



Deccan Education Society's

Fergusson College (Autonomous) Pune

Learning Outcomes-Based
Curriculum

for 3/4 years B.Sc. / B. Sc. (Honours)

Programme as per guidelines of

NEP-2020

for

F. Y. B. Sc. (Microbiology)

With effect from Academic Year

2024-2025

Program Outcomes (POs) for B.Sc. Microbiology	
PO1	<p>Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of an graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.</p>
PO2	<p>Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.</p>
PO3	<p>Social competence: Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.</p>
PO4	<p>Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.</p>
PO5	<p>Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.</p>
PO6	<p>Personal and professional competence: Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.</p>
PO7	<p>Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.</p>
PO8	<p>Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.</p>
PO9	<p>Self-directed and Life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.</p>

PSO No.	Program Specific Outcomes (PSOs) Upon completion of this programme the student will be able to
PSO1	Academic competence: (i) Understand fundamental concepts, principles and processes underlying the field of Microbiology, its different subfields and its linkage with related disciplinary areas/subjects. (ii) Demonstrate an understanding of a wide range of Microbiological techniques (e.g., basic microscopy, sterilization and disinfection methods, cultivation of microorganisms, isolation techniques, characterization of pathogens, blood grouping, microbiological assays of antibiotics and vitamins, enzyme kinetics, chromatography, electrophoresis, immunological assays.
PSO2	Personal and Professional Competence: (i) Carry out laboratory-orientated numerical calculations and be capable in data visualization and interpretation. (ii) Analyse biochemical data (e.g., in enzyme kinetics, biochemical analysis of serum components, sterility of pharmaceutical products). (iii) Formulate ideas, write scientific reports, demonstrate effective presentation and communication skills.
PSO3	Research Competence: (i) Apply microbiological methodology in order to conduct research and demonstrate appropriate skill to seek solutions to problems that emerge in various fields of Microbiology and interdisciplinary fields. (ii) Integrate informatics and statistical skills to explore and authenticate biological data for experimental and research purposes. (iii) Exhibit awareness of ethical issues in research with emphasis on academic and research ethics, scientific misconduct, intellectual property rights and issues of plagiarism.
PSO4	Entrepreneurial and Social competence: (i) Employ skills in specific areas related to Microbiology such as industrial production, technology development, clinical, health, agriculture and ensure multilevel commitment to health and human welfare.

Fergusson College (Autonomous), Pune
First Year Curriculum as per NEP 2020

NEP 2.0 Subject Credit Distribution Structure 2024-25

**Department of Microbiology
Course Structure**

Course Structure Semester I					
FYBSc Sem -I	Theory/ Practical	Paper Code	Paper Title	Credits	Exam type
Discipline Specific Core, DSC	Theory	MIC-1001	Introduction to the Microbial World	2	CE +ESE
Discipline Specific Core, DSC	Practical	MIC-1011	Microbiology Practical -I	2	CE +ESE
Open Elective- 1 (For other faculty)	Theory	MIC-1021	Microbiology in Everyday Life	2	Only CE

Course Structure Semester II					
FYBSc Sem -II	Theory/ Practical	Paper Code	Paper Title	Credits	Exam type
Discipline Specific Core, DSC-3	Theory	MIC-1002	Essential Methods in Bacteriology	2	CE +ESE
Discipline Specific Core, DSC-4	Practical	MIC-1012	Microbiology Practical -II	2	CE +ESE
Open Elective-2 (For other faculty)	Theory	MIC-1022	Human Microbe Interactions	2	Only CE
Skill Enhancement Course, SEC-1	Theory/ Practical	MIC-1032	Techniques in Haematology	2	Only CE

* *OE – Open Elective, SEC- Skill Enhancement Component.*

Teaching and Evaluation (Only for FORMAL education courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	15 / 30	1 / 2	25	10	15
2	30 / 60	2 / 4	50	20	30
3	45 / 90	3 / 6	75	30	45
4	60 / 120	4 / 8	100	40	60

Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)

