PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR, SALEM - 636011

DEGREE OF BACHELOR OF SCIENCE

Syllabus for

B.Sc., MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM

(SEMESTER PATTERN)

(For candidates admitted in the colleges affiliated to Periyar University from 2026 – 2027 onwards)

REGULATIONS

Program specific outcome (PSO)-Microbiology

Bachelor of Science in Microbiology students will gain fundamental knowledge about

- The microbiological equipment especially Microscope, Incubator, Laminar Air Flow chamber, Centrifuge etc.,
- The microorganism especially Bacteria, Fungi, Algae, Protozoa, Virus.
- The various fields in microbiology particularly Agricultural, Medical, Environmental, Industrial areas.

Conditions for admission (OBE Pattern)

A candidate who has passed higher secondary examination in any one of the biological sciences (Botany, Zoology, Biology).(Academic/Vocational stream - Agri, Nursing, Home Science, Poultry) Under higher secondary board of examination, Tamil Nadu or as per norms set by the Government of Tamil Nadu or an examination accepted as Equivalent there to by the Syndicate subject to such conditions as may be prescribed there to are permitted to appear and qualify for the B.Sc., Microbiology degree examination of this University after a course of study of three academic years.

Duration of the course

The course for the degree of Bachelor of Microbiology shall consist of three academic years divided into six semesters.

Course of study

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time.

Examinations

The theory examination shall be three hours duration to each paper at the end of each semester. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examinations. The practical examinations for UG course should be conducted in the even semesters.

Maximum Duration for the completion

The maximum duration for completion of the UG Program shall not exceed twelve semesters.

Commencement of this Regulation

These regulations shall take effect from the academic year 2026-2027,i.e., for students who are to be admitted to the first year of the course during the academic year 2026-2027 and there after

COURSE OF STUDY AND SCHEME OF EXAMINATION

SEMESTER – I

S.No	Semester	Paper code	Part	Course Group	Paper Type	Subject Title	Hours Week	Exam Hours	Internal Marks	External Marks	Total Marks	Credit	Page No
1	**SEM -I**		Part- I	Language	Theory	Tamil - I	6	3	25	75	100	3	-
2			Part II	Language	Theory	English- I	6	3	25	75	100	3	-
3			Part - III	Core- I	Theory	Fundamentals of Microbiology	5	3	25	75	100	5	10
4			Part - III	Core - II	Theory	Taxonomy and Microbial Diversity	5	3	25	75	100	5	12
5			Part – III	Allied - I	Theory	Biochemistry - I	5	3	25	75	100	4	-
6			Part - IV	NME - I	Theory	Basics of Microbiology	2	3	25	75	100	2	14
7			Part - IV		Theory	Value Education	1	3	25	75	100	1	-
Total Credits												23	

SEMESTER – II

S.No	Semester	Paper code	Part	Course Group	Paper Type	Subject Title	Hours Week	Exam Hours	Internal Marks	External Marks	Total Marks	Credit	Page No
1	**SEM -II**		Part- I	Language	Theory	Tamil - II	6	3	25	75	100	3	-
2			Part II	Language	Theory	English- II	6	3	25	75	100	3	-
3			Part - III	Core- III	Theory	Microbial Physiology and Metabolism	5	3	25	75	100	5	16
4			Part - III	Core	Practical	Core Practical I	4	6	40	60	100	5	18
5			Part – III	Allied - I	Practical	Allied Practical- I	3	3	40	60	100	4	-
6			Part - IV	NME - II	Theory	Microbial Disease and Prevention	2	3	25	75	100	2	20
7			Part - IV		Theory	Disaster Management	2	3	25	75	100	1	-
8			NMSDC				2	3	25	75	100	2	69
Total Credits												23+2= 25	

SEMESTER – III

S.No	Semester	Paper code	Part	Course Group	Paper Type	Subject Title	Hours Week	Exam Hours	Internal Marks	External Marks	Total Marks	Credit	Page No
1	**SEM - III**		Part- I	Language	Theory	Tamil - III	6	3	25	75	100	3	-
2			Part II	Language	Theory	English- III	6	3	25	75	100	3	-
3			Part - III	Core- IV	Theory	Microbial Genetics	5	3	25	75	100	5	22
4			Part - III	Allied - II	Theory	Analytical Microbiology	4	3	25	75	100	4	24
5			Part – III	Elective - I	Theory	Bioinstrumentation	4	3	25	75	100	3	26
						Nanotechnology & AI in Life Science							28
6			Part - IV	SEC - I	Theory	Entrepreneur Microbiology	2	3	25	75	100	2	31
7			Part - IV		Report	Health and Wellness	1	3	25	75	100	1	-
8				NMSDC			2	3	25	75	100	2	71
Total Credits												21 +2= 23	

SEMESTER – IV

S.No	Semester	Paper code	Part	Course Group	Paper Type	Subject Title	Hours Week	Exam Hours	Internal Marks	External Marks	Total Marks	Credit	Page No
1	**SEM - IV**		Part- I	Language	Theory	Tamil - IV	6	3	25	75	100	3	-
2			Part II	Language	Theory	English- IV	6	3	25	75	100	3	-
3			Part - III	Core- V	Theory	Immunology and Immunotechnology	5	3	25	75	100	5	33
4			Part - III	Core	Practical	Core Practical - II	3	6	40	60	100	5	35
5			Part – III	Allied	Practical	Allied Practical - II	3	3	40	60	100	4	37
6			Part - III	Elective II	Theory	Clinical Laboratory Technology	3	3	25	75	100	3	39
						Biosafety and Bioethics							41
7			Part - IV	SEC- II	Theory	Veterinary Microbiology	2	2	25	75	100	2	43
8				NMSDC	Theory		2	3	25	75	100	2	73
Total Credits												25 + 2= 27	

SEMESTER – V

S.No	Semester	Paper code	Part	Course Group	Paper Type	Subject Title	Hours Week	Exam Hours	Internal Marks	External Marks	Total Marks	Credit	Page No
1	**SEM -V**		Part - III	Core -VI	Theory	Medical Bacteriology and Mycology	6	3	25	75	100	5	45
2			Part - III	Core -VII	Theory	Food and Dairy Microbiology	5	3	25	75	100	5	47
3			Part - III	Core- VIII	Theory	Environmental Microbiology	5	3	25	75	100	5	49
4			Part - III	Elective - III	Theory	Recombinant DNA Technology	5	3	25	75	100	3	52
						Microbial Technology							54
5			Part – IV	SEC -III	Theory	Microbial quality control and testing	5	3	25	75	100	2	56
6			Part - IV	-	-	Summer Internship / Industrial training	Commended / Highly commended					2	-
7			Part - IV	EVS	Theory	EVS	2	3	25	75	100	2	-
8				NMSDC	Theory		2	3	25	75	100	2	75
Total Credits												24+2=26	

SEMESTER – VI

S.No	Semester	Paper code	Part	Course Group	Paper Type	Subject Title	Hours Week	Exam Hours	Internal Marks	External Marks	Total Marks	Credit	Page No
1	**SEM - VI**		Part - III	Core -IX	Theory	Medical Virology and Parasitology	6	3	25	75	100	5	58
2			Part - III	Core -X	Theory	Bioprocess and Pharmaceutical Microbiology	6	3	25	75	100	5	60
			Part - III	Core -XI	Theory	Soil and Agricultural Microbiology	6	3	25	75	100	5	63
3			Part - III	Core	Practical	Core Practical - III	5	6	40	60	100	5	65
4			Part - III	Core	Practical	Core Practical - IV	5	6	40	60	100	5	67
5			Part - IV			Extension activity	-	-	-	-	-	1	-
				NMSDC	Theory		2	3	25	75	100	2	77
Total Credits												26+2=28	

B.Sc., Microbiology

(CBCS Pattern)

THEORY QUESTION PAPER PATTERN

Time: 3 hour **Max. Marks: 75**

Part A - 15x1=15(Choose the best answer and fill up the blanks, Definitions)

(3 Questions each unit)

Part-B - (5Marks)(Answer any two questions)

2x5 =10 (One question in each unit)

Part–C - (50 Marks) (Either or Choice)

5x10=50 (Two question from each unit)

B.Sc., Microbiology (CBCS Pattern)

CORE PRACTICAL QUESTION PAPER PATTERN

Time : 6 hours

Maximum Marks(University Exam)	- 60
Major Practical–1	- 20Marks
Minor Practical -1&2	- 2× 10 =20 Marks (A&B)
Spotters	- 5× 2=10 Marks
Record	- 05 Marks
Viva voce	- 05 Marks
Internal Marks	- 40 Marks
Total	- 100 Marks

ALLIED PRACTICAL QUESTION PAPER PATTERN

Time : 3 hours

Maximum Marks (University Exam)	- 60 Marks
Major Practical–1	- 25 Marks
Minor Practical -1	- 15 Marks
Spotters	- 5× 2=10 Marks
Record	- 05 Marks
Viva voce	- 05 Marks
Internal Marks	- 40 Marks
Total	- 100 Marks

SEMESTER – I

Subject Code	Subject Name	
	FUNDAMENTALS OF MICROBIOLOGY	
Course Objectives		
CO1	Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.	
CO2	Describe the structural organization, morphology and reproduction of microbes.	
CO3	Explain the methods of cultivation of microbes and measurement of growth.	
CO4	Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.	
CO5	Compare and contrast the different methods of sterilization.	
UNIT	**Portion Details**	**No. of Hours**
I	History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity- ecological niche. Basic concepts of Eubacteria, Archaebacteria and Eucarya. Conservation of Biodiversity.	
II	General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of microalgae.	
III	Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques.	
IV	Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Confocal	

	microscopy, and Atomic Force Microscopy. Stains and staining methods.	
V	Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.	
	Total	

Course Outcomes	
Course Outcomes	Upon completion of this course students will be able to
CO1	Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.
CO3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.
CO4	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application.
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants.

REFERENCE BOOKS

1. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9th Edition). Jones &Bartlett learning 2010.
2. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5th Edition., MacMillan Press Ltd
3. Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11th Edition., Benjamin Cummings.
4. Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition., McGraw Hill Publications.
5. Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co.

SEMESTER - I

Subject Code	Subject Name	
	TAXONOMY AND MICROBIAL DIVERSITY	
Course Objectives		
CO1	To recall the fundamental concepts and terminologies in microbial taxonomy.	
CO2	To explain the basis of phenetic, phylogenetic, and modern taxonomic approaches.	
CO3	To apply classical and molecular techniques in the classification of microorganisms.	
CO4	To analyze the diversity of bacteria, fungi, algae, protozoa, and viruses.	
CO5	To evaluate phylogenetic relationships and the significance of microbial taxonomy.	
UNIT	**Portion Details**	**No. of Hours**
I	**Taxonomy :** Principle, classification - Phenetic, Phylogenetic, Genotypic; Modern approaches - Numerical, Molecular-NGS- Sequencing- Taxonomic Ranks. Techniques to determine Microbial Taxonomy and Phylogeny - Characteristics – Classical and Molecular type (16SrRNA based, 18SrRNA, ITS) - Phylogenetic tree.	
II	**Bacterial Taxonomy:** Bergey's Manual of Systematic Bacteriology-II edition - general characteristics and organization - Archaea (Crenarchaeota); Euryarchaeota (Methanobacterium, Halobacterium) –Proteobacteria – (Alpha- Caulobacter; Beta-Alcaligens; Gamma-Legionella; Delta-Myxococcus; Epsilon- Camphylobacter), Low G+C Gram positive bacteria - Eubacteria; High G+C Gram positive bacteria - Bifidobacterium; Fusobacterium – Characteristics of Actinomycetes.	
III	**Fungal Taxonomy:** Classification of fungi (Alexopoulos) - General characteristics and organization – Chytridiomycota (Allomyces); Zygomycota (Amoebophilus); Ascomycota (Ascobolus); Basidiomycota (Agaricus); Ustilaginomycota (Malassezia)-economic importance of fungi-role of fungi in Biotechnology.	
IV	**Algae and Protozoa – Taxonomy:** Algal cell structure- General characteristics- Classification of Algae (Fritsch) - morphology and reproduction cycle - Rhodophycophyta. Protozoa - General characteristics, classification, life cycle of Sarcodina (*Entamoebahistolytica)*, and Sporozoa (*Plasmodium malariae*).	
V	**Viruses Structure and Types :** General characteristics- classification (Baltimore) and multiplication of viruses. Structure of viruses - virion size-structural properties - helical, icosahedral- complex capsid - nucleic acid - viral envelope and enzymes.	
	Total	
Course Outcomes		
Course	On completion of this course, students will be able to	

Outcomes	
CO1	Describe the principles of microbial taxonomy and classification systems.
CO2	Explain and apply suitable techniques toconstruct phylogenetic trees.
CO3	Classify and differentiate major groups of bacteria based on their characteristics.
CO4	Analyze the taxonomy, structure and life cycles of fungi, algae and protozoa.
CO5	Evaluate the structure, classification and replication strategies of viruses.

