Clinical Microbiology and Immunology (Theory)

Total: 8hours /week
Lecture: 4 hours/week
Tutorial: 0 hour/week
Practical: 4 hours/week
Lab: 0 hours/week

Course Description
This course provides knowledge and skills on microbiology and immunology. It is designed to develop basic but comprehensive knowledge of common microorganisms, the diseases they cause, and the skills of laboratory procedures adopted in bacteriology, mycology, virology and Immunology.

Course Objectives
After the completion of this course the students will be enabled to:
- Explain historical background of medical microbiology and identify common bacteria.
- Classify the medically important fungi and identify the fungal culture media.
- Study about different viral diseases.
- Explain the defense mechanism including humoral and cell-mediated immunity.

Course Content

Part 1: Microbiology

Unit 1: General concept of Microbiology **5hrs**

- Introduction to Microbiology and microorganisms.
- Scope of Microbiology.
- Classification of microorganisms
- Units in department of Microbiology
- General biological characteristics of bacteria, viruses, protozoa and fungi.
- Brief history of Medical Microbiology:
    - Early years of microbiology in relation to theory of Spontaneous generation, and contribution of Antony van Leeuwenhoek
    - Golden age of microbiology in relation to Louis Pasteur and Robert Koch
    - Modern age of microbiology in relation to molecular biology

Unit 2: Bacteriology
Bacterial cell structure: **2hrs**

- External structures - Flagella, Fimbriae and Pili
- COVERING: Structure, Composition, and function of i) cell wall ii) cytoplasmic membrane iii) capsule
- Cytoplasm- nucleoid (chromosomal DNA and plasmid), inclusions, ribosomes, mesosomes

Unit 3: Morphological classification of bacteria. **2hrs**

- Cocci, Bacilli, Spirillum, Vibrio, Spirochaetes

Unit 4: Arrangements of bacteria **2hrs**

- Singles, Pairs, Clusters (including tetrads and sarcinae), Chains, Palisades, Chinese letter patterns

Unit 5: Bacterial Growth **2hrs**

- Bacterial generation time
- Bacterial growth requirements
- Bacterial growth curve

Unit 6: Staining **4hrs**

- Introduction, types
    - Simple stain
    - Differential stain
    - Negative stain
- Principle, requirements, procedure, result, clinical significance, reporting and precautions involved in following staining techniques-
    - Gram's stain
    - Ziehl-Nelsen's stain
    - Albert's stain
    - Capsule stain (India ink)

Unit 7: Normal bacterial flora of human body. **2hrs**

- Beneficial roles
- Harmful roles
- Examples of normal microbiota in different body sites

Unit 8: Sample collection for the diagnosis of bacterial infections **1hrs**

- Blood, CSF,Urine, Fluid,stool, Sputum, Pus, catheter tip

Unit 9: Media Preparation **10hrs**

- **Culture media**
    - Definition
    - Classification, based on
        - Consistency (solid, semisolid, liquid) including their advantages and limitations
        - Function
- **Simple or basal media**
- **Special media**
    - Enriched media
    - Enrichment media
    - Selective media

- Indicator media
- Differential media
- Transport media
- Anaerobic culture media

- **Bacterial culture techniques**
  - Definition of Inoculum and Colony
  - Streak, stroke, stab and law

Unit 10: Controlling microbial growth in the environment **10hrs**

- Definition, types, principle, advantages and limitations of sterilization
- Method of sterilization
  - Physical method
    - Sunlight
    - Heat
      - Dry heat (Red heat, Flaming, Hot air oven)
      - Moist heat
  - Filtration
  - Radiation
  - Chemical method (Phenol and phenolics, alcohols, halogens, oxidizing agents, heavy metals, aldehydes, gaseous agents)
- Difference between sterilization, disinfection and antisepsis
- Standard safety precautions
- Disposal of biological wastes

Unit 11: Controlling bacterial growth in the body **4hrs**

- Antibiotics- Definition
- Classification of antibiotics based on following modes of action
  - Inhibition of cell wall synthesis
  - Inhibition of protein synthesis
  - Disruption of cytoplasmic membrane
  - Inhibition of metabolic pathways
  - Inhibition of nucleic acid synthesis

Unit 12: Various methods for the identification of bacteria **4hrs**

- Phenotypic methods
  - Staining
  - Culture
  - Biochemical test
  - Serological test
- Genotypic method (Polymerase chain reaction-PCR)

Unit 13: Antimicrobial susceptibility testing by **4hrs**

- Disc diffusion methods
  - Stokes' method
  - Kirby-Bauer method
- Tube dilution method

- E-Test method

Unit 14: Quality control in microbiology laboratory **18hrs**

- **Biochemical test**
  - Indole test
  - Simmons Citrate test
  - Urease test
  - Catalase test
  - Oxidase test
  - Coagulase test
  - Triple sugar iron (TSI) test
  - Hanging drop preparation
  - SIM medium
- Bacterial culture
  - Aerobic culture
  - Microaerophilic/Capnophilic culture
  - Anaerobic culture

Unit 15: Morphology, cultural characteristics, disease caused & laboratory diagnosis, and antibiotics sensitivity of the following common bacteria from clinical samples, their preventive measures (in brief): **10hrs**

- Staphylococcus aureus
- Streptococcus pyogenes, and S. pneumoniae
- Hemophilus influenzae
- Neisseria meningitides, N. gonorrhoeae
- Mycobacterium tuberculosis
- Mycobacterium leprae
- Escherichia coli
- Klebsiella pneumoniae.
- Pseudomonas aeruginosa.
- Proteus spp.
- Treponema pallidum
- Salmonella spp.
- Shigella spp.
- Vibrio cholerae.

