



SACRED HEART COLLEGE (AUTONOMOUS)

Tirupattur – 635 601, Tamil Nadu, S.India

Resi : (04179) 220103

College : (04179) 220553

Fax : (04179) 226423

Ready for
Every Good Work

A Don Bosco Institution of Higher Education, Founded in 1951 * Affiliated to Thiruvalluvar University, Vellore * Autonomous since 1987

Accredited by NAAC (4th Cycle – under RAF) with CGPA of 3.31 / 4 at 'A+' Grade

M.Sc. Applied Microbiology

Sem	Part	Subject Code	Subject Title	Hrs	Credit (s)	Exam Hrs	CA	SE	Total
I	Core Paper I	MB701	General Microbiology and Microbial Diversity	4	4	3	50	50	100
	Core Paper II	MB702	Microbial Physiology and Metabolism	4	4	3	50	50	100
	Core Paper III	MB703	Immunology	4	3	3	50	50	100
	Core Paper IV	MB704	Molecular Microbiology	4	4	3	50	50	100
	Core Practical I	PMB801	General and Medical Microbiology	5	-	-	-	-	-
	Core Practical II	PMB802	Immunology, Hematology and Molecular Biology	5	-	-	-	-	-
	Elective Paper I		(to choose 1 out of 3)						
	MB705A	1. Microbial Instrumentation	4	3	3	50	50	100	
	MB705B	2. Biostatistics							
	MB705C	3. Phycology and Mycology							
				30	18	-	-	-	500
II	Core Paper V	MB801	Medical Bacteriology	6	4	3	50	50	100
	Core Paper VI	MB802	Medical Virology	5	4	3	50	50	100
	Core Paper VII	MB803	Medical Mycology and Parasitology	5	4	3	50	50	100
	Core Practical I	PMB801	General and Medical Microbiology	5	4	6	50	50	100
	Core Practical II	PMB802	Immunology, Hematology and Molecular Microbiology	5	4	6	50	50	100

	Elective Paper II	MB804A MB804B MB804C	(to choose 1 out of 3) 1. Pharmaceutical Microbiology 2. Bioinformatics 3. Public Health Microbiology	4	3	3	50	50	100
		PMB803J	Internship*	-	2*	-	-	-	-
				30	23+2*	-	-	-	600
III	Core Paper VIII	MB901	Research Methodology	4	4	3	50	50	100
	Core Paper IX	MB902	Bioinoculant Technology and Plant Pathology	4	4	3	50	50	100
	Core Paper X	MB903	Mushroom Technology	4	4	3	50	50	100
	Core Paper XI	MB904	Environmental Microbiology	4	4	3	50	50	100
	Core Practical III	PMB1001	Bioinoculant, Composting and Mushroom Technology	5	-	-	-	-	-
	Core Practical IV	PMB1002	Environmental and Food Microbiology	5	-	-	-	-	-
	Elective Paper III	MB905A MB905B MB905C	(to choose 1 out of 3) 1. Microbial Remediation 2. Vermitechnology 3. Microbial Nanotechnology	4	4	3	50	50	100
				30	20	-	-	-	500
IV	Core Paper XII	MB1001	Food Microbiology	4	4	3	50	50	100
	Core Paper XIII	MB1002	Industrial Microbiology	5	5	3	50	50	100
	Core Paper IX	MB1004J	Project/Dissertation with Viva voce	5	5	-	50	50	100
	Core Practical III	PMB1001	Bioinoculant, Composting and Mushroom Technology	5	5	6	50	50	100
	Core Practical IV	PMB1002	Environmental and Food Microbiology	5	5	6	50	50	100
	Elective Paper IV	MB1003A MB1003B MB1003C	(to choose 1 out of 3) 1. Microbial Biotechnology 2. Microalgal Technology 3. Probiotic Microbiology	4	4	3	50	50	100
	-	-	Human Rights	2	1	3	50	50	100

-	-	Self Study Paper (SSP): Comprehensive Microbiology	-	2*	-	-	-	-
-	-	NPTEL/MOOCs/Other Certificate courses*	-	2*	-	-	-	-
Total			30	29+4*	-	-	-	700
TOTAL			120	90+6*	-	-	-	220

Sacred Heart College (Autonomous), Tirupattur District

1.2.1 List of New Courses

S.No	Course Code	Course Name
1.	MB701	General Microbiology and Microbial Diversity
2.	MB702	Microbial Physiology and Metabolism
3.	MB703	Immunology
4.	MB704	Molecular Microbiology
5.	MB705A	Microbial Instrumentation
6.	MB705B	Biostatistics
7.	MB705C	Phycology and Mycology
8.	MB801	Medical Bacteriology
9.	MB802	Medical Virology
10.	MB803	Medical Mycology and Parasitology
11.	PMB801	General and Medical Microbiology
12.	PMB802	Immunology, Hematology and Molecular Microbiology
13.	MB804A	Pharmaceutical Microbiology
14.	MB804B	Bioinformatics
15.	MB804C	. Public Health Microbiology

Syllabus:

Semester – I

4 Hours/4Credits

MB 701: GENERAL MICROBIOLOGY AND MICROBIAL DIVERSITY

Objectives

- To impart basic knowledge about the History and classification of Microbiology.
- To make students to understand the fundamentals and diversity of Microbiology.
- To learn the Taxonomy, Ultrastructure, Classification of microorganisms.
- To provide insights on cultivation techniques and antibiotics.
- To recognize the fundamentals on Economic importance of microorganisms.

Course Outcomes

S.No.	Description	Cognitive Level (K-level)
CO-1	Knowledge on Landmark discoveries in Microbiology and different domains classification of living organisms.	K3
CO-2	Define and examine the structure, properties and classification of Bacteria, Fungi, Algae, Protozoa and Viruses.	K1
CO-3	Broad knowledge on the structure and functions of organelles of Prokaryotes and Eukaryotes.	K3, K6
CO-4	Discuss the Economic importance of Fungi, Algae and Protozoa.	K2
CO-5	Explore and recommend the Staining techniques, Culture medium and Biochemical tests applied in identification of microorganisms.	K4, K5
CO-6	Demonstrate a clear understanding of microbial control mechanisms through Sterilization techniques and Antibiotics.	K2

Mapping of CO with PO and PSO

C O	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Score s of COs	
	P	P	P	P	P	P	P	P	P	P	P	P	P	P	PSO		PSO

	O 1	O 2	O 3	O 4	O 5	S O 1	S O 2	S O 3	S O 4	S O 5	S O 6	S O 7	S O 8	9	10	
1	3	3	2	2	3	3	3	3	2	3	3	3	2	3	3	2.7
2	2	2	3	3	2	2	3	2	3	3	2	2	3	2	1	2.3
3	3	1	2	3	1	3	2	3	2	2	3	3	2	3	3	2.4
4	2	2	3	2	3	2	3	3	3	3	3	3	3	2	2	2.6
5	2	3	3	2	2	2	2	2	2	2	2	2	3	2	2	2.2
6	3	2	2	3	3	3	2	3	3	3	3	3	2	3	3	2.7
Mean Overall Score															2.5	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Members of Microbial world; Conflict over Spontaneous generation; The Discovery of Microorganisms; Contributions of Anton van Leeuwenhoek, Louis Pasteur, Edward Buchner, Robert Koch, Ignaz Semmelweis, Joseph Lister, Paul Ehrlich, Martinus Beijerinck, Sergi Winogradsky, Alexander Fleming and Selman Waksman; Golden age of Microbiology; Branches of Microbiology; Phylogenetic Hierarchy; Nomenclature of Microorganisms; Taxonomy and Taxonomic Hierarchy; Numerical Taxonomy; Kingdom concept of Organisms classification – Lennaeus Two Kingdom concept, Haeckel Three Kingdom concept, Copeland's Four Kingdom concept, Whittaker's Five Kingdom concept, Grey & Doolittle's Six Kingdom concept and Cavalier-Smith's Eight Kingdom concept; Cell and Cell theory; Wose – Fox's Three Domains of Life; Genetic and Intraspecies Classification.

Unit – II

Bacteria – Ultrastructure; Morphological Classification (Gram positive & Gram negative), Shape and Arrangement; Cell wall; Difference between Bacterial and Archaeal Cell wall; *Mycoplasma* and L - forms; Cell membrane; Bacterial Nucleoids; Cell inclusions; Ribosomes; Capsules and Slime layer; Gas vesicles; Bacterial Cytoskeleton; Endospore and Sporulation cycle; Surface appendages – Flagella, Fimbriae and Pili; Chemotaxis and Phototaxis; Bergey's manual of Systemic Bacteriology; Economical importance of Bacteria.

Unit – III

Stains and its types; Staining techniques – Simple staining, Differential staining (Gramstaining & Acid fast staining), Special staining (Capsule staining, Metachromatic granule staining, Endospore staining & Flagella staining); Motility test; Culture medium and its classification; Biochemical Tests for bacterial identification; Sterilization - Physical method and Chemical method; Quality control and Sterility checking; Required Concentrations and Times for Chemical Destruction of Microorganisms; Evaluation of Disinfectants – Phenol coefficient test, Filter paper method, Use - Dilution test, In-Use Test and Kelsey-Sykes Capacity Test; Antibiotics – Classification, Antimicrobial resistance and Antibiotic sensitivity test.

Unit – IV

Organelles of Eukaryotic cells – Plasma membrane, Nucleus, Endoplasmic reticulum, Golgi complex, Ribosomes, Lysosomes, Gas vacuoles, Mitochondria, Hydrogenosomes, Peroxisomes, Centrosome, Cytoskeleton, Chloroplast; Organs for Locomotion – Flagella, Cilia and Pseudopodia; Fungi – Ultrastructure; Classification; Characteristics of Molds & Yeast; Budding in Yeast; Nutrition and Reproduction; Fungal cell wall and its composition; Identification and Cultivation of Fungi; Water molds; Economical importance of Fungi.

