Progressive Education Society's

Modern College of Arts, Science and Commerce

Shivajinagar, Pune 5

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Course Name: B. Sc. Microbiology

Third Year B. Sc. Microbiology

Semester 5 (Third Year)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
DSET-1	19ScMicU501	Medical Microbiology I	04	2.5	40	60	100
DSET-2	19ScMicU502	Molecular Biology I	04	2.5	40	60	100
DSET-3	19ScMicU503	Enzymology	04	2.5	40	60	100
DSET-4	19ScMicU504	Immunology I	04	2.5	40	60	100
DSET-5	19ScMicU505	Industrial Microbiology I	04	2.5	40	60	100
DSET-6	19ScMicU506	Food and Dairy Microbiology	04	2.5	40	60	100
	19ScMicU507	Mathematics and Statistics in Biology	04	2.5	40	60	100
DSEP-1	19ScMicU508	Diagnostic Microbiology practical paper –I	04	2	40	60	100
DSEP-2	19ScMicU509	Biochemistry practical paper II	04	2	40	60	100
DSEP-3	19ScMicU510	Industrial Microbiology practical paper-III	04	2	40	60	100
	Total Credits		-	**21**			

Semester 6 (Third Year)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
DSET-7	19ScMicU601	Medical Microbiology II	04	2.5	40	60	100
DSET-8	19ScMicU602	Molecular Biology II	04	2.5	40	60	100

DSET-9	19ScMicU603	Metabolism	04	2.5	40	60	100
DSET-10	19ScMicU604	Immunology II	04	2.5	40	60	100
DSET-11	19ScMicU605	Industrial Microbiology II	04	2.5	40	60	100
DSET-12	19ScMicU606	Biophysics	04	2.5	40	60	100
	19ScMicU607	Microbial Ecology and Evolution	04	2.5	40	60	100
DSEP-4	19ScMicU608	Clinical microbiology and Immunology practical paper-IV	04	2	40	60	100
DSEP-5	19ScMicU609	Molecular Biology practical paper –V	04	2	40	60	100
DSEP-6	19ScMicU610	Applied Microbiology Practical Paper -VI	04	2	40	60	100
	Total Credits		**-**	**21**			

Progressive Education Society's

Modern College of Arts, Science, and Commerce (Autonomous), Shivajinagar, Pune - 5

Third Year (AY 2021-22 Course) B. Sc. Microbiology

Course Name: Medical Microbiology I **Sem V**

Teaching Scheme (TH): 4 Hours/Week **Credit:2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Prerequisite Courses: Second Year B.Sc. Microbiology passout

Course Code: 19ScMicU501: Medical microbiology I (Theory Paper I)

Course Objectives:

- To introduce the students to various aspects of Medical Microbiology
- To enrich students with the knowledge and concepts of Medical Microbiology
- To make students cognizant about applications of Medical Microbiology
- To help the students to build up a successful career

Course Outcomes:

On completion of the course, the student will be–

- Aware of medical microbiology
- Perceptive about the human body systems, diseases and chemotherapy
- Cognizant about the applications of microbiology

Course Contents:

Chapter 1	**Introduction to human body systems and host pathogen interactions**	**No. of lectures**
	Brief anatomy, physiology, defence mechanisms and diseases a. Respiratory system b. Digestive and excretory system c. Renal and urinary system d. Reproductive system	**10**

	e. Central nervous system **Host pathogen interaction:** Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Opportunistic infections, Nosocomial infections.	
Chapter 2	**Study of bacterial diseases**	**No. of lectures**
	Classification and Biochemical characters, Antigenic structure, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology, Prophylaxis and Chemotherapy 1. Enteric pathogens: *E. coli, Salmonella typhi* 2. Pyogenic organisms: *Staphylococcus aureus* 3. Spirochetes: *Treponema pallidium* 4. Pneumococci: *Streptococcus pneumonia* 5. *Mycobacterium tuberculosis* 6. *Clostridium tetani* 7. *Acinetobacter baumannii* 8. *Rickettsia prowazaki*	**20**
Chapter 3	**Epidemiology:**	**No. of lectures**
	a. Definition, scope and applications b. Incidence and prevalence rates, mortality and morbidity rates c. Disease distribution based on time, place and person d. Case control and cohort studies – study design and application e. Principle and methods – Clinical trials of drugs and vaccines (Randomized control trials Concurrent parallel and cross-over trials) f. Epidemiology of infectious diseases i. Sources and reservoirs of infection ii. Modes of transmission of infections iii. Disease prevention and control measures	**15**
	Experiential learning: **Epidemiological survey on infectious disease** Development of hypothesis, Data collection, organization, statistical analysis, graphical representation using computers and interpretation, Preparation of report	**01**

References:

1. Tortora, G. J., Funke, B. R., Case, C. L., Weber, D., & Bair, W. (2004). *Microbiology: an introduction* (Vol. 9). San Francisco, CA: Benjamin Cummings.13th Edition.
2. Paniker, C. K. J., & Ananthanarayan. *Ananthanarayan and Paniker's textbook of microbiology*. Himayatnagar, Hyderabad: Orient Longman. 11th Edition (2020) by Reba Kanungo.

3. Greenwood, D., Slack, R. C. B., Peutherer, J. F., & Duguid, J. P. (1992). *Medical microbiology: A guide to microbial infections : pathogenesis, immunity, laboratory diagnosis, and control*. Edinburgh: Churchill Livingstone. 18th Edition.
4. Brooks, G. F., Jawetz, E., Melnick, J. L., Adelberg, E. A., Carroll, K. C., Butel, J. S., Morse, S. A., ... Mietzner, T. A. (2013). *Jawetz, Melnick & Adelberg's medical microbiology*. New York: McGraw-Hill. 27th Edition.
5. Ryan, K. J., & Ray, C. G. (2004). *Medical microbiology*. McGraw Hill, 4, 370. 7th Edition.
6. Park, K. (2011). *Park's textbook of preventive and social medicine*. Jabalpur: M/S Banarsidas Bhanot.25th Edition.
7. Procop, G. W., Church, D. L., Hall, G. S., & Janda, W. M. (2020). *Koneman's Color Atlas and Textbook of Diagnostic Microbiology*. Jones & Bartlett Publishers.

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Modern College of Arts, Science, and Commerce (Autonomous)

Shivajinagar, Pune – 5

Third Year (AY 2021-22 Course) B. Sc. Microbiology

Semester V

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU502

Course Name: Molecular Biology (Paper II)

Course Objectives:

- To learn and understand the central dogma process in Eukaryotes.
- To provide a deeper insight into the DNA mutations, reversion, damage and repair.
- To enrich the knowledge of students with respect to gene linkage and crossing over.
- To introduce different techniques used in molecular biology.

Course Outcomes:

On completion of the course, student will be able to–

- Explain the central dogma process in Eukaryotes.
- Discuss about DNA mutations, reversion, damage and repair, gene linkage and
- Apply crossing over principles in solving chromosome mapping related problems.