Part 2:

Unit 16: Mycology **15 hrs**

- Classification of medically important fungi based on their morphology.
- Common terminologies used in mycology (mycelium, hypha, conidiophore, conidia, pseudo hyphae, germ tube and mycoses).
- Brief description:
  - Candida albicans
  - Cryptococcus neoformans
- General classification of dermatophytes

- Collection techniques of various clinical samples for the diagnosis of fungal infection (Skin, Nail, Hair and Sputum sample).
- Laboratory diagnosis of fungal infection
  - KOH Mount
  - India ink preparation
  - Culture (SDA, DTM)
  - Germ tube test
  - Lactophenol Cotton Blue (LPCB) Mount

Part 3:

Unit 17: Virology **20 hrs.**

- Common terminologies used in virology (inclusion body, bacteriophage, paired sera, cytopathic effect and viral transport medium).
- Properties of viruses
- Structure and classification of viruses
- Replication of viruses
- List the common viral diseases**.**
  - Describe structure, mode of infection, pathogenicity and Laboratory diagnosis of HIV and viral hepatitis
- Introduction to basic laboratory procedure used in the diagnosis of viral diseases.
  - Viral Culture, Serological tests, Immunofluorescence, Electron microscopy

Part 4:

Unit 18: Immunology **24 hrs**

- Introduction (Immunity, antigen/ hapten, antibody, epitopes, adjuvants, Cells of immune system, MHC, Complement)
- Innate and acquired defense systems
- Primary and Secondary immune response
- Adaptive Immune System- Humoral and Cell mediated.
- Properties of Antigen-antibody reaction
- Classification of antigen antibody reactions
  - Agglutination
  - Precipitation
  - Neutralization
  - Complement Fixation
  - ELISA
- Introduction to Hypersensitivity reactions.

Unit19: Hospital acquired Infection **1hrs**

Unit20: Quality control in Microbiology **2hrs**

Reference Books

- District laboratory Manual for developing Countries (Volume I and II) - Monica Cheesbrough
- Practical Medical Microbiology,Mackie and McCortney
- Textbook of Microbiology, R. Anantnarayan & C.K.J. Panikar
- Diagnostic Medical Microbiology,Baily & Scoots
- Medical Microbiology Volume I & II,Robert Cruishank
- Review of Medical Microbiology, Jawetz et al
- Lynch's Medical Laboratory Technology, Stanley S Raphael, Igaku-Shoinl
- Quality Control in Clinical Laboratory, David Tonks
- Guide to Medical Laboratory Instruments, Cliffortd D Fervis

Final written exam marking scheme

Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total**
Unit Hours	5	2	2	2	2	2	2	1	10	10	4	4	4	18	10	15	20	24	1	2	140
Marks	3	1	1	1	1	1	1	1	6	6	2	2	2	10	6	8	12	14	1	1	80

Clinical Microbiology and Immunology(Practical)

Practical: 140hrs

Bacteriology

- Learn code of practice in clinical microbiology laboratory
- Use a light microscope and carry out its maintenance.
- Clean, decontaminate and sterilize glassware by using autoclave, hot air oven, direct flaming and chemical disinfectants.
- Prepare stains used in Gram's staining method and Ziehl Neelsen method. Perform above mentioned staining, report your findings and interpret.
- Prepare various culture media (nutrient broth, nutrient agar, blood agar, chocolate agar, MacConkey agar, cystine-lactose-electrolyte-deficient medium and Mueller Hinton agar).
- Prepare basic biochemical media (peptone water, Simmon's citrate, TSI agar, SIM medium and Christensen's urea agar).
- Demonstrate normal flora of human body by culturing skin swab or nasal swab.
- Process various clinical samples received in bacteriology lab.
- Perform antimicrobial susceptibility testing of isolated organism in pure form (disc diffusion method).
- Perform catalase, coagulase, oxidase, motility and common biochemical tests.
- Dispose of various contaminated materials.

Mycology

- Prepare 10% KOH solution and SDA medium.
- Perform skin/Nail, /hair-scraping, KOH preparation and inoculation in SDA.
- Perform India ink preparation.
- Perform germ tube test.
- Perform LPCB Mount.

Virology

- Demonstration of viral inclusion bodies.
- Perform serological tests based on immunochromatography technique for HIV, HBV & HCV infections.
- Demonstration of ELISA for the diagnosis of HIV infection.

Immunology

- Perform intradermal skin test (Mantoux test).
- Perform RPR , ASO titre, RA factor, CRP, Widal tests.