Course Title	**Microbiology and Virology**				
Course Code	**MED-302**				
Course Type	Required				
Level	Undergraduate				
Year / Semester	Year 3/ Semester 5 (Fall)				
Teacher's Name	**Course Lead:** Dr Ender Volkan **Contributors:** Prof Peter Karayiannis Dr Zoe-Dorothea Pana Dr Danny Alon-Ellenbogen				
ECTS	6	Lectures / week	3	Laboratories / week	1.5
Course Purpose and Objectives	This course aims to help students understand infectious diseases through the study of the general microbiology concepts of structure, growth and metabolism of microorganisms and viruses and their interrelationship with humans. The course also aims to train students in standard microbiology techniques utilized on a daily basis in laboratories. The main objectives of the course are to: • Make students aware of the appropriate terminology in the fields of studying microorganisms and viruses. • Differentiate between bacterial, viral, parasitic and fungal infections and to describe the mechanisms by which such microorganisms can cause disease. • Become familiar with infectious diseases and the pathogens that cause them. • Introduce the processes of infection of opportunistic and pathogenic microorganisms and the body's defence systems. • Present the basic principles for the prevention and control of infections by microorganisms. • Enable students to understand the mode of action of antibacterial, antiviral, antifungal and anti-parasitic drugs/compounds, and their use. • Become familiar with the use of vaccines, their production and limitations. • Enable students to make informed decisions on health and hygiene regarding infectious diseases. • Provide the opportunity to practise in microbiology laboratory techniques and to draw and report appropriate conclusions from the analysis of experimental data.				

Learning Outcomes	The following list provides the learning objectives that will be covered in the lectures, and tutorials of each week: **Week 1** ***Lobs covered during lectures:*** 1. Describe the purpose of microbe existence on earth. 2. Outline the role of normal flora and describe the relationship between microbes and humans. 3. Describe bacterial characteristics, structure and classification. 4. Describe the mechanisms of bacterial invasion of hosts and virulence factors. 5. Define various portals of entry and the routes of transmission of the infection. 6. Describe the metabolic processes of bacteria. 7. Outline the bacterial processes involved in replication and growth. 8. Describe the main mechanisms of immune response against infections. 9. Describe the basic aspects of vaccination. **Week 2** ***Lobs covered during lectures:*** 10. Describe the mechanisms of action and resistance of antimicrobials. 11. Describe the major methods of susceptibility testing and recognise the resistance phenotypes most frequently found in a clinical microbiology laboratory. 12. Define MIC and MBC. 13. Describe the characteristics, virulence factors and clinical syndromes caused by *Staphylococci*. 14. Define the characteristics, virulence factors and clinical syndromes caused by *Streptococci* and *Enterococci*. **Week 3** ***Lobs covered during lectures:*** 15. Define the characteristics, virulence factors and clinical syndromes caused by *E. coli, Salmonella/Shigella* and other *Enterobacteriaceae*. 16. Define the characteristics, virulence factors and clinical syndromes caused by *Pseudomonas aeruginosa* and *Acinetobacter baumanii*. 17. Describe the main characteristics of HCAI & the role of MDR microorganisms. 18. Describe the main characteristics & resistance mechanisms of MDR microorganisms.

19. Describe the main aspects of infection control & prevention of nosocomial infections.

Week 4

Lobs covered during lectures:

20. Describe the characteristics, pathogenesis & clinical manifestations of *T. pallidum*, including assessment of syphilis serology for diagnosis and follow-up of patients.
21. Describe epidemiology, clinical course and diagnosis of *Leptospira* and *Borrelia* infections.
22. Describe the characteristics, pathogenesis and clinical syndromes caused by the *Neisseriae.*
23. Describe the characteristics, pathogenesis and clinical syndromes caused by *Haemophilus influenzae/ H. ducrei/ Gardnerella/ Bordetella/ Moraxella/ Legionella*.
24. Describe the characteristics, pathogenesis and clinical syndromes caused by *Mycoplasmas* and *Chlamydiae*.

Week 5

Lobs covered during lectures:

25. Discuss the characteristics, pathogenesis and clinical syndromes caused by *C. tetani*, *C. botulinum* & *C. perfringens* and describe mechanism of action of their associated toxins.
26. Describe the characteristics, biology, virulence, pathogenicity, epidemiology of *Clostridium difficile* and outline the main principles of Infection Control.
27. Describe the characteristics, pathogenesis and clinical syndromes caused by *Vibrio*, *Aeromonas*, *Campylobacter*, and *Helicobacter*.
28. Describe clinical syndromes, epidemiology and diagnosis of infections caused by fastidious & other pleomorphic Gram-positive & Gram-negative
29. Describe characteristics and clinical syndromes caused by *Actinomyces.*
30. Define characteristics and clinical relevance of *Nocardia.*

Lob covered during lab practical:

31. Describe main resistance phenotypes in Gram (-) & Gram (+) isolates encountered in daily clinical practice and provide basic information on resistance mechanisms.
32. Briefly describe the medical approach of a patient with hospital acquired infection.