REFERENCE

1. Bergey's Manual of Systematics of Archaea and Bacteria Whitman, W.B. (ed.) (2022) Bergey's Manual of Systematics of Archaea and Bacteria. Wiley.
2. Adl, S.M. et al. (2021) 'The revised classification of eukaryotes', Journal of Eukaryotic Microbiology.
3. Fungal Biology Deacon, J. (2022) Fungal Biology. 5th edn. Wiley-Blackwell.
4. Koonin, E.V. and Wolf, Y.I. (2021) Evolution of Viruses and Virus-Like Elements. Academic Press.
5. Brock Biology of Microorganisms Madigan, M.T., Bender, K.S., Buckley, D.H., Sattley, W.M. and Stahl, D.A. (2021) Brock Biology of Microorganisms. 16th edn. Pearson.
6. Microbiology: An Evolving Science Slonczewski, J.L. and Foster, J.W. (2020) Microbiology: An Evolving Science. 5th edn. W. W. Norton.

SEMESTER - I

Subject Code	Subject Name	
	BASICS OF MICROBIOLOGY	
Course Objectives		
CO1	Understand the history, scope, and key contributions in microbiology by scientists	
CO2	Learn principles and applications of microscopes and different staining techniques.	
CO3	Gain knowledge of sterilization and disinfection methods for controlling microorganisms.	
CO4	Understand preparation of culture media and pure culture techniques.	
CO5	Study general characteristics of major groups of microorganisms and their role in human health.	
UNIT	**Portion Details**	**No. of Hours**
I	**History and scope:** History and scope of microbiology, spontaneous generation – biogenesis theory – contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich and Fleming.	
II	**Microscopy:** Microscope – Principles, working mechanism and application - Simple and compound microscope, Electron Microscope. Types of Staining - Simple, Differential staining and LPCB, KOH mount.	
III	**Control of Microorganisms** Sterilization and disinfection – principles – methods of sterilization – physical methods – dry heat – moist heat – radiation – filtration (membrane and HEPA) – chemical sterilization – chemical agents – mode of action.	
IV	**Culture and media:** Culture and media preparation: solid and liquid. Types of media, Pure culture techniques – Pour, Spread, Streak plate. Anaerobic culture technique-Anaerobic Jar. Preservation – Subculture and Lyophilization.	
V	**Features of Microbes:** General characteristic features of bacteria, virus, algae, fungi, protozoa and parasites. Microbiology and human health – any two examples	
	Total	
Course Outcomes		
Course	On completion of this course, students will:	

Outcomes	
CO1	Explain the development and significance of microbiology and contributions of key scientists.
CO2	Demonstrate proper use of microscopes and perform staining techniques.
CO3	Apply suitable sterilization and disinfection methods in laboratory practices.
CO4	Prepare culture media and perform pure culture isolation techniques effectively.
CO5	Identify major microbial groups and relate their importance to human health

REFERENCE

1. Prescott L M, J P Harley and D A Klein (2005). Microbiology.Sixth edition, International edition, McGraw Hill.

2. PelczarTR M J Chan ECS and Kreig N R (2006). Microbiology.Fifth edition, Tata McGraw-Hill INC. New York.

3. Hans G. Schlegel. General microbiology.7'h edition. Cambridge university press (1993).

4. Dubey RC and Maheswari DK (2012). A text of Microbiology (Revised edition). S. Chand and Company Ltd., New Delhi.

5. GeetaSumbali and Mehrotra RS (2009). Principles of Microbiology. First edition, Tata McGraw Hill P. Ltd., New Delhi

6.Talaro K.P. and Chess B. (2012) Foundations in Microbiology, 8th Edn. The McGraw Hill Companies.

7. Tortora, G.J., Funke, B.R. and Chase C.L. (2013) Microbiology: An Introduction, 11th Edn. Pearson-Benjamin Cummings

SEMESTER – II

Subject Code	Subject Name	
	MICROBIAL PHYSIOLOGY AND METABOLISM	
Course Objectives		
CO1	To discuss various aspects of the nutrition and growth conditions of microorganisms.	
CO2	To relate bacterial growth and measurement methods.	
CO3	To explain the respiration mechanism and energy synthesis by microorganisms.	
CO4	To describe the mechanism of respiration and fermentation.	
CO5	To understand the mechanism and significance of photosynthetic pathways.	
UNIT	**Portion Details**	**No. of Hours**
I	**Microbial Nutrition :**Nutritional requirements of microorganisms –macro elements, micro elements and growth factors, nutritional groups of microbes - transport mechanisms and types-simple diffusion – facilitated diffusion- active transport – group translocation - Iron uptake.	
II	**Bacterial Growth:** Growth curve – Generation time –factors influencing microbial growth – Methods of evaluating microbial growth- direct microscopic count, viable plate count, turbidity measurement using spectrophotometry, dry weight determination, and biochemical estimation of cellular components.	
III	**Respiration:** EMP – HMP – ED pathways – TCA cycle- organization of the electron transport chain in bacteria - Substrate level phosphorylation and oxidative phosphorylation- ATP synthase. Anaerobic respiration – sulphur, nitrogenous compounds, and CO_2 as terminal electron acceptor – Methanogenesis.	
IV	**Fermentation:** Fermentation – alcoholic-yeast, lactic acid- lactic acid bacteria, propionic acid- *Propionibacterium*, butanediol –*Enterobacter* sp. and mixed acid fermentation-enteric bacteria.	
V	**Photosynthesis:** Photosynthesis in green bacteria, purple bacteria and cyanobacteria–photosynthetic pigments-oxygenic and anoxygenic-photophosphorylation, carbon-dioxide fixation**.**	
	Total	
Course Outcomes		

Course Outcomes	On completion of this course, students will be able to
CO1	Describe the nutritional requirements and transport mechanisms in bacteria.
CO2	Discuss the growth pattern and measurement in microorganisms.
CO3	Explain and apply the biochemical pathways involved in respiration.
CO4	Demonstrate the processes of various types of fermentation in microorganisms.
CO5	Analyze photosynthetic processes in different groups of microorganisms.

REFERENCES

1. Moat, A. G., Foster, J. W., & Spector, M. P. (2003). *Microbial physiology* (4th ed.). John Wiley & Sons.
2. Doelle, H. W. (2005). *Microbial metabolism*. Academic Press.
3. Kumari, S. M. (2019). *Microbial physiology*. MJP Publishers.
4. Murray, R. K., Granner, D. K., Mayes, P. A., &Rodwell, V. W. (2004). *Harper's biochemistry*. Appleton & Lange.
5. Schlegel, H. G. (2009). *Microbiology*. Cambridge University Press.
6. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., & Painter, P. R. (2008). *Microbial physiology*. McGraw-Hill Higher Education.

SEMESTER –II

Subject Code	Subject Name
	CORE PRACTICAL I-FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL PHYSIOLOGY & METABOLISM
Course Objectives	
CO1	To understand the cleaning of glassware's and disposal of waste.
CO2	To perform aseptic techniques to cultivate and enumerate microorganisms.
CO3	To develop the skill to identify bacteria and fungi using suitable staining methods.
CO4	To understand the generation time of bacteria.
CO5	To study the biochemical test, carbohydrate fermentation and hydrolytic enzymes in bacteria.
S.No	**Portion Details**
1.	Cleaning of Glassware and disposal of waste
2.	Parts of a Light Microscope
3.	Culture media preparation and colony characteristics in liquid and solid medium
4.	Selective and differential media: 1. EMB agar 2. Mannitol Salt Agar
5.	Pure culture techniques – Serial dilution, Pour plate, Spread plate and Streak Plate methods
6.	Enumeration of bacteria, fungi and actinobacteria from soil
7.	Determination of Motility – Hanging drop method
8.	Staining Methods 1. Simple staining 2. Gram staining 3. Endospore staining 4. Fungal staining – LactoPhenol Cotton Blue
9.	Growth curve- Determination of generation time of *E.coli* 1. Neubauer counting chamber 2. Turbidity 3. Viable count
10.	Biochemical tests – IMViC, TSI, oxidase, Catalase and urease test
11.	Carbohydrate fermentation tests- Glucose, Lactose
12.	Hydrolysis test: 1. Starch hydrolysis 2. Gelatin hydrolysis 3. Casein hydrolysis
Course Outcomes	
Course Outcomes	On completion of this course, students will be able to:

CO1	Recall the principles of cleaning glassware's and proper disposal of microbiological waste.
CO2	Explain the principles and applications of microscopy, culture media (selective, differential) and staining techniques used for microbial identification.
CO3	Apply aseptic techniques for media preparation and isolation of pure cultures (serial dilution, pour, spread, and streak plate methods).
CO4	Execute microbiological techniques such as motility determination and enumeration of microorganisms.
CO5	Calculate the generation time of bacteria by different methods.

REFERENCES

1. Murugalatha, N., Growther, L., Hena, J. V., Hemashenpagam, N., Anitha, R., Kanchana Devi, D., &Rajalakshmi, G. (2013). Microbiological Techniques.MJP Publisher.
2. Rajan, S., & Christy, E. J. (2013).Experimental Procedures in Life Sciences.Anjanaa Book House.
3. Cappuccino, J. G., & Sherman, N. (2014). Microbiology: A Laboratory Manual. Pearson.
4. Cullimore, D. R. (2010). Practical Atlas for Bacterial Identification (2nd ed.). Kindle Edition.
5. Goldman, E., & Green, L. H. (Eds.). (2015). Practical Handbook of Microbiology (3rd ed.). CRC Press.
6. Saravanan, R., Dhachinamoorthi, D., &PrasadaRao, C. H. M. M. (2019). A Handbook of Practical Microbiology. S. Chand & Company.

SEMESTER – II

Subject Code	Subject Name	
	MICROBIAL DISEASES AND PREVENTION	
Course Objectives		
CO1	To describe the causative agents, transmission, and prevention of air-borne diseases.	
CO2	To explain the sources, and prevention of food-borne and water-borne diseases.	
CO3	To identify the causative organisms and transmission of zoonotic diseases.	
CO4	To analyze the vectors and spread of important vector-borne diseases.	
CO5	To evaluate the laboratory diagnosis and control measures of microbial diseases.	
UNIT	**Portion Details**	**No. of Hours**
I	**Air borne diseases:** Respiratory microbial diseases: influenza, mumps, measles, rubella and tuberculosis-etiological agents- modes of transmission-pathogenesis- symptoms- laboratory diagnosis and preventive measures.	
II	**Food Borne diseases:** Food poisoning- Staphylococcus aureus- Botulism-Clostridium botulinum- Listeriosis- Listeria monocytogenes- Hepatitis-Hepatitis A -Mycotoxins- Aspergillus sp.- parasitic- Giardiasis- Sources of infection- transmission- clinical manifestations- laboratory diagnosis-preventive methods.	
III	**Water-Borne diseases :** Microbial intestinal diseases – poliomyelitis- cholera-typhoid fever - amoebiasis- sources of infection- transmission- clinical manifestations- laboratory diagnosis- preventive methods.	
IV	**Zoonotic diseases:** Zoonoses- viral-Rabies- bacterial- Plague, Anthrax, Leptospirosis- fungi- dermatophytic infections - parasitic disease-Toxoplasmosis- causative organisms- transmission- symptoms- laboratory diagnosis- treatment and prevention.	
V	**Vector borne diseases:** Mosquito-borne diseases-malaria –*Anopheles* mosquitoes-dengue fever – *Aedes* mosquitoes - Lymphatic filariasis –Culex mosquitoes- Flea-borne diseases- Plague – rat fleas -Tick-borne diseases- Lyme disease – ticks - mosquitoes -Louse-borne diseases-Epidemic typhus – body lice.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will be able to:
CO1	Explain the causative agents, transmission, and prevention of air-borne diseases.
CO2	Describe the sources of infection, laboratory diagnosis, and preventive measures of food-borne and water-borne diseases.
CO3	Identify the causative organisms, transmission routes, and control measures of zoonotic diseases.
CO4	Analyze the vectors, and prevention strategies of vector-borne diseases.
CO5	Evaluate the laboratory diagnostic methods, and public health measures used in the control of microbial diseases.