F. Y. B. Sc. Semester I				
Evaluation Criteria for (Major- Theory)				
Discipline Specific Course				
MIC – 1001 : Introduction to the Microbial World				
Credits: 2				
Hours: 30				
Sr. No.	Course Outcome	Blooms Taxonomy level	Weightage in %	Exam type
1	CO-1: Describe the evolution of the microbiology field and the early scientific discoveries relating to each field. Write about the different characteristics of various groups of microorganisms.	Remember	20	CE+ESE
2	CO-2: Diagrammatically explain the principle, working and applications of different types of microscopic techniques. Explain different types of aberrations in objective lens. Discuss different methods of sterilization & disinfection	Understand	20	CE+ESE
3	CO-3: Outline various physical & chemical methods of sterilization. Demonstrate the diversity of microbial world	Apply	20	Only CE
4	CO-4: Classify different species according to the six kingdom classification system and write about the morphological and differential characteristics of different groups of microorganisms. Explain the diversification of microbiology into different fields.	Analyze	20	CE+ESE
5	CO-5: Determine the mode of action and application of various methods of sterilization & disinfection. Compare various types of microscopic techniques.	Evaluate	10	CE+ESE
6	CO-6: Design models of different types of microscopes. Write scientific contributions in the field of microbiology by different scientists.	Create	10	Only CE

F. Y. B. Sc. Semester I		
MIC - 1001	Discipline Specific Course Introduction to the Microbial World (Major- Theory)	Credits: 2 Hours: 30
Course Outcome (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe the evolution of the microbiology field and the early scientific discoveries relating to each field. Write about the different characteristics of various groups of microorganisms.	1
CO2	Diagrammatically explain the principle, working and applications of different types of microscopic techniques. Explain different types of aberrations in objective lens. Outline different methods of sterilization & disinfection.	2
CO3	Outline various physical & chemical methods of sterilization. Demonstrate the diversity of microbial world	3
CO4	Classify different species according to the six kingdom classification system and write about the morphological and differential characteristics of different groups of microorganisms. Explain the diversification of microbiology into different fields.	4
CO5	Determine the mode of action and application of various methods of sterilization & disinfection. Compare various types of microscopic techniques.	5
CO6	Design models of different types of microscopes. Write scientific contributions in the field of microbiology by different scientists.	6

Unit No	Title of Unit and Contents	No of Lectures
I	<p>i. Evolution of life: Biogenesis Vs Abiogenesis (Hypothesis and experiments)</p> <p>ii. History of Microbiology</p> <p>Significance of Scientific contributions in development in Microbiology as a discipline:</p> <p>a. Early contributions: Robert Hook, Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, John Tyndall.</p> <p>b. Scientific contribution leading to diversification of Microbiology: Milestone discoveries in the field of microbiology.</p> <p>1. Medical Microbiology and Immunology: Edward Jenner, Paul Ehrlich, Ellie Metchnikoff, Joseph Lister</p> <p>2. Food Microbiology and Fermentation: Alexander Fleming, Louis Pasteur, Selman Waksman</p> <p>3. Soil Microbiology: Sergei Winogradsky, Martinus Beijerinck</p> <p>4. Microbial Genetics: Watson and Crick, Hargobind Khurana, Griffith, Avery, McCarty, and Macloed.</p> <p>c. Recent developments in Microbiology</p>	15