Unit – V

Algae – Ultrastructure and Nutrition; Classification of Algae; Algal Chloroplast; Diatoms and Dinoflagellates; Identification and Cultivation of Algae; Economical importance of Algae; Lichens; Protozoa - Ultrastructure, Classification, Nutrition and Locomotion; Identification and Protozoa; Slime Molds – Cellular Slime Molds & Plasmodial Slime Molds; Economic importance of Protozoa; Virus – Structure and Classification; Animal Viruses and Plant Viruses; Viruses of Archaea; Viroids and Prions; Current Research Thoughts in Microbiology.

Text Books

- 1) Gerard J. Tortora, Berdell R. Funke and Christine L. Case. 2015. Microbiology – An Introduction, 12th Edition, Peareson Publishers, San Francisco.
- 2) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 3) Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.

- 4) Madigan, M. T., Martinko, J. M., Dunlap, P. V and Clark, D. P. 2017. Brock Biology of Microorganisms, 14th edition, Prentice Hall, USA.
- 5) Robert W. Bauman. 2015. Microbiology with Body Diseases by Body System, 4th Edition, Pearson Education, UK.
- 6) Saranraj, P. 2020. Basic Techniques in Microbiology. 1st Edition, JPS Scientific Publications, India.

References

- 1) Jeffrey C. Pommerville. 2006. Alcamo's Fundamentals of Microbiology. 4th Edition, Jones and Bartlett Publishers, Canada.
- 2) Dubey, R.C. and D. K. Maheswari. 2010. A Text book of Microbiology. 3rd Edition, S. Chand and Company, New Delhi.
- 3) Kathleen Park Talaro and Bary Chess. 2015. Foundations in Microbiology. 9th Edition, McGraw Hill Publication, New York.
- 4) Pelczar Jr. M. J., Chan, E. C. S and Kreig, N. R. 2006. Microbiology. 5th Edition, McGraw Hill Inc. New York.
- 5) Marjorie Kelly Cowan. 2012. Microbiology – A System Approach. 3rd Edition, McGraw Hill Publication, United States.
- 6) Jacquelyn G. Black. 2012. Microbiology – Principles and Explorations. 8th Edition, John Wiley and Sons, United States.

Semester – I

4 Hours/4Credits

MICROBIAL PHYSIOLOGY AND METABOLISM

Objectives

- To illustrate Bacterial nutrition and their utilization.
- To discuss cultivation methods and factors related to microbial growth.
- To study the Microbial growth, nutrition and its uptake.
- To demonstrate the concepts of Microbial metabolism and Respiration.
- To understand the Photosynthesis reaction in microorganisms.

Course Outcomes

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Help learners to define and understand the objectives of Microbial physiology, Microbial nutrition and Microbial metabolism.	K1, K2
CO-2	Analyze and understand the basic concepts of Nutrient requirements and Nutrition types of microorganisms.	K4
CO-3	Provide students with learning experiences that help in still deep interests in learning Transport of nutrients in Microorganisms.	K3

CO-4	Develop broad and balanced knowledge and understanding of Microbial growth, Factors influencing growth, Growth measurement and Preservation of microorganisms.	K6
CO-5	Equip students with appropriate knowledge on major fermentation and metabolic pathways for energy generation in microbial cells.	K4
CO-6	Recommend students to find the reactions of Intermediate metabolism and Photosynthesis in microorganisms.	K5

Mapping of CO with PO and PSO

C O	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Scores of Cos
	P O 1	P O 2	P O 3	P O 4	P O 5	P S O 1	P S O 2	P S O 3	P S O 4	P S O 5	P S O 6	P S O 7	P S O 8	PSO 9	PS O 10	
	1	3	2	3	3	3	3	3	3	2	3	3	3	3	2	
2	3	2	3	3	2	3	3	2	3	3	3	3	3	2	3	2.7
3	3	2	3	3	2	3	2	3	2	2	3	3	3	3	2	2.6
4	3	3	2	3	3	2	3	2	3	3	3	3	3	2	3	2.7
5	3	2	3	3	3	3	2	3	2	3	3	3	2	3	2	2.6
6	3	3	2	2	3	3	3	3	3	3	3	3	2	3	2	2.7
Mean Overall Score																2.7
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Microbial Nutrition – Chemical nutrient requirements and Growth factors, Nutritional groups of microorganisms; Adaptation of microorganisms towards Limited nutrients; Uptake of nutrients by cells: Passive transport - Simple diffusion, Facilitated diffusion and Osmosis; Active transport – ABC Transporters, Group translocation, Endocytosis (Phagocytosis & Pinocytosis) and Exocytosis; Difference between Passive transport and Active transport; Iron uptake by microorganisms.

Unit – II

Cell division in Prokaryotes and Eukaryotes; Microbial Growth – Generation time and Growth Curve; Influence of environmental factors on growth; Microbial life in Cold environment and High temperature; Measurement of microbial growth – Direct methods (Plate counts, Filtration, Most Probable Number [MPN] Method & Direct Microscopic Count) and Indirect methods (Turbidity, Metabolic activity and Dry weight); Continuous culture of microorganisms – Chemostat & Turbidostat; Diauxic growth and Synchronous growth; Preservation of Bacterial cultures.

Unit – III

Microbial Metabolism; Fermentation and its types; Generation of ATP - Substrate level Phosphorylation, Oxidative Phosphorylation and Electron transport chain; Carbohydrate catabolism – Glycolysis, Pentose phosphate pathway, Phosphoketolase pathway; Entner - Doudoroff pathway; Mixed acid fermentation pathway; Propionic acid fermentation pathway; Degradation of Amino acids, Proteins, Lipids, Purines and Pyrimidines.

Unit – IV

Microbial Respiration - Aerobic and Anaerobic respiration by microorganisms; Aerobic Respiration – Krebs's cycle; Biosynthesis of Polysaccharides, Peptidoglycan, Amino acids, Purines and Pyrimidines; Lipogenesis - Biosynthesis of Fatty acid, Triglycerides, Phospholipids, Sterols and Cholesterol; Anaerobic Respiration – Acetogenesis and Methanogenesis; Biosurfactant production by microorganisms.

Unit – V

Photosynthesis; Diversity of photosynthetic organisms; Phototrophic bacteria – Cyanobacteria, Purple Sulfur Bacteria, Purple Non-sulfur Bacteria, Aerobic Anoxygenic Phototrophs, Green Sulfur Bacteria, Green Non-sulfur Bacteria and Heliobacteria; Difference between plant, algal and bacterial photosynthesis; Photosynthetic pigments; Light reaction (Photophosphorylation) and Dark reaction (Calvin cycle); Biosynthesis of Chlorophyll; Quorum sensing – Mechanism of Quorum sensing, Virulence factors and Biofilm formation; Current Research Thoughts in Microbial metabolism.

Text Books

- 1) Gerard J. Tortora, Berdell R. Funke and Christine L. Case. 2015. Microbiology – An Introduction, 12th Edition, Peareson Publishers, San Francisco.
- 2) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 3) Stanier, R. Y., Ingraham, J. L., Wheelis, M. L and Painter, P. R. 2010. General Microbiology. 5th Ednition, Macmilan Education Ltd. London.
- 4) Madigan, M. T., Martinko, J. M., Dunlap, P. V and Clark, D. P. 2017. Brock Biology of Microorganisms, 14th edition, Prentice Hall, USA.
- 5) Kathleen Park Talaro and Bary Chess. 2015. Foundations in Microbiology. 9th Edition, McGraw Hill Publication, New York.
- 6) Jacquelyn G. Black. 2012. Microbiology – Principles and Explorations. 8th Edition, John Wiley and Sons, United States.

References

- 1) Caldwell, D.R., 2008. Microbial Physiology and Metabolism. Wm C Brown Publishers, England.
- 2) Chatterjee, N and Rana Shinde. 2012. Textbook of Medical Biochemistry, 8th edition, Jaypee publication, New Delhi.
- 3) Marjorie Kelly Cowan. 2012. Microbiology – A System Approach. 3rd Edition, MacGraw Hill Publication, United States.
- 4) Albert G. Moat, John W. Foster and Michael P. Spector. 2003. Microbial Physiology. 4th Edition, John Wiley and Sons, New York.
- 5) Jeffrey C. Pommerville. 2006. Alcamo's Fundamentals of Microbiology. 4th Edition, Jones and Bartelett Publishers, Canada.

Semester – I

4Hours/3 Credits

IMMUNOLOGY

Objectives

- To provide overview of immune system, antigen antibody structure and interactions.
- To inculcate the principles of vaccine development.
- To provide insights to the Human Defense Mechanisms against Infections.
- To strengthen the knowledge of students through a detailed study on Antigens, Antibodies and Immunoassays.
- To integrate immunology with health and enrich the knowledge for autoimmune disorders, hypersensitivity reaction.

Course Outcomes

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Discuss cells and organs of immune system and its role in types of	K2

	Immunity.	
CO-2	Evaluate the reactions between various antigens and antibodies and apply the knowledge in diagnosing diseases and disorders.	K3, K5
CO-3	Analyse the concepts and factors influencing immunity, HLA typing and its applications.	K3, K4
CO-4	Compare the role of MHC in graft rejection in transplantation and plan appropriate strategies.	K2
CO-5	Describe the principles of immunity for vaccine development and analyse types of hypersensitivity reactions.	K1
CO-6	Develop theoretical knowledge of various diseased conditions generated due to interplay of immune system components.	K6

Mapping of CO with PO and PSO

C O	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Score s of COs
	P O 1	P O 2	P O 3	P O 4	P O 5	P S O 1	P S O 2	P S O 3	P S O 4	P S O 5	P S O 6	P S O 7	P S O 8	PSO 9	PS O 10	
1	3	2	2	3	2	2	2	2	3	3	3	3	2	3	3	2.5
2	3	2	2	3	3	2	3	2	3	2	3	3	2	2	3	2.5
3	2	2	2	3	2	2	3	3	1	2	3	2	3	2	2	2.2
4	2	2	3	3	2	2	3	2	3	2	3	3	2	2	3	2.4
5	2	2	3	2	3	3	2	2	2	1	2	2	2	2	2	2.1
6	3	3	2	2	3	3	2	3	2	2	3	3	3	2	2	2.5
Mean Overall Score															2.4	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20

Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

History of Immunology – Contributions of Louis Pasteur, Edward Jenner, Elie Metchnikoff, Paul Ehrlich and Karl Landsteiner; Immunity – Innate and Acquired immunity; Humoral immunity and Cell mediated immunity; Vaccines - Attenuated Live vaccine, Inactivated or Killed vaccine, Sub-unit vaccine, DNA vaccine, Synthetic peptide vaccine and Anti-idiotypic vaccine; Toxoids - Antitoxins.