REFERENCE

1. Prescott's Microbiology Willey, J.M., Sherwood, L. and Woolverton, C.J. (2020) 10th edn. McGraw-Hill Education.
2. Microbiology: An Introduction Tortora, G.J., Funke, B.R. and Case, C.L. (2021) 13th edn. Pearson.
3. Sherris Medical Microbiology Ryan, K.J., Reller, M.E., Sterling, C.R. and Drew, W.L. (2022) 8th edn. McGraw-Hill Education.
4. Jawetz, Melnick&Adelberg's Medical Microbiology Miller, S., Riedel, S., Morse, S.A. and Mietzner, T.A. (2019) 28th edn. McGraw-Hill Education.
5. Medical Microbiology Murray, P.R., Rosenthal, K.S. and Pfaller, M.A. (2025) Medical Microbiology. 10th edn. Elsevier.
6. Review of Medical Microbiology and Immunology Levinson, W., Chin-Hong, P., Joyce, E.A., Nussbaum, J. and Schwartz, B. (2022) 17th edn. McGraw-Hill Education.
7. Essentials of Medical Microbiology Sastry, A.S. and Bhat, S. (2021) 3rd edn. Jaypee Brothers Medical Publishers.
8. Microbiology with Diseases by Taxonomy Bauman, R.W. (2022) 6th edn. Pearson.

SEMESTER - III

Subject Code	Subject Name	
	MICROBIAL GENETICS	
Course Objectives		
CO1	To understand the basic principles and concepts of microbial genetics.	
CO2	To study DNA replication, mutation, repair mechanisms and gene regulation in microorganisms.	
CO3	To gain knowledge on microbial gene transfer and recombination mechanisms.	
CO4	To understand recombinant DNA technology and molecular genetic techniques.	
CO5	To study the applications of microbial genetics in biotechnology, medicine and industry.	
UNIT	**Portion Details**	**No. of Hours**
I	**Introduction to Microbial Genetics:** History and scope of microbial genetics, DNA and RNA as genetic material, structure and properties of DNA, bacterial chromosome organization, plasmids and episomes, types of RNA, and microbial genome organization, nucleosome concept, denaturation and renaturation of DNA, and extra chromosomal genetic elements.	
II	**DNA Replication and Mutation:** Mechanism of DNA replication in prokaryotes, enzymes involved in replication, semiconservative androlling circle replication, mutation and mutagens, spontaneous and induced mutations, point mutation and frame shift mutation, Ames test, DNA damage, photoreactivation, excision repair, mismatch repair, SOS repair mechanism, and molecular basis of mutation.	
III	**Gene Expression and Regulation:** Transcription in prokaryotes, RNA polymerase and promoter regions, post transcriptional modification, genetic code, translation and protein synthesis, ribosome structure, operon concept, regulation of gene expression, lac operon and trp operon, attenuation, repression and induction mechanisms, and post translational modification.	
IV	**Gene Transfer Mechanisms:** Transformation, conjugation and transduction,	

	generalized and specialized transduction, transposons and insertion sequences, recombination in bacteria, homologous recombination, site specific recombination, genetic mapping in bacteria, bacteriophage genetics, and applications of microbial genetics.	
V	**Molecular and Applied Genetics:** Genetic engineering techniques, recombinant DNA technology, restriction enzymes and ligases, cloning vectors, plasmid and bacteriophage vectors, PCR, blotting techniques, plasmid isolation, electrophoresis, DNA sequencing, gene cloning, genomics and proteomics, applications of microbial genetics in medicine, agriculture, industry and environmental biotechnology.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will be able to:
CO1	Explain the structure, organization and function of microbial genetic material.
CO2	Describe DNA replication, mutation and DNA repair mechanisms in microorganisms.
CO3	Understand transcription, translation and regulation of gene expression in prokaryotes.
CO4	Demonstrate knowledge on transformation, conjugation, transduction and recombination mechanisms.
CO5	Understand the applications of microbial genetics in biotechnology, medicine and industry.

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1. Freifelder, D. *Microbial Genetics*. Narosa Publishing House.
2. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. *General Microbiology*. Macmillan Education Publishers.
3. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. *Microbiology*. Tata McGraw Hill Publications.
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5. Lewin, B. *Genes*. Jones and Bartlett Publishers.
6. Primrose, S.B. and Twyman, R.M. *Principles of Gene Manipulation*. Blackwell Scientific Publications.

SEMESTER - III

Subject Code	Subject Name	
	ANALYTICAL MICROBIOLOGY	
Course Objectives		
CO1	Understand roles, responsibilities, ethics, and safety practices in a microbiology laboratory. Gain knowledge of preparation of solutions, buffers, and use of pH measurement techniques.	
CO2	Learn units of measurement, reference ranges, and quality control in clinical laboratories.	
CO3	Understand principles and applications of common laboratory instruments.	
CO4	Acquire skills in record maintenance, SOPs, and basic histopathology techniques	
CO5		
UNIT	**Portion Details**	**No. of Hours**
I	**Laboratory Safety, Ethics and Hazard Management:** Role, responsibility, ethics to be followed by Microbiology laboratory, types of hazards and laboratory accidents – first aid and safety measures to be followed. Glassware and chemical maintenance. Washing and preparation for sterilization and decontamination.	
II	**Solution Preparation, Buffers and pH Measurement:** Buffers, Molar and Normal solutions, Preparation of solution and reagents, normal solution, molar solutions, per cent solution, buffer solution, dilutions, w/v, v/v, standard solution, aqueous solutions, concepts of acid and base. pH meter, pH electrodes – Colomel and glass electrode	
III	**Units of Measurement and Quality Control in Clinical Laboratories**: Units of measurement: SI Unit, reference range, conversion factor, Units for measurement of bio metabolite, enzymes, protein, drugs, hormones, vitamins. Quality Control and Assurance in Clinical Laboratories.	
IV	**Laboratory Instruments: Principles and Applications:** Principles and Applications of Autoclave, Hot air oven, Incubator, Laminar air flow chamber / Biosafety cabinets, BOD incubator, Metabolic shaker, Incinerator	
V	**Record Maintenance, SOPs and Histopathology Techniques:** Mainatance of	

	recod and catalog. SOP – Instrumentation Usage in Microbiology Laboratory for Histopathology: Tissue Processing Fixing, Embedding, Microtomy, Staining, mounting, decalcifications. Automation and Advances in Laboratory Instrumentation.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Follow laboratory ethics, safety measures, and manage hazards effectively.
CO2	Prepare standard solutions, buffers, and operate pH meters accurately.
CO3	Apply correct units and maintain quality assurance in laboratory analysis.
CO4	Demonstrate proper use of laboratory instruments and equipment.
CO5	Maintain laboratory records and perform basic histopathology procedures

REFERENCE

7. Prescott's Microbiology – Joanne M. Willey, Linda Sherwood & Christopher Woolverton, 11th Edition, 2020.
8. Microbiology: An Introduction – Gerard J. Tortora, Berdell R. Funke & Christine L. Case, 13th Edition, 2019.
9. Textbook of Microbiology – R. Ananthanarayan & C.K.J. Paniker, 10th Edition, 2017.
10. Medical Laboratory Technology – Ramnik Sood, 8th Edition, 2019, Volume 1 & 2.
11. Clinical Laboratory Science – Mary Louise Turgeon, 7th Edition, 2016, Volume 1.
12. Laboratory Biosafety Manual – World Health Organization, 4th Edition, 2020.
13. Histological Techniques – John D. Bancroft & Marilyn Gamble, 7th Edition, 2019.
14. Practical Clinical Biochemistry – Harold Varley, 6th Edition, 2018.

SEMESTER-III

Subject Code	Subject Name
	BIOINSTRUMENTATION

Course objectives	
CO1	Understand the principles and working mechanism of laboratory instruments.
CO2	Acquire knowledge on spectroscopic techniques.
CO3	To gain knowledge about chromatographic & Electrophoresis techniques.
CO4	Demonstrate the use of radioisotopes in various techniques
CO5	To understand the principle and working mechanism of various types of scans used in medical diagnosis.

Unit	Portion Details	No. of Hours
I	Basic laboratory instruments- pH meter, Aerobic and Anaerobic incubator. Centrifugation techniques- Preparative, Analytical and Ultra.	
II	Spectroscopic techniques- Colorimeter, Ultraviolet, Visible, Infrared and Mass spectroscopy.	
III	Chromatographic and electrophoresis technique- Thin layer, Paper, Column, HPLC, LPLC & GC. Electrophoresis- AGE, Starch, SDS-PAGE and Blotting techniques.	
IV	Radio isotopic techniques- Spectrofluorimeter, Scintillation counter, Giger Muller Counter, Flame photometer and autoradiography.	
V	Imaging techniques- ECG, EEG, EMG, MRI, CT and PET.	
	Total	

Course outcomes	
Course outcomes	On completion of this course, students will;
CO1	Make use of basic laboratory instruments following SOP.
CO2	Measures the amounts or concentration of compounds within a biological sample.

CO3	Perform chromatographic & Electrophoresis techniques to separate the biomolecules in the sample.
CO4	Gain knowledge in the working principle and applications of radiation and fluorescence techniques.
CO5	Understand the principles of imaging techniques and assistive devices.

REFERENCE

1. Jayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi.
2. Ponmurugan. P and Gangathara PB (2012). Biotechniques.1stEdition. MJP publishers.
3. Veerakumari, L (2009). Bioinstrumentation- 5th Edition -.MJP publishers.
4. Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition. Himalaya publishing home.
5. Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S. Himalaya Publishing House, Mumbai.
6. Rodney.F. Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
7. Skoog A., WestM (2014). Principles of Instrumental Analysis – 14th Edition W.B. SaundersCo. Philadephia.
8. N. Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJP Publishers.
9. Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7thEdition. Cambridge University Press.
10. Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt.Ltd, Singapore.

SEMESTER – III

Subject Code	Subject Name	
	NANOTECHNOLOGY & AI IN LIFE SCIENCE	
Course objectives		
CO1	Understand the basic concepts, history, and evolution of nanoscience and nanotechnology.	
CO2	Explain the principles of nanoparticle-based drug development and formulation techniques	
CO3	Understand the synthesis and applications of microbial nanoparticles in cleaning air and environmental remediation.	
CO4	Introduce Artificial Intelligence for biology students	
CO5	Facilitate students to learn and apply AI tools for disease diagnosis.	
Unit	**Portion Details**	**No. of Hours**
I	Definition – Evolution of Nano science. Need of Nano technology. Hurdles for Nanotechnology development. Factors affecting the manufacturing process of nano materials.	
II	Nanotechnology for drug development and medical applications. Nanotechnology for drug solubilization and drug delivery. Diagnosis using nanomaterials. Nanotherapy for cancer treatment.	
III	Cleaner environment with Nanotech. Cleaning the air with Nanotechnology. Nanotechnology for water treatment. Microbial nanoparticles used in cleaning air. Possible harm from Nanomaterials. Nanoscience in India – Ethics and safety.	
IV	Introduction to AI – Fundamentals – Need for AI – Foundations of AI – AI environment – Application domains of AI – AI tools – Challenges and Future of AI.	
V	Artificial Intelligence Diagnostic Testing - AI and Gram Stain - AI and Parasitology - AI andBacterial Culture Plate Images -AI in bacterial counting - Prediction of Microbial Species and Antimicrobial Activity. AI and	

	MALDI-TOF MS - AI and Whole Genome Sequencing.	
	Total	

Course outcomes	
Course outcomes	On completion of this course, students will;
CO1	Outline the evolution of nanoscience and hurdles in the development of nanotechnology..
CO2	Utilize nano materials for drug development and its application.
CO3	Apply nanotechnology for air and water treatment and become familiar with nanoscience education in India.
CO4	Understand the concept of Artificial Intelligence
CO5	Apply and validate Artificial Intelligence in clinical diagnosis of infectious disease

REFERENCE

1. Richard Brooker and Earl Boysen (2006). Nanotechnology. 1st edition, Wiley Publishing Inc., India.

2. VadlapudiVarahalarao and Nayak B.K (2017). Microbial Nanotechnology: Mycofabrication of Nano particles and their Novel Applications.1st edition.IGI global publishers. India.

3. Nicola Cioffi and Mahendra Rai (2012). Nano - Antimicrobials.1st edition, Springer. United States

4. Anton Ficai and AlexandruGrumaezescu.(2017) .Nanostructures for Antimicrobial Therapy. 1st edition, Elsevier. Netherlands.