	<p>iii. Microscopy –</p> <ul style="list-style-type: none"> a. History of Simple and compound microscope b. Terms in microscopy – Magnification, Refractive index, Numerical aperture, Resolving power c. Aberrations in lenses d. Principle, working, ray diagram and applications of Bright field microscopy. e. Principle and applications of: <ul style="list-style-type: none"> a. Dark field microscopy b. Phase contrast microscopy c. Fluorescence microscopy d. Confocal microscopy e. Electron microscopy – SEM, TEM 	
<p>II</p>	<p>Diversity of Microbial World</p> <ul style="list-style-type: none"> i. Six kingdom classification system. ii. Introduction to different groups microorganisms with respect to Morphological and differential characteristics, Nutrition and cultivation methods, habitats, classification, economic importance, harmful and beneficial activities: - <ul style="list-style-type: none"> a. Bacteria and Actinomycetes b. Yeast c. Fungi d. Algae e. Viruses f. Protozoa/ parasites g. Viroids and Prions iii. Modern methods of taxonomy iv. Sterilization and disinfection: <ul style="list-style-type: none"> A. Physical methods of sterilization- <ul style="list-style-type: none"> 1. Heat <ul style="list-style-type: none"> a. factors affecting sterilization b. concept of decimal reduction time c. sterilization using dry heat d. sterilization using moist heat 2. Radiation <ul style="list-style-type: none"> a. ionizing radiation b. non-ionizing radiation 3. Filtration <ul style="list-style-type: none"> a. earthenware filters b. glass filters c. Membrane filters d. HEPA filters B. Chemical methods of sterilization - Ethylene oxide C. Disinfection - Mode of action and application of Aldehydes, Halogens, Quaternary ammonium compounds, Phenol and Phenolic compounds, Heavy metals, Alcohols, Dyes and Detergents 	<p>15</p>

Learning resources:

1. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
2. Daniel Lim, Microbiology, 2nd Edition; McGraw-Hill Publication.
3. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata McGraw Hill Press.
4. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. McGraw Hill Companies Inc.
5. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006). Microbiology, 6th Edition, McGraw Hill Higher Education.
6. Salle A.J. (1971) Fundamental Principles of Bacteriology.7th Edition. Tata McGraw Hill Publishing Co.
7. Review articles

F. Y. B. Sc. Semester I Evaluation Criteria for (Major-Practical) Discipline Specific Course MIC – 1011 : Microbiology Practical I Credits: 2 Hours: 60				
Sr. No.	Course Outcome	Blooms Taxonomy level	Weightage in %	Exam type
1	CO-1: Describe the good lab practices and biosafety measures to be adopted while working in a microbiology lab. Identify and observe different types of microorganisms from natural samples.	Remember	18	CE+ESE
2	CO-2: Give examples of different nutrient media popularly used in culturing microorganisms and compare different methods of sterilizing them. Explain principle and applications of instruments used in microbiology laboratory.	Understand	18	CE+ESE
3	CO-3: Carry out isolation of bacteria using streak plate method. Examine the effect of disinfectants on skin microflora. Carry out aseptic transfer techniques.	Apply	18	CE+ESE
4	CO-4: Classify bacteria based on their nutritional requirements and explain various methods to cultivate them.	Analyze	18	CE+ESE
5	CO-5: Validate different methods of sterilization. Measure dimensions of microorganisms using micrometry. Evaluate the efficacy of disinfectants using phenol coefficient test	Evaluate	18	CE+ESE
6	CO-6: Write standard operating procedure of various instruments used in microbiology laboratory.	Create	10	Only CE

F. Y. B. Sc. Semester I		
MIC - 1011	Discipline Specific Course- Microbiology Practical I	Credits: 2 Hours: 60
Course Outcome (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe the good lab practices and biosafety measures to be adopted while working in a microbiology lab. Identify and observe different types of microorganisms from natural samples.	1
CO2	Give examples of different nutrient media popularly used in culturing microorganisms and compare different methods of sterilizing them. Explain principle and applications of instruments used in microbiology laboratory.	2
CO3	Carry out isolation of bacteria using streak plate method. Examine the effect of disinfectants on skin microflora. Carry out aseptic transfer techniques.	3
CO4	Classify bacteria based on their nutritional requirements and explain various methods to cultivate them.	4
CO5	Validate different methods of sterilization. Measure dimensions of microorganisms using micrometry. Evaluate the efficacy of disinfectants using phenol coefficient test	5
CO6	Write standard operating procedure of various instruments used in microbiology laboratory.	6