Course Contents:

Chapter 1	Central Dogma Process in Eukaryotes	No. of Lectures
	A. Replication a. Single replicon b. Bidirectional movement of replication fork c. Origin site d. Pre priming and Priming reaction e. DNA polymerases f. DNA synthesis of leading, lagging strand g. Termination **B. Transcription**	**18**

	a. Structure of Promoters b. Structure and role of RNA polymerases c. Initiation, elongation and termination d. Post transcriptional modification e. Regulation of transcription f. Introduction to RNAsplicing **C. Translation** a. Role of mRNA, tRNA and Ribosomes in translation b. Synthesis of aminoacyl tRNA c. Initiation, elongation, translocation and termination of protein synthesis d. Regulation of translation	
Chapter 2	**DNA Mutations & Reversions, DNA Damage & Repair**	**No. of Lectures**
	A. **DNA Mutations & Reversions** Concept of Mutation and Types of mutations: Nonsense, Missense, Silent, Conditional lethal- temperature sensitive, Amber, Reverse, suppressor i. Spontaneous Mutation a. Discovery of spontaneous mutation b. Mechanism of spontaneous mutation c. Isolation of Mutants: Replica plate technique ii. Induced Mutations a. Base pair substitution:- Transitions, Transversions, Insertions and deletions:- Frame /Phase shift mutations b. Physical mutagenic agent:- UV and X-ray c. Chemical mutagenic agents:- Base analogues (2-amino purine, 5-bromouracil), HNO2, Alkylating agents d. Intercalating agents:- Ethidium Bromide, Acridine orange) e. Biological agents:- Transposons, Virus **B. DNA Damage & Repair** a. DNA damage by hydrolysis, deamination, alkylation oxidation and radiation b. Mismatch repair c. Base excision repair and nucleotide excision repair d. Recombinational repair e. Photo-reactivation f. Translesion DNA synthesis	15
Chapter 3	**Recombination and Techniques used in Molecular Biology**	**No. of Lectures**

	A. Recombination a. Cell cycle (basic and revision of Mitosis and Meiosis) b. Gene linkage and crossover c. Recombination in prokaryotes (RecBCD pathway and phage λ Red pathway) d. Recombination in eukaryotes Double Strand Break (DSB) model e. Recombination frequency, Map unit, Chromosome mapping f. Mapping Chromosome by Tetrad analysis **B. Techniques used in Molecular Biology** a. Isolation and purification of genomic DNA b. Blotting Technique - Southern, Northern c. Introduction of Microarray, PCR	12
Chapter 4	**Experiential learning** Problem solving on Recombination frequency, Map unit, Chromosome mapping	**01**

References:

1. Benjamin Lewin,(2000) Gene VII, Oxford University Press England .
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter(2002) Molecular biology of the Cell (4th Edi.), Garland publishing Inc. New York.
3. Darnell, Lodish and Baltimore (2000) Molecular Cell Biology, Scientific American Publishing Inc. New York .
4. Watson J.D, Baker T.A, Bell S.P, Gann A., Levine M., Losick R (2003) Molecular Biology of Gene (5th Edi.), The Benjamin / Cummings Pub. Co. Inc.
5. Brown T.A. (2004) Gene Cloning and DNA analysis (2nd Edi.), ASM press Washington, DC .
6. Sandy Primrose (2006) Principles of Gene Manipulation and Genomics (7th Edi.), Wiley Blackwell Publishers New Jersey .
7. Glick B. R. and Pasternak J. J. (2003) Molecular Biotechnology, (2nd Edi.), ASM press Washington, DC .
8. Uldis N. S., Ronald E. Y. (2002) Modern Microbial Genetics(2nd Edi.), Wiley- Liss Inc. Hoboken
9. Gardner E J, Simmons M J and Snupstad DP (2006) Principles of Genetics (7th Edi.), Wiley- Liss Inc. Hoboken
10. Lodish H., Berk A., Kaiser C. A., Krieger M., Bretscher A., Ploegh H., Angelika Amon A., Martin K. C., HarrisonS. C. (2016) Molecular Cell biology (8th Edi.), Macmillan publisher

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Shivajinagar, Pune – 5

Third Year (AY 2021-22 Course) B. Sc. Microbiology

Semester V

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU503

Course Name: Enzymology (Theory Paper III)

Course Objectives:

- To learn about the structure and functioning of the enzyme active site
- To understand the principles of enzyme assays and purification with various methods
- To learn about the techniques in enzymology
- To understand kinetics of enzymes with respective to mathematical expression

Course Outcomes:

On completion of the course, student will

- Acquire knowledge and understanding of the enzymology concepts
- Develop a broader perspective about purification and application of enzymes to diverse areas

Course contents:

Chapter 1	**Structure of enzymes and immobilization**	**No. of lectures**
	Structure of enzymes: 1. Sequencing of proteins and enzymes, Introduction to protein databases 2. Structure of active site in enzymes 3. Active site determination by physical, chemical method 4. factors affecting enzyme stability (pH and temperature) **Immobilization of enzymes:** Concept, methods of immobilization and applications Effect of physical factor:	9

Chapter 2	Enzyme kinetics and Metabolic regulation	No. of lectures
	1. Enzyme kinetics and their regulation: a. Concept and use of initial velocity b. Michaelis Menton equation for the initial velocity of a single substrate enzyme catalyzed reaction. Brigg's Haldane modification of Michaelis Menton equation. Michaelis Menton plot. Definition with significance of Km, Ks, Vmax	18

	c. Different plots for plotting Kinetic data: i. Lineweaver and Burk plot ii. Hanes plot iii. EadieHofstee plot iv. Eisanthal, Cornish-Bowden plot d. Concepts and types of Enzyme Inhibitions: reversible and irreversible **2. Metabolic Regulations:** a. Enzyme compartmentalization at cellular level b. Allosteric enzymes c. Feedback mechanisms d. Covalently modified regulatory enzymes (e.g. Glycogen phosphorylase) e. Proteolytic activation of zymogens f. Isozymes - concept and examples g. Multienzyme complex e.g. Pyruvate dehydrogenase complex (PDH)	
Chapter 3	**Techniques in Enzymology**	**No. of lectures**
	1. Principles and Methods of Enzyme purification: a. Methods of cell fractionation b. Principles and methods of enzyme purification: i. Based on molecular size ii. Based on charge iii. Based on solubility differences iv. Based on specific binding property and selective adsorption c. Criteria for purity: SDS-PAGE, ultracentrifugation, and construction of purification chart d. Characterization of enzymes: Determination of Molecular weight based on- Ultracentrifugation, SDS-PAGE, gel filtration **2. Enzyme assays:** a. Principles of enzyme assays: Sampling methods and continuous assay b. Enzymes assays with examples by: i. Spectrophotometric methods ii. Spectrofluorimetric methods iii Manometric assay v. Luminescence based assays	17
Chapter 4	**Experiential learning-** Problem solving based on this theory paper	1

References:

1. Nelson D. L. and Cox M. M. (2008) Lehninger's Principles of Biochemistry (10th Edi.), Mac MillanWorth Pub. Co. New Delhi
2. Segel Irvin H. (2010). Biochemical Calculations,(2nd Ed) John Wiley and Sons, New York.

3. Garrett, R. H. and Grisham, C. M. (2004) Biochemistry. (3rd Ed.) Brooks/Cole, Publishing Company, California.
4. Conn Eric, Stumpf Paul K., Bruuening George, Doi Roy H., (2006) Outlines of Biochemistry (6th Ed) John Wiley and Sons, New Delhi.
5. Palmer Trevor (2001) Enzymes: Biochemistry, Biotechnology and Clinical chemistry, (2nd Ed.)Horwood Pub. Co. Chinchester, England.
6. White David (2000) Physiology and Biochemistry of Prokaryotes. (2nd Ed.) Oxford University Press, New York.