5. Bernd H.A.Rehm (2006). Microbial Bionanotechnology: Biological self-assembly systems and Biopolymer Based Nanostructures. 1st edition, Horizon Bio Science.UK.

6. Paul P. Bourbeau, Nathan A. Ledeboer; Automation in Clinical Microbiology, Journal of Clinical Microbiology May 2013, 51 (6) 1658-1665; DOI: 10.1128/JCM.00301-13

7. Cui W, Aouidate A, Wang S, Yu Q, Li Y, Yuan S. Discovering Anti-Cancer Drugs via Computational Methods. Front Pharmacol. 2020; 11:733. Published 2020 May 20. doi:10.3389/fphar.2020.00733

8. Qu K, Guo F, Liu X, Lin Y and Zou Q (2019) Application of Machine Learning in Microbiology. Front. Microbiol. 10:827. doi: 10.3389/fmicb.2019.00827

9. Park HS, Rinehart MT, Walzer KA, Chi J-TA, Wax A (2016) Automated Detection of P. falciparum Using Machine Learning Algorithms with Quantitative Phase Images of Unstained Cells. PLoS ONE 11(9): e0163045. https://doi.org/10.1371/journal.pone.0163045

10. Yang X, Wang Y, Byrne R, Schneider G, Yang S. Concepts of Artificial Intelligence for Computer-Assisted Drug Discovery. Chem Rev. 2019;119(18):10520-10594. doi:10.1021/acs.chemrev.8b00728

SEMESTER - III

Subject Code	Subject Name	
	ENTREPRENEUR MICROBIOLOGY	
Course Objectives		
CO1	To introduce the concept of Entrepreneurship within the context of global bio-business.	
CO2	To familiarize with the patent processing, including the costs, procedures, and different types of patents.	
CO3	To provide technical and business knowledge for the production and marketing of microbial goods.	
UNIT	**Portion Details**	**No. of Hours**
I	**Entrepreneurship:** Entrepreneurship and Entrepreneurial society, Entrepreneur development, important factors in entrepreneurship, Government contribution to entrepreneur, Institution involvement in new entrepreneurship, Risk assessment and management.	
II	**Patent and History of Patent:** Patent and its secret of processing, Important factors and characterization of patent. Cost of patent, Utility and design patent, Patent procedure in India and other countries.	
III	**Entrepreneurship in Microbiology:** Mushroom cultivation- Edible and medically important mushrooms, its cultivation methods, Alcoholic products- Beer production, wine production and wine production from other fruits. Bio fertilizer production and marketing. Recent economic development in microbiological field.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Understand the legal and financial requirements for filing patents, ensuring the protection of microbiological innovations through proper risk assessment and management.
CO2	Evaluate the recent economic trends in the microbiological field to identify new opportunities for innovation.
CO3	To develop a comprehensive business model that identifies market needs to develop and manufacturemicrobial products**.**

REFERENCE

1. Saira Mulla (2020) Guidelines to obtain Patent in India, Walnut Publication.
2. David E. Blau and David Pressman (2025) Patent It Yourself: Your Step-by-Step Guide to Filing at the U.S. Patent Office, Atlantic Publishers and Distributors (P) Ltd.

3. Amritesh C. Shukla (2023) Entrepreneurship with Microorganisms - 1st Edition, Atlantic Publishers and Distributors (P) Ltd.
4. KL Benson (2016) Industrial Microbiology, CBS Publishers and Distributors Pvt. Ltd.
5. Zahoor Ahmad Bhat (2026) A Text Book of Commercial Mushroom Cultivation as Per Nep 2020, LexArcheus Publications.
6. Md Mijan Hossain (2023) Cultivation of Edible And Medicinal Mushrooms In India, Walnut Publication.

Web Resources

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2. https://ipindia.gov.in/frontend/pdf/patents/Manual_for_Patent_Office_Practice_and_Procedure_.pdf
3. https://tnagriculture.in/dashboard/CPG/12_Mushroom_Cultivation.pdf
4. https://link.springer.com/article/10.1007/s00253-018-9226-8, Mushroom cultivation in the circular economy.
5. https://www.ncbi.nlm.nih.gov/books/NBK531660/Worldwide Production and Use of Alcoholic Beverages

SEMESTER – IV

Subject Code	Subject Name	
	IMMUNOLOGY AND IMMUNOTECHNOLOGY	
Course Objectives		
CO1	To gain knowledge about immune system, organs and cells involved.	
CO2	To distinguish the types of antigens, antibodies and their properties.	
CO3	To provide in-depth knowledge on Immuno-techniques.	
CO4	To discuss the role of MHC system in transplantation; functions of Tumor specific antigens.	
CO5	To impart knowledge on immunological disorders.	
UNIT	**Portion Details**	**No. of Hours**
I	Organs and Cells in Immune System and Immune Response: Primary lymphoid organs, secondary lymphoid organs, and lymphoid tissues; T – cell and B cell development and maturation –Haematopoisis reaction. Physiology of immune response- innate, humoral and cell mediated immunity; Immunohematology	
II	Antigen and Antibody: Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes; Antigen and Antibody Reactions: precipitation, agglutination, complement fixation, opsonization, neutralization; Vaccines – active and passive immunization; Classification of vaccines; Other approaches to new vaccines; Types of vaccine - antibacterial, antiviral; Vaccination schedule.	
III	Immunoassay and Immunotechniques - Preparation and standardization of bacterial antigens; Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - RIA, ELISA, Immuno fluorescence techniques.	
IV	Transplantation and Tumor Immunology - MHC Antigens - structure and function; HLA system - Regulation and response to immune system; Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumor	

	specific antigens; Immune response to tumors; Cancer diagnosis; Apoptosis. Cancer immune therapy.	
V	Immunological disorders and diseases - Hypersensitivity reactions (Type I, II, III and IV); acquired immunodeficiency syndrome; Auto immune disorders and diseases: organ specific and non-organ specific.	
	Total	

Course Outcomes	
Course Outcomes	**Upon completion of this course students will be able to**
CO1	Assess the fundamental concepts of immunity, contributions of the organs and cells in immune responses.
CO2	Investigate the structures of Ag and Ab; Immunization.
CO3	Justify the Immunoassay and Immunotechniques.
CO4	Explain about the immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation
CO5	Analyze the overreaction by our immune system leading to hypersensitive conditions and its consequences.

REFERENCE BOOKS

1. Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
2. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition., Wiley-Blackwell.
3. William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York.
4. Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4thEdition., Wiley-Blackwell.
5. Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM.3rd Edition.

SEMESTER -IV

Subject Code	**Subject Name**
	CORE PRACTICAL II **MICROBIAL GENETICS & IMMUNOLOGY**
Course Objectives	
CO1	To understand the basic principles and techniques used in microbial genetics and immunology laboratory.
CO2	To develop practical skills in DNA isolation, estimation and electrophoretic techniques.
CO3	To study genetic transfer mechanisms such as transformation and conjugation in bacteria.
CO4	To gain knowledge on antigen-antibody reactions and immunological diagnostic techniques.
CO5	To perform clinical immunological tests used in disease diagnosis and public health laboratories.
S.No	**Portion Details**
1	Isolation of genomic DNA from bacteria.
2	Extraction of plasmid DNA from bacterial cells.
3	Isolation of antibiotic resistant mutants by gradient plate technique.
4	Demonstration of bacterial transformation.
5	Demonstration of bacterial conjugation.
6	Estimation of DNA by diphenylamine method
7	Agarose gel electrophoresis of DNA samples.
8	Observation of onion root tip cell division.
9	Prepare Blood smear-Blood cells observation
10	Identification of blood groups by ABO blood grouping method.
11	WIDAL test for typhoid diagnosis.
12	VDRL / RPR test for syphilis detection.
13	Rheumatoid Arthritis (RA) test.
14	C-Reactive Protein (CRP) test.
15	Ouchterlony double immune diffusion test.

16	ELISA demonstration technique.
Course Outcomes	
Course Outcomes	On completion of this course, students will be able to:
CO1	Perform microbial genetics experiments including mutation studies and replica plating techniques.
CO2	Isolate plasmid and genomic DNA from microbial samples.
CO3	Apply DNA estimation and agarose gel electrophoresis techniques in molecular studies.
CO4	Demonstrate bacterial genetic transfer mechanisms such as transformation and conjugation.
CO5	Understand antigen-antibody reactions and interpret immunological diagnostic results.

REFERENCES

1. Murugalatha, N., Growther, L., Hena, J. V., Hemashenpagam, N., Anitha, R., Kanchana Devi, D., & Rajalakshmi, G. (2013). Microbiological Techniques. MJP Publisher.
2. Rajan, S., & Christy, E. J. (2013). Experimental Procedures in Life Sciences. Anjanaa Book House.
3. Cappuccino, J. G., & Sherman, N. (2014). Microbiology: A Laboratory Manual. Pearson.
4. Cullimore, D. R. (2010). Practical Atlas for Bacterial Identification (2nd ed.). Kindle Edition.
5. Goldman, E., & Green, L. H. (Eds.). (2015). Practical Handbook of Microbiology (3rd ed.). CRC Press.
6. Saravanan, R., Dhachinamoorthi, D., & Prasada Rao, C. H. M. M. (2019). A Handbook of Practical Microbiology. S. Chand & Company.

SEMESTER -IV

Subject Code	Subject Name
	ALLIED PRACTICAL – II – ANALYTICAL MICROBIOLOGY
Course Objectives	
CO1	To develop skills in laboratory safety practices, PPE usage, and hazard identification.
CO2	To train students in preparation of solutions, buffers, and performing dilution techniques.
CO3	To provide hands-on experience in pH measurement and basic biochemical estimations (protein and carbohydrate).
CO4	To familiarize students with operation and maintenance of laboratory instruments and sterilization methods.
CO5	To introduce fundamental histopathology techniques including tissue processing, staining, and slide preparation.
S.No	**Portion Details**
1.	Demonstration of PPE usage (lab coat, gloves, mask, goggles)
2.	Identification of hazard symbols and safety signs
3.	Cleaning, washing, and drying of laboratory glassware
4.	Preparation of glassware for sterilization (wrapping, labeling)
5.	Demonstration of sterilization and decontamination methods
6.	Preparation of molar (M) and normal (N) solutions
7.	Preparation of percentage solutions (w/v, v/v)
8.	Preparation of standard and buffer solutions
9.	Serial dilution techniques
10.	Use and calibration of pH meter
11.	Measurement of pH of different solution
12.	Calculating the concentration of proteins - Bradford assay
13.	Calculating the concentration of proteins - Lowry method
14.	Calculating the concentration of Anthrone method
15.	Operation of autoclave (sterilization of media and glassware)
16.	Use of hot air oven for dry heat sterilization
17.	Tissue fixation and processing, Embedding and microtomy (section cutting), Staining techniques (e.g., Hematoxylin and Eosin staining)
18.	Mounting of slides for microscopic observation
Course Outcomes	

Course Outcomes	On completion of this course, students will be able to:
CO1	Demonstrate proper use of PPE, safety symbols, and laboratory safety protocols.
CO2	Prepare molar, normal, percentage, and buffer solutions accurately and perform serial dilutions.
CO3	Operate and calibrate pH meter and measure pH of various samples effectively.
CO4	Perform biochemical assays such as Bradford, Lowry, and Anthrone methods for concentration estimation.
CO5	Handle laboratory instruments and carry out sterilization, tissue processing, staining, and slide mounting techniques competently.

1. Rajan, S., & Christy, E. J. (2013). *Experimental Procedures in Life Sciences*. Anjanaa Book House.
2. Cappuccino, J. G., & Sherman, N. (2014). *Microbiology: A Laboratory Manual*. Pearson Education.
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6. Plummer, D. T. (2001). *An Introduction to Practical Biochemistry*. Tata McGraw-Hill.
7. Bancroft, J. D., & Gamble, M. (2008). *Theory and Practice of Histological Techniques*. Churchill Livingstone.