Unit No	Title of Unit and Contents	No of Practicals
I	<ul style="list-style-type: none"> i. Introduction to Microbiology laboratory <ul style="list-style-type: none"> a. GLP and Biosafety b. To study Principle and applications of instruments: Microscope (observation of slides under oil immersion objective), Autoclave, Hot- air oven, Centrifuge, pH meter, Incubator, Refrigerator, Distillation apparatus, Laminar Air-flow system, Water-bath, Colorimeter, Spectrophotometer and CE I -SOP writing. ii. Preparation of different types of culture media <ul style="list-style-type: none"> a. Minimal and complete media b. Selective media c. Differential media d. Enriched media e. Enrichment media iii. Isolation of bacteria by streak plate technique and study of colony characteristics using above medium. iii. Assessment of sterilization efficiency of <ul style="list-style-type: none"> a. Autoclave b. Hot air oven c. Membrane filtration process iv. Aseptic transfer technique <ul style="list-style-type: none"> a. tube to tube transfer b. flask to tube transfer 	<ul style="list-style-type: none"> 1 2 1 1 1

II	i. Disinfectants and disinfection: a. Primary demonstration of effect of disinfectants on skin microflora b. Phenol coefficient test - Demonstration of Rideal Walker coefficient /Chick Martin test ii. Observation of microorganisms: a. Observation of microorganisms from pond water b. Wet mount of fungi from different natural samples ii. Demonstration of cultivation of actinomycetes by slide culture technique and coverslip technique.	 2 1 1
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Learning Resources:

1. Fundamental Principles of Bacteriology by Salle, A.J. McGraw Hill Book Company Inc.
2. Experiments in Microbiology, Plant Pathology and Biotechnology Aneja, K.R.
3. Benson's Microbiological Applications, Laboratory Manual in General Microbiology, Short Version Alfred Brown; Heidi Smith.
4. Microbiology: A Laboratory Manual, 10th Edition James G. Cappuccino
5. Handbook Media Stains Reagents Microbiology by A. M. Deshmukh.

F. Y. B. Sc. Semester I				
Evaluation Criteria for				
Open Elective I				
MIC - 1021 - Microbiology In Everyday Life				
Credits: 2				
Hours: 30				
Sr. No.	Course Outcome	Blooms Taxonomy level	Weightage in %	Exam type
1	CO-1: Cite examples of various types of useful and harmful microorganisms and their ubiquitous nature.	Remember	25	Only CE
2	CO-2: Discuss the applications of microorganisms in various fields. y.	Understand	25	Only CE
3	CO-3: Outline the relatedness of the different upcoming areas of biological sciences to the field of Microbiology.	Apply	25	Only CE
4	CO-4: Classify the microorganisms into different types and compare their characteristic features	Analyze	25	Only CE

F. Y. B. Sc. Semester I		
MIC - 1021	Open Elective I - Microbiology In Everyday Life	Credits: 2 Hours: 30
Course Outcome (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Cite examples of various types of useful and harmful microorganisms and their ubiquitous nature.	1
CO2	Discuss the applications of microorganisms in various fields.	2
CO3	Outline the relatedness of the different upcoming areas of biological sciences to the field of Microbiology.	3
CO4	Classify the microorganisms into different types and compare their characteristic features.	4

Unit No	Title of Unit and Contents	No of Lectures
I	i. Introduction, Definition of Microbiology, Useful microorganisms, Harmful microorganisms, Microorganisms are everywhere (ubiquitous nature of microorganisms), Applications in various fields. ii. Types of Microorganisms: Bacteria (including actinomycetes), Archaea, Fungi, Algae, Protozoa and Viruses	15
II	i. Role of Microbiologists- to solve a range of problems affecting our health, environment, food, agriculture and defense. ii. Microbes used in day-to-day life, Use of sanitizers and disinfectants, Role of antimicrobials in toothpaste and cosmetics, antimicrobial activity of kitchen spices, Role of microorganisms in making fermented food like curd, idli and dosa. Role of microorganisms in spoilage of food.	15

Learning Resources:

1. Bender K.S., Buckley D. H., Stahl D. A., Sattley W. M. And Madigan M. T. (2017). Brock Biology of Microorganisms. E-Book, Global Edition. United Kingdom: Pearson Education.
2. Dubey R. C. and D. K. Maheshwary. (2012). A textbook of Microbiology. S Chand and Company. New Delhi, India
3. Goettel M. S. and Wilcks A. (2012). Beneficial Microorganisms in Agriculture, Food and the Environment: Safety Assessment and Regulation. United Kingdom: CAB International.
4. Klein D. A., Harley J. P. And Prescott L. (2001). Microbiology. United Kingdom: McGraw-Hill Higher Education.
5. Stanier R. Y. (2003). General Microbiology. United Kingdom: Palgrave Macmillan Limited.