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Modern College of Arts, Science, and Commerce (Autonomous)

Shivajinagar, Pune – 5

Third Year (AY 2021-22 Course) B. Sc. Microbiology

Semester V

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU504

Course Name: Immunology – I (paper IV)

Course Objective :

- To describe the overall organization of the immune system

Course Outcomes:

On completion of the course, student will be able to–

- Compare and contrast innate and adaptive immunity
- Describe which cell types and organs present in the immune response
- Identify the main mechanisms of inflammation

Course Contents

Chapter 1	**Immunity**	**No. of lectures**
	1. Immunity: Definition and Classification **2. Formation of blood cells:** Erythrocytic, myelocytic, monocytic and lymphocytic lineages and differentiation process, lymphocyte types and subsets. **3. Organs of immune system:** **a. Primary lymphoid organs** Thymus – structure, thymic education (positive and negative selection). **b. Secondary lymphoid organs** Structure and function of spleen and lymph node, mucous associated lymphoid tissue; response of secondary lymphoid organs to antigen, lymphatic system and lymph circulation.	9

Chapter 2	First and Second line of defense	No. of lectures
	Innate immunity: Non specific mechanisms of defense **1. First line of defense** – Physical, chemical and biological barriers **2. Second line of defense**: **a. Humoral components:** Defensins, pattern recognition proteins (PRP) and pathogen associated molecular patterns (PAMPs), complement, kinins, acute phase reactants. **b. Cellular components:** Phagocytic cells – PMNL, macrophages (reticulo-endothelial cell system) and dendritic cells **c. Functions:** Phagocytosis (oxygen dependent and independent systems), Complement activation (Classical, Alternative and lectin pathway), Coagulation system, Inflammation (cardinal signs, mediators, vascular and cellular changes, role of Toll-like receptors) **d. Innate Immunity cytokines**	17
Chapter 3	**Introduction to components of Third line of defense**	**No. of lectures**
	Adaptive Immunity: Specific mechanisms of defense **1. Antigen:** a. Concepts and factors affecting immunogenicity b. Antigenic determinants, haptens and cross-reactivity, Carriers, Adjuvants c. Types of antigens: Thymus-dependent and thymus-independent antigens, Synthetic antigens, Soluble and particulate antigens,Autoantigens, Isoantigens **2. Immunoglobulins:** a. Structure of basic unit, chemical and biological properties b. Characteristic of domain structure, functions of light and heavy chain domains c. Antigenic nature of immunoglobulin molecules d. Molecular basis of antibody diversity (kappa chain, lambda chain and heavy chain diversity) **e. Hybridoma Technology and Monoclonal Antibodies** i. Preparation, HAT selection ii. Applications of monoclonal antibodies **3. Major Histocompatibility Complex:** a. Structure of MHC in man and mouse b. Structure and functions of MHC class–I and class–II molecules c. Polymorphism of MHC molecules	18
Chapter 4	**Experiential learning/ field visit/ internship**	**01**

References:

1. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2017). Cellular and Molecular Immunology ,9th edition.Philadelphia: Saunders Elsevier. ISBN: 9780323479783
1. Kindt, T., Goldsby, R., Osborne, B., and Kuby, J., (2019). *Kuby immunology*. ,8th edition, New York: W.H. Freeman.ISBN: 9781319114701
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1. Ananthnarayana, R. and C. E., Jayaram Panikar, (2020). Textbook of Microbiology, 11th edition, Orient Longman, Universities Press, ISBN: 9789389211436

Progressive Education Society's

Modern College of Arts, Science, and Commerce

Shivajinagar, Pune - 5

Second Year (AY 2020-21 Course) B. Sc. Microbiology

Sem V

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Prerequisite Courses: Second Year B.Sc. Microbiology

Course Code: 19ScMicU505

Course Name: Industrial Microbiology I (Theory paper V)

Course Objective :

- To understand the different types of fermentation processes, the optimization of fermentation parameters and the downstream process of fermentation

Course Outcomes:

On completion of the course, student will be able to–

- Understand the basics of large scale fermentation processes with respect to constituents of media and types of crude media.
- Understand the control and monitoring aspects in commercial bioprocess technology.

Course Contents:

Chapter 1	**Introduction to Industrial Microbiology**	**No. of lectures**
	A. **Design, operations and processes involved in Fermenters** Design of the equipment and operations of the parts, screening of microorganisms and strain improvement **B. Media used in fermentation industry and sterilization** a. Constituents of media b. Media optimization : Classical Approach, PB design, RSM, Taguchi design and Central Composite Design **C. Types of fermentations** SSF, SmF, Batch, fed batch and continuous fermentation	18

Chapter 2	Media Sterilization and Contamination	No. of lectures
	A. **Sterilization of media** ● Methods of sterilization ● Batch and Continuous sterilization ● Concept of Del factor B. **Contamination** ● Sources, Effects and Precautions C. **Concept of Scale up and Scale down** ● Introduction to different levels of fermentation	9
Chapter 3	**Process control and Product recovery**	**No. of lectures**
	A. Criteria for control and monitoring of critical parameters Aeration, agitation, rheology, sterilization **B. Principles and methods of Downstream processing** ● Concentration: Cell disruption, Filtration, Centrifugation ● Purification: Liquid liquid extraction, distillation, Ion exchange chromatography, Drying ● Formulation	18
Chapter 4	**Experiential learning/ field visit/ internship**	**01**

References:

1. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2013). *Principles of fermentation technology*. Elsevie.
2. Casida JR L. E. (2019) Industrial Microbiology, Second Edition, New Age International Publishers, New Delhi, India
3. Patel. A. H. (2011) Industrial Microbiology, Second edition, Macmillan India Ltd.
4. Prescott and Dunn's (2004) , Industrial Microbiology, Edited by Reed, Fourth Edition,CBS Publications and Distributors, New Delhi, India
5. Latest Indian Pharmacopia : https://www.pharmdinfo.com/pharmacoepidemiology-and-pharmacoeconomics-f65/topic2081.html

Progressive Education Society's

Modern College of Arts, Science, and Commerce (Autonomous)

Shivajinagar, Pune – 5

Third Year (AY 2021-22 Course) B. Sc.
Microbiology

Semester V

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU506

Course Name: Food and Dairy Microbiology (Theory paper VI - Elective)

Course objectives:

- To understand the important developments in food and dairy microbiology and its scope.
- To know about pathogenic, non-pathogenic and useful microorganisms in the food and dairy industry.
- To become aware about the testing methods routinely used for testing food and milk quality.
- To understand the students about common causes of food spoilage.

Course outcomes:

On completion of the course, student will be able to–

- Students will be able to describe the role of microorganisms in the production of food and its Spoilage
- Students will develop experimental skills for testing the milk and different foods for the presence of microorganisms

Course Content:

Chapter 1	**Dairy Microbiology**	**No. of Lectures**
	A. Dairy Development in India: Role of National Dairy Development Board (NDDB), National Dairy Research Institute (NDRI), Military dairy farm, Indian Dairy Corporation (IDC), Dairy Co-operatives, Milk Grid, Operation Flood. **B. Milk Chemistry and Constituents:** and Composition of milk, Types of Milk (skimmed, toned and homogenized), Concept of clean milk, Factors affecting quality and quantity of milk. Nutritive value of milk, Physico-Chemical properties of milk. **C. Microbiology of milk:** Common micro-organisms found in milk, Fermentation and spoilage of milk, Milk borne diseases **D. Preservation of Milk by Pasteurization & its storage:** Methods of Pasteurization – LTH, HTST, UHT, Storage specifications after pasteurization, Phosphatase test and its significance **E. Microbial analysis of milk:** Dye reduction test (using methylene blue and resazurin), Total bacterial count, Brucella ring test and tests for mastitis, Somatic cell count	18
Chapter 2	**Food Microbiology**	**No. of Lectures**
	a. Classification of Foods based on stability: Perishable, Semi-perishable & stable **b. Microbial Food spoilage:** Chemical and physical properties of food affecting microbial growth, Sources of food spoilage micro-organisms, Spoilage of Meat and Poultry products, Bread ,Fruits and Vegetables, Eggs, Sea foods, Canned foods , Dried foods **c. Principles and methods of food preservation:** Principles of food preservation i. Thermal destruction of bacteria - use of low temperature and high temperature. ii. Determination of TDP, TDT, D, F, and Z values iii. Use of chemicals and antibiotics in food preservation iv. Canning v. Dehydration vi. Hydrostatic pressure vii. Use of radiations and microwave processing viii. Food additives ix. Aseptic packaging for RTE and RTC	18

	d. Food borne diseases (causative agents, foods involved, symptoms and preventive measures) a. Food poisoning by: *i. Staphylococcus aureus* *ii. Campylobacter* *iii. Clostridium botulinum* *iv. Aspergillus flavus* b. Food infection by : *i. Salmonella typhimurium* *ii. Vibrio parahemolyticus*	
Chapter 3	**Recent Advances and Quality control**	**No. of Lectures**
	a. Fermented food products Definition and Types, Starter culture, Significance of fermented foods (probiotic characteristics of lactic acid bacteria) **b. Applications of genetically modified microorganisms** Genetically modified foods i. Food grade Bio-preservatives ii. Recombinant Dairy enzymes and Proteins **c.Food sanitation and regulation (FSSAI , FDA)** HACCP, Shelf life analysis **d.Food Adulteration** Definition, classification of adulterants, list of foods commonly adulterated (milk and meat), harmful effects of adulterants and methods of detecting adulterants	9
Chapter 4	**Visit to Food/Dairy industry**	**01**