Unit – II

Lymphoid System – Primary and Secondary lymphoid organs; Hematopoiesis; Maturation of B – cells and T – cells; T - cell and B - cell receptors; Cells of the immune system: Lymphoid cells – B - Lymphocytes, T - Lymphocytes and NK cells; Mononuclear Phagocytes – Monocytes and Macrophages; Granulocytic cells – Neutrophils, Eosinophils, Basophils and Mast cells; Antigen presenting cells - Dendritic cells; Platelets; Erythrocytes; Cluster of Differentiation (CD); Cytokines - Properties and functions of Interleukins and Interferons; Cytokine storm.

Unit – III

Antigens – Types of Antigens, Antigenicity, Determinants of Antigenicity, Epitopes, Haptens and Adjuvants; Immunoglobulins – Structure and types (IgG, IgA, IgM, IgD & IgE); Theories of Antibody production; Isotypes, Allotypes and Idiotypes; Monoclonal antibodies and Polyclonal antibodies – Production and its applications; Complement system – Properties, Components and Functions.

Unit – IV

Laboratory Techniques in Immunology – Precipitation test (Mancini Radial Immunodiffusion, Ouchterlony Double Immunodiffusion, Immunoelectrophoresis and Rocket electrophoresis), Agglutination test (Hemagglutination, Bacterial Agglutination, Passive Agglutination & Agglutination Inhibition), Complement fixation test, Immunofluorescence test, Flow Cytometry, Immunohistochemistry, Immunoprecipitation, Avidin – Biotin Mediated Assay, Nephelometry, Hemocytometer, ELISPOT assay, RIA, ELISA and Western Blot; Immunohematology - Blood groups, Blood transfusion and Rh incompatibilities.

Unit – V

Immunodeficiency diseases; Autoimmune diseases; Hypersensitivity reactions – IgE Mediated Hypersensitivity (Type – I), Antibody Mediated Cytotoxic Hypersensitivity (Type – II), Immune Complex Mediated Hypersensitivity (Type – III) and Delayed Type

Hypersensitivity (Type – IV); Transplantation immunology - Graft versus Host reaction; Immunosuppression; Oncoimmunology and Cancer Immunotherapy; Major Histocompatibility Complex (MHC); Mechanism of Resistance to Microbial infections; Current Research Thoughts in Immunology.

Text Books

- 1) Judith A. Owen, Jenni Punt, Sharon A. Stanford and Patricia P. Jones. 2009. Kuby's Immunology, 4th Edition, W. H. Freeman and Company, New York.
- 2) Jeffrey K. Actor. 2012. Elsevier's Integrated Review – Immunology and Microbiology, 2nd Edition, Sabre Foundation, China.
- 3) Roitt, I. M. 2011. Roitt's Essential Immunology, 12th Edition, Wiley - Blackwell Scientific publishers, London, United Kingdom.
- 4) Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.
- 5) Robert W. Bauman. 2015. Microbiology with Body Diseases by Body System, 4th Edition, Pearson Education, UK.

References

- 1) Robert W. Bauman. 2015. Microbiology with Body Diseases by Body System, 4th Edition, Pearson Education, UK.
- 2) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 3) Chakraborty, P. 2013. A Text book of Microbiology, Published by New Central Book Agency (P) Ltd., Kolkata, India.
- 4) Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.
- 5) Abul K. Abbas, Andrew H. H. Lichtman and Shiv Pillai. 2015. Basic Immunology, Functions and Disorders of the Immune System. 5th Edition. Elsevier.

Semester – I

4Hours/4 Credits

MOLECULAR MICROBIOLOGY

Objectives

- To make the students to understand the Molecular Biology and Genetic Engineering.
- To focus on Genome organization, Transcription and Translation process in Prokaryotes.
- To introduce the basic principles of DNA Replication, Transcription, Translation, Mutation and DNA Repair mechanisms.
- To explain the application of various Gene cloning vectors.
- To be highly experienced in Prokaryotic and Eukaryotic Genetic Transformation.

Course Outcomes

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Analyze and understand the basic principles of DNA Replication, Transcription, Translation, Mutation and DNA Repair mechanisms.	K2, K4
CO-2	Describe the central cell biological processes and how they are regulated.	K1
CO-3	Evaluate the role of Vectors in Gene Cloning.	K5
CO-4	Apply the principles of selection, construction, screening of recombinants and application of artificial transformation techniques.	K3
CO-5	Better understanding of Gene expressions.	K2
CO-6	Development of Molecular Techniques for DNA and Protein analysis.	K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	
1	3	3	2	2	3	2	2	2	2	2	3	3	2	3	3	2.4
2	3	2	2	3	2	2	3	2	3	2	2	2	2	3	3	2.4
3	2	2	2	3	2	2	3	2	2	2	3	2	3	3	2	2.3
4	2	2	3	3	1	2	3	2	3	2	3	3	2	2	2	2.3
5	2	2	3	2	2	2	2	3	2	2	2	2	2	2	2	2.1
6	2	2	1	2	2	3	2	3	2	3	3	1	3	2	2	2.2
Mean Overall Score															2.3	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Genetics – History and Scope; DNA & RNA as a genetic material; DNA – History, Structure and forms; Organization of Gene in Prokaryotes and Eukaryotes; Chromosomes – Structure, Types and Functions; Chromosome theory of inheritance; Chromosomal aberrations. DNA Replication – Types and evidence for Semi-conservative replication; Enzymes involved in DNA Replication; DNA Replication in Prokaryotes and Eukaryotes; Inhibitors of DNA replication.

Unit – II

RNA - Structure and Types; Transcription and Inhibitors of Transcription; Genetic code; Translation and Inhibitors of Translation; Regulation of Gene expression – Lactose Operon concept and Tryptophan Operon concept; DNA Damage by Physical and Chemical agents; Mutation - Mutagens and Mutagenesis; Spontaneous Mutation; Induced Mutation and Point Mutation – Silent Mutation, Missense Mutation, Non-sense Mutation and Frameshift Mutation; Mutant detection, Mutant selection and Carcinogenicity testing; DNA Repair Mechanism – Excision repair, Direct repair, Recombination repair, Mismatch repair and SOS Response.

Unit – III

Restriction enzymes for cutting DNA; Enzyme for Joining DNA; Cloning Vectors – Plasmids (pBR 322), Phages (M13 & λ) and Cosmids; Plasmids – Structure, Characteristics, Types, Replication, Plasmid copy number, Partitioning and Segregative stability of Plasmids, Incompatibility of Plasmids, Isolation of Plasmids, Purification of Plasmid DNA and Desirable properties of Plasmid vector.

Unit – IV

Transposons - IS elements, Composite transposons, Simple transposition, Replicative transposition and Conjugative transposons; Mechanism of Transposition; Bacteriocinogens; Bacteriophages - General characteristics, Structure, Replication of Double stranded DNA Bacteriophages - Lytic cycle and Lysogenic cycle; Replication of Single stranded DNA Bacteriophage (M13 phage); Typing of Bacteriophage; Genetic recombination in Bacteria – Conjugation, Transformation and Transduction; Conjugation in Archaea.

Unit – V

Molecular Identification of Microorganisms – Fatty acid profiles, Flow Cytometry, DNA Base composition (G + C Content), DNA Fingerprinting, Nucleic acid Hybridization (Southern Blotting, Northern Blotting, DNA Chips, Ribotyping & rRNA Sequencing and FISH); Protein hybridization technique – Western Blotting technique; Gel Electrophoresis (Agarose Gel Electrophoresis & SDS-PAGE); Introduction to Genomics and Metagenomics; Genome Sequencing – First Generation, Second Generation, Third Generation and Fourth Generation; Metagenomics; CRISPR; Polymerase Chain Reaction (PCR), Types of PCR and Applications of PCR; Current Research Thoughts in Molecular Microbiology.

Text Books

- 1) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 2) Freifelder, D. 2008. Molecular Biology, 2nd Edition, Narose Book Distributors Pvt. Ltd., New Delhi, India.
- 3) Old, R. S and S. B. Primrose. 2006. Principles of Gene Manipulation, 7th Edition, Blackwell Scientific Publications, London.
- 4) Nelson, D. L and Cox, M. M. 2008. Lehninger Principles of Biochemistry, 5th Edition, W.H. Freeman and Company.
- 5) Brown T. A. 1995. Gene Cloning. 4th Edition, Chapman and Hall.

References

- 1) Gardner, E. J., M. J. Simmons and D. P. Snustad. 2005. Principles of Genetics, 8th Edition, John Wiley and Sons, New York.
- 2) Klug, W. S and M. R. Cummings. 2001. Essentials of Genetics, 4th Edition, Prentice Hall, New Jersey.
- 3) Chatterjee, N and Rana Shinde. 2012. Textbook of Medical Biochemistry, 8th Edition, Jaypee publication, New Delhi, India.
- 4) Weaver, R. F. 2008. Molecular Biology, 5th Edition, McGraw Hill, New York.