F. Y. B. Sc. Semester II				
Evaluation Criteria for (Major- Theory)				
Discipline Specific Course				
MIC – 1002 : Essential Methods in Bacteriology				
Credits: 2				
Hours: 30				
Sr. No.	Course Outcome	Blooms Taxonomy level	Weightage in %	Exam type
1	CO-1: Define different terms involved in nutrition of bacteria. Outline the basic concepts of bacterial growth & nutrition. Describe the significance of extremophiles.	Remember	20	CE+ESE
2	CO-2: Diagrammatically explain the structure of eubacterial and archaeobacterial cells. Explain concept of staining, types of stains and role of various reagents used.	Understand	20	CE+ESE
3	CO-3: Outline various methods of measurement of bacterial growth. Illustrate various patterns of growth of bacteria . Classify bacteria based on their nutritional requirement.	Apply	20	CE+ESE
4	CO-4: Distinguish between eubacterial & archaeobacterial cell envelopes. Explain chemical composition & functions of cellular structures & cytoplasmic inclusions.	Analyze	20	CE+ESE
5	CO-5: Compare different types of bacteria. Compare growth conditions of various types of extremophiles.	Evaluate	10	Only CE
6	CO-6: Design models explaining the cytology of bacteria. Prepare models/posters based on different patterns of bacterial growth.	Create	10	Only CE

F. Y. B. Sc. Semester II		
MIC - 1002	Discipline Specific Course Essential Methods In Bacteriology (Major- Theory)	Credits: 2 Hours: 30
Course Outcome (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Define different terms involved in nutrition of bacteria. Outline the basic concepts of bacterial growth & nutrition. Describe the significance of extremophiles.	1
CO2	Diagrammatically explain the structure of eubacterial and archaebacterial cells. Explain concept of staining, types of stains and role of various reagents used.	2
CO3	Outline various methods of measurement of bacterial growth. Illustrate various patterns of growth of bacteria . Classify bacteria based on their nutritional requirement.	3
CO4	Distinguish between eubacterial & archaebacterial cell envelopes. Explain chemical composition & functions of cellular structures & cytoplasmic inclusions.	4
CO5	Compare different types of bacteria. Compare growth conditions of various types of extremophiles.	5
CO6	Design models explaining the cytology of bacteria. Prepare models/posters based on different patterns of bacterial growth.	6

Unit No	Title of Unit and Contents	No of Lectures
I	<p>Bacterial nutrition and growth</p> <p>i. Nutrition</p> <p>a. Nutritional requirements and nutritional classification (Concept of fastidious organisms)</p> <p>b. Extremophiles and their significance</p> <p>ii. Growth</p> <p>a. Definition of binary fission, growth, generation time, growth rate, specific growth rate</p> <p>b. Batch culture - Growth curve and growth kinetics</p> <p>c. Methods of enumeration: Merits and demerits of each method</p> <p>1. Microscopic methods</p> <p>2. Plate count methods</p> <p>3. Estimation of biomass: Dry mass and wet mass.</p> <p>4. Optical density measurement (Mac-Farland standard)</p> <p>5. Chemical methods - cell carbon and nitrogen estimation, ATP, PCV.</p> <p>d. Different patterns of growth</p> <p>1. Continuous growth:- concept of chemostat and turbidostat</p> <p>2. Diauxic growth</p> <p>3. Synchronous growth</p>	15
II	<p>i. Bacterial Cytology</p> <p>A. Cell wall: Composition and detailed structure of Gram positive and</p>	