References

1. James M. Jay, Martin J. Loessner, David A. Golden (2005). Modern Food Microbiology, 7th Edition. Springer Science & Business.
2. Pieter Walstra, Jan T.M Wouters ,Tom J. G (2005). Dairy Science and Technology 2nd Edition Taylor & Francis
3. Sukumar De (2001). Outlines of Dairy Technology. 1st Edition. Oxford University Press, Delhi.
4. William C. Frazier, Dennis C. Westhoff, N. M. Vanitha (2013). Food Microbiology, 5th Edition. McGraw-Hill Education, India.
5. John I. Pitt, Ailsa D.Hocking (2009). Fungi and Food Spoilage, 3 rd Edition. Springer science & Business.
6. Da-Wen Sun (2008). Modern Techniques for Food Authentication, 2 nd Edition. Elsevier

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Shivajinagar, Pune – 5

Third Year (AY 2021-22 Course) B. Sc. Microbiology

Semester V

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU507

Course Name: Mathematics and Statistics in Biology (Paper VI - Elective)

Course objective:

- The main objective of this course is to acquaint students with some basic concepts in Mathematics and Statistics. They will be introduced to some elementary statistical methods of analysis of data

Course outcomes:

- Students will learn the significance of different statistical methods and solve various numerical problems.
- They will learn which method is appropriate to find out the significance of research as well as experiments
- By learning this course students will be able to apply these methods to real life situations, draw valid conclusions and interpretations.

Chapter 1	Concepts in Mathematics	No. of Lectures
	a. Sets, Scientific notations and metric prefixes **b.** Dilutions , Percent solution calculations	**22**

	c. Converting Molarity to percent and vice versa. d. Mathematical functions and graph of a function: Linear function, Power, Exponential function, Periodic function, Logarithmic function (Illustration of these functions in biological systems) e. Limits and idea of derivative f. Derivative of simple and exponential function g. Integration as reverse concept of differentiation (Emphasis on examples from biological system)	
Chapter 2	**Introduction to Statistics**	**No. of Lectures**
	a. Definitions, importance and Scope of statistics b. Data condensation and graphical methods c Graphical representation of frequency distribution i. Histogram ii. Bar diagram iii. Dot diagram iv. Pie diagram v. Frequency curve	**4**
Chapter 3	**Concepts in Statistics**	**No. of Lectures**
	a. Population and sample i. Population and Sample ii. Types and methods of sampling iii. Limitations of sampling **b. Descriptive statistics** i. Measure of central tendency and dispersion : Arithmetic Mean, Median, Mode ii. Variance and standard deviation iii. Standard Error **c. Probability**	**18**

	i. Random variable ii. Probability distribution (normal, log-normal, binomial, Poisson and exponential). **d. Concept of Skewness and Kurtosis** **e. Introduction to the concept of hypothesis** (Emphasis on examples from biological system)	
Chapter 4	**Experiential learning –Problem Solving**	**01**

References

1. Jagdish Arya and Robin W. Lardner.(1979) Mathematics for the Biological Sciences.Prentice Hall New Jersey
2. Frank H Stephenson (2003). Calculations in Molecular Biology and Biotechnology, Elsevier.
3. Irfan Ali Khan and Atiya Khanum (2009). Fundamentals of Biostatistics. 3rd Edition Ukaaz, Publications, Hyderabad
4. N.Gurumani (2015). An introduction to Biostatistics,2 nd Edition MJP Publishers.
5. Mukhopadhyay P. (2015). Applied Statistics,Publisher: Books & Allied (P) Ltd.
6. Agarwal, B. L. (2003). Programmed Statistics, 2nd Edition, New Age International Publishers, NewDelhi.
7. Das (2009). Statistical Methods, Tata Mcgraw Hill Publishing.
8. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. 1, 6th Revised Edition, The World Press Pvt. Ltd., Calcutta.

Progressive Education Society's
Modern College of Arts, Science, and Commerce (Autonomous), Shivajinagar, Pune - 5

Third Year (AY 2021-22 Course) B. Sc. Microbiology

Course Name: Diagnostic Microbiology Practical Sem V

Teaching Scheme (TH): 4 Hours/Week **Credit: 02**

Examination Scheme: CIA: 40 Mark **Term end: 60 Marks**

Prerequisite Courses: **Second Year B.Sc. Microbiology passout**

Course Code: 19ScMicU508: **Diagnostic Microbiology Practical**

Course Objectives:

- To enrich students' with the knowledge of medically important microorganisms
- To introduce the concepts related to isolation, identification and prevention of pathogenic microorganisms
- To inculcate a sense of scientific responsibilities and social and environmental awareness

Course Outcomes:

On completion of the course, the student will be able to –

- Handle pathogenic micro-organisms independently.
- Build up a progressive and successful career.

Course Contents:

Sr.No	Topic	No of practicals
1	Physical, Chemical and Microscopic examination of Clinical sample: Urine and Pus	**1**
2	Isolation, identification of following pathogens from clinical Samples :	**6**

	E. coli, *Salmonella spp*., *Pseudomonas spp.*,*Klebsiella spp*., *Staphylococcus spp.*(for identification use of keys as well as Bergey's Manual is recommended) *Candida spp.* (for identification use, Lodder, J., & Kreger-van Rij, N. J. W. (1952). The yeasts-a taxonomic study. *The yeasts-a taxonomic study.)* Antibiotic sensitivity testing of the isolates by antibiotic sensitivity disc (for Gram negative and Gram Positive)	
3	Study of growth characters of isolated pathogens on following media:	**1**
	Mannitol Salt Agar, Wilson Blair agar, Salmonella-Shigella agar, Cetrimide agar, TSI agar	
4	Demonstration of permanent slides of following parasites:	1
	a. Entamoeba histolytica b. *Ascaris* spp. c. *Plasmodium* spp.	

References:

1. Godkar B.P. and Godkar P. D. (2014). Textbook of Medical Laboratory Technology. Edition 3. Volume 1& 2. Bhalani Publishing House. ISBN 8185578583, 9788185578583.
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Shivajinagar, Pune – 5

Course Name: B.Sc.Microbiology

Third Year B. Sc. Microbiology

Semester V

Teaching Scheme (TH): 4Hours/Week **Credit: 2**

Examination Scheme: CIA: 40 Marks **term end: 60Marks**

Course Code: 19ScMicU509

Course name: Biochemistry Practical

Course objectives:

- To introduce the concepts related to production and purification of enzymes.
- To enrich students with knowledge about biomolecules and their importance in living cells and in the human body.

Course outcomes:

On completion of the course, the student will be able to –

- Isolate, produce and purify industrially important enzymes from microorganisms.
- Detect the biomolecules in the given samples.
- Analyze the clinical biochemistry from serum samples.

