromosomal elements, mechanisms of DNA exchange, recombination, genetic engineering, etc.)</li> </ul> <p>Assignment discussion 2</p>
6.	Mechanisms of Bacterial Pathogenesis: <ul style="list-style-type: none"> <li>Entry into the human body</li> <li>Adhesion, colonization &amp; invasion</li> <li>Pathogenic actions of bacteria (tissue destruction, toxins, immunopathogenesis)</li> <li>Mechanisms for escaping host defenses</li> </ul>
7.	Antimicrobial Chemotherapy: <ul style="list-style-type: none"> <li>Mechanisms of action of antimicrobial drugs</li> <li>Selective toxicity and resistance to antimicrobial drugs including biofilm formation.</li> </ul>
8.	Assignment Discussion 3
9.	The Gram-Positive Cocci -I: <ul style="list-style-type: none"> <li><i>Staphylococcus aureus</i> (cutaneous infections, foodpoisoning, endocarditis, toxic shock syndrome, etc.)</li> <li><i>Staphylococcus epidermidis</i> (endocarditis, catheter &amp; shunt infections, etc.)</li> </ul>

	<ul style="list-style-type: none"> <li>• <i>Enterococcus</i> (urinary infections, septicemia, etc.).</li> </ul>
10.	<p>The Gram-Positive Cocci - II:</p> <ul style="list-style-type: none"> <li>• <i>Streptococcus pyogenes</i> (pharyngitis, impetigo, erysipelas, rheumatic fever, etc.)</li> <li>• <i>Streptococcus pneumoniae</i> (pneumococcal pneumonia, otitis media, sinusitis, meningitis, etc.)</li> <li>• <i>Streptococcus agalactiae</i> (neonatal diseases, other infections)</li> </ul>
11.	<p>The Gram-Positive Bacilli:</p> <ul style="list-style-type: none"> <li>• <i>Bacillus anthracis</i> (anthrax)</li> <li>• <i>Listeria monocytogenes</i> (neonatal diseases, etc.)</li> <li>• <i>Corynebacterium diphtheriae</i> (diphtheria)</li> <li>• <i>Clostridium perfringens</i> (gas gangrene, food poisoning, etc.)</li> <li>• <i>Clostridium tetani</i> (tetanus)</li> <li>• <i>Clostridium botulinum</i> (botulism)</li> <li>• <i>Clostridium difficile</i> (gastroenteritis).</li> </ul>
12.	<p>The Gram-Negative Cocci &amp; Facultative Anaerobic Bacilli:</p> <ul style="list-style-type: none"> <li>• <i>Neisseria gonorrhoeae</i> (gonorrhea, PID, etc.)</li> <li>• <i>Neisseria meningitidis</i> (meningitis, etc.)</li> </ul>
13.	<p>Anaerobes, Actinomyces &amp; Mycobacteria:</p> <ul style="list-style-type: none"> <li>• Actinomyces (endogenous infections)</li> <li>• Propionibacterium (acne)</li> <li>• Anaerobic Gram- negative bacilli (chronic sinusitis &amp; otitis brain abscesses, skin &amp; tissue infections, etc.)</li> <li>• Nocardia (pulmonary &amp; cutaneous infections)</li> <li>• Mycobacterium (tuberculosis, leprosy, etc.)</li> </ul>
14.	Journal Critique

## Section 6: Learning Resources

### Required Textbook

1. Patrick R. Murray, Ken S. Rosenthal & Michael A. Pfaller. (2021). Medical Microbiology. (9th Ed). Elsevier.
2. Stefan Riedel, Hobden JA, Carroll, Miller S, Morse SA, Mietzner TA, et al (2019). Jawetz, Melnick, & Adelberg's Medical Microbiology (28th Ed). McGraw-Hill.

### Recommended Textbook

1. Karen C. Carroll, Michael A. Pfaller, James A Karlowsky, Marie Louse Landry, et al (2023), Manual of Clinical Microbiology, (13th Ed). ASM Press