ELECTIVE: MICROBIAL INSTRUMENTATION

Objectives

- To understand the principles and applications of various instruments used in Life science.
- To learn the techniques for operating the instruments.
- To study the concepts of Biological and Radiation hazard materials.
- To explain the principles and applications of types of centrifuge and chromatography techniques.
- To learn principles, types and applications of Spectroscopy.

Course Outcomes

Course Outcome (CO)	Description	Cognitive Level (K-Level)
CO-1	Determine the Safety measures in Microbiology laboratory.	K3
CO-2	Define and explain the principles and applications of various instruments used in Life science.	K1, K2
CO-3	Explain the Working principles and Applications of Various Microbiology laboratory instruments.	K4
CO-4	Analyzing the principles and applications of types of Chromatography techniques.	K4
CO-5	Evaluate the Working principle and Applications of Electrophoresis techniques.	K5
CO-6	Perform the detailed analysis on Calorimeter and Spectrophotometer.	K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)											Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10		
1	3	3	3	3	3	2	2	3	3	3	3	3	3	3	2	3	2.8
2	2	2	3	3	3	3	3	3	3	3	2	3	2	2	2	2	2.6
3	2	3	2	3	2	3	2	3	2	3	3	2	3	3	3	3	2.6
4	3	3	3	2	3	2	3	2	3	3	3	3	3	2	3	3	2.7
5	3	2	3	2	3	3	2	3	3	3	3	1	2	2	3	3	2.8
6	3	3	1	3	3	3	3	2	3	3	3	3	3	3	3	3	2.5
Mean Overall Score																2.6	
Result																High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

History of Microscopy; Principles of Microscopy; Principle, Instrumentation and Applications - Bright Field Microscopy, Dark Field Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Differential Interference Contrast (DIC) Microscopy, Confocal Scanning Laser Microscopy, Two – Photon Microscopy (TPM), Scanning Acoustic Microscopy (SAM), Electron Microscopy – Scanning Electron Microscopy (SEM) & Transmission Electron Microscopy (TEM), Scanned – Probe Microscopy – Scanning Tunneling Microscopy and Atomic Force Microscopy.

Unit – II

Bioinstruments - Principle, Instrumentation and Applications of pH Meter, Bacterial Incubator, Hot air oven, Autoclave, Colony counter, Lyophilizer and Laminar flow cabinet. Electrophoretic techniques - Principle, Instrumentation and Applications of Paper electrophoresis, Gel electrophoresis, Immunoelectrophoresis, Capillary electrophoresis and SDS-PAGE; Gel Documentation System.

Unit – III

Chromatographic techniques - Principle and Applications of Paper Chromatography (Ascending Paper Chromatography & Descending Paper Chromatography), Thin Layer Chromatography (TLC), Gel Filtration Chromatography, Adsorption Column Chromatography, Ion Exchange Chromatography, Affinity Chromatography, Countercurrent Chromatography (CCC), Gas Chromatography, High Performance Liquid Chromatography (HPLC) and HPTLC.

Unit – IV

Centrifugation techniques - Basic principles of Centrifuge; Types of Centrifuges – Small Bench Centrifuges, Large Capacity Refrigerated Centrifuges, High Speed Refrigerated Centrifuges and Ultracentrifuges; Different types of Rotors; Types of Centrifugation - Differential centrifugation, Density gradient centrifugation and Centrifugal elutriation; Safety aspects of Centrifuges.

Unit – V

Spectroscopy - Principle, Instrumentation and Applications of Colorimeter, Spectrophotometer, UV-Vis Spectrophotometer, Flame Photometry, Atomic Absorption Spectroscopy, IR Spectrophotometry, Fourier Transform Infrared Spectroscopy (FT-IR), Nuclear Magnetic Resonance (NMR) and X – ray Crystallography; Biosensors – Basic characteristic, Components, Requirements, Types and Applications; Current Research Thoughts in Microbial Instrumentation.

Text Books

- 1) Arumugam, S. 2002. Biomedical Instrumentation, Anuratha Agencies Publishers, 2nd edition, India.
- 2) Asokan, P. 2001. Analytical Biochemistry, Chinnaa Publications, India.
- 3) Gurumani, N. 2014. Research Methodology for Biological Sciences, MJP Publisher, India.
- 4) Veerakumari, L. 2019. Bioinstrumentation, MJP Publisher, India.

References

- 1) Chatwal, G. R and S. K. Anand. 2003. Instrumental Methods of Chemical Analysis. 5th Edition, Himalaya Publishing House, Mumbai
- 2) Mandeep Singh. 2014. Introduction to Biomedical Instrumentation, Paperback publishers, India.
- 3) Sharma, B. K. 2007. Instrumental Methods of Chemical Analysis, Krishna Prakashan Media (P) Ltd, India.
- 4) Wilson, K., Walker, J., Clokie, S and Hofmann, A. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th Edition, Cambridge University Press.

Semester – I

4Hours/3 Credits

ELECTIVE: BIOSTATISTICS

Objectives

- To demonstrate the importance of data collection and presentation of data
- To perform methods used for measuring central tendency, deviation and error
- To discuss Probability theory and applications
- To explain Correlation, regression and hypothesis testing methods
- To identify appropriate method for analysis of variance and learn few statistical packages

Course Outcomes

Course Outcome	Description	Cognitive Level

(CO)		(K-Level)
CO-1	Classify the data and understanding the role of Biostatistics in research.	K2
CO-2	Provide basic knowledge of statistics and tools used for several quantitative analysis in Microbiology.	K1
CO-3	Apply and provide knowledge of data collection and presentation of data in various fields of Microbiology.	K1, K3
CO-4	Assess and implement central tendency, deviation and error in the data collected during research.	K5
CO-5	Apply and develop the knowledge of probability theory and its applications in research data analysis.	K3, K6
CO-6	Predict the significance of the biological phenomenon on the basis of available data set.	K2

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Scores of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	
1	3	2	2	2	3	2	2	2	2	2	3	2	2	3	3	2.3
2	3	2	2	2	2	2	3	2	2	2	2	2	2	3	3	2.2
3	2	2	2	3	1	2	3	2	1	2	3	2	3	3	2	2.2
4	2	2	3	3	2	2	3	1	3	2	3	3	1	2	2	2.2
5	2	2	3	2	2	2	2	3	2	1	2	2	1	2	2	2.0
6	2	2	1	2	2	3	2	2	2	3	3	2	3	2	2	2.2
Mean Overall Score																2.2
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Introduction to Biostatistics, Biostatistics in Research; Data Collection and Analysis; Types of Data; Sampling – Designs and Types; Representation of Data - Tabulation, Frequency distribution, Diagrams and Graphs.

Unit – II

Measures of Central tendency – Mean – Geometric and Harmonic, Median and Mode and Percentiles; Measures of Dispersion - Range, Quartile deviation, Mean deviation, Standard deviation and Coefficient of variation; Standard error, Skewness and Kurtosis.

Unit – III

Probability: Random experiment, Events, Sample space, Mutually exclusive events, Independent and dependent events, Statement of addition and Multiplication theorems of probability, Random variables (Discrete and continuous), Probability Distributions - Binomial, Poisson and Normal distributions.

Unit – IV

Correlation - Types, Methods, Coefficient of correlation; Regression – Equations and Regression lines; Testing of hypothesis - Null Hypothesis, Alternate hypothesis, Type I and Type II errors; Tests of Significance - Chi-square test, Student t test and Z score.

Unit – V

Analysis of Variance, ANOVA - One-way classification and Two-way classification; Completely Randomized Design (CRD), Randomized Block Design (RBD), Least Significant Difference (LSD) and Duncan's multiple range test (DMR); Statistical package - Features of Statistical software; SPSS for various applications in Biostatistical programme; R Programming Language.

Text Books

- 1) Rastogi, V. B. 2011. Fundamental of Biostatistics. 2nd Edition, Ane books Pvt. Ltd.
- 2) Gupta, S. P. 2017. Statistical methods. 45th Edition, Sultan Chand & Sons Publisher, New Delhi.
- 3) Snedecar, G. W and Cochran, W. G. 1967. Statistical Methods. Oxford Press.

- 4) Zar, J. H. 2008. Biostatistical analysis. 4th Edition, Pearson education Inc. New Jersey.

References

- 1) Chatwal, G. R and S. K. Anand. 2003. Instrumental Methods of Chemical Analysis. 5th Edition, Himalaya Publishing House, Mumbai
- 2) Rosner, B. 2016. Fundamentals of Biostatistics, 8th Edition, Cengage Learning, USA.
- 3) Pagano, M and Gauvreau, K. 2018. Principles of Biostatistics, 2nd Edition, CRC press.
- 4) Daniel, W. W. 1999. Biostatistics: A foundation for analysis in health sciences. 7th Edition, John Wiley & Sons, New York.

Semester – I

4Hours/3 Credits

ELECTIVE: PHYCOLOGY AND MYCOLOGY

Objectives

- To illustrate the basics of Phycology and Mycology.
- To understand the relevance of algal- fungal interactions in maintaining aquatic periodicity.
- To implement the biomimetic products by studying the real internal symbiotic mechanisms in lichen.
- To acquire knowledge regarding harmful environmental changes occurred due to anthropogenic activity via lichen indicator.
- To study the various applications of Algae and Fungi.

