SHRI VISHWAKARMA SKILL UNIVERSITY

(Enacted by the Act 25 of 2016, State of Haryana)
DUDHOLA, PALWAL

M.Sc. MLT - Microbiology

Session: 2023-25

SCHEME

Semester-I

Category	Subject	Subject Code	Credit			Marks							Hours		
						Theory			Practical						
			T	P	To	I	E	To	I	E	To	To	T	P	To
General Education Component	Research Methodology & Biostatistics	23PMTH01	3	1	4	15	35	50	35	15	50	100	90	30	120
	Research Methodology & Biostatistics Lab	23PMTH02													
	Professional Communication	23PENG01	4	0	4	30	70	100	0	0	0	100	120	0	120
	GEC Total		**7**	**1**	**8**	**45**	**105**	**150**	**35**	**15**	**50**	**200**	**210**	**30**	**240**
Skill Education Component	Basic Medical Microbiology	23PMLT01	3	1	4	15	35	50	35	15	50	100	90	30	120
	Basic Medical Microbiology Lab	23PMLT02													
	Medical Laboratory Management	23PMLT03	3	1	4	15	35	50	35	15	50	100	90	30	120
	Medical Laboratory Management Lab	23PMLT04													
	Systematic Bacteriology	23PMLT05	3	1	4	15	35	50	35	15	50	100	90	30	120
	Systematic Bacteriology Lab	23PMLT06													
	SEC Total		**9**	**3**	**12**	**45**	**105**	**150**	**105**	**45**	**150**	**300**	**270**	**90**	**360**
Grand Total			**16**	**4**	**20**	**90**	**210**	**300**	**140**	**60**	**200**	**500**	**480**	**120**	**600**

Semester-II

Category	Subject	Subject Code	Credit			Marks							Hours		
						Theory			Practical						
			T	P	To	I	E	To	I	E	To	To	T	P	To
General Education Component	Microbial Genomics, Proteomics and Bioinformatics	23PMLT07	3	1	4	15	35	50	35	15	50	100	90	30	120
	Microbial Genomics, Proteomics and Bioinformatics Lab	23PMLT08													
	Molecular Biology	23PMLT09	3	1	4	15	35	50	35	15	50	100	90	30	120
	Molecular Biology Lab	23PMLT10													
	GEC Total		**6**	**2**	**8**	**30**	**70**	**100**	**70**	**30**	**100**	**200**	**180**	**60**	**240**
Skill Education Component	Applied Bacteriology-I	23PMLT11	3	1	4	15	35	50	35	15	50	100	90	30	120
	Applied Bacteriology-I Lab	23PMLT12													
	Immunology and Bacterial Serology	23PMLT13	3	1	4	15	35	50	35	15	50	100	90	30	120
	Immunology and Bacterial Serology Lab	23PMLT14													
	Medical Parasitology and Entomology	23PMLT15	3	1	4	15	35	50	35	15	50	100	90	30	120
	Medical Parasitology and Entomology Lab	23PMLT16													
	SEC Total		**9**	**3**	**12**	**45**	**105**	**150**	**105**	**45**	**150**	**300**	**270**	**90**	**360**
Grand Total			**15**	**5**	**20**	**75**	**175**	**250**	**175**	**75**	**250**	**500**	**450**	**150**	**600**

Semester-III															
Category	**Subject**	**Subject Code**	**Credit**			**Marks**							**Hours**		
						Theory			**Practical**			**To**			
			T	**P**	**To**	**I**	**E**	**To**	**I**	**E**	**To**		**T**	**P**	**To**
General Education Component	Advances in Medical Microbiology	23PMLT17	3	1	4	15	35	50	35	15	50	100	90	30	120
	Advances in Medical Microbiology Lab	23PMLT18													
	GEC Total		**3**	**1**	**4**	**15**	**35**	**50**	**35**	**15**	**50**	**100**	**90**	**30**	**120**
Skill Education Component	Applied Bacteriology-II	23PMLT19	3	1	4	15	35	50	35	15	50	100	90	30	120
	Applied Bacteriology-II Lab	23PMLT20													
	Medical Mycology	23PMLT21	3	1	4	15	35	50	35	15	50	100	90	30	120
	Medical Mycology Lab	23PMLT22													
	Medical Virology	23PMLT23	3	1	4	15	35	50	35	15	50	100	90	30	120
	Medical Virology Lab	23PMLT24													
	Medical Laboratory Posting	23PMLT25	0	4	4	0	0	0	70	30	100	100	-	120	120
	SEC Total		**9**	**7**	**16**	**45**	**105**	**150**	**175**	**75**	**250**	**400**	**270**	**210**	**600**
Grand Total			**12**	**8**	**20**	**60**	**140**	**200**	**210**	**90**	**300**	**500**	**450**	**150**	**600**

Category	**Subject**	**Subject Code**	**Credit**			**Marks**							**Hours**		
						Theory			**Practical**			**Total**			
			T	**P**	**To**	**I**	**E**	**To**	**I**	**E**	**To**		**T**	**P**	**To**
Skill Education Component	Dissertation/Project	23PMLT26	0	20	20	0	0	0	245	105	350	350	0	600	600
	SEC Total		**0**	**20**	**20**	**0**	**0**	**0**	**245**	**105**	**350**	**350**	**0**	**600**	**600**
Grand Total			**0**	**20**	**20**	**0**	**0**	**0**	**245**	**105**	**350**	**550**	**60**	**600**	**600**

SYLLABUS
SEMESTER – I

Subject: Research Methodology & Biostatistics
Subject Code: 23PMTH01

Objectives:

Research Methodology and mathematical principles are helpful in finding any trends or tendencies in a population with respect to any parameter or behavior. As disease not only affects individual but also the population as a whole and at some instances these mathematical deductions are helpful in having a manageable and meaningful approach in determining health and diagnosing and monitoring any disease.

Learning Outcomes:

At the end of the course student should be able to:

1. Understand the various research methods.
2. Understand the bio statistical parameter for evaluation of clinical data.
3. Differentiate between various data sets and perform comparisons.
4. Understand and apply the basic principles of quality assurance in a lab for any parameter by biostatistics.

Unit	Course Contents
I	Definition of research, Characteristics of research, Steps involved in research process, Types of Research methods and methodology, Research Design, Variables & Lifecycle of Research, Observational Studies: Descriptive, explanatory, and exploratory, Experimental Studies: Pre-test design, post-test design, Follow-up or longitudinal design, Cohort Studies, Case Control Studies, Cross sectional studies, Intervention studies, Panel Studies.
II	**Sampling Designs:** Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs (Probability sampling and non-probability sampling), How to Select a Random Sample?, Systematic sampling, Stratified sampling, Cluster sampling, Area sampling, Multi-stage sampling, Sampling with probability proportional to size, Sequential sampling.
III	**Methods of Data Collection:** Types of data, Collection of Primary Data, Observation Method, Interview Method, Collection of Primary Data, Technique of Developing Measurement Tools, Scaling Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Techniques.
IV	**Statistics, data, population, samples, parameters; Representation of Data:** Tabular, Graphical, Measures of central tendency, Arithmetic mean, mode, median; Measures of dispersion, Range, mean deviation, variation, standard deviation, Standard error, Chi- square test, Introduction to SPSS.
V	**Introduction and significance of Student's t-distribution:** Test for single mean, difference of means and paired t- test, F- distribution, one-way and two-way analysis of variance (ANOVA). Small sample test based on t-test, Z- test and F test; Confidence Interval; Distribution-free test.
VI	Introduction to Philosophy & Publications ethics: Definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions. Ethics with respect to science and research Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, Conflicts of interest, Publication misconduct.