SEMESTER -IV

Subject Code	Subject Name	
	CLINICAL LABORATORY TECHNOLOGY	
Course Objectives		
CO1	To provide foundational knowledge of clinical laboratory operations and their role in healthcare.	
CO2	To expose the students for specimen collection, handling, and diagnostic microbiology techniques.	
CO3	To introduce advanced diagnostic methods including molecular and immunological techniques.	
CO4	To emphasize biosafety, ethics, and quality assurance in clinical laboratory practice.	
CO5	To impart training to the students for taking up the professional roles in hospital laboratories, diagnostic centers, and research facilities.	
UNIT	**Portion Details**	**No. of Hours**
I	**Introduction to Clinical Laboratory Technology:** Introduction and scope-Definition of Clinical Laboratory technology, role of clinical laboratories in disease diagnosis, monitoring and prevention, Evolution and current trends in clinical laboratory science. Laboratory safety-Personal Protective equipment (PPE),Laboratory ethics and patient confidentiality. Biosafety levels and infection control practices	
II	**Organization of Clinical Laboratory:** Organization of Clinical Laboratory-Structure, Hospital- based, reference and public health laboratories. Workflow of diagnostic labs- Specimen collection to report generation. Specimen collection and processing- Types of clinical specimen- blood, urine, sputum, stool, CSF, swabs-collection methods, transport media and storage conditions, Rejection criteria for poor sampling. Automation in specimen handling.	
III	**Diagnostic Microbiological Techniques:** Introduction to Microbiological methods- Bacteriology- culture methods, biochemical test and antibiotic susceptibility testing. Mycology- fungal culture, staining and identification. Virology-Cell culture- Types and uses, serological test, rapid antigen detection. Parasitology-Stool examination, blood parasite detection and immunodiagnostic methods	
IV	**Advanced Diagnostic Methods:** Molecular diagnostics-PCR, RT-PCR, Sequencing-Principle, Procedure and uses. Immunological methods: ELISA, Western blot--Principle, Procedure and uses. Rapid diagnostic immunological kits. Automation in Pre-analytical Phase of Laboratory Testing. Quality control in advanced diagnostics.	
V	**Laboratory Quality Assurance and Accreditation:** Quality Control programs in Clinical Laboratories- Internal and external, Standard operating procedures (SOPs), Laboratory accreditation-NABL,ISO standards, Case studies on diagnostic errors and corrective actions.	

	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Explain the organization, workflow, and ethical responsibilities of clinical laboratories.
CO2	Demonstrate correct procedures for specimen collection, transport, and processing of clinical specimens.
CO3	Perform diagnostic microbiology tests for bacteria, fungi, viruses, and parasites and apply biosafety and quality assurance practices in laboratory operations
CO4	Evaluate diagnostic methods and select appropriate tests for specific infections.
CO5	Integrate theoretical knowledge with practical skills to contribute effectively to healthcare diagnostics.

REFERENCE

1. Praful B. Godkar and Darshan P.Godkar(2021)Textbook of Medical Laboratory Technology (Vol. 1 & 2**)** by Book Bundle publisher.
2. Mary Louise Turgeon(2025)Immunology and Serology in Laboratory Medicine (8th Edition) by Churchill Livingstone publisher.
3. Patricia M. Tille (2024) Bailey and Scott's Diagnostic Microbiology (16th Edition) by Elsevier publisher.
4. Paula R. Howard and Wyenona Hicks (2024)Basic & Applied Concepts of Blood Banking and Transfusion Practices (6th Edition) by Elsevier publisher.
5. Connie R. Mahon and Carol A. Rentas (2026). Management and Leadership in the Clinical Laboratory, (Edition 1) by Elsevier publisher.
6. Praful B and Godkar (2024).Medical Biochemistry (1thEdition) byCBS Publishers & Distributors Pvt. Ltd.

Web Resources

1. https://www.microbe.net/resources/microbiology/web-resources/
2. https://www.omicsonline.org/medicalmicrobiology-diagnosis.php.
3. https://currentprotocols.onlinelibrary.wiley.com/
4. https://clinlab.ucsf.edu/
5. https://library.med.utah.edu/WebPath/TUTORIAL/URINE/URINE.html.
6. http://www.hematologyatlas.com/principalpage.htm.
7. https://www.bloodline.net/ 8. http://www.protocol-online.org/prot/Histology/index.htm.

SEMESTER – IV

Subject Code	Subject Name	
	BIOSAFETY AND BIOETHICS	
Course Objectives		
CO1	To illustrate the perspective of ethical values and bioethics.	
CO2	To describe biosafety in environmental and medical research.	
CO3	To interpret different levels of biosafety cabinets.	
CO4	To analyze the discarding of hazardous waste.	
CO5	To explain the rules and regulations of biosafety and microbiological practices.	
UNIT	**Portion Details**	**No. of Hours**
I	**Bioethics:** Biotechnology ethics in agriculture and environment: GM crops and GMO‟s - benefits and risks – ethical aspects of genetic testing – ethical aspects relating to use of genetic information and bio-warfare.	
II	**Ethics in Cloning:** Ethical implications of cloning -Reproductive cloning, therapeutic cloning; Ethical, legal and socio-economic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research.	
III	**Ethics in Waste disposal:** Discarding biohazardous waste - Methodology of Disinfection, Autoclaving (Dry and Moist) & Biological and Chemical Incineration- types of biosafety containment.	
IV	**Biosafety:** Introduction - Biosafety issues in microbiology – risk assessment and risk management – safety protocols: risk groups – biosafety levels – Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL- 1, BSL-2, BSL-3.	
V	**Biosafety Guidelines :** Biosafety regulations (National and International) – Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), State Biosafety Coordination Committee (SBCC), District Level Committee (DLC).	
	Total	
Course Outcomes		
Course Outcomes	On completion of this course, students will be able to:	
CO1	Explain the ethical issues associated with applications in agriculture, environment,	

	genetic testing, and bio-warfare.
CO2	Discuss the ethical and socio-economic implications of cloning and gene therapy.
CO3	Explain the types of levels of Biosafety cabinets.
CO4	Analyze and predict the biosafety in using genetically modified organisms
CO5	Evaluate the biosafety guidelines for microbiology research

REFERENCE

1. Joshi, R. M. (2006). Biosafety and bioethics. Gyan Books Pvt. Ltd.
2. Ministry of the Environment and Government of India. (2006). Regulatory framework for GMOs in India. Government of India.
3. Ministry of Environment and Forests, Government of India. (2006). Cartagena protocol on biosafety. Government of India.
4. Bhattacharya, S., 2006. *Bioethics: Principles, Issues and Cases.* New Delhi: Elsevier India.
5. Dubey, R.C. and Maheshwari, D.K., 2013. *A Textbook of Microbiology*. 4th ed. New Delhi: S. Chand Publishing.
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SEMESTER – IV

Subject Code	Subject Name	
	VETERINARY MICROBIOLOGY	
Course Objectives		
CO1	To explore the different aspects of small and large domestic animals, laboratory animals, and poultry while highlighting their economic importance.	
CO2	To introduce the students to recent developments in the diagnosis and management of animal diseases.	
CO3	To provide knowledge on the prevention and control strategies for bacterial, fungal, and viral diseases in livestock.	
UNIT	**Portion Details**	**No. of Hours**
I	**Veterinary Microbiology:** Small and large domestics animals, laboratory animals, poultry lives. Economical importance of small, large and poultry animals. Recent development in animal disease diagnosis and management.	
II	**Veterinary Bacteriology:**Morphology, cultural, antigenic, epidemiology and pathogenicity, diagnosis, prevention and control of bacterial diseases caused by following bacteria: *Staphylococcus aureus,Corynebacterium, Truperella, Listeria, Mycobacterium pseudotuberclosis* and *Erysepelothrix. Bacillus Anthrox*	
III	**Veterinary Mycology and Virology:** Growth, reproduction, pathogenicity, treatment and control measures of following fungi: *Candida, Rhinosporidium* and *Sporotrichum*. Mycotic mastitis and mycotic abortion. Veterinary Virology- genetic and non-genetic viral interactions in animals. Common viral diseases in cow and pig. Disease producing viruses in livestock's. Parasitic Disease – *Tenia solium, Tenia sarcinata.*	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Describe the role of microbiologist in managing the health of domestic and poultry animals and its impact on the economy.
CO2	Identify and characterize key veterinary bacterial pathogens and understand their epidemiological patterns to implement control measures.
CO3	Discuss genetic and non-genetic viral interactions in animals and identify the causative agents of common viral diseases in cows and pigs.

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SEMESTER - V

Subject Code	Subject Name	
	MEDICAL BACTERIOLOGY AND MYCOLOGY	
Course Objectives		
CO1	Acquire Knowledge on collection, transportation and processing of various kinds of clinical specimens.	
CO2	Explain morphology, characteristics and pathogenesis of bacteria.	
CO3	Discuss various factors leading to pathogenesis of bacteria.	
CO4	Acquire knowledge on antifungal agents and their importance.	
CO5	Describe various diagnostic methods available for fungal disease diagnosis	
UNIT	**Portion Details**	**No. of Hours**
I	Classification of medically important bacteria, Normal flora of human body, Collection, transport, storage and processing of clinical specimens, Microbiological examination of clinical specimens, antimicrobial susceptibility testing. Handling and maintenance of laboratory animals – Rabbits, guinea pigs and mice.	
II	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of *Staphylococci, Streptococci, Pneumococci, Neisseriae., Bacillus, Corynebacteria, Mycobacteria* and *Clostridium.*	
III	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by Enterobacteriaceae members, *Yersinia, Pseudomonas, Vibrio, Mycoplasma, Helicobacter, Rickettsiae Rickettsi, Chlamydiae, Bordetella, a*nd *Treponema*. Nosocomial, zoonotic and opportunistic infections -prevention and control.	
IV	Morphology, taxonomy and classification of fungi. Detection and recovery of fungi from clinical specimens. Dermatophytes and agents of superficial mycoses. *Trichophyton, Epidermophyton & Microsporum*. Yeasts of medical importance – *Candida, Cryptococcus*.	

	Mycotoxins. Antifungal agents, testing methods and quality control.	
V	Dimorphic fungi causing Systemic mycoses, *Histoplasma, Coccidioides, Sporothrix, Blastomyces.* Fungi causing Eumycotic Mycetoma, Opportunistic fungi- Fungi causing secondary infections in immunocompromised patients. Immunodiagnostic methods in mycology- Recent advancements in diagnosis. Antifungal agents.	
	Total	

Course Outcomes	
Course Outcomes	Upon completion of this course students will be able to
CO1	Collect, transport and process of various kinds of clinical specimens.
CO2	Analyze various bacteria based on morphology and pathogenesis.
CO3	Discuss various treatment methods for bacterial disease.
CO4	Employ various methods detect fungi in clinical samples and apply knowledge on antifungal agents.
CO5	Apply various immunodiagnostic methods to detect fungal infections.

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SEMESTER - V

Subject Code	Subject Name	
	FOOD AND DAIRY MICROBIOLOGY	
Course Objectives		
CO1	To understand the importance of microorganisms in food and dairy products.	
CO2	To study food spoilage organisms and methods of food preservation.	
CO3	To gain knowledge on milk microbiology and fermented dairy products.	
CO4	To understand the role of microorganisms in food fermentation and probiotics.	
CO5	To study food safety measures, quality control systems and food borne diseases.	
UNIT	**Portion Details**	**No. of Hours**
I	**Fundamentals of Food Microbiology :** Food as a substrate for microorganisms, intrinsic and extrinsic factors affecting microbial growth in foods, natural microflora of food, sources of contamination in food and milk, and microorganisms important in food microbiology such as bacteria, fungi and yeasts.	
II	**Food Preservation and Food Spoilage:** General principles of food preservation, preservation by high and low temperature, drying, irradiation and chemical preservatives, microbial spoilage of cereals, fruits, vegetables, meat, fish, eggs and canned foods, and biological methods of food preservation.	
III	**Dairy Microbiology :** Composition and microbiology of milk, sources of milk contamination, pasteurization and preservation of milk, spoilage of milk and dairy products, starter cultures used in dairy industry, and microbiological examination of milk.	
IV	**Fermented Foods and Probiotics:** Production and microbiology of fermented foods including curd, yoghurt, cheese, kefir, bread and vinegar, microorganisms used in food fermentation, probiotics and prebiotics, nutritional importance of fermented foods, and microbial enzymes used in	

	food industries.	
V	**Food Safety and Quality Control:** Food borne infections and intoxications, bacterial and fungal food poisoning, food sanitation and hygiene, HACCP, GMP, microbiological quality standards of foods and milk, food safety regulations including FSSAI, BIS and AGMARK, and quality control in food and dairy industries.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will be able to
CO1	Explain the principles and scope of food and dairy microbiology.
CO2	Identify microorganisms involved in food spoilage and food preservation.
CO3	Understand the microbiology of milk and dairy products.
CO4	Apply knowledge of fermented foods, starter cultures and probiotics.
CO5	Apply food safety regulations and quality control systems including GMP and HACCP.