Course Outcomes

Course Outcome (CO)	Description	Cognitive Level (K-Level)
CO-1	Illustrate the basic principles of Phycology and Mycology.	K2
CO-2	Understanding and evaluate the natural biodiversity for controlling pollution rate.	K2, K6
CO-3	Identify, Classify and Cultivate medically important fungi and parasites.	K1, K2
CO-4	Evaluate the toxic effect of fungi and algae for avoid the hazardous affects.	K5
CO-5	Examine the food industry in curbing the growth of toxic mold in food and animal feed.	K1

CO-6	Focusing on associative benefits of Algae and Fungi.	K4
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Mapping of CO with PO and PSO

C O	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Score s of COs
	P O 1	P O 2	P O 3	P O 4	P O 5	P S O 1	P S O 2	P S O 3	P S O 4	P S O 5	P S O 6	P S O 7	P S O 8	PSO 9	PS O 10	
1	3	2	3	3	3	3	3	3	2	3	3	3	3	2	3	2.8
2	3	2	3	3	2	3	3	2	3	3	3	3	3	2	3	2.7
3	3	2	3	3	2	3	2	3	2	2	3	3	3	3	2	2.6
4	3	3	2	3	3	2	3	2	3	3	3	3	3	2	3	2.7
5	3	2	3	3	3	3	2	3	2	3	3	3	2	3	2	2.6
6	3	3	2	2	3	3	3	3	3	3	3	3	2	3	2	2.7
Mean Overall Score															2.7	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

History of Indian Phycology; Ultrastructure of Algae; Classification of Algae; Habitat and Distribution of Algae – Freshwater and Marine; Reproduction of Algae – Sexual and Asexual reproduction; Life cycle of Algae; Culture medium for Algae cultivation; Bioluminescence; General characteristics of Cyanophyta, Dinophyta, Cryptophyta, Rhodophyta, Chrysophyta, Bacillariophyta, Xanthophyta, Phaeophyta, Chlorophyta, Charophyta and Euglenophyta.

Unit – II

Algal protein and Algal peptides; SCP – Cultivation and Health benefits; Pigments from Algae – Carotenoids, Phycocyanin and Phycoerythrin; Growth promoting substance from microalgae; Algal Toxins. Phycoremediation - Heavy metals remediation, Dye degradation and Hydrocarbon degradation; Products from Algae – Biofuels, Biodiesel, Biobutanol and Biohydrogen; Nanoparticles from Algae; Algae in Transgenics; Antimicrobials from microalgae; CO₂ sequestration; Algae in Space.

Unit – III

Fungi - General characteristics, Vegetative structure, Ultrastructure, Origin, Occurrence and Distribution, Nutrition, Ecological groups, Respiration and Reproduction; Economic importance of Fungi.

Unit – IV

Fungal taxonomy - Nomenclature and Classification of Fungi; Classification of Mycoses; Characteristics of Molds and Yeasts; Characteristic features of Chytridiomycetes, Zygomycota, Ascomycota, Basidiomycota, Urediniomycetes, Ustilaginomycetes, Glomeromycota and Microsporidia.

Unit – V

Fungi as food and natural recycler; Fungi in Antibiotics production; Fermented products from fungi - Organic acids and Enzymes; Pigment production from Fungi; Fungal diseases in plants, animals and humans; Fungi as Biocontrol agent and Bioinsecticide; Mycotoxins and its types; Current Research Thoughts in Phycology and Mycology.

Text Books

- 1) Hoek, C., Mann, D. G and Jahns, H. M. 1995. Algae - An introduction to Phycology, 39; Cambridge University Press.
- 2) Stephen, J. O. 1993. Bacteria, Algae, and Protozoa - Cold Spring Harbor Laboratory Press.
- 3) Sarabhai, B. P and Arora, C. K. 2005. Textbook of Algae. Anmol Publishing Pvt. Ltd. New Delhi.
- 4) Sharma, O. P. 2001. Textbook of Algae. Tata McGraw Hill Company, New Delhi.
- 5) Sharma, O. P. 2001. Text book of Fungi. Tata McGraw Hill Company, New Delhi.

References

- 1) Khan, M. 1970. Algae today, Gajendra Singh Gahlot at Siva Printers, Dehra Dun, India.
- 2) Amrik, S. A. 2003. Phycology: Principles, processes and applications. Daya Publishing House, Delhi.
- 3) Rajarao, V. N. 1990. Perspectives in Phycology, Today and Tomorrow Printers and publishers, New Delhi.
- 4) Steve, P. 2009. Protozoans, Algae & Other Protists - Capstone Press.

Semester – II

6Hours/4 Credits

MEDICAL BACTERIOLOGY

Objectives

- To impart in-depth understanding of normal flora and its importance, learn bacterial classification and virulence factors contributing to pathogenicity.
- To provide insights into processing of samples and laboratory diagnosis of pathogenic bacteria.
- To illustrate methods involved in collection and transport of samples and its biosafety guidelines for bacterial identification.
- To teach various cultivation methods, pathogenesis and clinical features of bacteria affecting humans.
- To provide the ability to characterize, isolate and identify different Medically important bacteria.

Course Outcomes

Course Outcome (CO)	Description	Cognitive Level (K-Level)
CO-1	Introducing the knowledge of the Medically important bacteria.	K3
CO-2	Differentiate normal flora from pathogens, analyse the factors contributing to pathogenicity and acquire the skill of sample collection, transport and processing for bacterial identification.	K2, K3, K4
CO-3	Describe the morphology with the focuses being the pathogenicity, symptoms, identification and treatment for different bacteria.	K1
CO-4	Analyse and create an awareness on bacterial diseases and classification for diagnosing Gram positive bacteria and spore formers.	K3, K6
CO-5	Evaluate the implications of Mycobacterial diseases and drug resistance in the society.	K5
CO-6	Detect the etiology and virulence factors of Gram negative bacterial diseases, interpreting the laboratory results after	K2

	following standard operating procedures.	
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Mapping of CO with PO and PSO

C O	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Score s of COs
	P O 1	P O 2	P O 3	P O 4	P O 5	P S O 1	P S O 2	P S O 3	P S O 4	P S O 5	P S O 6	P S O 7	P S O 8	PSO 9	PS O 10	
1	3	3	2	2	3	3	3	3	2	3	3	3	2	3	3	2.7
2	2	2	3	3	2	2	3	2	3	3	2	2	3	2	1	2.3
3	3	1	2	3	1	3	2	3	2	2	3	3	2	3	3	2.4
4	2	2	3	2	3	2	3	3	3	3	3	3	3	2	2	2.6
5	2	3	3	2	2	2	2	2	2	2	2	2	3	2	2	2.2
6	3	2	2	3	3	3	2	3	3	3	3	3	2	3	3	2.7
Mean Overall Score															2.5	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit - I

Normal microbial flora of human body; Microbial Infection – Types, Source, Transmission and Factors predisposing to Microbial Pathogenicity; Epidemiology of Microbial infections; Clinical Specimens - Collection, Transport and Storage; Laboratory diagnosis of Bacteria – Staining techniques, Culture medium, Biochemical tests and Serological tests; Antibiotics – Microorganisms involved in Antibiotics production, Spectrum of activity of Antibiotics;

Classification based on mode of action, Antibiotic Sensitivity Test and Antimicrobial Resistance.

Unit – II

Morphology, Cultural characteristics, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Gram Positive Cocci - *Staphylococcus aureus*, Coagulase negative *Staphylococcus* sp., *Streptococcus pyogenes*, *Streptococcus agalactiae*, Viridans *Streptococci* (*Streptococcus pneumoniae*), *Enterococcus* sp. and Gram Negative Cocci – *Neisseria meningitidis* and *Neisseria gonorrhoeae*.

Unit – III

Morphology, Cultural characteristics, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Gram Positive Bacilli - *Bacillus anthracis*, *Bacillus cereus*, *Clostridium tetani*, *Clostridium perfringens*, *Clostridium botulinum*, *Clostridium difficile*, *Listeria monocytogenes*, *Erysipelothrix rhusiopathiae*, *Corynebacterium diphtheriae*, *Nocardia brasiliensis*, *Mycobacterium leprae*, *Mycobacterium tuberculosis* and *Mycobacterium avium* Complex.

Unit – IV

Morphology, Cultural characteristics, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Enterobacteriaceae (*Escherichia coli*, *Klebsiella pneumoniae*, *Proteus* sp., *Salmonella* sp., *Shigella* sp., *Serratia marcescens* and *Yersinia pestis*), *Pseudomonas aeruginosa*, *Vibrio cholerae*, *Aeromonas hydrophila*, *Campylobacter jejuni* and *Helicobacter pylori*.

Unit – V

Morphology, Cultural characteristics, Pathogenicity, Laboratory diagnosis, Treatment and Preventive measures for *Haemophilus influenzae*, *Pasteurella multocida*, *Propionibacterium acne*, *Francisella tularensis*, *Brucella* sp., *Bordetella pertussis*, *Legionella pneumophila*, Spirochaetes (*Treponema pallidum*, *Borrelia* sp. and *Leptospira* sp.), *Mycoplasma* sp., *Rickettsia* sp. and *Chlamydia trachomatis*; Current Research Thoughts in Medical Bacteriology.

Text Books

- 1) Jawetz, E., J. L. Melnic and E. A. Adelberg. 2013. Review of Medical Microbiology, 26th Edition, Lange Medical Publishers, New York.
- 2) Patrick Murray, Ken Rosenthal and Michael Pfaller. 2016. Medical Microbiology, 8th Edition, Elsevier Publications, United States.
- 3) Saranraj, P. 2020. Medical Bacteriology, 1st Edition, JPS Scientific Publications, India.
- 4) Robert W. Bauman. 2015. Microbiology with Body Diseases by Body System, 4th Edition, Pearson Education, UK.

References

- 1) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 2) Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.
- 3) Chakraborty, P. 2013. A Text book of Microbiology, Published by New Central Book Agency (P) Ltd., Kolkata, India.
- 4) Baron, E. J and S. M. Finegold. 1990. Bailey and Scott's Diagnostic Microbiology, 8th Edition, The C.V. Mosby Company. St. Louis, Missouri.

Semester – II

5Hours/4 Credits

MEDICAL VIROLOGY

Objectives

- To make the students to understand the role of viruses in major diseases.
- To provide the knowledge on general characters and classification of viruses.
- To teach the structure, cultivation and various strategies of Virus replication.
- To impart knowledge regarding the diagnostics, clinical aspects and related implications of human viral diseases and emerging viral infections.
- To describe the growth behaviour differences between normal cells and cells transformed by DNA and RNA viruses.