Suggested Readings

1. Cooper, "Business Research Methods", Tata Mc Graw Hill, New Delhi.
2. Fowler, F. J. Survey Research Methods. New Delhi, Sage, 1993
3. Goode, W. Jand Hatt, P. K. Methods in Social Science Research. New Delhi, McGraw Hill,1986
4. Leddy, Paul. D Practical Research: Planning Design. London, Clive Bingley. 1980

Subject: Research Methodology & Biostatistics Lab
Subject Code: 23PMTH02

Objectives:
Research Methodology and mathematical principles are helpful in finding any trends or tendencies in a population with respect to any parameter or behavior. As disease not only affects individual but also the population as a whole and at some instances these mathematical deductions are helpful in having a manageable and meaningful approach in determining health and diagnosing and monitoring any disease.

Learning Outcomes:
At the end of the course student should be able to:

1. Able to perform the various research methods.
2. Able to learn the bio statistical parameter for evaluation of clinical data.
3. How to apply various bio statistical software and tools.

List of Practical:

1. Uses of LATEX
2. Uses of MS Excel/MSWord/MS Power Point
3. Uses of R Software
4. Uses of SPSS
5. Uses of Web Technology
6. Uses of ANOVA
7. Uses of Plagiarism software
8. Uses of t-test, Z- test and F test

Subject: Professional Communication
Subject Code: 23PENG01

Objectives: The aim of the course is to develop skills and competencies in participants to be able to communicate effectively through written, oral and social medium. This course will make students conversant with the basic forms, formats and techniques of business writing so that they would be thoroughly prepared to communicate effectively in all contexts. Sensitivity towards cross-cultural communication will be developed with familiarity with global business etiquette and protocols. The pedagogical focus of the course will be lecture cum workshop based format with emphasis on practice and skills development.

Learning Outcomes:

1. Able to understanding the role of communication in the organizational and Global Context
2. Able to understanding the basics of effective written and verbal communication
3. Able to understanding the theoretical models of communication and development in communication research
4. Analyzing one's own communication style in different contexts and mediums
5. Exposure and training of technical writing, responsibilities of a communicator, Ethical Issues and Legal Issues

Unit	Course Contents
I	**Concepts of Communication in Business**: Introduction to Business Communication, Components of Communication (7Cs), Listening Skills, Verbal and Non-Verbal Skills and Presentation Skills., Legal issues in Communication
II	**Formal Communication**: Planning and executing different types of messages, writing reports, proposals and Business plans, Improving personal writing skills
III	**Interpersonal Communication Skills**: Communicating in teams, Negotiation Skills, Communication skills during a conflict, Mentoring and Appraisals, Communication in Social Media and Digital Communication
IV	**Cross Cultural Communication**: Theoretical Framework of Cross-Cultural Communication, Communication across cultures through different mediums, Business Etiquettes across cultures
V	**Communication for career**: Resume writing and cover letters, Group Discussions and Interviews, Communication during Exit Interviews, Ethics and Communication

Note: Faculty members are requested; please include in lecture patient communication, building rapport and how to communicate with patient and physician.

Suggested Readings:

- Lehman, C. M., Dufrene D. D.,&Sinha, M. BCOM: The South Asian Perspective on Business Communication(latest ed.). New Delhi: CengageLearning.
- Murphy, H. A., Hildebrandt, H.W.,& Thomas, J.P. Effective Business Communication (latest ed.). Boston: McGraw-HillCompanies.
- Bovee, C., & Thill, J.V., & Raina, R.L. Business Communication Today (latest ed.). Pearson.
- Mukerjee, H. S. Business Communication (latest ed.). New-Delhi: Oxford University Press
- Post Emily. The Etiquette Advantage in Business (latest ed.). New York: Collins.
- Sandra, M. O. Handbook of Corporate Communication and Strategic Public Relations: Pure and Applied. Routledge.

Subject: Basic Medical Microbiology
Subject Code: 23PMLT01

Objectives:

Course is designed to impart knowledge and skills required to learn various aspects and concepts about Microbiology, the related disorders and diseases.

Learning Outcomes:

1. Able to recognize various culture media, its preparation method and uses.
2. Understanding of concepts of culturing methods.
3. Able to understand principle, perform and interpret various biochemical tests.
4. Able to differentiate various microorganisms.

Unit	Course Content
I	**Organization of clinical microbiology laboratory** Introduction, Clinical microbiology laboratory set-up, Laboratory management, Laboratory safety, First aid measures, Waste management
II	**Introduction and history of microbiology** Discovery of microorganisms, Contributions of Robert Koch, Antony Van Leeuwenhoek, Louis Pasteur, Bordet, Paul Ehrlich, Alexander Fleming, Elie Metchnikoff, John Needham, JohnTyndall, Joseph Listerand Karls Landsteiner, Scope of medical microbiology
III	**Equipment's and other tools of medical microbiology** Types and uses of microscopes-Bright field microscope, dark field microscope, Phase-Contrast microscope, Fluorescence microscope, Electronmicroscope (SEM and TEM) Principle, uses, care and maintenance of equipment Biosafety cabinet, Laminar airflow, Balances,Hotplateandmagneticstirrer,centrifuge,hotairoven,autoclave, incubator, spectrophotometer, **pH** meter, water distillation plant
IV	**Classification of microorganisms** Introduction to classification, morphological classification, classification based on oxygen requirement, nutritional requirement, pH requirements, Gram's Positive and Gram's negative bacteria **Microbial growth:** Bacterial growthcurve, Batchculture, fedbatchculture, continuous culture, Factors influencing microbial growth, Microbial metabolism and energy production.
V	**Interactions between human and microbes** Introduction, Defense of the body, Acute reaction to infection, Markers of cytokines response, complement system, pathogenic properties of bacteria, Virulence factors, Safety measures used in microbiology laboratory

Suggested Readings:

1. Practical Medical Microbiology by Mackieand McCartney
2. Microbiology for Medical Sciences by Bhagat Singh & Renu Singh
3. Textbook of Microbiology by Anantha Narayan
4. Medical Microbiology by Panikar & Satish Gupte
5. Medical Laboratory Technology vol. I, II, III by Mukherjee
6. District Laboratory Practice in tropical countries Vol II Microbiology by Monica Cheese Rough
7. Textbook of Microbiology Prescott

Subject: Basic Medical Microbiology Lab
Subject Code: 23PMLT02

Objectives: Course is designed to impart knowledge and skills required to learn various aspects and concepts about Microbiology, the related disorders and diseases.

Learning Outcomes:

1. Able to preparation, recognize and identification of various culture media.
2. To perform the staining procedure for the identification of organism.
3. Able to perform interpretation of various biochemical tests for differentiate organism.

List of Practical's:

1. Identification of different types of culture media
2. To perform AFB stain for diagnosis of respiratory disease
3. Preparation of stains and staining procedures
4. Methods for isolation of pure culture
5. Preservation of stock culture
6. Biochemical tests for identification of bacteria
7. Microscopic examination of bacterial isolates
8. To perform gram staining for differentiate of bacteria
9. Procedure to perform antibiotic sensitivity test
10. To study principle and working maintenance of microbiology equipments

Subject: Medical Laboratory Management
Subject Code: 23PMLT03

Objectives:

Producing error free report is the essence of Laboratory testing. This forms the study of quality assurance. Herein the attributes which are required to be checked for identifying an error are studied in required detail. Quantification of possible error and the extent to which a test can reflect the true status of the patient is known by studying confidence levels.