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SEMESTER – V

Subject Code	Subject Name	
	ENVIRONMENTAL MICROBIOLOGY	
Course Objectives		
CO1	To understand the basic concepts and scope of environmental microbiology.	
CO2	To study microorganisms present in air, water and environment and their significance.	
CO3	To gain knowledge on air sanitation, water purification and environmental monitoring techniques.	
CO4	To understand waste management, biodegradation and bioremediation processes.	
CO5	To study environmental pollution, biosafety measures, GMP and HACCP systems related to public health.	
UNIT	**Portion Details**	**No. of Hours**
I	**Fundamentals of Environmental Microbiology :** Introduction to environmental microbiology, scope and importance of environmental microbiology, microbial habitats and ecosystems, distribution of microorganisms in environment, microbial interactions, environmental factors influencing microbial growth, and microbial ecology.	
II	**Air Microbiology and Air Sanitation:** Composition and microflora of air, Airborne microorganisms, sources of air contamination, air sampling devices and techniques, air sanitation methods including UV radiation and filtration, indoor air quality monitoring, and microbial control of air pollutants, and standards for air hygiene.	
III	**Water and Wastewater Microbiology:** Microbiology of potable water and aquatic environments, water microflora,Water pollution and sources of contamination, water borne pathogens and diseases, indicators of water quality, microbiological examination of water, MPN test for water analysis, purification of drinking water, chlorination and disinfection methods, sewage and wastewater treatment processes, biological oxygen demand (BOD), chemical oxygen demand (COD), eutrophication, and microbial analysis of potable water and wastewater.	

IV	**Applied Environmental Microbiology:** Solid and industrial waste management, biodegradation of pollutants, bioremediation of contaminated environments, microbial treatment of pollutants, biofertilizers, biopesticides, biomining and bioleaching, microbial recovery of pollutants, biogas production, biodegradation of xenobiotics, microbial applications in environmental protection, and role of microorganisms in sustainable agriculture and waste recycling.	
V	**Environmental Safety and Public Health Management:** Environmental sanitation and hygiene, biosafety measures, hazard analysis and risk assessment, environmental monitoring techniques, waste management regulations, biomedical waste management, quality control systems including GMP and HACCP, and public health microbiology.	
	Total	

Course Outcomes

Course Outcomes	On completion of this course, students will be able to
CO1	Explain the principles and importance of environmental microbiology.
CO2	Identify microorganisms associated with air, water and environmental pollution.
CO3	Apply microbiological techniques for environmental analysis and monitoring.
CO4	Demonstrate knowledge on air sanitation, water purification and sewage treatment methods.
CO5	Apply biosafety measures, GMP and HACCP systems in environmental health management.

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SEMESTER - V

Subject Code	Subject Name	
	RECOMBINANT DNA TECHNOLOGY	
Course Objectives		
CO1	To understand the basics and applications of recombinant DNA technology.	
CO2	To study cloning vectors and enzymes used in genetic engineering	
CO3	To learn gene cloning, library construction and gene transfer methods	
CO4	To understand screening and selection of recombinant organisms	
CO5	To study recombinant products, transgenic organisms, and PCR applications	
UNIT	**Portion Details**	**No. of Hours**
I	**Recombinant DNA:** Historical perspective and early experiment, Achievements of r-DNA technology. Basic steps involved in r-DNA Technology-Isolation, purification of DNA, RNA and Plasmid. General features of Vector.	
II	**Cloning vectors:** Plasmid based vectors -Natural (pSClOl, pMBl), Artificial – pBR322 and pUC18. Phage based vectors – A (Lambda) phage, M13. Hybrid vectors – Phagemid, Phasmid and Cosmid, BAC and YAC.	
III	**Enzymes in Genetic Engineering:** Restriction endonucleases -Types, Nomenclature, ligases, Alkaline phosphatase, polynucleotide kinase, Terminal deoxynucleotide transferase – III, Taq polymerase, Reverse transcriptase – use of linkers and adaptors. Gene cloning in prokaryotes – Cloning strategies – Construction of genomic libraries and cDNA libraries	
IV	**Gene transfer methods and screening:** Transfection – Electroporation and particle bombardment – microinjection – liposome mediated gene transfer, Biological in-vitro pakage, ultrasonication– Screening of cloned foreign genes - Screening and selection of recombinants.	
V	**Microbial synthesis of commercial products:** Insulin, Interferons, Human growth hormone, recombinant COVID – 19 Vaccines Transgenic Plants–(Ti plasmid) insect resistant plant, golden rice. Transgenic animal – mice –	

	retroviral method, PCR methods and its applications.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Explain the principles and steps of recombinant DNA technology
CO2	dentify different cloning vectors and their applications.
CO3	Describe enzymes and techniques used in genetic engineering
CO4	Understand gene transfer, screening, and cloning strategies
CO5	Discuss recombinant products, transgenic organisms, and PCR applications

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SEMESTER - V

Subject Code	Subject Name	
	MICROBIAL TECHNOLOGY	
Course Objectives		
CO1	To understand the role of microorganisms in food, dairy, and fermented product production.	
CO2	To study microbial production of antimicrobials, organic acids, and industrial enzymes.	
CO3	To learn principles and applications of microbial wastewater and solid waste treatment.	
CO4	To gain knowledge on biofertilizers, biopesticides, and plant growth–promoting microorganisms.	
CO5	To explore the use of microorganisms in renewable bioenergy production and environmental sustainability	
UNIT	**Portion Details**	**No. of Hours**
I	Beverages and enzymes – Role of microorganisms in food and dairy industry. Fermented beverages-beer, wine and other alcoholic beverages. Microbial preparation of Tempeh, sauerkraut, Miso, yogurt. Probiotics. Single cell protein. Mushroom cultivation	
II	Antimicrobials, Organic acids and enzymes- microbial production of pencillin, Tetracycline and peptide antibiotics; Acetic acid; Lactic acid; Gluconic acid. Microbial production and commercial applications of Amylases, Proteases, Lipases. Biotransformation of steroids.	
III	Microbiology of wastewater and solid waste treatment: - biological, aerobic, anaerobic, primary, secondary and tertiary treatments. Activated sludge and Anaerobic digestion process. Treatment of industrial effluents by microorganisms. Composting. Microbiology of degradation of xenobiotics. Bioremediation of insecticides, pesticides and heavy metals.	
IV	Plant Growth Promoting Rhizobacteria (PGPR). Biofertilizers- Rhizobium, Azospirillum, Azotobacter, Gluconacetobacter, Azorhizobium, phosphobacteria - mycorrhizae - Blue Green Algae and Azolla. Biopesticides - Bacillus thuringiensis, NPV, Beauveria bassiana. Mass production of biofertilizers and biopesticides.	

V	Renewable bioenergy using microorganisms – Methanogenesis, Methane production by anaerobic digestion of waste organic materials. Bioethanol and Biobutanolproduction by using microorganisms. Biohydrogen Generation, Microbial Fuel. Biodiesel from algae.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Explain microbial processes involved in food fermentation, probiotics, and mushroom cultivation.
CO2	Describe the industrial production and applications of antibiotics, organic acids, and enzymes.
CO3	Analyze wastewater treatment methods and microbial roles in bioremediation.
CO4	Evaluate the importance and application of biofertilizers and biopesticides in agriculture.
CO5	Demonstrate understanding of microbial bioenergy production such as bioethanol, biogas, and biodiesel.

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SEMESTER - V

Subject Code	Subject Name	
	MICROBIAL QUALITY CONTROL AND TESTING	
Course Objectives		
CO1	To introduce to the students the principles and practices of microbial quality control in food, water, pharmaceuticals, and clinical laboratories.	
CO2	To familiarize students with national and international regulatory standards and guidelines for microbial testing.	
CO3	To develop skills in quality assurance, documentation, and laboratory accreditation processes.	
CO4	To provide training to students in conventional and modern microbial detection methods, including culture-based and rapid techniques.	
CO5	To emphasize the importance to apply microbial quality control concepts in industrial, clinical, and environmental settings.	
UNIT	**Portion Details**	**No. of Hours**
I	**Fundamentals of Microbial Quality**: Introduction to Microbial Quality control-Definition, scope and importance in healthcare & industry. Difference between quality control and quality assurance in microbiology. Sources of contamination in food, water, pharmaceuticals, and clinical samples. Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).	
II	**Sampling and Microbial testing methods**: Sampling techniques for food, water, and pharmaceutical products. Culture-based methods- plate count, MPN, membrane filtration. Rapid detection methods- ATP bioluminescence, immunoassays, PCR-based techniques. Sterility testing- principle, importance and limitations and endotoxin testing- types and validation.	
III	**Quality assurance in Microbiology**: Validation of microbiological methods. Documents and record keeping-Document hierarchy, good documentation practices. Internal and External quality audits-planning and conducting internal audits. Accreditation of microbiological laboratories-Definition and need for accreditation, Accreditation bodies-NABL, ISO 17025, NABL accreditation process, documentation for accreditation and maintaining accreditation.	
	Total	
Course Outcomes		
Course	On completion of this course, students will:	

Outcomes	
CO1	Demonstrate proficiency in sampling and microbial testing methods for food, water, and pharmaceutical products.
CO2	Apply quality assurance practices, including validation, documentation, and audits, in microbiology laboratories.
CO3	Evaluate microbial risks and design control strategies in food, water, pharmaceutical, and clinical sectors.
CO4	Perform practical experiments such as enumeration, sterility testing, and rapid microbial detection with accuracy and reliability.
CO5	Integrate theoretical knowledge with practical skills to meet industry and research requirements in microbial quality control.

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SEMESTER-VI

Subject Code	Subject Name
	MEDICAL VIROLOGY AND PARASITOLOGY

Course objectives	
CO1	To learn isolation, cultivation and purification methods used for viruses.
CO2	Acquire Knowledge about medically important Viruses and diseases.
CO3	To gain Knowledge about re-emerging Viral diseases.
CO4	To introduce general Parasitology and to impart advanced knowledge on various important protozoan parasites.
CO5	To provide the basic knowledge about medically important helminths and their detection methods

Unit	**Portion Details**	**No. of Hours**
I	General properties of viruses- Structure and classification of viruses- Cultivation of viruses (in animals, embryonated eggs and tissue culture)- Virus purification assays	
II	Viral diseases with reference to symptoms, pathogenesis, transmission, laboratory diagnosis, treatment and control- DNA Viruses (Pox virus, Herpes, Adeno, Papova), RNA Viruses (Polio, Orthomyxo, Rhabdo, HIV, and Hepatitis viruses), Oncogenic viruses (Human papilloma Virus)	
III	Emerging and re-emerging viral infections (SARS, Swine flu, Ebola, Dengue, Chikungunya, and Corona)- Serological and molecular diagnosis, antiviral agents and viral vaccines.	
IV	Introduction to Medical Parasitology- Classification, Host parasite relationship. Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment for the following protozoan parasites- *Entamoebahistolytica*, *Giardia intestinalis*, *Leishmaniadonovani*, *Trypanosomacruzi* and *Plasmodium spp*	
V	Introduction to helminths, Platyhelminthes- *Taeniasollium*, *Fasciola hepatica*, *Paragonimuswestermani*. Nemathelminthes- *Ascarislumbricoides*, *Enterobiusvermicularis*, *Wuchereriabancrofti*. Diagnosis of parasitic infections- Examination of feaces and blood.	
	Total	

Course outcomes	
Course outcomes	On completion of this course, students will;

CO1	Understand the architecture of viruses, their classification and the methods used in their study.
CO2	Comprehend the role of viruses in diseases and ways of preventing/ treating viral infections.
CO3	Understand the principles of antiviral therapy, vaccine design, and the management of emerging and re-emerging viral threat
CO4	Identify and understand the morphology, life cycles, and pathogenicity of medically significant protozoa and helminths
CO5	Develop practical skills in diagnosing parasitic infections through microscopic identification of parasite stages in clinical samples