Sr.No.	Title and content	No of practicals
1	Buffer preparation with numerical	1
2	Qualitative analysis of carbohydrates and proteins (Experiential Learning approach)	1
3	Quantitative analysis of biomolecules: 1. Sugar- DNSA 2. Proteins- Folin lowry method	2
4	Enzymology:	4

	1. Isolation and identification of amylase producing bacteria 2. Production of amylase 3. Purification of amylase by salt precipitation 4. Effect of pH, temperature on enzyme activity	
5	Clinical Biochemistry - Estimations of: a. blood sugar b. blood urea c. serum cholesterol d. serum proteins and albumin	4

References:

1. Geetha Damodaran,(2010) Practical Biochemistry, (1st Ed)Jaypee Brothers,Medical Publishers Pvt. Limited, India, ISBN 978-93-5025-141-6
2. David T. Plummer,(2000) An Introduction to practical biochemistry (2nd edition), McGraw-Hill Book Company (U.K.) Ltd., London
3. Segel Irvin H. (2010). Biochemical Calculations. (2nd Ed). John Wiley and Sons, New York.
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7. Conn Eric, Stumpf Paul K., Bruuening George, Doi Roy H., (2006) Outlines of Biochemistry 6th Ed , John Wiley and Sons, New Delhi.
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Third Year (AY 2021-22 Course) B. Sc.
Microbiology

Semester V

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU510

Course Name: Industrial Microbiology Practical

Course Objectives:

- Understand laboratory scale fermentation and downstream processing.
- Analyze and evaluate the yield of fermented products.
- Develop interest in quality assurance tests.

Course Outcomes:

On completion of the course, student will be able to :

- Explain fermentation process and product recovery.
- Discuss about quality assurance tests.

Course Contents

Sr. No	Name of the practical	No. of practical's
1	i. Citric acid Fermentation - a. Isolation and Identification of citric acid producing organism b. Production of citric acid on Laboratory scale c. Optimization of Media (Temperature, carbon source) ii. Demonstration of Ames test	6

2	i. Ethanol Fermentation - a. Laboratory scale production and product recovery b. Estimation by CAN and yield calculation. ii. Quality assurance tests: a. Antibiotic assay (agar gel diffusion technique) b. Growth factor assay (agar gel diffusion technique). c. Sterility testing of non-biocidal injectables (FDA guildlines) d. MIC and MBC of Antibacterial compounds	4
4	**Industrial visit / Experiential Learning**	1

Reference

1. 1. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2013). *Principles of fermentation technology*. Elsevie.
2. 2. Casida JR L. E. (2019) Industrial Microbiology, Second Edition, New Age International
3. Publishers, New Delhi, India
4. 3. Patel. A. H. (2011) Industrial Microbiology, Second edition, Macmillan India Ltd.
5. 4. Prescott and Dunn's (2004) , Industrial Microbiology, Edited by Reed, Fourth Edition,CBS
6. Publications and Distributors, New Delhi, India
7. Latest Indian Pharmacopia : https://www.pharmdinfo.com/pharmacoepidemiology-and-pharmacoeconomics-f65/topic2081.html

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Third Year (AY 2021-22 Course) B. Sc.

Microbiology

Course Name: Medical Microbiology I Sem VI

Teaching Scheme (TH): 4 Hours/Week Credit:2.5

Examination Scheme: CIA: 40 Marks Term end: 60Marks

Prerequisite Courses: Second Year B.Sc. Microbiology passout

Course Code: 19ScMicU601: Medical microbiology I (Theory Paper I)

Course Objectives:

- To introduce the students to various aspects of Medical Microbiology
- To enrich students with the knowledge and concepts of Medical Microbiology
- To make students cognizant about applications of Medical Microbiology
- To help the students to build up a successful career

Course Outcomes:

On completion of the course, the student will be–

- Aware of medical microbiology
- Perceptive about the diseases and chemotherapy
- Cognizant about the applications of microbiology

Course Contents:

Chapter 1	Study of viral diseases	No of lectures

	Study of following viral pathogens (with respect to – Virion characteristics, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology, Prophylaxis and Treatment): 1. HIV 2. Polio virus 3. Dengue virus 4. Influenza virus 5. Rota virus 6. Rabies virus 7. Hepatitis A and Hepatitis B virus 8. Japanese encephalitis virus 9. SARS-associated Coronavirus *(SARS-CoV)*	**20**
Chapter 2	**Study of fungal and protozoal diseases**	**No of lectures**
	Study of following groups of parasites (with respect to – Morphological characteristic, life cycle and classification, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis (serological diagnosis wherever applicable), Epidemiology, Prophylaxis and Chemotherapy): 1. Plasmodium 2. Giardia Study of following groups of fungal pathogens (with respect to – Morphological and cultural characteristics,Classification, Pathogenecity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology, Prophylaxis and Chemotherapy): Systemic and superficial fungal pathogens: *Cryptococococus* and *Candida*	**06**
Chapter 3	**Chemotherapy**	**No of lectures**
	1. Introduction to chemotherapy 2. Desirable parameters of chemotherapeutic agent: (Selective toxicity, Bioavailability of Drug, MIC, MBC, LD-50 value, routes of drug administration) 3. Mode of action of antimicrobial agents on:	**18**

	a. Bacteria: i. Cell wall (Beta lactams [1st to 6th Generation- e.g. Meropenem, Imipenem Piperacillin], Tazobactam, Cycloserine, Bacitracin) ii. Cell membrane (Polymyxin, Monensin) iii. Protein synthesis (Streptomycin, Tetracycline) iv. Nucleic acids (Nalidixic acid, Rifamycin, Quinolones) v. Enzyme inhibitors (Trimethoprim) **b. Fungi:** (Griseofulvin, Nystatin, Anidulafungin, Voriconazole) **c. Viruses:** (Acyclovir, Zidovudine, Oseltamivir) **d. Protozoa:** (Metronidazole, Mepacrine) **4. Resistance to antibiotics:** i. Development of antibiotic resistance (e.g. ESBL, VRE, MRSA) ii. Reasons and Mechanisms of drug resistance	
	Experiential learning: Field Visit	**01**

References:

1. Tortora, G. J., Funke, B. R., & Case, C. L. (2019). Microbiology: An introduction. Pearson, 13th Edition.
2. Paniker, C. K. J., & Ananthanarayan. Ananthanarayan and Paniker's textbook of microbiology. Himayatnagar, Hyderabad: Orient Longman. 11th Edition (2020) by Reba Kanungo.
3. Greenwood, D., Slack, R. C. B., Peutherer, J. F., & Duguid, J. P. (1992). Medical microbiology: A guide to microbial infections : pathogenesis, immunity, laboratory diagnosis, and control. Edinburgh: Churchill Livingstone. 18th Edition.

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Third Year (AY 2021-22 Course) B. Sc. Microbiology

Semester VI

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU601

Course Name: Molecular Biology II (Theory Paper II)

Course Code: 19ScMicU602: Molecular Biology II

Course Objectives:

- To enrich the knowledge of the students with respect to Horizontal Gene Transfer methods.
- To introduce recombination and mutants in bacteriophages.
- To develop an interest in the recombinant DNA technology.

Course Outcomes:

On completion of the course, student will able to –

- Learn about the recombinant DNA technology
- Developed a fairly good knowledge about the three well known horizontal gene transfer mechanisms by which genetic material is transferred among the microorganisms namely transformation, transduction and conjugation.
- Illustrate the process for recombinant DNA technology.