	<p>Gram negative cell walls, Acid fast bacterial cell wall , archaeobacterial cell wall, Lipopolysaccharide, Sphaeroplasts, protoplasts and L: forms. Effect of antibiotics and enzymes on the cell wall.</p> <p>B. Cell membrane: Structure, function and chemical composition of bacterial and archael cell membranes.</p> <p>C. Endospore: Structure, formation and stages of sporulation</p> <p>D. Capsule: Structure, composition and function.</p> <p>E. Flagella: Structure, composition and function F. Fimbriae and pili: structure, composition and function</p> <p>G. Cytoplasm: Ribosomes, mesosomes, nucleoid, chromosome and plasmids.</p> <p>H. Cell inclusions: Gas vesicles, carboxysomes, PHB granules, metachromatic granules and glycogen bodies.</p> <p>ii. Concept of stains and staining solutions</p> <p>a.Stain: Definition, Concept of chromophore and auxochrome group</p> <p>b.Acidity and basic stains Role of fixatives, accentuators, mordants and decolorisers.</p>	15
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Learning resources:

1. Daniel Lim, Microbiology, 2nd Edition; McGraw-Hill Publication.
2. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
3. Madigan M.T. Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.
5. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGrawHill Companies Inc.
6. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education.
7. Willey J.M., Sherwood L.M., Woolverton C.J. (2013) Prescott's Microbiology 8th Edition, McGraw-Hill Higher Education.
8. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGrawHill Publishing Co.
9. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
10. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc
11. Wilson K. and Walker J.M. (2005) Principles and Techniques of Biochemistry and Molecular Biology. 6th Edition. Cambridge University Press.
12. Hans G. Schlegel (1993) General Microbiology, 8th Edition, Cambridge University Press.
13. David T. Plummer (1993) An Introduction to Practical Biochemistry, 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
14. Review articles.

F. Y. B. Sc. Semester II Evaluation Criteria for (Major-Practical) Discipline Specific Course MIC – 1012 : Microbiology Practical II Credits: 2 Hours: 60				
Sr. No.	Course Outcome	Blooms Taxonomy level	Weightage in %	Exam type
1	CO-1: Show an experiment to isolate the bacteria and determine the total count of bacteria from different environmental samples using different plate methods	Remember	18	CE+ESE
2	CO-2: Differentiate bacteria based on their cell wall composition using differential staining techniques	Understand	18	CE+ESE
3	CO-3: Examine morphological characteristics of bacteria by different staining techniques.	Apply	18	CE+ESE
4	CO-4: Detect the phototaxis and chemotaxis in bacteria. .	Analyze	18	CE+ESE
5	CO-5: Determine the growth curve of bacteria in batch culture under standard environmental conditions.	Evaluate	10	Only CE
6	CO-6: Design experiments to determine the effect of different environmental parameters on the growth of bacteria.	Create	18	CE+ESE

F. Y. B. Sc. Semester II		
MIC - 1012	Discipline Specific Course- Microbiology Practical II	Credits: 2 Hours: 60
Course Outcome (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Show an experiment to isolate the bacteria and determine the total count of bacteria from different environmental samples using different plate methods.	1
CO2	Differentiate bacteria based on their cell wall composition using differential staining techniques.	2
CO3	Examine morphological characteristics of bacteria by different staining techniques. Demonstrate presence of microorganisms in the air.	3
CO4	Detect the phototaxis and chemotaxis in bacteria.	4
CO5	Determine the growth curve of bacteria in batch culture under standard environmental conditions. Compare various methods of preservation of bacterial culture.	5
CO6	Design experiments to determine the effect of different environmental parameters on the growth of bacteria.	6