Formative Midterm Exam

Week 6

Lobs covered during lectures:

33. Describe viral structure, virion components, nucleic acid replication and different types of viral life cycles.
34. Explain the concept of viral tropism (infectivity).
35. Describe portals of entry into the body and define pathogenicity.
36. Explain acute, chronic and latent viral infection.
37. Explain the criteria for the classification of viruses and introduction of DNA virus families
38. Describe the symptoms and diseases caused by DNA viruses such as Herpes, Hepatitis B and Papilloma viruses.
39. Differentiate between the different hepatitis viruses and serological profiles.

Week 7

Lob covered during lab practical:

40. Outline the main steps and technical procedures for the isolation and identification of the causative agents in staphylococcal and streptococcal infections.
41. Explain the main laboratory techniques used to differentiate the species between them.

Lobs covered during lectures:

42. Describe the characteristics, pathogenesis and clinical syndromes caused by *Rickettsia, Orientia, Coxiella, Ehrlichia and Anaplasma*.
43. Describe the characteristics, pathogenesis and clinical syndromes caused by *Y. pestis, Bartonella* spp, *Pasteurella* spp & *Francisella*.
44. Describe the characteristics, pathogenesis and clinical syndromes caused by *Brucella, B. anthracis, E.rhusiopathiae, Streptobacillus & S. minus*.
45. Describe the characteristics, pathogenesis and clinical syndromes caused by *Listeria*, *Corynebacteria* and other *Bacillus* spp.

Week 8

Lobs covered during lectures and tutorials:

46. Explain the criteria for the classification of RNA viruses and introduction of RNA virus families.
47. Describe the symptoms and diseases caused by RNA viruses such as HIV, Rabies, flavi- and filoviruses.
48. Describe viral infection in childhood and recognise differences in rashes (exanthemata) produced.
49. Describe the characteristics, pathogenesis and clinical syndromes caused by *M. tuberculosis* and antibacterial treatment.
50. Discuss in detail the diagnostics of *M. tuberculosis*.
51. Describe the characteristics, pathogenesis and clinical syndromes caused by *M. leprae* and non-tuberculous Mycobacteria.

Lob covered during lab practical:

40. Outline the main steps and technical procedures for the isolation and identification of the causative agents in staphylococcal and streptococcal infections.
41. Explain the main laboratory techniques used to differentiate the species between them.

Week 9

Lobs covered during lectures:

52. Explain seasonality of flu viruses and the concept of genetic drift or shift.
53. Describe signs and symptoms of respiratory infections by myxo- and paramyxoviruses, rhino- and coronaviruses.
54. Describe the role of the immune system in the clearance or not of viral infections.
55. Describe different mechanisms of immune evasion by viruses.
56. Discuss different types of vaccines for both bacteria and viruses. Immunisation schedule.
57. Discuss mechanisms of action of antivirals and reasons for antiviral drug resistance.
58. Discuss use of antivirals depending on viral infection.

Lob covered during lab practical:

40. Outline the main steps and technical procedures for the isolation and identification of the causative agents in staphylococcal and streptococcal infections.
41. Explain the main laboratory techniques used to differentiate the species between them.

Week 10

Lobs covered during lectures:

60. Describe viral genetics and manipulation of their genomes for various purposes.
61. Define mycology and the importance of fungi in nature.
62. Describe the relationship of fungi to other organisms and their role in disease.
63. Describe fungal classification and taxonomic features.
64. Define fungal structure, antigenicity, pathogenicity and immune response.
65. Describe the morphological characteristics of yeasts, their reproduction and their medical importance.
66. Describe the morphological characteristics of moulds, their reproduction and their medical importance.
67. Define macroscopic and microscopic features of yeasts and moulds.
68. Perform differential diagnosis between yeasts and moulds and between the main species.
69. Describe mode of action of antifungals, route of administration and spectrum.

Week 11

Lobs covered during lectures:

69. Define phylogenetic classification of fungi and recognise representative genera causing fungal infections.
70. Define dimorphic fungi and dermatophytes and their role in fungal infections.
71. Describe the most important superficial and systemic mycoses and their laboratory diagnosis.
72. Describe route of transmission and major epidemiology of dimorphic fungi
73. Describe clinically significant predisposing factors for dimorphic fungi systemic infections.

Week 12

Lobs covered during lectures:

74. Describe the basic biology and life cycles of human parasites, human parasitic infections, including their epidemiology, clinical features, laboratory diagnosis, treatment and prevention.
75. Describe the ways by which parasites affect their hosts.
76. Clinical and pathological manifestations of the most important and prevalent parasitic infections.