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SEMESTER-VI

Subject Code	Subject Name	
	BIOPROCESS AND PHARMACEUTICAL MICROBIOLOGY	
Course Objectives		
CO1	Discuss about fermentation and its types, sensitize on methods of strain development for improved yield.	
CO2	Impart knowledge on the fermenter design and types.	
CO3	Acquire knowledge on the effective recovery and purification of the products.	
CO4	Explain the importance of pharmaceutical microbiology.	
CO5	Illustrate methods for production products using microorganisms and their quality control.	
UNIT	**Portion Details**	**No. of Hours**
I	Scope of Bioprocess, Industrially important microorganisms – screening - primary and secondary, preservation and improvement of industrially important strains. Upstream processing - Development of inoculums for fermentation process. Media for industrial fermentation - Formulation, optimization. Sterilization. Stages of upstream - fermenter pre-culture and production fermentation. Types of fermentation - Batch, continuous, dual or multiple, surface, submerged, aerobic and anaerobic.	
II	Fermenter – Design, types and construction, Heat production. Aeration and agitation. Gas exchange and mass transfer. Computer Applications in fermentation technology. Downstream Processing - Recovery and purification of intracellular and extracellular products. Biomass separation by centrifugation, filtration, flocculation and other recent developments. Cell disintegration - Physical, chemical and enzymatic methods. Drying and crystallization.	
III	Microbial production of organic acids (Citric acid, Lactic acid), Amino acids (L - Glutamic acid and L - Lysine), Antibiotics (Penicillin, Tetracycline's), enzymes (Amylases, Pectinases), vitamins (B12 and C),	

	alcoholic beverages (Ethanol and Wine).	
IV	Current good manufacturing practices, Good laboratory practices, Good documentation practices, Standard operating procedures, FSSAI, HACCP, ISO Standards, Laboratory information management system (LIMS). Pharmacopaea– Pharmacopaea updates, US, Europea, British and Indian Standard Organization, Audit related to pharma. United States Federal Drug Administration Audits.	
V	Growth promotion test (GPT), Disinfectant efficacy study for different types of Disinfectants, Container Closure Integrity test (CCIT), Preservative efficacy study (PET), Qualitative and quantitative methods of environmental monitoring samples, Gowning qualifications, Isolation and identification of isolates - VITEK - Biochemical method, Trend analysis, Results and Discussions reporting (OOS & OOT), Out of specifications and Out of trend.	
	Total	

Course Outcomes	
Course Outcomes	**Upon completion of this course students will be able to**
CO1	Develop microbial strains, carry out fermentation and recover the products of the process.
CO2	Design fermenters according to needs for various products.
CO3	Recover the end products of the fermentation process economically.
CO4	Utilize the knowledge on pharmaceutical microbiology for industrial production of products.
CO5	Produce therapeutic products from microbes employing technology and analyze the quality the products.

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SEMESTER-VI

Subject Code	Subject Name	
	SOIL AND AGRICULTURAL MICROBIOLOGY	
Course objectives		
CO1	Discuss the distribution of soil microorganisms and the role of soil microbes in biogeochemical cycle.	
CO2	Explain the role of soil microbes in organic matter decomposition and soil fertility.	
CO3	Discuss the interaction of soil microbes and their benefits.	
CO4	Gain knowledge on various plant diseases and pathogens.	
CO5	Acquire awareness about microbes as Biofertilizer and biocontrol agents.	
Unit	**Portion Details**	**No. of Hours**
I	Soil microflora and significance of soil microbes. Autochthonous and zymogenous. Soil profile- Soil formation. Factors influencing the soil microbial population. Biogeochemical cycle- Carbon, Nitrogen, Phosphorous, Sulphur.	
II	Decomposition of organic matter, humus formation and composting. Biological nitrogen fixation- Nitrogen fixers- types- *Rhizobium*, Symbiotic and non-symbiotic nitrogen fixation. Root nodule formation, Structure of nodule and biochemistry of nitrogen fixation, Nitrogenous, nitrogen fixation in cyanobacteria, Heterocyst.	
III	Microbial interactions- Commensalism, Synergism, Mutualism. Amensalism, Competition, Parasitism and predation. Interaction of microbes with plants. Rhizosphere, Phyllosphere, Mycorrihzae, PGPR (Plant growth promoting Rhizobacteria), Rumen flora, Insect symbiosis.	
IV	Plant pathology- Mode of entry of pathogen, symptoms, disease cycle and control measures- Bacterial diseases- Citrus canker, Blight of rice. Fungal diseases- Red rot of sugarcane, Tikka leaf spot of groundnut. Viral diseases- TMV, vein clearing disease of Bhendi (*Abelmoschusesculentus)*. Plant defense mechanism-SAR, PR, Planty bodies, Phenolic and Phytalexin	
V	Biofertilizers- Classification, Mass cultivation and field application- *Rhizobium*, *Azatobacter*, *Azospirllium*. Phosphate solubilizers, Potash mobilizers (*Frateuriaaurentia)*, VAM, Azolla. Green manure and organic farming. Biopesticides- Classification, mode of action -Bacterial insecticides (*Bacillus thuringiensis*) and Viral insecticides – NPV, Fungal - *T.viridae*. Significance of biofertilizers and biocontrol agents.	

	Total	

Course outcomes	
Course outcomes	On completion of this course, students will;
CO1	Understand the diversity and significance of soil microbes in biogeochemical cycle.
CO2	Analyse the role of microbes in biological nitrogen fixation.
CO3	Utilize the knowledge of microbial interactions with beneficial applications.
CO4	Gain knowledge about plant diseases caused by microbes and acquire a clear idea on pathogenic interactions and control measures.
CO5	Apply knowledge of microbial activities to create biofertilizers, bio pesticides, and green manures.

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6. Robert, L Tate (1995). Soil Microbiology. First edition, John Wiley and Sons, Inc. New York.
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SEMESTER-VI

Subject Code	Subject Name
	CORE PRACTICAL III - MEDICAL MICROBIOLOGY
Course objectives	
CO1	To learn the techniques for isolation, identification of bacterial pathogens and antimicrobial sensitivity.
CO2	Impart knowledge on medically important fungi
CO3	To learn various techniques for the isolation of clinically important viral pathogen.
CO4	Develop skills in the diagnosis of parasitic infection
S.No	**Portion Details**
1	Simple, Differential and special staining of clinical samples
2	Identification of bacterial pathogens by their biochemical reactions- IMViC, TSI, Catalase, Urease and Oxidase
3	Microscopic identification of medically important Fungi by KOH and LPCB staining.
4	Slide culture technique for Fungal identification.
5	Examination of *Candida albicans* by Gram staining and Germ tube test.
6	Carbohydrate assimilation test for Yeast
7	Isolation of bacteriophage from sewage
8	ELISA- HIV/ HBsAg
9	Demonstration of protozoan cyst and helminthic eggs by direct examination
10	Stool examination by Formalin-ether sedimentation and Zinc-sulphate flotation technique.
11	Blood smear examination for malarial parasite.
12	Antimicrobial susceptibility test by Kirby Bauer Disc Diffusion method.
Course outcomes	
Course outcomes	On completion of this course, students will;
CO1	Identify medically important Bacteria, Fungus and Parasites from the clinically samples by staining and biochemical test.

CO2	Promote diagnostics skills, interpret laboratory test in the diagnosis of infectious diseases.
CO3	Isolate and identify bacteriophage from natural sources.
CO4	Perform antibiotic sensitivity test and compare with the standard charts.

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SEMESTER-VI

Subject Code	Subject Name
	CORE PRACTICAL- IV- APPLIED MICROBIOLOGY

Course objectives	
CO1	Improve Knowledge on common plant pathogen
CO2	Analyse and estimate water quality and potability
CO3	To acquire knowledge on enumeration of bacteria from milk and milk quality analysis
CO4	Develop skills on the isolation of extracellular enzyme producers from soil
S.No	**Portion Details**
1	. Enumeration of bacteria and fungi from soil
2	Isolation of nitrogen fixing bacteria from root nodules.
3	Demonstration of phosphate solubilisation
4	Study of plant pathogens- Tikka disease, citrus canker, Blight of paddy and Red rot of sugarcane
5	Study of Morphology of cyanobacteria- *Oscillatoria, Anabaena*
6	MPN test (Presumptive, completed and confirmatory test)
7	Chemical assessment of water- DO, BOD, COD
8	Enumeration of microbes from air by settle plate method.
9	Isolation and identification of microbes from fruits and vegetables.
10	Methylene blue reductase test and Resazurin test
11	Microbiological examination of milk by SPC
12	Isolation of extra cellular enzyme producers- Amylase, protease and lipase

Course outcomes	
Course outcomes	On completion of this course, students will;
CO1	Identify and differentiate important plant pathogens associated with bacterial and fungal diseases affecting agricultural crops.
CO2	Access the microbial quality of water and air and relate the results to standards
CO3	Evaluate the quality of milk and enumerate the bacteria in milk by SPC

CO4	Interpret the results of enzyme activity assays and correlate microbial growth with enzyme production.

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SEMESTER - II

Subject Code	Subject Name	
	SERICULTURE	
Course Objectives		
CO1	Understand sericulture as an agro-based industry and the nature and varieties of silk produced in India.	
CO2	Gain knowledge of mulberry cultivation, varieties, and management practices for quality leaf production.	
CO3	Learn principles and environmental requirements for efficient silkworm rearing.	
CO4	Identify major silkworm diseases, pests, and their prevention and control measures.	
CO5	Understand cocoon marketing, grading, pricing, and the role of supportive agencies in sericulture development	
UNIT	**Portion Details**	**No. of Hours**
I	**Sericulture as n Agro-Industry:** Nature of silk – Conciseaccount of four varieties of silk produced in India – Life cycle of silkworm – Economic importance and prospects of silk fibers. Sericulture Research institution in India and its schemes.	
II	**Mulberry Cultivation:** Mulberry-silkworm, different varieties of mulberry - Cultivation of food plants – mulberry, Harvesting and Preservation of mulberry leaves. Disease – powdery mild dew leaf spot – Prevention and Control of insect pests	
III	**Silk Worm Rearing:** Principles of silkworm rearing – Facilities for rearing – Rearing housing and rearing equipment– Environmental conditions for rearing silk worms – Temperature, humidity, light and air. Rearing of late stage of silkworm – Mounting and Harvesting	
IV	**Diseases of Silkworms:** Causative agent, infection symptoms and control measures of Disease Pebrine, Flacheries, Grasseries, and Calcimo. Uzifly (Tricholygeabambyis) life cycle and disease - Dermistid beetle - life cycle, disease and culture.	
V	**Cocoon Marketing and Agencies:** Cocoons Sorting–testing and grading .Price fixation, Cocoon auctioning, silk exchange supportive agencies–DRDA, ISDP,	

	National Banks, NABARD and Co-operative institutions. Employment potential of sericulture industry in rural India	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Explain the life cycle of silkworms and economic importance of sericulture in rural development.
CO2	Apply appropriate mulberry cultivation and leaf preservation techniques.
CO3	Demonstrate effective silkworm rearing practices under controlled environmental conditions.
CO4	Diagnose common silkworm diseases and implement suitable control measures.
CO5	Analyze cocoon marketing systems and evaluate employment opportunities in the sericulture industry.

REFERENCE

1. Johnson, M. and Kesary, M. (2020). Sericulture.(Ed. 1).Saras Publication.

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SEMESTER - III

Subject Code	Subject Name	
	ORGANIC FARMING AND BIOFERTILIZER TECHNOLOGY	
Course Objectives		
CO1	To understand the principles, scope and importance of organic farming.	
CO2	To study soil fertility, composting and organic nutrient management.	
CO3	To learn the types and functions of biofertilizers.	
CO4	To understand mass production, formulation and quality control of biofertilizers.	
CO5	To gain knowledge on application methods, organic certification and entrepreneurship opportunities.	
UNIT	**Portion Details**	**No. of Hours**
I	**Introduction to Organic Farming:** Definition, principles, scope and importance of organic farming – conventional farming versus organic farming – sustainable agriculture – soil health and organic matter – advantages and limitations of organic farming.NPOP	
II	**Organic Nutrient Management:** Farmyard manure, green manure, compost, vermicompost and oil cakes – composting methods – crop residue recycling – biochar – role of microorganisms in decomposition – integrated nutrient management.	
III	**Biofertilizers:** Definition, types and importance of biofertilizers – nitrogen-fixing biofertilizers: *Rhizobium*, *Azotobacter*, *Azospirillum* and cyanobacteria – phosphate solubilizing microorganisms – potassium solubilizers – mycorrhiza and plant growth-promoting rhizobacteria.	
IV	**Biofertilizer Production Technology:** Isolation and selection of efficient strains – mass multiplication – carrier-based and liquid biofertilizers – formulation, packing, storage and shelf life – quality control standards – contamination testing and viability count.BIS standards for biofertilizers, Fertilizer Control Order	
V	**Application, Certification and Entrepreneurship:** Seed treatment, seedling root dip and soil application methods – field application of biofertilizers – organic pest and disease management – organic certification and standards – marketing, economics and entrepreneurship opportunities in organic inputs.	