Learning Outcomes:

1. Understand the concept of quality care in Laboratories.
2. Be aware about Quality Assurance
3. Understand the ISO 15198 requirements for Laboratory accreditation
4. Know the procedure involved in the quality improvement of Laboratory.
5. Work on documentation of lab manuals and results.
6. Use different controls in laboratory procedures.

Unit	Course Contents
I	**Introduction about medical microbiology lab:** Introduction, Elements of the service, Guidance to users, Delivery of specimens, Request forms, Reception of specimens, Safety in the reception area, Work sections of the laboratory, Choice of tests, Reading of results, Wording of reports, Issue of reports, Computerization of reports, The laboratory manual, Training and Safety precautions in medical microbiology laboratory.
II	**Quality Assurance**: Introduction about quality control, Quality control of materials, Internal quality Assessment and External quality assessment, Laboratory audit, Duties of the QC officer.
III	**Laboratory design** Designing laboratories for different types and sizes of institutions: selection of equipment and systems for the laboratory, concepts of workstation consolidation, workflow analysis, concepts in laboratory automation (sample transportation systems, modular systems, robotics). **Safety in Microbiology Laboratory** Fire, chemical, radiation and infection control, hazardous waste and transport of hazardous materials
IV	**Training of technical staff** Familiarity of various training programs; knowledge of the teaching requirements and level of knowledge technical staff; understanding of qualifications of technologists trained in other countries. **Maintenance of records** Procedure manuals, work instructions, patient data retrieval
V	**Hospital organization** Interactions between the laboratory service and the rest of the hospital **Disposal of Laboratory/Hospital Waste** Definition, classification of laboratory/hospital waste, methods of laboratory/hospital waste disposal (Non-infectious waste, Infectious waste disposal, etc.)

Suggested Readings

1. Medical Laboratories Management- Cost effective methods by Sangeeta Sharma,Rachna Agarwal ,Sujata Chaturved I and Rajiv Thakur
2. Practical Medical Microbiology by Mackieand Mc Cartney
3. Microbiology for Medical Sciences by Bhagat Singh & Renu Singh Medical Laboratory Technology vol. I, II, III by Mukherjee

Subject: Medical Laboratory Management Lab
Subject Code: 23PMLT04

Objectives:

Producing error free report is the essence of Laboratory testing. This forms the study of quality assurance. Herein the attributes which are required to be checked for identifying an error are studied in required detail. Quantification of possible error and the extent to which a test can reflect the true status of the patient is known by studying confidence levels.

Learning Outcomes:

1. To learn about quality care in Microbiology Laboratories.
2. To know about Quality Assurance
3. To know and how to implement the ISO 15198 in Medical Laboratory for accreditation.
4. Able to perform the procedure involved in the quality improvement of Laboratory.
5. Preparation and maintain the documentation such as standard operating procedure, lab formats and lab manuals.

List of Practicals:

1. Preparation of lab design for medical
2. To study safety measures used in medical microbiology lab
3. Isolation and identification of microbes from hospital wards and OPD
4. Methods for disposal of infectious laboratory waste
5. To prepare request form of microbiology specimen
6. To prepare report for microbiology
7. Computerization of report for microbiology
8. Preservation of stock culture
9. Demonstration of waste bin and waste discard policy
10. Demonstration of internal audit in microbiology lab

Subject: Systemic Bacteriology
Subject Code: 23PMLT05

Objectives:

Bacteriology is the study of bacteria (microbes) and immunology is the study of interaction between microbes and humans. The knowledge of microbes and their interaction is essential for students to understand diseases as well as to learn to avoid it. Accordingly, this course aims to cover the fundamental aspects of diagnosing, treating and monitoring microbial diseases.

Learning Outcomes:

At the end of the course student should be able to:

1. Describe the various types of sterilization.
2. Describe the characteristics of bacterial cell wall and its appendages like capsule, fimbriae, Pilli etc.,
3. Perform various process - different staining methods & inoculation of culture media
4. Identify medically important bacteria via morphological and cultural characteristics and perform various biochemical tests
5. Perform antibiotic microbial susceptibility testing and interpret the same.

Unit	Course Content
I	Biosafety in clinical microbiology laboratory including universal containment, personal protective equipment for biological agent, Isolation precautions including standard precautions and transmission-based precautions
II	Principles and methods of sterilization physical and chemical methods, pasteurization, disinfection, factors affecting effectiveness of disinfectant, preservation of microorganisms and lyophilization
III	Gram-positive cocci of medical importance including Staphylococcus, Streptococcus, Micrococcus, anaerobic cocci etc. Gram-negative cocci medical importance including Neisseria meningitidis, Neisseria gonorrhoeae, Moraxella etc. Gram-positive bacilli of medical importance including Lactobacillus, Corynebacterium, Bacillus, Clostridium, Listeria, Actinomyces and Nocardia etc
IV	Gram-positive bacilli of medical importance including Lactobacillus, Corynebacterium, Bacillus, Clostridium, Listeria, Actinomyces and Nocardia etc
V	Gram-negative enteric bacilli of medical importance including Escherichia coli, Klebsiella pneumoniae, Salmonella, Proteus, Shigella, Vibrio cholerae, Campy loba cter etc.Gram negative non-entericbacilli of medical importance including Brucella, Bordetella, Francisella, Haemophilus, Pseudomonas, Legionella and Yersinia

Suggested Readings

1. Practical Medical Microbiology Mackie and McCartney
2. Microbiology for Medical Sciences by Bhagat Singh & Renu Singh
3. Textbook Microbiology by Anantha Narayan
4. Medica Microbiolofeb, anikar &Satish Gupte .
5. Medical Laboratory ecology vol.I,II,Ill by Mukherjee
6. District Laboratory Practice in tropical countries VolII Microbiology by Monica Chees brough
7. Textbook of Microbiology by PrescottElementsofMedicalMicrobiology,4thed, Rajesh Bhatia and Rattan Lal Ichhpujani.

Subject: Systematic Bacteriology Lab
Subject Code: 23PMLT06

Objectives:

Bacteriology is the study of bacteria (microbes) and immunology is the study of interaction between microbes and humans. The knowledge of microbes and their interaction is essential for students to understand diseases as well as to learn to avoid it. Accordingly, this course aims to cover the fundamental aspects of diagnosing, treating and monitoring microbial diseases.

Learning Outcomes:

At the end of the course student should be able to:

1. Able to perform various types of sterilization methods.
2. Describe the characteristics of bacterial cell wall and its appendages like capsule, fimbriae, Pilli etc.,
3. Perform various process - different staining methods & inoculation of culture media
4. Identify medically important bacteria via morphological and cultural characteristics and perform various biochemical tests
5. Perform antibiotic microbial susceptibility testing and interpret the same.

List of Practicals:

1. Universal containers and swabs used in medical microbiology
2. Preparation of blood agar for bacteria
3. Preparation of selective culture media for bacteria
4. Isolation and identification of E. coli from clinical specimen
5. Isolation and identification of Salmonella from clinical specimen
6. Isolation and identification of Klebsiella from clinical specimen
7. Isolation and identification of Shigella from clinical specimen
8. Isolation and identification of Streptococci and Staphylococcus aureus from clinical specimen
9. Study of bacterial growth curve
10. To perform antibiotic sensitivity test for bacteria using antibiotic disc diffusion method

Subject: Microbial Genomics, Proteomics and Bioinformatics
Subject Code: 23PMLT07

Objective:

With the completion of the course, the students will acquire detailed knowledge of different advances in the field of genomics, proteomics and transcriptomic using bioinformatics and computation biology tools.