Course Contents:

Chapter 1	**Horizontal Gene transfer**	**No. of lectures**
	A. Transformation a. Development of competence in Gram positive and Gram negative bacteria b. Process of transformation in Gram positive and Gram negative bacteria c. Factors affecting transformation d. Mapping of chromosome by co-transformation **B. Conjugation** a. F^+, F^-, Hfr and F′strains b. Process of conjugation between F^+ and F^- and Hfr and F^- c. Mapping of conjugant's by interrupted mating experiment. **C. Transduction** a. Process of generalized transduction. b. Process of specialized transduction. c. Mapping of chromosomes by Co-transduction.	17
Chapter 2	**Recombination and Mutants in Bacteriophages**	**No. of lectures**
	a. Bacteriophage cycles (lytic cycle and lysogenic cycle in detail) b. Bacteriophage mutants i. Plaque morphology ii. Conditional lethal (Ts and Am) mutants iii. Deletion Mutants c. Deletion Mapping using bacteriophage deletion mutants d. Benzer`s spot tests (Experiment) e. Genetic Complementation i. Cis-trans test of genetic function ii. Intercistronic (rII locus of T4 phage) iii. Intracistronic (β galactosidase)	12
Chapter 3	**Recombinant DNA technology**	**No. of lectures**

	A. Guidelines for gene manipulation a. History of recombinant DNA technology - Potential uses and biohazards b. Safety guidelines for recombinant DNA technology laboratory setup **B. Procedure and Tools of Recombinant DNA technology** a. Cutting and joining the DNA molecules - i. Restriction Enzymes ii. Vectors used: Plasmids, Viral DNA, cosmids, phagemids, PACs, BACs, YACs, Expression vectors iii. Ligase Enzymes b. Methods to transfer recombinant DNA into host cells. i. Insertion of foreign DNA in hosts (Physical transformation by using Electroporation & Heat shock, Gene gun, Transfection, Chemical transformation by using $CaCl_2$) c. Methods of screening the cells containing the recombinant DNA (Immuno-Colony ELISA blot, hybridization-Colony Hybridization, Gain of function) d. Genomic, c DNA library and it's databases e. Concept of a clone and probe f. Identification of clones using probes	15
Chapter 4	**Experiential learning - – Problem solving on Chromosome mapping by Co-transformation, Co-transduction and interrupted mating experiment, Recombinant DNA technology.**	**01**

References

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Course Name: B.Sc.Microbiology

Third Year B. Sc. Microbiology

Semester VI

Teaching Scheme (TH): 4Hours/Week **Credit: 2.5**

Examination Scheme: CIA:40 Marks **term end: 60Marks**

Course Code: 19ScMicU603

Course name: Metabolism (Theory paper-III)

Course objectives:

- Understand the concepts of transport of molecules in the cells.
- Learn bioenergetics and metabolic patterns for macromolecules in living cells.
- Learn the process of photosynthesis in bacteria.

Course outcomes:

On completion of the course, student will able to –

- Acquire knowledge of metabolism in the living cells.
- Develop perspective about transport, photosynthesis and energetics in living cells.

Chapter 1	**Bioenergetics**	**No. of lectures**
	i. Types of reactions in cells ii. Introduction to terms in bioenergetics: Laws of thermodynamics, Concepts of free energy, entropy, high energy compounds	**10**

	iii. Biological oxidation and reduction reaction iv. Phosphorylation: substrate level, oxidative v. Experimental analysis of Mitochondrial electron transport chain: components, arrangement of different components in the inner membrane, structure and function of ATP synthase, inhibitors and uncouplers of ETC and oxidative phosphorylation, energetics of mitochondrial electron transfer chain vi. Shuttle system, Regulation of oxidative phosphorylation vii. Role of mitochondria in thermogenesis, steroid synthesis, apoptosis	
Chapter 2	**Metabolism of macromolecules**	**25**
	1. Biosynthesis and Degradation of Macromolecules: a. Chemistry, concept of polymerization of macromolecules: Polysaccharides. (Starch, glycogen and peptidoglycan) and Lipids (Fatty acids, triglycerides and phospholipids) b. Degradation of macromolecules – Polysaccharides (starch, glycogen), Lipids (fatty acids oxidation) and Proteins (urea cycle) **2.Bacterial Photosynthesis:** i. Habitat and examples of photosynthetic bacteria ii. Photosynthetic apparatus iii. Oxygenic and Anoxygenic mechanisms iv. Calvin cycle and its regulation **3.Nitrogen Metabolism:** Bacterial Nitrogen fixation Biochemistry of biological nitrogen fixation, properties of nitrogenase and its regulation, ammonia assimilation with respect to glutamine synthetase, glutamate dehydrogenase, glutamate synthetase, their properties and regulation	
Chapter 3	**Membrane transport mechanisms in bacteria**	**9**

	i. Passive transport - Diffusion, Osmosis, Facilitated transport ii. Active transport - Active transport systems in bacteria iii. Group translocation of sugars in bacteria iv. Ionophores: Mechanism and examples	
Chapter 4	Experiential learning / field visit/ internship	1

References:

1. Nelson D. L. and Cox M. M. (2008) Lehninger's Principles of Biochemistry, (10th Ed) Mac MillanWorth Pub. Co. New Delhi
2. Segel Irvin H. (2010). Biochemical Calculations. 2nd Ed. John Wiley and Sons, NewYork.
3. Garrett, R. H. and Grisham, C. M. (2004) Biochemistry. 3rd Ed. Brooks/Cole, PublishingCompany, California.
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6. White David (2000) Physiology and Biochemistry of Prokaryotes. 2nd Ed. OxfordUniversity Press, New York.
7. David A. Hall & Krishna Rao (1999) Photosynthesis (Studies in Biology) 6th Edition,Cambridge University Press, London
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Course Name: B.Sc.Microbiology

Third Year B. Sc. Microbiology

Semester VI

Teaching Scheme (TH): 4Hours/Week **Credit: 2.5**

Examination Scheme: CIA:40 Marks **term end: 60Marks**

Course Code:19ScMicU604

Course name: Immunology - II (Paper IV)

Course Objectives:

- · To describe structures and functions of Adaptive immunity components.
- · To describe the significance of clinical immunology.

Course Outcomes:

On completion of the course, the student will be–

- Illustrate the adverse effect of immune system including Allergy, hypersensitivity and autoimmunity
- Learn concepts and basic techniques based on antigen antibody interactions.
- Clarify the significance of immunization and different vaccination programs.

Course Contents:

Chapter 1	**Third line of defense**	**No. of lectures**

	1. Humoral Immune Response a. Primary and secondary response kinetics b. Antigen processing and presentation (MHC class I and class II restriction pathways), cell-cell interactions and adhesion molecules response to superantigens	**18**

	2. Cell Mediated Immune Response a. Activation and differentiation of T cells b. Mechanism of CTL mediated cytotoxicity, ADCC c. Significance of CMI **3.Humoral Immune response** a.Activation and differentiation of B cells b. role of cytokines in activation and differentiation of B-cells **4. Public health immunology** a. Types of vaccines and antisera b. Immunization schedules in developing and developed countries **5. Adaptive immunity cytokines**	
Chapter 2	**Antigen- Antibody Interactions and Immunohematology**	**17 lectures**
	1. Antigen- Antibody Interactions **a. Principles** of interactions: Antibody affinity and avidity, ratio of antigen antibody, lattice hypothesis and two stage theory, antigen-antibody reaction kinetics (dialysis equilibrium experiment) **b. Visualization** of antigen antibody complexes a. Precipitation reactions: in fluid and in gel, immunoelectrophoresis b. Agglutination reactions: hemagglutination, bacterial agglutination, passive agglutination and agglutination-inhibition c. Immunofluorescence techniques: direct and indirect, FACS d. ELISA, biotin-avidin system,	

	e. RIA f. Jerne's hemolytic plaque assay, ELISpot assay **2. Immunohematology** a. Systems of blood group antigens b. **ABO system -** Biochemistry of blood group substances, Bombay blood group, Inheritance of ABH antigens c. Rh system d. Laboratory methods of blood group typing, Coomb's test e. Medico-legal applications of blood groups f. Blood banking practices, transfusion reactions	
Chapter 3	**Clinical Immunology**	**9 lectures**
	1. Transplantation and Immunity a. Types of Grafts, b. Allograft rejection mechanisms c. Prevention of allograft rejection d.MHC antigen typing (microcytoxicity and mixed lymphocyte reaction) **2. Hypersensitivity** a. Immediate and delayed type hypersensitivity b. Gell and Coomb's classification of hypersensitivity – mechanism with examples for type I, II, III and IV **3. Autoimmunity** a. Types, Immunopathological mechanisms, Theories of origin of autoimmunity,	

	b. Pathophysiology (mechanism of symptom generation) of Myasthenia gravis ,Rheumatoid arthritis and SLE. c.Therapeutic immunosuppression for autoimmunity	
Chapter 4	**Experiential learning/ field visit/ internship**	**01**