Course Outcomes

Course Outcome (CO)	Description	Cognitive Level (K-Level)
CO-1	Recognize characters of different types of viruses.	K1
CO-2	Compare the complex interaction between viruses and host cells.	K2
CO-3	Analyze and teach newer emerging viral infections including the viral mutant forms for emerging.	K3, K4
CO-4	Outline the basics and essential concepts of Virology.	K4
CO-5	Evaluate and discuss the structure, classification, pathogenesis, replication, purification and disease control.	K5, K6
CO-6	Discuss viral vaccines and create awareness about the new emerging threats of viral diseases and modern approaches of virus control.	K2, K6

Mapping of CO with PO and PSO

C O	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Score s of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	
1	3	3	2	2	3	2	2	2	2	2	3	3	2	3	3	2.4
2	3	2	2	3	2	2	3	2	3	2	2	2	2	3	3	2.4
3	2	2	2	3	2	2	3	2	2	2	3	2	3	3	2	2.3
4	2	2	3	3	1	2	3	2	3	2	3	3	2	2	2	2.3
5	2	2	3	2	2	2	2	3	2	2	2	2	2	2	2	2.1
6	2	2	1	2	2	3	2	3	2	3	3	1	3	2	2	2.2
Mean Overall Score															2.3	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

General properties and Structure of Viruses; Classification of Virus – Based on Host, Structure and Nucleic acids; Replication of Viruses; Viral pathogenesis; Viral Epidemiology; Lab diagnosis of Viruses – Microscopic examination, Cultivation of Viruses, Serological and Molecular diagnosis of Viruses; Antiviral agents; Viral vectors for therapy; Interferons; Interleukins; Viral Vaccines and its Immunization Schedule; Control of Viral spread.

Unit – II

General properties, Structure, Replication, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for DNA Viruses – Poxviridae (Pox Virus); Herpesviridae (Herpes Simplex Virus, Varicella Zoster Virus, Cytomegalovirus and Epstein-

Barr Virus); Adenoviridae (Adenovirus); Hepadnaviridae (Hepatitis – B Virus); Papillomaviridae (Human Papilloma Virus); Polymaviridae (BK Virus & JC Virus) and Parvoviridae (B19 Parvo Virus).

Unit – III

General properties, Structure, Replication, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for RNA Viruses – Paramyxoviridae (Parainfluenza virus, Measles virus, Mumps virus, Respiratory syncytial virus & Nipahvirus); Orthomyxoviridae (Influenza virus); Coronaviridae (SARS, MERS & Covid-19); Caliciviridae (Noroviruses); Rhabdoviridae (Rabies Virus).

Unit – IV

General properties, Structure, Replication, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for RNA Viruses – Filoviridae (Ebola virus & Marburg virus); Retroviridae (HIV, Human T-cell lymphotropic virus & Other Oncogenic Retroviruses); Togaviridae (Togaviruses - Rubella virus & Chikungunya); Flaviviridae (Flaviviruses - Yellow fever virus, Dengue virus & Hepatitis C virus).

Unit – V

General properties, Structure, Replication, Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for RNA Viruses – Reoviridae (Rotavirus & Colorado Tick fever virus); Bunyaviridae (Bunyaviruses & Arenaviruses); Arenaviridae (Lassa fever virus); Picornaviridae (Rhinoviruses, Poliovirus, Echoviruses, Coxsackievirus & Hepatitis A virus); Current Research Thoughts in Medical Virology.

Text Books

- 1) Jawetz, E., J. L. Melnick and E. A. Adelberg. 2013. Review of Medical Microbiology, 26th Edition, Lange Medical Publishers, New York.
- 2) Patrick Murray, Ken Rosenthal and Michael Pfaller. 2016. Medical Microbiology, 8th Edition, Elsevier Publications, United States.
- 3) Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.
- 4) Robert W. Bauman. 2015. Microbiology with Body Diseases by Body System, 4th Edition, Pearson Education, UK.

References

- 1) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 2) Dimmock, N. J., Easton, A. J., and Leppard, K. N. 2001. Introduction to Modern Virology. 5th Edition, Blackwell publishing, USA.
- 3) Baron, E. J and S. M. Finegold. 1990. Bailey and Scott's Diagnostic Microbiology, 8th Edition, The C.V. Mosby Company. St. Louis, Missouri.
- 4) John, B. C and Venetia, A. S. 2007. Virology, Principles and Applications. John Wiley and Sons limited, England.

Semester – II

5Hours/4 Credits

MEDICAL MYCOLOGY AND PARASITOLOGY

Objectives

- To illustrate the basics of medically important Fungi and Parasites.
- To provide in-depth knowledge on Superficial and Systemic fungi.
- Demonstrate the importance of Opportunistic infections caused by fungi.
- To study general aspects of Pathogenicity, Clinical Syndrome, Laboratory diagnosis, Treatment and Preventive measures for Fungal and Parasitic diseases.
- To explain the role of Protozoans and Helminths as infectious agents.

Course Outcomes

Course Outcome (CO)	Description	Cognitive Level (K-Level)
CO-1	Identify, Classify and Cultivate medically important fungi and parasites.	K1, K2
CO-2	Evaluate and analyze the role of superficial and systemic fungi.	K4, K5
CO-3	Predict the importance of fungi causing opportunistic infections in immunocompromised individuals.	K2
CO-4	Assess the role of Protozoans and Helminthes in anthroponotic and zoonotic infections.	K5
CO-5	Apply diagnostic techniques to identify, isolate and interpret fungal and parasitic infections.	K3, K4
CO-6	Creating awareness on appropriate preventive and chemotherapeutic measures.	K6

Mapping of CO with PO and PSO

C O	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Score s of	
	P	P	P	P	P	P	P	P	P	P	P	P	P	P	PSO		PS

	O 1	O 2	O 3	O 4	O 5	S O 1	S O 2	S O 3	S O 4	S O 5	S O 6	S O 7	S O 8	9	O 10	COs
1	3	2	3	3	3	3	3	3	2	3	3	3	3	2	3	2.8
2	3	2	3	3	2	3	3	2	3	3	3	3	3	2	3	2.7
3	3	2	3	3	2	3	2	3	2	2	3	3	3	3	2	2.6
4	3	3	2	3	3	2	3	2	3	3	3	3	3	2	3	2.7
5	3	2	3	3	3	3	2	3	2	3	3	3	2	3	2	2.6
6	3	3	2	2	3	3	3	3	3	3	3	3	2	3	2	2.7
Mean Overall Score																2.7
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

General characteristics of Fungi (Mold and Yeast); Classification of Human Mycoses – Superficial Mycoses, Cutaneous Mycoses, Subcutaneous Mycoses, Endemic Mycoses and Opportunistic Mycoses; Pathogenesis of Fungal diseases - Primary fungal pathogens and Opportunistic fungal pathogens; Laboratory diagnosis of fungi from clinical specimens – Microscopic examination, Culture medium; Antigenic, Biochemical, and Molecular Markers for Direct Detection of Invasive Fungal Infections; Antifungal agents; Antifungal activity testing methods; Mechanism of resistance to Antifungal agents.

Unit – II

General Characteristics, Pathogenesis, Clinical Manifestations, Laboratory Diagnosis and Treatment for Opportunistic Mycoses (Candidiasis, Cryptococcosis, Aspergillosis,

Trichosporonosis, Hyalohyphomycosis, Mucormycosis, Phaeohyphomycosis and Pneumocytosis); Endemic Mycoses (Blastomycosis, Histoplasmosis, Coccidioidomycosis, Paracoccidioidomycosis and Penicilliosis).

Unit – III

General Characteristics, Pathogenesis, Clinical Manifestations, Laboratory Diagnosis and Treatment for Superficial Mycoses (Black piedra, White piedra, Tinea nigra & Pityriasis versicolor), Cutaneous and Subcutaneous Mycoses (Dermatophytoses, Tinea unguium, Onychomycosis, Mycotic keratitis and Chromoblastomycosis); Mycotoxins and Mycotoxicoses.

Unit – IV

General characteristics of Protozoa; Morphology, Life cycle, Clinical Manifestations, Lab diagnosis and Treatment for Intestinal Protozoa (*Entamoeba histolytica*, *Giardia lamblia*, *Cryptosporidium parvum* & *Balantidium coli*), Urogenital Protozoa (*Trichomonas vaginalis*) and Blood and Tissue Protozoa (*Plasmodium* sp., *Leishmania donovani*, *Leishmania tropica*, *Leishmania mexicana*, *Leishmania braziliensis*, *Toxoplasma gondii*, *Trypanosoma cruzi* & *Trypanosoma brucei*); Antiprotozoan drugs.

Unit – V

General characteristics of Helminths; Morphology, Life cycle, Clinical Manifestations, Lab diagnosis and Treatment for Nematodes (*Ascaris lumbricoides*, *Trichuris trichiura*, *Enterobius vermicularis* & *Wuchereria bancrofti*), Trematodes (*Fasciola hepatica*, *Paragonimus westermani* & *Schistosoma* sp.) and Cestodes (*Taenia saginata*, *Taenia solium*, *Dipylidium caninum* & *Echinococcus granulosus*); Anthelmintic drugs; Current Research Thoughts in Mycology and Parasitology.

Text Books

- 1) Subhash Chandra Parija. 2013. Textbook of Medical Parasitology, 4th Edition, All India Publishers and Distributors, India.
- 2) Jagdish Chander. 2017. Textbook of Medical Mycology, 4th Edition, Jaypee Brothers Medical Publishers, India.
- 3) Patrick Murray, Ken Rosenthal and Michael Pfaller. 2016. Medical Microbiology, 8th Edition, Elsevier Publications, United States.
- 4) Chatterjee, J. 2009. Medical Parasitology. 13th Edition, CBS Publishers, New Delhi.
- 5) Robert W. Bauman. 2015. Microbiology with Body Diseases by Body System, 4th Edition, Pearson Education, UK.
- 6) Alexopolus, C. J and Mims, C. W. 1995. Introductory Mycology. 4th Edition, John Wiley and Sons, New York.