Learning Outcomes:

Upon successful completion of the course, the student:

1. Will get a comprehensive understanding of different fields of computational biology and bioinformatics
2. Will develop understanding of recent advances, techniques and applications in the field of genomics, transcriptomic and proteomics
3. Will be able to have application based understanding of different bioinfom1atics databases and software's.

Unit	Course Content
I	Introduction to Bioinformatics and OMICS; Biological databases; Annotated sequence databases- primary sequence databases, protein sequence and structure databases; Organism specific databases; Current Status of microbial genomics, Metagenomics; NGS and recent Sequencing methodology.
II	Structural Genomics: Characteristics features of prokaryotic and eukaryotic genomes- repeat sequences etc. Genome sequence comparison, alignment and data base searching. Gene Bank-NCBI, EMBL & DDBJ-retrieving sequences, ENTREZ. Sequence analysis software :BLAST, RNAstructureprediction,Rest1ictionenzymepatterns
III	Functional Genomics and transcriptomics: Gene annotation and function prediction. High throughput Screening methodologies, Microarrays; Multiparameter footprint analysis.
IV	Proteomics: Basics of mass spectrometry. Maldi TOF and ESI, and their application in proteomics. Peptide sequencing by tandem mass spectrometry, Affinity purification of protein. Protein Structural databases; Protein structure prediction: homology and ab initio methods.
V	Comparative genomics: Tools used for phylogenetic analysis -Ribosomal Database Project, FASTA, BLAST, CLUSTAL, MEGA etc. Recent advances in genomics and proteomics. Application of microbial genomics and proteomics. IPR in genomics and proteomics

Suggested Readings:

1. Bioinformatics-A Practical Guide to the Analysis of Genes and Proteins.2nd Edition by Baxevanis.
2. Functional Genomics. A Practical Approach Edited by Stephen PHuntandRickLiveey(OUP)2000.
3. Introduction to Bioinformatics. A Lesk.
4. Bioinformatics: Sequence and Genome Analyis. David Mount. CSHL Press

Subject: Microbial Genomics, Proteomics and Bioinformatics Lab
Subject Code: 23PMLT08

Objectives:

With the completion of the course, the students will acquire detailed knowledge of different advances in the field of genomics, proteomics and transcriptomics using bioinformatics and computation biology tools.

Learning Outcomes:

Upon successful completion of the course the student:

1. Will get a comprehensive understanding of different fields of computational biology and bioinformatics
2. Will develop understanding of recent advances, techniques and applications in the field of genomics, transcriptomic and proteomics
3. Will be able to have application based understanding of different bioinfom1atics databases and softwares.

List of Practicals:

1. Introduction to literature database at NCBI and querying the Pubmed central database using the ENTREZ search engine.
2. Analysis of protein sequence from protein database
3. Analysis of gene sequence from gene database
4. Analysis of Sequence by BLAST
5. Analysis of Sequences by CLUSTAL and FASTA
6. Demonstration of NGS Techniques
7. Demonstration of Microarrays techniques
8. Demonstration of Maldi Tof Techniques
9. Protein isolation, estimation and preservation
10. Extraction of genomic DNA

Suggested Readings:

1. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition by Baxevanis.
2. Functional Genomics. A Practical Approach Edited by Stephen P Hunt and Rick Liveey (OUP) 2000.
3. Introduction to Bioinformatics. A Lesk.
4. Bioinformatics: Sequence and Genome Analyis. David Mount. CSHL Press

Subject: Molecular Biology
Subject Code: 23PMLT09

Objectives:
This course is aimed at introducing the students to the various types of advanced molecular tests and developing expertise in the students to handle advanced instruments used in molecular laboratories. The Advanced Diagnostic Technology part included in the course aims at exposing the students to the latest advancements in genetic investigations. Also, in this section students will be made aware of terminology used in molecular biology and get to know about the various instruments and their maintenance and also learn the processing of various samples for Molecular investigations.

Learning Outcomes:
At the end of the student will be able to:

1. Understand the various parts of PCR machine.
2. Understand the procedure involved in Molecular Biology & methods
3. Understand the procedure involved in the study of infertility techniques.
4. Understand the procedure of DNA technology
5. Understand the various bioinformatics tools.

Unit	Course Content
I	**Gene: Structure, replication, and expression** DNA as a genetic material, flow of genetic information, structure and replication of DNA, replication origin ,structure of gene, transcription, translation, genetic code, Chromosomes- structure, number, sex chromosomes, human karyotype, methods for chromosome analysis - chromosome banding, CGH, cell cycle,
II	**RNA synthesis and processing** - transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport, transcriptional inhibitors
II	**Protein synthesis and processing** - Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins, Protein trafficking
III	**Molecular Techniques :**Essentials of Gene cloning Clone: meaning, Overview of the procedure, Gene library, Hybridization, Importance of DNA Cloning, Principles of Cell-based DNA Cloning and cell independent DNA cloning Isolation, identification and manipulation of genes **Purification and Separation of nucleic acids** – Extraction and Purification of nucleic acids, Detection and Quantitation of Nucleic acids, Gel Electrophoresis.
IV	**Modification of nucleic acids**- Cutting and Joining DNA – Restriction Endonucleases, Ligation, Alkaline Phosphate, Double Digest, Modification of Restriction Fragments ends, Other Ways of joining DNA Molecules, ligation independent gene cloning, methylases, DNA polymerases, Nucleases, T4 polynucleotide kinases. **Amplifying DNA** : Primer design, PCR: basic features and application, types – standard, hot start PCR, touch-down PCR, Nested PCR, RT-PCR, Real time PCR, overlap PCR, Multiplex PCR & others
V	**Nucleic Acid Hybridization to detect genes** - Principle and application - Preparation of nucleic probes, Principle of Nucleic acid hybridization, Nucleic acid hybridization assays – clone detection, southern, Northern hybridization ,gene diagnosis, Sequencing and types, recombinant DNA technology.

Suggested readings:

1. Concepts of Genetics, 12th Edition – Pearson
2. Clinical Chemistry, Teitz
3. Fundamentals of Bioinformatics byHarisha S.
4. Molecular Biology by David Clark
5. Molecular Biology by N Arumugam

Subject: Molecular Biology Lab
Subject Code: 23PMLT10

Objectives:

This course is aimed at introducing the students to the various types of advanced molecular tests and developing expertise in the students to handle advanced instruments used in molecular laboratories. The Advanced Diagnostic Technology part included in the course aims at exposing the students to the latest advancements in genetic investigations. Also, in this section students will be made aware of terminology used in molecular biology and get to know about the various instruments and their maintenance and also learn the processing of various samples for Molecular investigations.

Learning Outcomes:

At the end of the student will be able to:

2. Demonstration of PCR and know about the various parts of PCR machine.
3. To demonstrate various Molecular Biology techniques
4. Isolation of nucleic acid from different types of human specimen.
5. To demonstrate the various bioinformatics tools.
6. Demonstration of PCR for mycobacterium tuberculosis and different RNA viruses.

List of Practical's:

1. Methods for extraction of genetic material from blood/tissue.
2. Principal and use of polymerase chain reaction (PCR)
3. Principal and use of reverse transcriptase polymerase chain reaction (RT-PCR)
4. Amplification of DNA through PCR
5. Separation of DNA by Agarose gel electrophoresis
6. To demonstration of karyotyping technique
7. To demonstration Hybridization of DNA
8. To perform Extraction of viral RNA
9. Use of RT-PCR for detection of viral RNA
10. To perform of PCR for detection of pathogen

Subject: Applied Bacteriology-I
Subject Code: 23PMLT11

Objectives:

Bacteriology is the study of bacteria (microbes) and immunology is the study of interaction between microbes and humans. The knowledge of microbes and their interaction is essential for students to understand diseases as well as to learn to avoid it. Accordingly, this course aims to cover the fundamental aspects of diagnosing, treating and monitoring microbial diseases.