	77. Describe mode of transmission for human parasitosis. 78. Describe most common clinical manifestations of most common human parasites. 79. Be able to make a differential diagnosis of some of the most important and prevalent parasitic infections. 80. Briefly describe major laboratory methods for diagnosis most important human parasitosis.		
Prerequisites	None	Required	None.
Course Content	***Bacteriology:*** • Introduction to Medical Microbiology. • Human Microbiome and the Relationship between host and microbes. • Microorganisms' classification, cell structure. • Mechanisms of Bacterial Pathogenesis and Routes of transmission. • Metabolic processes. • Replication and growth. • Immune Response to infections and vaccines. • Antibacterial agents: Classification, Activity Spectrum and Mechanisms of action. • Conventional laboratory techniques for AST (Antimicrobial Susceptibility Testing) in a routine clinical microbiology laboratory. MIC&MBC explanation. Resistance phenotypes most frequently found in clinical practice. • *Staphylococci.* • *Streptococci/ Enterococci.* • *Enterobacteriaceae* –Part I: *E. coli.* • *Enterobacteriaceae* –Part II: *Klebsiella, Proteus, Enterobacter, Salmonella, Shigella* and others. • Non-fermenting Gram-Negative Bacilli: *Pseudomonas, Acinetobacter.* • HCAI (Health Care Associated Infections). MDR (Multi-Drug-Resistance) microorganisms and their role in infections. • Spirochetes Part I: *Treponema pallidum* and syphilis, endemic treponematoses. • Spirochetes Part II: *Borrelia* & *Leptospira* • Miscellaneous Gram Negative and pleomorphic bacteria: *Haemophilus, Gardnerella, Bordetella, Moraxella, Legionella.* • *Neisseria meningitidis* and meningococcaemia. • *Neisseria gonorrhoeae* and gonorrhoea related species.		

- Miscellaneous gram negative and pleomorphic bacteria: *Haemophilus, Gardnerella, Bordetella, Moraxella, and Legionella*.
- Other pleomorphic bacteria: *Mycoplasmas* and *Chlamydiae.*
- *Clostridia* Part I. *Clostridium botulinum, Clostridium tetani, Clostridium perfringens.*
- *Clostridium difficile:* Characteristics, Biology, Virulence, Pathogenicity, and Epidemiology and Infection control, non-spore forming anaerobes: *Bacteroides, Fusobacterium* & others.
- Miscellaneous Gram positive & gram negative and other fastidious and pleomorphic bacteria Part I: Aerobic gram positive bacilli & branching filamentous bacilli, *Vibrio, Aeromonas, Campylobacter, Helicobacter.*
- Rickettsiae (*Rickettsiae, Orientia, Coxiella, Ehrlichia, Anaplasma*).
- Bacterial Zoonoses I (*Yersinia pestis, Bartonellosis, Pasteurella, Francisella*).
- Bacterial Zoonoses II (*Brucella, Bacillus anthracis, Erysipelothrix rhusiopathiae, Streptobacillus & Spirillum minus*).
- *Listeria*, *Corynebacteria*, *Bacillus* spp.
- *Mycobacterium tuberculosis* and related acid-fast bacteria.

Virology:

- Viral structure.
- Tropism and pathogenicity.
- Classification and DNA viruses.
- DNA viruses: Herpes/ Hepatitis B /Papilloma.
- Classification of RNA viruses.
- RNA viruses: HIV/Rabies/Flaviviruses/ Filoviruses.
- Childhood infections.
- Respiratory infections.
- Immune responses.
- Vaccines.
- Antivirals and resistance.
- Viruses of medical importance (tutorial).

Mycology:

- Introduction to Mycology and Fungi.
- Fungal classification, structure and pathogenicity.
- Yeasts.
- Moulds.

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Fungal infection.
Systemic mycoses by dimorphic fungi
Superficial Mycoses.

Parasitology:

Introduction to parasitology.
Intestinal and urogenital protozoa.
Blood and tissue flagellates.
Sporozoa.
Helminthes: Trematodes, Cestodes & Nematodes

<u>Lab practicals and Demonstrations:</u>

Antibiotic susceptibility testing. Major resistance phenotypes encountered in clinical practice - real life medical cases.
Laboratory diagnosis of Staphylococcal and Streptococcal infections: Microscopy, Culture, Biochemical characteristics and Identification. MIC and AST of Staphylococci and Streptococci.

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<tr><td>Teaching Methodology</td><td>Lectures, Tutorials, Laboratory Practical Sessions.</td></tr>
<tr><td>Bibliography</td><td>
Required Textbooks/Reading:
<table>
<tr><th>Authors</th><th>Title</th><th>Publisher</th><th>Year</th><th>ISBN</th></tr>
<tr><td>Patrick R. Murray & Ken S. Rosenthal & Michael A. Pfaller</td><td>Medical Microbiology (9^{th} Edition)</td><td>Elsevier</td><td>2020</td><td>9780323673228</td></tr>
</table>
Recommended Textbooks/Reading:
<table>
<tr><th>Title</th><th>Publisher</th><th>Year</th><th>ISBN</th></tr>
<tr><td>Step 1 Lecture Notes 2022 in Immunology & Microbiology.</td><td>Kaplan</td><td>2022</td><td>9781506272962
(for set of all topics)</td></tr>
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<tr><td>Assessment</td><td>Formative Midterm Exam and Summative Final Exam. The Summative Final Exam will contribute towards 100% of the course grade. Assessment is by Single Best Answer MCQs (SBAs) and there may also be some Short Answer Questions (SAQs).</td></tr>
<tr><td>Language</td><td>English</td></tr>
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