References

- 1) Jawetz, E., J. L. Melnic and E. A. Adelberg. 2013. Review of Medical Microbiology, 26th Edition, Lange Medical Publishers, New York.

- 2) Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2017. Prescott's Microbiology, 10th Edition, McGraw Hill Publication, United States.
- 3) Reba Kanungo. 2017. Ananthanarayan and Paniker's Text book of Microbiology, 7th Edition, Orient Longman Limited, Chennai, India.
- 4) Levanthal, R and Cheadle, R. S. 2012. Medical Parasitology. 6th Edition, S. A. Davies Co., Philadelphia.
- 5) Choidini, P. L., Moody, A. H and Manser, W. M. 2001. Atlas of Medical Helminthology and Parasitology. 4th edition, Churchill Living Stone.

Semester – I & II

5Hours/4 Credits

PRACTICAL – I: GENERAL AND MEDICAL MICROBIOLOGY

- 1) Orientation to the Microbiology Laboratory
- 2) Sterilization Techniques
- 3) Handling of Microscopes
- 4) Preparation of Broth and Agar medium for Bacteria and Fungi
- 5) Bacterial Staining Techniques
- 6) Motility Test – Hanging Drop Method
- 7) Biochemical tests for Bacterial identification
- 8) Pure culture technique – Spread plate technique and Pour plate technique
- 9) Bacterial Growth curve
- 10) Effect of pH, NaCl concentration and UV light on Bacterial growth.
- 11) Lyophilization of Bacterial culture.
- 12) Collection and transport of clinical samples.
- 13) Identification of bacteria from clinical samples – *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, *Shigella* sp., *Proteus vulgaris*, *Klebsiella pneumoniae*, *Vibrio cholerae* and *Pseudomonas aeruginosa*.
- 14) Antibiotic sensitivity test – Disc diffusion assay.
- 15) Antibiotic sensitivity test – Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC).
- 16) Determination of β -Lactamase activity- Acidometric method and Iodometric method.
- 17) Slide Culture Technique for fungal identification.
- 18) Examination of *Candida albicans* by Germ tube test and Sugar assimilation test.
- 19) Microscopic examination of Protozoa.
- 20) Microscopic examination of Algae.
- 21) Inoculation of Viruses in Egg membrane.
- 22) Isolation of Bacteriophages and Plague assay.

**PRACTICAL – II: IMMUNOLOGY, HEMATOLOGY AND MOLECULAR
MICROBIOLOGY**

Semester – I & II

5 Hours/4 Credits

- 1) Blood collection and Plasma/Serum separation.
- 2) Blood Grouping and Rh Typing.
- 3) Staining and Microscopic examination of Blood cells - RBC, WBC and Differential Cell Counts.
- 4) Separation of Lymphocytes from Peripheral Blood by Density Gradient Centrifugation.
- 5) Purification of Antibodies by Ammonium Sulfate Precipitation.
- 6) Agglutination reaction – WIDAL Test, RPR Card Test, TPHA Test, ASO Test, RA Test, CRP Test and Pregnancy Test.
- 7) Precipitation reaction – Mancini Radial Immunodiffusion, Ouchterlony Double Immunodiffusion, Immunoelectrophoresis, Serum electrophoresis and Rocket electrophoresis.
- 8) ELISA Test.
- 9) Isolation of Plasmid DNA
- 10) Isolation of Chromosomal DNA
- 11) Transformation in *Escherichia coli*
- 12) Estimation of DNA by Diphenylamine method.
- 13) Estimation of RNA.
- 14) Chromatographic techniques – Paper chromatography, Thin Layer chromatography and Column chromatography
- 15) Polymerase Chain Reaction (PCR)

ELECTIVE - PHARMACEUTICAL MICROBIOLOGY

Semester – II

4Hours/3 Credits

Objectives

- To illustrate the Principles of Pharmaceutical Microbiology.
- To understand the basics of Pharmaceutical Microbiology and important microorganism playing role pharmaceutically.
- To understand different products of microbial origin playing key role in Pharmaceutical applications.
- To understand role of Secondary metabolites in Pharmaceutical industry.

- To understand good practices and regulation involved in utilizing microbial product for pharmaceutical application

Course Outcomes

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Understanding and explaining the role of microbes in Pharma industries in both positive and negative aspects.	K2
CO-2	Administering antibiotics and determine Antibiotics resistance for advanced Drug delivery system.	K3
CO-3	Analyzing and determining drug formulation regarding to guidelines and regulations.	K3, K4
CO-4	Examining microbial contamination during pharmaceuticals formulations and production.	K1
CO-5	Advice good laboratory practices for better understanding.	K2, K5
CO-6	Formulate regulations for utilizing microbial product in pharmaceutical applications.	K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Score s of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	
1	3	3	3	3	3	2	2	3	3	3	3	3	3	2	3	2.8
2	2	2	3	3	3	3	3	3	3	3	2	3	2	2	2	2.6
3	2	3	2	3	2	3	2	3	2	3	3	2	3	3	3	2.6
4	3	3	3	2	3	2	3	2	3	3	3	3	3	2	3	2.7

5	3	2	3	2	3	3	2	3	3	3	3	1	2	2	3	2.8
6	3	3	1	3	3	3	3	2	3	3	3	3	3	3	3	2.5
Mean Overall Score															2.6	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Pharmaceutically Useful and Problematic Microorganisms; Identification and Characterization of Pharmaceutically Important Microbes; Microbial contamination of Pharmaceutical products; Pharmaceutical products and its Sterilization; Sterility testing of Pharmaceutical products and Quality assurance; Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in Pharmaceutical industry; Laboratory animals for Pharmaceutical testing; Biosensors in Pharmaceutical industry.

Unit - II

History of Chemotherapy; Common terminologies related to Chemotherapy; Drugs - Definition, Sources, Classification, Routes of Drug administration, Dosage forms, Drug receptors, Mechanism of action of Drugs, Combined effect of Drugs, Factors modifying Drug action and Selective toxicity; Molecular principles of Drug delivery; Drug delivery system in Gene therapy; Negative interaction between Drugs and Host.

Unit – III

Chemical Disinfectants, Common terminologies related to Disinfectants; Antiseptics and Preservatives – Acids and Esters, Alcohols, Aldehydes, Biguanides, Halogens, Heavy metals, Hydrogen peroxide & peroxygen compounds, Phenols, Surface active agents and Dyes; Required Concentrations and Times for Chemical Destruction of Microorganisms; Evaluation of Disinfectants – Phenol coefficient test, Filter paper method, Use - Dilution test, In-Use Test and Kelsey-Sykes Capacity Test. Antimicrobial combination and systems; Disinfection policy.

Unit – IV

Antibiotics – Cell wall inhibitors, Cell membrane inhibitors, Protein synthesis inhibitors, Nucleic acid inhibitors and Antimetabolites; Antimicrobial drug resistance; Antibiotic sensitivity tests; Therapeutic index; Common side effects of Antibiotics.

Unit – V

Antiviral drugs; Antifungal drugs; Antiprotozoan drugs; Vaccines and its types; Covid-19 Vaccine and its impacts; Antihelminthic drugs; Common side effects of Antiviral, Antifungal, Antiprotozoan and Antihelminthic drugs; Natural products as Antimicrobial agents – Medicinal plants, Mushrooms, Kitchen spices, Algae, Actinobacteria and Lactic acidbacteria; Government regulatory practices and policies in Pharmaceuticals; Current Research Thoughts in Pharmaceutical Microbiology.

Text Books

- 1) Luis Jimenez. 2004. Microbial Contamination Control in the Pharmaceutical Industry, Marcel Dekker Inc., New York, USA.
- 2) Hugo and Russell. 2011. Pharmaceutical Microbiology. 8th Edition. Wiley Blackwell Publications, USA.
- 3) Ashutosh Kar. 2008. Pharmaceutical Microbiology, New Age International Publishers, New Delhi, India.
- 4) Vyas, S. P and Dixit, V. K. 2010. Pharmaceutical Biotechnology, CBS Publishers & Distributors, New Delhi, India.
- 5) Geoff Hanlon and Norman A. Hodges. 2013. Essential Microbiology for Pharmacy and Pharmaceutical Science, Wiley-Blackwell, USA.

References

- 1) Stephen P Denyer, Norman A Hodges and Sean P Gorman. 2011. Hugo and Russell's Pharmaceutical Microbiology, 8th Edition, Blackwell Publishing Company, New York, United States.
- 2) Thomas N. Tozer, Malcolm Rowland. Introduction to Pharmacokinetics and Pharmacodynamics: The Quantitative Basis of Drug Therapy. 2006. Lippincott Williams & Wilkins publishers.
- 3) Nita K. Pandit. 2007. Introduction to the Pharmaceutical Sciences. Lippincott Williams & Wilkins publishers.
- 4) Joseph D Nally. 2016. Good Manufacturing Practices for Pharmaceuticals. 6th Edition, CRC Press, USA.
- 5) Madhu Raju Saghee, Tim Sandle and Edward C. Tidswell. 2011. Microbiology and Sterility Assurance in Pharmaceuticals and Medical Devices, Business Horizons.

ELECTIVE - BIOINFORMATICS**Objectives**

- To explain basics and uses of internet and biological databases.
- To provide an overview of various bioinformatics tools, databases available and sequence analysis.
- To provide knowledge on database concept, management, retrieval along with utilization in gene and protein analysis.
- To demonstrate the use of tools for parsing and retrieving sequences and structures from appropriate databases and predicting genes.
- To impart in-depth knowledge on deducing protein structures, analyse the expression of proteins, genes and to study variations.