Learning Outcomes:
At the end of the course student should be able to:

1. Describe the parts of microscope and demonstrate organisms under a microscope
2. Describe the characteristics of bacterial cell wall and its appendages like capsule, fimbriae, Pilli etc.,
3. Perform various process - different staining methods & inoculation of culture media
4. Identify medically important bacteria via morphological and cultural characteristics and perform various biochemical tests
5. Perform antibiotic microbial susceptibility testing and interpret the same.

Unit	Course Content
I	**Applied bacteriology:**Introduction, recent advances in bacteriology, Collection and transport of specimen for microbiology, Different techniques for isolation and identification of bacteria, PCR, electrophoresis etc.
II	Recent techniques used for isolation and identification of pathogens from Clinical specimen, air, water and food, rapidbiochemical test detection kits, pathogen detection based on lateral flow assay.
III	Infections caused by Mycobacterium tuberculosis and Mycobacterium leprae,rapid method for detection of Mycobacterium, Infections caused by Rickettsia Infections caused by Chlamydia, hospital acquired infection (HAI)
IV	Bacterial metabolism, Introduction, production of bacterial enzymes, toxins antimicrobials and bacteriocins and other virulence factors, Antibiotic sensitivity test for bacteria.
V	Antimicrobial agents, types and classification, mechanisms of drug resistance, Microbial genetics and bacteriophages Molecular genetics relevant to medical microbiology

Suggested readings

1 . Practical Medical Microbiology by Macldeand McCartney
2. Microbiology for Medical Sciences by Bhagat Singh &Renu Sinet
3. Text book Microbiology by Ananthanarayan
4. Medical Microbiology: Anikar & Satish Gupte
5. Medical Laboratory vol. I, II, III by Mukherjee
6. Textbook of Microbiology by rescott
7. ElementsofMedicalMicrobiology,4th ed, Rajesh Bhatia and Rattan Lalichhpujani

Subject: Applied Bacteriology-I Lab
Subject Code: 23PMLT12

Objectives:

Bacteriology is the study of bacteria (microbes) and immunology is the study of interaction between microbes and humans. The knowledge of microbes and their interaction is essential for students to understand diseases as well as to learn to avoid it. Accordingly, this course aims to cover the fundamental aspects of diagnosing, treating and monitoring microbial diseases.

Learning Outcomes:

At the end of the course student should be able to:

1. To demonstrate the parts of microscope and demonstrate organisms under a microscope
2. Describe the characteristics of bacterial cell wall and its appendages like capsule, fimbriae, Pilli etc.,
3. TO Perform various process - different staining methods & inoculation of culture media
4. To Identify medically important bacteria via morphological and cultural characteristics and perform various biochemical tests
5. To Perform antibiotic microbial susceptibility testing and interpret the same.

List of Practicals:

1. Methods for isolation of pure culture of bacteria
2. Different containers used for collection of specimens for microbiology tests
3. Preparation of selective culture media for isolation of Bacteria
4. Preparation of differential culture media for isolation of Bacteria
5. Different biochemical tests for identification of bacteria
6. Isolation and identification of bacillus from clinical specimen
7. Isolation and identification of Proteus from clinical Specimen
8. Cultivation of anaerobic bacteria
9. To demonstrate automated antimicrobial susceptibility test
10. Isolation of microorganism form air, milk and water

Suggested readings

1 . Practical Medical Microbiology by Maclde and McCartney
2. Microbiology for Medical Sciences by Bhagat Singh & Renu Sinet
3. Text book Microbiology by Anantha narayan
4. Medical Microbiology : anikar & Satish Gupte
5. Medical laboratoryvol.I ,II, III by Mukherjee
6. Textbook of Microbiology byrescott
7. ElementsofMedicalMicrobiology,4th ed,RajeshBhatia and Rattan Lalichhpujani

Subject: Immunology and Bacterial Serology
Subject Code: 23PMLT13

Objectives:

This course has been formulated to impart basic aspects of immunity, antigens, antibodies, various serological reactions, techniques and their utility in laboratory diagnosis of human diseases.

Learning Outcomes:

1. The students will learn scientific approaches/techniques that are used to investigate various diseases.
2. Provides an understanding of which techniques are used to diagnosis the disease in immunology and serology
3. Explains the basic principles of immunology and serology, their application in the diagnosis of diseases

Unit	Course Content
I	**Introduction and scope of immunity** Antigens Definition, properties and types of antigen, Factors influencing immunogenicity, Chemical nature of immunogens, T-Independent antigens and T-Dependent antigens, Hapten-carrier conjugates, Antigenic determinants, Determinants recognized by B-cells, T- cells and superantigens
II	**Immunoglobulins/antibodies** Properties and structure of antibodies/immunoglobulins, Electrophoretic mobility, Types of Immunoglobulins, Immunoglobulin-G (IgG), Types of Light Chains and Subclasses of IgG, Immunoglobulin-M (IgM), Immunoglobulin-A (lgA), Immunoglobulin D (lgD), Immunoglobulin E(IgE)
III	**Types of Immunity**-Cell mediated (innate /non-specific) immunity, Anatomical barriers to infections, Mechanical barriers, chemical barriers and biological barriers Humoral barriers to infections Complement system, Coagulation system, Lactoferrin and transferring, Interferons, Lysozyme and Interleukin-I Cellular barriers to infections Neutrophils, Macrophages, Natural killer (NK) cells and Eosinophils
IV	**Acquired (specific/ humoral) immunity** Primary and secondary responses, Fate of antigen in tissues, Production of antibodies, B-cell biology, B-cell activation, T-dependent antigen triggering, T-independent antigen triggering Hypersensitivity reactions and its types Vaccines and immune therapy
V	**Antigen-antibody reactions-** Agglutination: Qualitative agglutination test, Quantitative agglutination test, Applications of agglutination tests **Hemagglutination test:** Coomb's Test (Antiglobulin Test), Direct Coomb's Test, Indirect Coomb's Test Hemagglutination Inhibition Precipitation: Radial Immunodiffusion, Immunoelectrophoresis, Countercurrent electrophoresis Enzyme linked immunosorbent assay (ELISA) direct and indirect Radioimmunoassay (RIA), chemiluminescent immunoassay (CLIA), Fluorescenceimmunoassay (FIA)

Suggestions Readings

1. Practical Medical Microbiology by Mackie and McCartney
2. Microbiology for Medical Sciences by Bhagat Singh &Renu Singh
3. Textbook of Microbiology by Anantha Narayan
4. Medical Microbiology by Panikar & Satish Gupte
5. Medical laboratory Technology vol. I, Il, III by Mukherjee
6. District Laboratory Practice in tropical countries Vol II Microbiology by Monica Chees brough
7. Textbook of Microbiology by Prescott

Subject: Immunology and Bacterial Serology Lab
Subject Code: 23PMLT14

Objectives

This course has been formulated to impart basic aspects of immunity, antigens, antibodies, various serological reactions, techniques and their utility in laboratory diagnosis of human diseases.

Learning Outcomes

1. The students will learn scientific approaches/techniques that are used to investigate variousdiseases.
2. To perform techniques are used to diagnosis the disease in immunology and serology
3. Able to explain the basic principles of immunology and serology, their application in the diagnosis of diseases.