References

1. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2017). Cellular and Molecular Immunology ,9th edition.Philadelphia: Saunders Elsevier. ISBN: 9780323479783
2. Kindt, T., Goldsby, R., Osborne, B., and Kuby, J., (2019). Kuby immunology. 8th edition, New York: W.H. Freeman.ISBN: 9781319114701
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Third Year (AY 2021-22 Course) B. Sc. Microbiology

Semester VI

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU605

Course Name: Industrial Microbiology (Paper II)

Course Objectives:

- To understand the types of fermentation.
- To understand the optimization of fermentation parameters.
- Understanding the quality assurance tests and learning about the concept of IPR
- To understand the downstream process of fermentation.

Course Outcomes:

- Understand the upstream, fermentation process and downstream processing of several fermentation products like antibiotics, enzymes, solvents and beverages produced in industries.

Course Contents:

Chapter 1	**Large scale production of Primary and Secondary metabolites**	**No. of Lectures**

	a.Primary metabolites i.Organic acids : Acetic acid/ vinegar ii. Vitamins : Vit. B2 iii. Amino acids : Glutamic acid iv. Enzymes : Amylase b. Secondary metabolites i. Antibiotics : Streptomycin ii. Solvents : Ethanol iii. Alcoholic beverages : Beer, Wine	16
Chapter 2	**Large scale production of therapeutic agents and biomass based products**	**No. of lectures**

	a. Microbial transformation of steroids b. Biomass based products i. Yeast: Baker's and Distiller's yeast ii. Mushroom production c. Milk products: Cheese and Yogurt d. Vaccines : Polio, Tetanus e. Immune sera	15
Chapter 3	**Quality Assurance, Fermentation Economics and concept of IPR**	**No. of lectures**
	a. Quality Assurance of Fermentation Product i. Detection and Quantification of the product by physicochemical, biological and enzymatic methods ii. Sterility testing iii. Pyrogen testing – Endotoxin detection iv. Ames test and modified Ames test v. Toxicity testing b. Contribution of various expense heads to a process i. Recurring and nonrecurring expenditures citing any suitable examples c. Introduction to Intellectual Property Rights (IPR) i. Types of IPR : Patents, Indian patent act	14
Chapter 4	**Experiential learning/ field visit/ internship**	**01**

References:

1. A. H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd.

2. Bioreactor Design and Product Yield (1992), BIOTOL series, Butterworths Heinemann.

3. Casida, L. E., (1984), Industrial Microbiology, Wiley Easterbs, New Delhi

4. Dilip K. (2005) Arora editor, Fungal Biotechnology in agriculture, food and environmental applications (Mycology), Marcel Dekker, Inc. New York. Basel

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Third Year (AY 2021-22 Course) B. Sc. Microbiology

Semester VI

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU607

Course Name: Microbial Ecology and Evolution (Theory paper VI - Elective)

Course objective:

- To develop a fairly good knowledge and understanding of different types of environments and habitats where microorganisms grow and microbe interactions with other organisms.
- To acquaint students with basic knowledge on evolution

Expected outcomes:

- Students will be able to understand various interactions of microorganisms with other organisms and their application in bioremediation.
- Apply evolutionary theory and concepts to address empirical and theoretical questions in evolutionary biology

Chapter 1	Microbial Interactions and habitats	No. of lectures

5	**a. Introduction to Ecology** Three domain classification system, Relationship of microbial Ecology to general ecology , Ubiquity of microorganisms, Metabolic diversity of microorganisms **b. The microbial habitats-** Aquatic, soil, rock and sub surface habitats, Atmospheric habitats (with features and associated microorganisms) Sample collection **c. Microbe- Microbe interaction** Classification of Microbial Interactions, Symbiotic Associations, Fungus-bacteria symbiosis. **d. Microbe-Animal interaction** Parasitism – viruses of nematodes Endosymbiosis :*Wolbachia*, Mutualism- Gut animal-microbe interaction Luminescent bacteria **e.Microbe-Plant interaction** Interaction in the Rhizosphere, Nitrogen Fixing bacteria and higher plants, *Mycorrhizae,* Bacteria supporting plant growth, Detrimental activities of microorganisms on plants, biocontrol of pest and pathogens. **f. Microbe-vertebrate interaction**	12

	g. Microbial communities Biofilm and Biomat formation ,concept of microbial biodiversity with diversity indices and formation of organized communities, Quorum sensing (*Myxobacteria* and *Dictyostelium discoideium*)	
Chapter 2	**Microbes at work: Bioremediation**	**No. of lectures**
	a. Bioremediation: Definition, Role of plants & Microbes in 1.Bioremediation of: i. Hydrocarbons ii. Industrial Wastes: (Dyes, Paper & Pulp, Heavy metals, Dairy, Distillery , Tannery iii. Xenobiotics **b. Bioaugmentation:** i. Definition ii. Use of microbial cultures and enzymes for bioaugmentation iii. Applications **c. Genetically modified microorganisms in bioremediation** **d. Biosorption** **e.Bioleaching:** a. Microorganisms used b. Bioleaching process c. Bioleaching of - Copper, Iron, Manganese, Gold, Silver d. Advantages of Bioleaching	18
Chapter 3	**Evolution**	**No. of lectures**
	a. Origin and evolution of life ; Parallel ,Divergent, Convergent evolution b. Natural selection and adaptation, Types of selection (stabilizing, directional and disruptive) c. Phenotypic evolution , Genetic drift d. Species and speciation – Allopatric, Parapatric, Peripatric and Sympatric e. Evolution of microbial diversity	10

	f. Co-operation, r and k selection g. Evolution by endosymbiosis. h. Introduction to phylogenetic tree (nodes, internodes, root, topology, lineage, terminal node, leaves, branch, branch length, derived and ancestral traits.)	
Chapter 4	**Experiential learning/ field visit/ internship**	**01**

References

1. Barker, KH, and Herson, D.S. Bioremediation. Mc Craw Hill Inc., New York.
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3. Willey,Sherwood,Woolverton. (2017) Prescott's Microbiology, 10 th Edition .McGraw-Hill publication.
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5. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
6. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
7. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
8. Larry L. Barton and Diana E. Northup (2011) Microbial ecology. Wiley-Blackwell
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Modern College of Arts, Science, and Commerce (Autonomous)

Shivajinagar, Pune – 5

Third Year (AY 2021-22 Course) B. Sc.
Microbiology

Semester VI

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU606

Course Name: Biophysics (Theory paper VI - Elective)

Course objective:

- To understand the important instrumentation techniques
- To understand applications and calibration protocols of various instruments
- To understand the routinely used techniques in industry and research

Expected outcomes:

- Acquire principles and science behind different instruments, their role, and importance in research as well as in different applications

- Students will be skilled in using various important instruments with detailed knowledge of each instrument used in research as well as industries.