Course Outcomes

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Effectively use internet in biological database searching, communicating biological data by depositing, storing and retrieving sequences and structures.	K3
CO-2	Analyse and identify genes and proteins from a set of sequences using appropriate Bioinformatic tools.	K1, K4
CO-3	Apply the evolutionary relatedness in predicting structure, function of biomolecules, metabolism and to Perform <i>In silico</i> Drug designing.	K3, K6
CO-4	Demonstrate and evaluate the protein and nucleotide interaction through Bioinformatics tools.	K2, K5
CO-5	Deduce the structure of proteins, gene expressions.	K4, K6
CO-6	Justify the variations thus applying Bioinformatics in several fields for benefit of the society.	K5

Mapping of CO with PO and PSO

C O	Programme Outcomes (PO)	Programme Specific Outcomes (PSO)	Mean Score

	P O 1	P O 2	P O 3	P O 4	P O 5	P S O 1	P S O 2	P S O 3	P S O 4	P S O 5	P S O 6	P S O 7	P S O 8	PSO 9	PS O 10	s of COs
1	3	3	2	2	3	3	3	3	2	3	3	3	2	3	3	2.7
2	2	2	3	3	2	2	3	2	3	3	2	2	3	2	1	2.3
3	3	1	2	3	1	3	2	3	2	2	3	3	2	3	3	2.4
4	2	2	3	2	3	2	3	3	3	3	3	3	3	2	2	2.6
5	2	3	3	2	2	2	2	2	2	2	2	2	3	2	2	2.2
6	3	2	2	3	3	3	2	3	3	3	3	3	2	3	3	2.7
Mean Overall Score																2.5
Result																High

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Bioinformatics – Definition, History and Development, Role of Bioinformatics in Biology; Introduction to Internet - Local area and wide area network, Types of files – HTML, TXT and PDF; Search Engines - Types and applications; Application of Bioinformatics.

Unit – II

Biological sequence database – Primary databases (NCBI, EMBL and DDBJ), Secondary databases – Nucleic acid secondary databases and Protein secondary databases; Phylogenetic analysis and Sequence submission tools; Sequence Annotation; DNA analysis for repeats (Direct and Inverted palindromes) related tools BLAST, FASTA, SSEARCH, Phylogenetic analysis and Multiple sequence alignment.

Unit – III

Applied Genomics – Prokaryotic and Eukaryotic Genomes, DNA Microarray, Microarray Database, Tools for analysis of Human Genome and Human Genome Project; Pharmacogenomics; Proteomics – Protein – protein interaction and Yeast two hybrid system; Protein Microarray; MALDI-TOF method of analysis of Proteins; 2D Two Gel Electrophoresis; Proteomics in Drug discovery.

Unit – IV

Structural Biology; Principles of Structural organization, Conformational analysis and Structure determination; Visualization and Computational methods used in Protein structure prediction, Homology modelling, Threading, Abinitio, Neural networks and Structure based drug design; Molecular docking - Mechanisms in Molecular docking, Virtual screening, Active site analysis tools, Docking tools de novo Ligand design; Application of Molecular docking.

Unit – V

Commercial application of Bioinformatics, Genome technology, High throughput sequencing and assembly; Genomics in Medicine - Disease monitoring and Profiles for Therapeutic Molecular Targeting; Drug discovery and genomics; Comparative Proteomics and its applications; IPR and Bioinformatics patents; Current Research Thoughts in Bioinformatics.

Text Books

- 1) Jin Xiong. 2006. Essential Bioinformatics, 1st Edition, Cambridge University Press, New York, United States.
- 2) Hooman Rashidi and Lukas K. Buehler. 2005. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, Taylor & Francis Group, United Kingdom.
- 3) Mount, D. W. 2013. Bioinformatics Sequence and Genome analysis. 2nd Edition, CBS Publishers, New Delhi.
- 4) Rastogi, S. C., Mendiratla, N and Rastogi, P. 2013. Bioinformatics methods and applications - Genomics, Proteomics and Drug Discovery. Prentice Hall India.

References

- 1) Stephen A. Krawetz, David D. Womble. Stephen A. Krawetz and David D. Womble. 2003. Introduction to Bioinformatics: A theoretical and Practical approach, Humana Press, USA.
- 2) Bryan Bergeron. 2002. Bioinformatics Computing, Prentice Hall.
- 3) Claverie, J. M and C. Notredame. 2003. Bioinformatics for Dummies, Wiley Publishing, Inc., United Kingdom.
- 4) Xiong, J. 2011. Essential Bioinformatics, First south Indian Edition, Cambridge University Press.

ELECTIVE – PUBLIC HEALTH MICROBIOLOGY

Semester – II

4Hours/3 Credits

Objectives

- To strengthen the knowledge of personal health care and hygienic to students.
- To provide a detailed study on vaccine and its schedule throughout the life time.
- To acquaint the student with basic concept of public health and prophylactic measures.
- To understand air, Food, water, insect borne infectious diseases.
- To create public awareness, individual behavior, and disease prevention.

Course Outcomes

Course Outcome (CO)	Description	Cognitive level (K level)
CO-1	Create awareness to prevent disease, promote health, and prolong life among the population as a whole.	K6
CO-2	Provide conditions in which people can be healthy and focus on entire populations, not on individual patients or diseases.	K1, K4
CO-3	Operate and employ the National disease control plans for major infectious diseases.	K3
CO-4	Understanding the Comprehensive health education campaigns to increase public awareness of these diseases in rural areas of India.	K2
CO-5	Support for the investigation, management and control of infection and outbreaks of Communicable disease.	K5
CO-6	Provide assistance during field investigations by processing Clinical samples.	K1

Mapping of CO with PO and PSO

C O	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)										Mean Score s of COs	
	P	P	P	P	P	P	P	P	P	P	P	P	P	PSO	PSO		

	O 1	O 2	O 3	O 4	O 5	S O 1	S O 2	S O 3	S O 4	S O 5	S O 6	S O 7	S O 8	9	10	
1	3	2	2	3	2	2	2	2	3	3	3	3	2	3	3	2.5
2	3	2	2	3	3	2	3	2	3	2	3	3	2	2	3	2.5
3	2	2	2	3	2	2	3	3	1	2	3	2	3	2	2	2.2
4	2	2	3	3	2	2	3	2	3	2	3	3	2	2	3	2.4
5	2	2	3	2	3	3	2	2	2	1	2	2	2	2	2	2.1
6	3	3	2	2	3	3	2	3	2	2	3	3	3	2	2	2.5
Mean Overall Score															2.4	
Result															High	

Assessment Pattern

Bloom's Category	CA Tests (Marks Allotment)		Term End Exam (100) Marks Allotment
	I CA (50)	II CA (50)	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	10
Analyze	10	10	10
Evaluate	5	5	10
Create	5	5	20

Unit – I

Hygiene – Personal hygiene and Grooming routines; Importance of Public Health Microbiology; Factors for Good health; Importance of Hand washing; Role of Microbiologists in Public health; Indicators of health; National Health Programmes; Health status in India; Present and Future challenges in Public health.

Unit – II

Vaccines and Vaccination – History, Types of Vaccines, Route of Administrations, Mechanisms of Inducing immunity; Diseases prevented by Vaccination; Microbial synthesis of Vaccines; Vaccines for Tuberculosis and Covid-19; Vaccination schedule; Vaccine risks and safety.

Unit – III

Child Health Management – General child health and Types of infection in Child; Vaccination schedule in Children – New born, Child below 5 years and Child below 10 years; Vaccination schedule for Adults - Hepatitis B vaccines, MMR vaccines, Tetanus vaccines and Varicella vaccines; Vaccines for Travelers; Universal Immunization Programme; Public awareness about Vaccines and Vaccination.

Unit – IV

Common diseases caused by Microorganisms – Air borne, Water borne, Soil borne, Vector borne and Zoonotic diseases; Vaccination for Pets; Methods for controlling Insect vectors; Sexually transmitted diseases and its awareness to public; Air pollution and Indicators of Air pollution; Water pollution; Water quality and analysis of Drinking water quality; Sanitary surveys; World Health Organization (WHO) and Centre for Disease Control and Prevention (CDC).

Unit – V

Industrial Pollution and Toxic pollutants from industries; Hygienic practices in Industries; Hygienic practices in Hospitals; Nosocomial Infections and its preventive measures; Vaccines for Healthcare workers; Biomedical wastes and its management in Hospitals; Public awareness about Water, Air and Insect borne diseases; Current Research Thoughts in Vaccines and Pollution control.

Text Books

- 1) Robert S. Burlage. 2012. Principles of Public Health Microbiology. Jones & Bartlett learning LLC, Canada.
- 2) Robert W. Bauman. 2015. Microbiology with Body Diseases by Body System, 4th Edition, Pearson Education, UK.
- 3) Reed, G. 2004. Prescott and Dunn's Industrial Microbiology, 4th Edition, CBS Publishers and Distributors, New Delhi, India.
- 4) Prasada Rao, J. V. R. 1999. Manual for Control of Hospital Associated Infections National AIDS Control Organization. Ministry of Health and Family Welfare, Government of India. New Delhi.

References

- 1) Judith A. Owen, Jenni Punt, Sharon A. Stanford and Patricia P. Jones. 2009. Kuby's Immunology, 4th Edition, W. H. Freeman and Company, New York.
- 2) Chaudhri, A. K. 1998. Tripathy, G. C. and D. Sharma - Common sense rules for wellbeing, Naval Printing Press, New Delhi.
- 3) Dunne, J. 1997. Webb, M., R. Scott and P. Beale - First Aid Manual, 7th Edition, Dorling Kindersley Ltd., London.
- 4) Spencer, John F. T., Alicia L. Ragout de Spencer. 2004. Public Health Microbiology- Methods and Protocols. Springer.