List of Practicals:

1. Collection of blood for immunology and serological tests
2. To perform Venereal disease research laboratory (VDRL) test
3. To perform Brucella Agglutination test
4. To Demonstrate Weil felix test (Demonstration only)
5. To Demonstrate Paul Bunnel test (Demonstration only)
6. To diagnose rheumatoid disease (RA/CRP) test
7. To perform Treponema pallidum hemagglutination assay (TPHA) test
8. To perform Anti-streptolysin O antibody (ASO) test
9. To perform Widal test, slide and tube method for enteric fever
10. To perform ELISA for diagnose of viral and bacterial disease
11. To demonstrate chemiluminescent immunoassay (CLIA)

Suggestions Readings

1. Practical Medical Microbiology by Mackie and McCartney
2. Microbiology for Medical Sciences by Bhagat Singh &RenuSingh
3. Textbook of Microbiology by Anantha Narayan
4. Medical Microbiology by Panikar & SatishGupte
5. Medical Laboratory Technology vol.I, II,III by Mukherjee
6. District Laboratory Practice in tropical countries Vol II Microbiology by Monica Chees brough
7. Textbook of Microbiology by Prescott

Subject: Medical Parasitology & Entomology
Subject Code: 23PMLT15

Objectives:

In the previous semester, students will be exposed to diseases caused by bacteria. In addition to bacteria, other microorganisms like virus and fungi may also cause diseases in humans. Further there are also significant number of diseases caused by infestation of parasites in humans. The knowledge of these and processing clinical samples for identification is essential to treat such diseases and hence this course has been included as an integral part of the curriculum.

Learning Outcomes

1. Describe morphologic criteria of the common parasites of protozoa and helminth.
2. Perform laboratory diagnosis of medically important protozoa and helminth.
3. State the proper collection and transport of specimens for parasites in stool. Perform concentration test for cysts and ova.
4. Perform laboratory diagnosis of medically important virus and fungi

Unit	Course Content
I	General characters and classifications of parasites Nature and types of parasitism, Host, types of hosts, parasite types of parasites, vectors, types of parasitism etc.
II	Protozoan parasites of medical importance: Morphology, lifecycle, disease and diagnosis of Entamoeba, Free living Amoeba, Giardia, Trichomonas, Leishmania, Trypanosoma, Toxoplasma, Sarcocystis, Cryptosporidium, Microsporidium, Cyclospora, lsospora,Babesia, Balantidium etc
III	**Helminthic parasite of medical importance** Morphology, lifecycle, diseaseanddiagnosisof a. **Cestodes-** *T.solium,T.saginata,E.granulosus,* Diphyllobothrium, Dipylidium, Multicepsetc. b. **Trematodes**- *S.haematobium &F.hepatica,Fasciolopsis, Gastrodiscoides,Paragonimus,* Clonorchis *etc.* c. **Nematodes-** Lifecycle,Morphology,disease&labdiagnosisof *Ascarislumbricoides (roundworm) Enterobius vermicularis* (Thread worm) *Ancylostomaduodenale*(Hookworm) **Tissue Nematodes:***W.Bancrofti*-Lifecycle, Morphology, Disease & Lab Diagnosis
IV	**Entomology** Commonarthropodvectors, mosquito, sand fly, ticks, mire, cyclops, louse and myasis.
V	Common Blood Parasites: Morphology, lifecycle, disease and diagnosis of plasmodium species, Toxoplasma gondii, Trypanosoma, Leishmenia,

Suggested Readings

1. Parasitology inrelation to Clinical Medicine by KD Chhatterjee
2. Medical Entomology by A. K. Hati, Pub. Allied Book Agency
3. Medical Parasitology by D.R.Arora

Subject: Medical Parasitology & Entomology Lab
Subject Code: 23PMLT16

Objectives:

In the previous semester, students will be exposed to diseases caused by bacteria. In addition to bacteria, other microorganisms like virus and fungi may also cause diseases in humans. Further there are also significant numbers of diseases caused by infestation of parasites in humans. The knowledge of these and processing clinical samples for identification is essential to treat such diseases and hence this course has been included as an integral part of the curriculum.

Learning Outcomes

1. To know about methods for collection, transportation and preservation of fecal specimen.
2. Able to perform laboratory diagnosis of protozoa and helminth.
3. Able to perform concentration test for cysts and ova.
4. Able to perform laboratory diagnosis of virus and fungal elements.

List of Practicals:

1. Methods for collection, preservation of fecal material for examination of parasites
2. Methods for transportation of fecal material
3. Concentration techniques of stool for ova and cyst
4. Wet preparation of fecal sample for ova and cyst
5. Method for identification of ova and cyst in stool sample
6. Identification of different ova & cysts in stool samples
7. Identification of different stage of Plasmodium in blood Films
8. Differentiation of cyst and trophozoite
9. Routine examination of stool
10. Rapid test for detection of malaria Ag

Suggested Readings

1. Parasitology inrelation to Clinical Medicine by KD Chhatterjee
2. Medical Entomology by A.K.Hati,Pub.Allied Book Agency
3. Medical Parasitology by D.R.Arora

Subject: Advances in Medical Microbiology
Subject Code: 23PMLT17

Objectives:

This course is aimed at introducing the students to the various types of advanced medical microbiology tests and developing expertise in the students to handle advanced instruments used in microbiology laboratories. The Advanced Diagnostic Technology part included in the course aims at exposing the students to the latest advancements in genetic investigations. Also, in this section students will be made aware of terminology used in micro biology and get to know about the various instruments and their maintenance and also learn the processing of various samples for Microbiology investigations.

Learning Outcomes:

At the end of the student will be able to:

1. Understand the principle of automated machines.
2. Understand the procedure involved in point care of testing
3. Understand the procedure involved in advance methods in antibiotic susceptibility testing
4. Understand the procedure of Immunoassay.

Unit	Course Content
I	**Automation in Medical Microbiology** -Introduction, definition, types and use of autoanalyzer's in microbiology, Principle & Applications, Latest trends in Autom\ation: Microchip based assay, Nano sensors advantages and disadvantages, Gold nanoparticle based lateral flow assay
II	**Introduction, principle and recent advancement in rapid detection:** 1. Component steps in fully automated analyzers 2. Mini Vidas analyzers 3. Auto analyzers based on immunoassay techniques, Micro particle enzyme immunoassay (MEIA) 4. BO Phoenix™ M50 Automated Microbiology System 5. Immulite automated immunoassay analyzers
III	Polymerase chain reaction (PCR), Real Time Polymerase chain reaction (RT-PCR) principle and applications.
IV	**Lateral flow assay for point of care testing(POCT)of bacterial and viral disease** Automated blood culture systems for the detection of pathogens from blood specimens Chromogenic media as rapid culture-based tests an alternative to molecular testing Improving efficiency and patient care via real-time communication
V	**Advances in antibiotic susceptibility testing** Use of combi-disc for determination of antimicrobial resistance, Epsilometer test (E- test) an 'exponential gradient' method for determination of antimicrobial resistance

Suggested Readings

1. Practical Medical Microbiology by Macki eand McCartney
2. Microbiology for Medical Sciences by Bhagat Singh & Renu Singh
3. Textbook of Microbiology by Ananthanarayan
4. Medical Microbiology Panikar &Satish Gupte
5. Medical laboratory Technology vol .I,II,III by Mukherjee
6. DistrictLaboratoryPracticeintropicalcountriesVolIIMicrobiologybyMonic a Chees brough
7. Textbook of Microbiology by Prescott

Subject: Advances in Medical Microbiology Lab
Subject Code: 23PMLT18

Objectives:
This course is aimed at introducing the students to the various types of advanced medical microbiology tests and developing expertise in the students to handle advanced instruments used in microbiology laboratories. The Advanced Diagnostic Technology part included in the course aims at exposing the students to the latest advancements in genetic investigations. Also, in this section students will be made aware of terminology used in micro biology and get to know about the various instruments and their maintenance and also learn the processing of various samples for Microbiology investigations.