	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Explain the principles and significance of organic farming in sustainable agriculture.
CO2	Describe organic nutrient sources and composting methods for soil fertility improvement.
CO3	Identify different types of biofertilizers and their role in plant growth promotion.
CO4	Demonstrate basic methods of biofertilizer production, formulation and quality control.
CO5	Apply biofertilizers in field conditions and evaluate entrepreneurship opportunities in organic farming.

REFERENCE

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4.Sharma AK. *Biofertilizers for Sustainable Agriculture*. Agrobios (India); 2002.
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SEMESTER - IV

Subject Code	Subject Name	
	MUSHROOM TECHNOLOGY	
Course Objectives		
CO1	Understand the history, scope, and current status of mushroom cultivation and industry in India.	
CO2	Learn pure culture techniques, media preparation, and spawn production methods.	
CO3	Gain knowledge of cultivation practices including infrastructure, substrates, and inoculation methods.	
CO4	Understand preservation techniques, post-harvest handling, and storage of mushrooms.	
CO5	Identify nutritional, medicinal, and commercial importance of edible and medicinal mushrooms along with poisonous types.	
UNIT	**Portion Details**	**No. of Hours**
I	**Introduction to Mushroom Technology:** Introduction – History – Scope and importance of mushroom cultivation. Present status of mushroom industry in India – Mushroom research and development.	
II	**Pure Culture and Spawn Production:** Pure Culture- Media –Preparation and maintenance of mother culture. Spawn production– types – methods, storage and transportation.	
III	**Cultivation and Preservation Technology:** Cultivation Technology – Infrastructures – substrates – inoculation methods. Mushroom bed preparation. Preservation technology- long term storage – short term storage. Post - harvest handling.	
IV	**Nutritional and Commercial Importance of Mushrooms:** Types and importance of edible mushroom in India– *Agaricus bisporus*, *Pleurotus sps*, Mushroom contamination. Importance of Medicinal mushroom – *Inonotus obliquus, Trametes versicolor* and *Lentinula edodus*. Poisonous Mushroom.	
V	**Edible, Medicinal and Poisonous Mushrooms:** Nutritional and Medicinal values of Mushroom – protein – carbohydrates – vitamins –minerals– fiber content. Preparation of low calorie foods – soups /curry. Value added products in India –export value.	

	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Explain the development and economic importance of mushroom cultivation in India.
CO2	Perform pure culture preparation and spawn production techniques efficiently
CO3	Apply suitable cultivation methods for different mushroom species.
CO4	Demonstrate proper post-harvest handling and preservation techniques.
CO5	Evaluate nutritional, medicinal, and commercial value of mushrooms and distinguish edible, medicinal, and poisonous varieties.

REFERENCE

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SEMESTER - V

Subject Code	Subject Name	
	VERMI TECHNOLOGY	
Course Objectives		
CO1	To understand the history, scope and importance of vermitechnology in organic waste management.	
CO2	To study the biology, classification and ecological role of earthworms.	
CO3	To learn methods of vermicomposting and vermiculture.	
CO4	To understand the role of microbes and earthworms in decomposition and nutrient recycling.	
CO5	To gain knowledge on vermicompost quality, applications, entrepreneurship and commercial production.	
UNIT	**Portion Details**	**No. of Hours**
I	**Introduction to Vermi Technology:** Definition, history, scope and importance of vermitechnology – organic waste management – advantages of vermicomposting – role of vermicompost in sustainable agriculture.	
II	**Earthworm Biology: Classification of earthworms – ecological groups:** epigeic, endogeic and anecic earthworms – external morphology, digestive system, reproduction and life cycle – common species used in vermicomposting: *Eisenia fetida*, *Eudriluseugeniae* and *Perionyx excavatus*.	
III	**Vermicomposting Methods:** Selection of site – raw materials for vermicomposting – pre-composting – bed method, pit method and tank method – maintenance of moisture, temperature, pH and aeration – harvesting and storage of vermicompost.	
IV	**Microbiology of Vermicomposting:** Role of bacteria, fungi and actinomycetes in decomposition – interaction between earthworms and microorganisms – nutrient enrichment – vermiwash preparation and uses – factors affecting compost quality.	
V	**Applications and Entrepreneurship:** Quality parameters of vermicompost – application in agriculture, horticulture and nursery practices – packaging, marketing and storage – small-scale and commercial vermicompost production	

	– economics of vermicomposting – government schemes and employment opportunities.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Explain the importance of vermitechnology in organic waste management and sustainable agriculture.
CO2	Identify earthworm types and describe their biology and ecological role.
CO3	Demonstrate different methods of vermicompost preparation.
CO4	Describe the role of microorganisms and earthworms in decomposition and nutrient recycling.
CO5	Evaluate vermicompost quality and develop basic entrepreneurship skills in vermicompost production.

REFERENCE

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SEMESTER - VI

Subject Code	Subject Name	
	DIAGNOSTIC MICROBIOLOGY	
Course Objectives		
CO1	To understand the principles, scope, and importance of diagnostic microbiology in clinical practice.	
CO2	To learn the collection, transport, processing, and preservation of clinical specimens.	
CO3	To study conventional methods used for laboratory diagnosis of bacterial, fungal, viral, and parasitic infections.	
CO4	To understand immunological, serological, and molecular methods used in diagnosis of infectious diseases.	
CO5	To gain knowledge on antimicrobial susceptibility testing, quality control, biosafety, and reporting in diagnostic laboratories.	
UNIT	**Portion Details**	**No. of Hours**
I	**Introduction to Diagnostic Microbiology:** Scope and importance of diagnostic microbiology – role of microbiology laboratory in patient care – normal flora and pathogens – principles of laboratory diagnosis – pre-analytical, analytical and post-analytical phases – laboratory safety.	
II	**Collection and Processing of Clinical Specimens:** Principles of specimen collection, transport and storage – blood, urine, sputum, throat swab, pus, stool, cerebrospinal fluid and body fluids – transport media – direct microscopy – Gram stain, Ziehl–Neelsen stain, wet mount, LPCB and KOH mount. Specimen Rejection Criteria	
III	**Culture Methods and Microbial Identification**: Culture media used in diagnostic microbiology – enriched, enrichment, selective, differential and transport media – aerobic and anaerobic culture methods – colony morphology – biochemical tests for bacterial identification – fungal culture and identification.	
IV	**Serological and Molecular Diagnosis:** Antigen and antibody detection methods – agglutination, precipitation, ELISA,MALDI-TOF, immunofluorescence and rapid diagnostic tests – serological diagnosis of infectious diseases – PCR, RT-PCR, real-time PCR and applications in	

	microbial diagnosis**.**	
V	**Antimicrobial Susceptibility Testing and Quality Control:** Kirby-Bauer disc diffusion method, MIC, MBC, E-test and automated methods – detection of ESBL, MRSA and carbapenemase producers – quality control in diagnostic microbiology – biosafety levels – interpretation and reporting of microbiology results.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Explain the role and importance of diagnostic microbiology in clinical practice.
CO2	Demonstrate proper collection and processing of clinical specimens.
CO3	Perform staining, culture and biochemical tests for microbial identification.
CO4	Describe serological and molecular methods used in infectious disease diagnosis.
CO5	Interpret antimicrobial susceptibility test results and apply biosafety and quality control practices.

REFERENCE

1. Saxena S, *Ananthanarayan and Paniker's Textbook of Microbiology*. 13th ed. Universities Press; 2024

2.Collee JG, Fraser AG, Marmion BP, Simmons A, editors. *Mackie & McCartney Practical Medical Microbiology*. 14th ed. Churchill Livingstone; 1996.

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ALLIED SYLLABUS FOR OTHER MAJORS

Subject Code	Subject Name	
	ALLIED - MICROBIOLOGY	
Course Objectives		
CO1	To understand the fundamental concepts, history, and scope of Microbiology, including major scientist contributions and classification systems.	
CO2	To study various microscopy techniques and staining methods for observing microbial structure and morphology.	
CO3	To develop skills in culture techniques, media preparation, and isolation of pure microbial cultures.	
CO4	To gain knowledge of antimicrobial agents, their mechanisms, resistance, and microbial identification methods.	
CO5	To understand microbial growth, measurement techniques, and structural characteristics of selected microorganisms.	
UNIT	**Portion Details**	**No. of Hours**
I	Definition and scope of Microbiology, History and Recent Developments, Spontaneous generation, Biogenesis, Contribution of Louis Pasteur, Antony van Leeuwenhoek, John Tyndall, Joseph Lister, Robert Koch, Edward Jenner, Alexander Fleming, Two Kingdom, Three Kingdom Five Kingdom and Eight Kingdom concept. Binomial nomenclature - Genus and species concept classical approach with examples.	
II	Microscopy - Simple, Compound, Light Microscopy Dark ground, Phase contrast, Florescence and Electron microscopy. Microbial morphology - wet mount, Hanging drop method, Simple, Differential and Special staining techniques - Acid fast staining spore stain, Capsule stain.	
III	Culture Techniques, Media preparation, types of Media. Preservation of cultures, Aerobic and Anaerobic culture techniques. Development of Laboratory Techniques for pure culture – Serial dilution, pour plate, spread plate. Streak plate methods.	
IV	Antimicrobial chemotherapy - Antibiotics - source, classification mode of action - Antimicrobial resistance - Tests for Sensitivity to Antimicrobial agents and its Quality control classical techniques of Microbial identification -	

	Morphological, Physiological and Biochemical properties.	
V	Measurement of microbial growth Batch and continuous culture, Growth Determination - Growth curve. Structural characteristics of algae - Cholrella, Chlamydomonas Fungi – Mucor, Aspergillus and Protozoa – Entamoeba, Plasmodium.	
	Total	

Course Outcomes	
Course Outcomes	On completion of this course, students will:
CO1	Able to explain the history, scope, and classification of microorganisms using systems like Five Kingdom and binomial nomenclature.
CO2	Demonstrate proficiency **in** microscopy and staining techniques to identify microbial morphology.
CO3	Perform microbial culture, isolation, and preservation techniques effectively in the laboratory.
CO4	Analyze antibiotic action, antimicrobial resistance, and conduct sensitivity testing**.**
CO5	Valuate microbial growth patterns and identify structural features of algae, fungi, and protozoa.

REFERENCE

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2. Microbiology: An Introduction Tortora G.J., Funke B.R., Case C.L. (2019). 13th Edition, Pearson.
3. General Microbiology Stanier R.Y., Ingraham J.L., Wheelis M.L., Painter P.R. (2010). 5th Edition, MacMillan Press Ltd.
4. Textbook of Microbiology Ananthanarayan R., Paniker C.K.J. (2017). 10th Edition, Universities Press.
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Subject Code	Subject Name
	ALLIED PRACTICAL -MICROBIOLOGY

Course Objectives	
CO1	To understand basic laboratory practices including sterilization techniques such as autoclaving and glassware preparation.
CO2	To develop skills in preparation of liquid and solid culture media for microbial growth.
CO3	To train students in isolation and pure culture techniques like serial dilution, streak plate, spread plate, and pour plate methods
CO4	To provide knowledge of microbial identification using staining, morphological, and biochemical characteristics.
CO5	To enable students to analyze microbial growth, motility, and antibiotic sensitivity through standard laboratory methods.
S.No	**Portion Details**
19.	Introduction to sterilization techniques- sterilization of glass wares, autoclaving.
20.	Preparation of liquid and solid media
21.	Isolation of Bacteria and fungi from soil samples – serial dilution technique
22.	Measurement of bacterial population
23.	Pure culture techniques: spread plate, streak plate technique and pour plate
24.	Methylene blue reductase test (MBRT).
25.	Determination of Bacterial growth curve
26.	Identification of bacteria by Biochemical characteristics - IMViC
27.	Smear preparation and staining of bacteria: Simple staining, Grams staining and spore staining
28.	Determination of Motility by Hanging drop method
29.	In vitro antibiotic sensitivity tests for selected bacterial cultures

Course Outcomes	
Course Outcomes	On completion of this course, students will be able to:
CO1	Able to perform sterilization and maintain aseptic conditions in the laboratory. .
CO2	Able to prepare different types of culture media and handle microbial cultures effectively.
CO3	Able to isolate, cultivate, and maintain pure cultures of bacteria and fungi.
CO4	Aable to identify microorganisms using staining techniques, motility tests, and biochemical methods.
CO5	Able to evaluate bacterial growth patterns and determine antibiotic sensitivity using standard tests like MBRT and antibiogram

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