Chapter 1	**Concepts in Biophysics**	**No. of lectures**
	a. **Definition and History of Biophysics** (Physical properties applied to biology- Surface tension, Viscosity, adsorption, diffusion, osmosis, dialysis and colloids) b. **Cell:** Animal and plant cell, types of cell and composition, Functional aspects of cell membrane, cytoplasm, nucleus, mitochondria, chloroplast (Bioenergetics of mitochondria and chloroplast) **c. Biophysical techniques** Basic principle, Construction and working of i. Colorimeters and pH meter ii. Centrifugation Basic principle, Relation between RCF and RPM (with numericals), Preparative and analytical centrifugation, fixed angle and swinging bucket rotors, differential centrifugation, density gradient centrifugation and ultracentrifugation. iii. Chromatography Principles and applications of Paper chromatography, Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion exchange chromatography and affinity chromatography, GLC, HPLC.	20
Chapter 2	**Spectrophotometry / Characterization of Biomolecules**	**No. of lectures**
	a. **Basics of spectroscopy:** i. Simple theory of the absorption of light by molecules, Lambert Beer's law, deviation from Lambert Beer's law, instrumentation for measuring the absorbance of visible light, ii. Factors affecting the absorption properties of a chromophore. **b. Introduction, basic principle and applications of following**	12

	i. UV visible spectroscopy, ii. Fluorescence spectroscopy, iii. Infrared spectroscopy iv. Mass spectroscopy. **c. Radiation Biophysics** i. Definition, Units of Radioactivity and radiation doses, X-Ray Crystallography as a method for a structure determination of biomolecules NMR .(Basic introduction) ii. Nuclear detector (G M Counter), radioimmunoassays (in brief)	
Chapter 3	**Advanced techniques in Microscopy**	**No. of lectures**
	a. Basic principles of optical microscopy, Concept of resolution and magnification. b. Different contrast enhancing techniques: Phase contrast, dark field, differential interference contrast, fluorescence. c. Concepts of digital microscopy and image analysis (image j) d. Confocal microscopy, SEM and TEM	13
Chapter 4	**Experiential learning/ field visit/ internship**	**01**

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2. Pattabhi, V. and Gautham, N. (2002).Biophysics. Kluwer Academic Publishers, New York, and Narosa Publishing House,Delhi.
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Shivajinagar, Pune – 5

Third Year (AY 2021-22 Course) B. Sc. Microbiology

Semester VI

Course Name: Clinical Microbiology and Immunology Sem V

Teaching Scheme (TH): 4 Hours/Week **Credit:02**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Prerequisite Courses: Second Year B.Sc. Microbiology passout Course Code:

19ScMicU608: Clinical Microbiology and Immunology

Course Objectives:

- To enrich students' with the knowledge of laboratory techniques in clinical microbiology and immunology.

- To introduce the concepts related to clinical sample collection and primary processing of the samples in the laboratory.
- To inculcate a sense of scientific responsibilities and social and environmental awareness

Course Outcomes:

On completion of the course, the student will be able to –

- Handle clinical samples for processing of different laboratory tests.
- Build up a progressive and successful career.

Course Contents:

Sr.NO	Topic	No of practical
1	Identification of human blood groups.	1
	Blood group typing by slide test for ABO and Rh systems	
2	Immunoprecipitation:	1
	Double diffusion (Ouchterlony) technique	
3	Estimation of hemoglobin	1
	Cyanomethemoglobin method	
4	Perform Differential Leukocyte Count of the given blood sample.	1
	White blood cell differential count from peripheral blood	
5	Perform Total Leukocyte and Erythrocyte Count of the given blood sample.	2
	Counting of RBCs and WBCs using counting chamber	
6	ESR and PCV determination	1
7	Calculation of hematological indices	1
	MCV, MCHC, MCH	
8	Demonstration:	1
	1. Rapid Widal Test 2. ELISA	

References:

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2. Procop, G. W., Church, D. L., Hall, G. S., & Janda, W. M. (2020). Koneman's Color Atlas and Textbook of Diagnostic Microbiology. Jones & Bartlett Publishers.

3. Kindt, T., Goldsby, R., Osborne, B., and Kuby, J., (2019). Kuby immunology. 8th edition, New York: W.H. Freeman.ISBN: 9781319114701.
4. Gladwin, M., Trattler, B., & Mahan, C. S. (2004). Clinical microbiology made ridiculously simple (pp. 114-132). MedMaster.
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Third Year (AY 2021-22 Course) B. Sc.
Microbiology

Semester VI

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU609

Course Name: Molecular Biology Practical

Course Objectives:

- To enrich students' with the knowledge of molecular biology based practicals.
- To introduce the concepts related to horizontal gene transfer and its use in recombinant DNA technology.
- To learn about bacteriophages.

Course Outcomes:

On completion of the course, the student will be able to –

- Isolate, detect and purify DNA (Genomic DNA, Plasmid) from microorganisms.
- Enumerate the bacteriophages.
- Induct mutations in microorganisms and isolate mutants.

Sr.No.	Title and content	No of lecture
1	Genomic (bacterial) DNA isolation, detection by DPA method and Agarose gel electrophoresis (demonstration)	2
2	Bacterial Plasmid isolation and transformation of E. coli and selection of recombinants	2
3	Isolation & enumeration of bacteriophages and study of phage morphology	2
3	Perform conjugation process and selection of recombinants	1
4	a. Induction of mutations by using physical mutagen (e.g. UV rays) b. Isolation of mutants by any suitable method c. Demonstration of UV survival curve	2
5	Experiential Learning - Field Visit	1

References

1. Keith Wilson and John Walker (2018). Principles and techniques of Biochemistry and Molecular Biology. 8th Ed. Cambridge University Press, Cambridge, England.
2. Jane Flint, Vincent R. Raceniello (2020). Principles of Virology, Volume 1: Molecular Biology, 5th Ed. American Society for Microbiology Press.
3. Bernard Fields, David Knipe (2013), Fields Virology, 6th Ed.Wolters Kluwer Health/Lippincott Williams & Wilkins, Philadelphia.
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Third Year (AY 2021-22 Course) B. Sc. Microbiology

Semester VI

Teaching Scheme (TH): 4 Hours/Week **Credit: 2.5**

Examination Scheme: CIA: 40 Marks **Term end: 60 Marks**

Course Code: 19ScMicU610

Course Name: Applied Microbiology Practical

Course Objectives:

- Develop an interest in biophysics and mathematics in biology
- Analyze and evaluate the soil flora and fauna
- Analyze some cultural practices for tests of Milk and Dairy products

Course Outcomes:

On completion of the course, student will be able to :

- Solve problems related to mathematics in biology
- Compare different indices related to diversity determination
- Explain tests of Milk and Dairy products

Course Contents:

Sr. No	Name of the practical	No. of practical's
1	i. Tests for Milk and Dairy products a. Phosphatase test b. MBRT test c. Test for mastitis d. Standard Plate Count (for milk / milk product e.g. milk powder) e. Milk adulteration test ii.Isolation and identification of food spoilage causing organisms (onion/ groundnut)	5
2	i. Soil flora:- a. Diversity determination – Shannon index b. Comparison between H and S indices ii. Demonstration of biofilm production and detection	5

3	i. Diagrammatic and Graphical representation of statistical data ii. Mean, Median, Mode from grouped and ungrouped Dataset iii. Determination of absorption spectra and molar extinction coefficient iv. Paper chromatography	3
4	**Industrial visit / Experiential Learning**	1

References

1. Sukumar De (2001). Outlines of Dairy Technology. 1st Edition. Oxford University Press, Delhi.
2. William C. Frazier, Dennis C. Westhoff, N. M. Vanitha (2013). Food Microbiology, 5th Edition. McGraw-Hill Education, India.
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