Learning Outcomes:

At the end of the student will be able to:

1. To know about the principle of advance equipment in Medical Laboratory.
2. Identification and detection of different organism from microchip techniques and RT-PCR technique.
3. To demonstrate of RT- PCR and identification of COVID 19.

List of Practicals:

1. Use of advanced instruments for rapid identification of microorganisms
2. Microchip based detection of pathogenic bacteria
3. Lateral flow assay for point of care testing (POCT) of viral disease
4. Determination of pathogen by using RTPCR
5. Determination of HCV RNA using RT- PCR
6. Detection of COVID-19 using RT-PCR
7. Use of chromogenic culture media for detection of pathogenic bacteria
8. Detection of pathogens from blood specimens using automated blood culture method
9. To demonstrate daily and weekly maintenance of advance equipment in microbiology
10. To demonstrate use of Immulite automated immunoassay analyzers

Suggested Readings

1. Practical Medical Microbiology by Mackie and McCartney
2. Microbiology for Medical Sciences by Bhagat Singh & Renu Singh
3. Textbook of Microbiology by Ananthanarayan
4. Medical Microbiology Panikar & Satish Gupte
5. Medical laboratory Technology vol .I,II,III by Mukherjee
6. DistrictLaboratoryPracticeintropicalcountriesVolIIIMicrobiologybyMonic a Chees brough
7. Textbook of Microbiology by Prescott

Subject: Applied Bacteriology-II
Subject Code: 23PMLT19

Objectives:

Bacteriology is the study of bacteria (microbes) and immunology is the study of interaction between microbes and humans. The knowledge of microbes and their interaction is essential for students to understand diseases as well as to learn to avoid it. Accordingly, this course aims to cover the fundamental aspects of diagnosing, treating and monitoring microbial diseases.

Learning Outcomes:

At the end of the course student should be able to:

1. To understand the microbial epidemiology.
2. To understand the vaccine and development
3. To understand the processing of clinical samples in various disease.
4. Perform various process - different staining methods & inoculation of culture media

Unit	Course Content
I	Microbial pathogenicity and epidemiology:Pathogenicity, Epidemiology of disease transmission, Reservoirs of infection, Mode of disease transmission, Control of epidemic disease
II	Antimicrobial prophylaxis introduction to chemotherapy, types and classification of antibiotics, mode of action of antibiotic, production of antibiotics
III	Vaccines, types of vaccines, methods of preparation and route of administration, cold chain
IV	Routes of disease transmission introduction, methods of disease transmission including air, water, food, vectors etc.Prevention of hospital-acquired infections
V	Causes, symptoms and treatment of various bacterial infections of: Respiratory tract infections Urinary tract infections Infection of circulatory system Infection of nervous system, Central nervous system infections Congenital infections Gastrointestinal infections Infections of skin, mouth, eye, ear, and nose, Opportunistic infections causes and prevention, sexually transmitted diseases, Human and Animal ethics involved in microbiology work

Suggested Readings

1. Practical Medical Microbiology by Mackieand McCartney
2. Microbiology for Medical Sciences by Bhagat Singh &Renu Singh
3. Textbook ofMicrobiology by Anantha Narayan
4. Medical Microbiology by Panikar & Satish Gupte
5. Medical laboratory Technology I,II,III by Mukherjee
6. DistrictLaboratoryPracticeintropicalcountriesVolIIMicrobiologybyMonicaCheesbrough
7. Textbook of Microbiology &byPrescott

Subject: Applied Bacteriology-II Lab
Subject Code: 23PMLT20

Objectives:

Bacteriology is the study of bacteria (microbes) and immunology is the study of interaction between microbes and humans. The knowledge of microbes and their interaction is essential for students to understand diseases as well as to learn to avoid it. Accordingly, this course aims to cover the fundamental aspects of diagnosing, treating and monitoring microbial diseases.

Learning Outcomes

At the end of the course student should be able to:

1. To perform collection and isolation of organism from different clinical specimen such as blood, urine, sputum etc.
2. To perform antimicrobial susceptibility test on bacterial isolates.
3. To perform the processing of clinical samples in various disease.
4. To Perform various process - different staining methods & inoculation of culture media
5. To isolation and identification of microorganismfrom water and air.

List of Practicals:

1. Collection of clinical materials like blood, urine, stool, sputum, swabs, CSF etc.
2. Isolation and identification of microorganisms from blood
3. Isolation and identification of microorganisms from urine.
4. Isolation and identification of microorganisms from sputum.
5. Isolation and identification of microorganisms from CSF
6. Isolation and identification of microorganisms from throatswabs.
7. Isolation and identification of microorganisms from ear
8. Isolation and identification of microorganisms from nose
9. Isolation and identification of microorganisms fromdifferent food material
10. To Maintain transportation and preservation of clinical specimen

Suggested Readings

1. Practical Medical Microbiology by Mackie and McCartney
2. Microbiology for Medical Sciences by Bhagat Singh &Renu Singh
3. Textbook of Microbiology by Anantha Narayan
4. Medical Microbiology by Panikar & Satish Gupte
5. Medical laboratory Technology I, II, III by Mukherjee
6. DistrictLaboratoryPracticeintropicalcountriesVolIIMicrobiologybyMonica Cheesbrough
7. Textbook of Microbiology & by Prescott

Subject: Medical Mycology
Subject Code: 23PMLT21

Objectives:

In the previous semester, students will be exposed to diseases caused by fungus. In addition to bacteria, other microorganisms like virus may also cause diseases in humans. Further there are also significant number of diseases caused by infection of fungus in humans. The knowledge of these and processing clinical samples for identification is essential to treat such diseases and hence this course has been included as an integral part of the curriculum.

Learning Outcomes:

1. Describe morphologic criteria of the common fungus.
2. Perform laboratory diagnosis of medically important fungus.
3. State the proper collection and transport of specimens for fungal.

Unit	Course Content
I	**General characteristics and classification of pathogenic fungi** Morphology and reproduction of fungi, Isolation and identification of fungi
II	**Fungal pathogens associated with cutaneous infections** Morphology culture characters and infectionscaused by Epidermophyton species, Microsporum species and Trichophyton species
III	**Fungal pathogens associated with subcutaneous infections** Morphology culture characters and infectionscaused by:Actinomaduramadurae, Cladosporium Madurella grisea Phialophora and Sporothrixschenckii
IV	**Fungal pathogens associated with systemic infections:** Morphologyculture characters and infectionscausedby:Blastomyces dermatitidis Coccidioides immitis Histoplasma capsulatum and Paracoccidioides brasiliensis
V	**Fungal pathogensassociated with opportunistic infections** Morphology culture characters and infectionscaused by: Aspergillusfumigatus Candida albicans Cryptococcus neoformans Pneumocystis cariniiand Rhizopus species **Antifungal agent sand*in-vitro* susceptibility testing**

Suggested Readings

1. Practical Medical Microbiology by Mackieand McCartney
2. Microbiology for Medical Sciences byBhagatSingh&RenuSingh
3. Textbook of Microbiology by Ananthanarayan
4. Medical Microbiology by Panikar & Satish Gupte
5. Medical laboratory Technology. I,II,III by Mukherjee

Subject: Medical Mycology Lab
Subject Code: 23PMLT22

Objectives:

In the previous semester, students will be exposed to diseases caused by fungus. In addition to bacteria, other microorganisms like virus may also cause diseases in humans. Further there are also significant numbers of diseases caused by infection of fungus in humans. The knowledge of these and processing clinical samples for identification is essential to treat such diseases and hence this course has been included as an integral part of the curriculum.

Learning Outcomes:

1. To preparation of various fungal culture media.
2. To perform laboratory diagnosis of fungal infection.
3. To know about the collection and transport of various specimens for diagnosis of fungal disease.

List of Practicals

1. Preparation of fungal culture media
2. Cultivation and morphological identification of fungi on solid culture media
3. Staining of fungi for microscopic examination
4. Examination of fungi by wet mount
5. Different methods for isolation of fungi from clinical specimen
6. Isolation and identification of fungus from skin and swabs
7. Isolation and identification of fungimucornmycosis
8. Differentiation of Epidennophyton, Microsporium and Trichophyton
9. Isolation and identification of candidaalbicans
10. Microscopic examination of fungi showing morphology, width and branching of septa
11. Anti-fungal susceptibility testing

Suggested Readings

1. Practical Medical Microbiology by Mackieand McCartney
2. Microbiology for Medical Sciences by Bhagat Singh &Renu Singh
3. Textbook of Microbiology by Ananthanarayan
4. Medical Microbiology by Panikar & Satish Gupte
5. Medical laboratory Technology.I,II,III by Mukherjee

Subject: Medical Virology
Subject Code: 23PMLT23

Objectives:

In the previous semester, students will be exposed to diseases caused by virus. In addition to virus, other microorganisms also cause diseases in humans. Further there are also significant numbers of diseases caused by infestation of viruses in humans. The knowledge of these and processing clinical samples for identification is essential to treat such diseases and hence this course has been included as an integral part of the curriculum

Learning Outcomes:

1. Describe morphologic criteria of the common Viruses.
2. Perform laboratory diagnosis of medically important of viruses.
3. State the proper collection and transport of specimens for viruses.

Unit	Course Content
I	**General characteristics** and classification of viruses Morphology and structure of viruses Isolation and identification of viruses, cultivation of viruses
II	**Non-Enveloped DNA Viruses** Morphology, Replication, Transmission, Pathogenesis, Clinical Significance, Laboratory Identification, Prevention and Control of:Adenoviruses and Papillomavirus (Papovaviridae and Parvoviridae)
III	**Enveloped DNA Viruses** Morphology, Replication, Transmission, Pathogenesis, Clinical Significance, Laboratory Identification, Prevention and Controlof:Herpes Viruses, Herpes Simplex Virus (HSV), Varicella-Zoster Virus (also known as Herpes Zoster Virus, Human Herpes Virus-3), Human Cytomegalovirus, Epstein-Barr Virus Poxviruses, Poxviridae, Molluscum Contagiosum Virus (MCV) Hepatitis Viruses Hepatitis -B Virus, Hepatitis -C Virus and Hepatitis D Virus (Delta Agent)
IV	**Viruses with Positive RNA Strand** Morphology, Replication, Transmission, Pathogenesis, Clinical Significance, Laboratory Identification, Prevention and Control of: Picomaviruses,Togaviruses, Flavivirus and Caliciviruses Retroviruses and Immunodeficiency Diseases, Human immunodeficiency virus (HIV)
V	**Viruses with Negative RNA Strand** Morphology, Replication, Transmission, Pathogenesis, Clinical Significance, Laboratory Identification, Prevention and Control of: Rhabdovirus (Rabies Virus), Orthomyxoviruses(Influenza Viruses) and Paramyxovirus Coronaviruses (SARS CoVs), COVID 19 Viriods and prions

Suggested readings

1. Practical Medical Microbiology by Mackie and McCartney
2. Microbiology for Medical Sciences by Bhagat Singh & RenuSingh
3. Textbook of Microbiology by Ananthanarayan
4. Medical Microbiology by Panikar & Satish Gupte
5. Medical Laboratory Technology. I, II, III by Mukherjee
6. District Laboratory Practice in tropical countries Vol II Microbiology by MonicaC

Subject: Medical Virology Lab
Subject Code: 23PMLT24

Objectives:

In the previous semester, students will be exposed to diseases caused by virus. In addition to virus, other microorganisms also cause diseases in humans. Further there are also significant numbers of diseases caused by infestation of viruses in humans. The knowledge of these and processing clinical samples for identification is essential to treat such diseases and hence this course has been included as an integral part of the curriculum.

Learning Outcomes:

1. To Collection and transportation of different clinical specimen for diagnosis of viral disease.
2. To Perform and use different techniques for diagnosis of viral infection.
3. Identification of various virus from immunochromatic techniques or lateral flow assay.

List of Practicals:

1. Collection of throat swabs for isolation of viruses
2. Packing of throat swabs for transportation and preservation
3. Different methods for cultivation of viruses
4. Rapid methods of identification of viruses
5. Identification of HBsAg using lateral flow assay
6. Identification of Hepatitis C virus using lateral flow assay
7. Methods for extraction of RNA from COVID-19
8. Identification of COVID-19 using lateral flow assay
9. Identification of COVID-19 using RT-PCR
10. Methods for in-vitro cultivation of viruses
11. Different containment levels of biosafety lab
12. Use of personal protective equipment (PPE) kit, Donning and Doffing

Suggested Readings

1. Practical Medical Microbiology by Mackieand McCartney
2. Microbiology for Medical Sciences by Bhagat Singh &Renu Singh
3. Textbook ofMicrobiology by Ananthanarayan
4. Medical Microbiology by Panikar & Satish Gupte
5. Medical laboratory Technology I,II,III by Mukherjee
6. District Laboratory Practice in tropical countries Vol II Microbiology by Monica C

Subject: Medical Laboratory Posting
Subject Code: 23PMLT25

Objectives:
This course objective is to impart competent skills to thrive in in house laboratory.

Learning Outcomes:
Upon successful completion students should be able to:

1. List the objectives and state the laboratory posting report.
2. To collection and transportation of different clinical specimen in medical laboratory.
3. To perform and use different techniques for diagnosis of disease in medical laboratory.

Unit	Course Content
I	Medical laboratory posting will involve experimental work.
II	Students are required to do an individual experiment during posting.
III	Students are required to submit a report for assessment and need to demonstrate the experiment.

Subject: Dissertation/Project
Subject Code: 23PMLT26

Objectives:
This course objective is to impart competent skills to thrive in research institution and industries.

Learning Outcomes:
Upon successful completion students should be able to:

1. List the objectives and state the hypothesis of the research project.
2. Outline the methodology that will be followed to achieve the listed objectives.
3. Employ the finalized methodology to solve the problem which has been undertaken.
4. Analyse the data which has been generated by carrying out several experiments.
5. Evaluate the data-accuracy and precision, sources of errors, specificity, sensitivity and detection limits, regression analysis, reporting results.
6. Organize the inferences to prove the hypothesis.

Unit	Course Content
I	Project work will involve experimental work. Every student will be assigned a project topic in the end of 2nd semester and it will be pursued by him/her under the supervision of an internal supervisor. Students will be asked their choice for Project work at the end of2nd semester and all formalities of topic and mentor selection will be completed by this time.
II	Students are required to do an individual research project.
III	The project report along with soft copy will be submitted by the students in the fourth semester. The internal assessment shall be done on the basis of a presentation by the student as per the assessment schedule to be decided and announced by the School/Institution. The external assessment shall be done on the basis of Viva Voce and the report by an examiner to be appointed from the Panel of Experts as recommended by the BOS of the Skill faculty of applied science and humanities.