Unit No	Title of Unit and Contents	No of Practicals
I	Isolation, enumeration and motility A. Enumeration of bacteria from soil/ water (TVC): Spread plate technique. B. Enumeration of bacteria from soil/ water (TVC): Pour plate technique C. Enumeration of yeast cells using counting chamber D. Observation of bacterial motility by Hanging drop technique E. Demonstration of microflora from air F. Preservation of bacterial and fungal cultures	5
II	Staining and growth A. Observation of morphology of bacteria by Negative staining technique, Monochrome staining technique. B. Differential staining: Gram staining technique C. Growth curve of bacteria. D. Effect of environmental parameters on bacterial growth: pH and temperature E. Effect of environmental parameters on bacterial growth: Salt and Heavy metals. F. Measurement of cell dimension by Micrometry.	5

Learning Resources:

1. Fundamental Principles of Bacteriology by Salle, A.J. Publisher- McGraw Hill Book Company Inc.
2. Experiments in Microbiology, Plant Pathology and Biotechnology. Aneja, K.R.
3. Benson's Microbiological Applications, Laboratory Manual in General Microbiology, Short Version Alfred Brown; Heidi Smith
4. Microbiology: A Laboratory Manual, 10th Edition James G. Cappuccino. Handbook Media Stains, Reagents Microbiology by A. M. Deshmukh.
5. Microbiology: A Laboratory Manual, 10th Edition James G. Cappuccino.

F. Y. B. Sc. Semester II				
Evaluation Criteria for				
Open Elective II				
MIC – 1022: Human Microbe Interactions				
Credits: 2				
Hours: 30				
Sr. No.	Course Outcome	Blooms Taxonomy level	Weightage in %	Exam type
1	CO-1: Describe the normal flora of the human body. Define the various types of associations between host and microorganisms.	Remember	25	Only CE
2	CO-2: Give examples of different pathogens. Cite the significance of immune- privileged sites in the human body	Understand	25	Only CE
3	CO-3: Explain the origin and importance of normal flora of the human body. Chart different routes of transmission of diseases	Apply	25	Only CE
4	CO-4: Differentiate between different types of host- microbe interactions. Compare and contrast between air- borne and water-borne infections, food borne, zoonotic and vector borne infections.	Analyze	25	Only CE

F. Y. B. Sc. Semester II		
MIC - 1022	Open Elective II - Human Microbe Interactions	Credits: 2 Hours: 30
Course Outcome (COs)		Bloom's cognitive level
On completion of the course, the students will be able to:		
CO1	Describe the normal flora of the human body. Define the various types of associations between host and microorganisms.	1
CO2	Give examples of different pathogens. Cite the significance of immune-privileged sites in the human body	2
CO3	Explain the origin and importance of normal flora of the human body. Chart different routes of transmission of diseases	3
CO4	Differentiate between different types of host- microbe interactions. Compare and contrast between air- borne and water-borne infections, food borne, zoonotic and vector borne infections.	4

Unit No.	Title of Unit and Contents	No. of lectures
I	<p>A. Microorganisms residing on and in human body: Importance of normal flora</p> <p>B. Normal flora of skin, gastro - intestinal tract, genitourinary tract, respiratory tract</p> <p>C. Immune - privileged sites: eye, brain, reproductive system</p> <p>D. Associations: symbiosis, parasitism, commensalism</p>	15

II	<p>A. How do humans catch infections?</p> <p>B. Host defence against infections: Overview</p> <p>a. Importance of Public Health Microbiology</p> <p>b. Microorganisms infecting our body when immunity lowers down-skin infections, disorders of the digestive system</p> <p>c. Infections of our body after visiting a hospital- Respiratory tract infection</p> <p>d. Pathogens infecting our body through air- Upper and Lower respiratory tract infections</p> <p>e. Pathogens infecting our body through contaminated water- Disorders of the gastro- intestinal system</p>	15
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Learning resources:

1. Tortora, G.J., Funke, B.R., Case, C.L, 2016. Microbiology: An introduction. 12th Edition, Benjamin Pub. Co. NY
2. Indira T. Kudva, Nancy A. Cornick, Paul J. Plummer, Qijing Zhang, Tracy L. Nicholson, John P. Bannantine, Bryan H. Bellair 2016. Virulence mechanisms of bacterial pathogens. 5th edition. ISBN: 978-1-555-81927-9.
3. Ananthanarayan, R. and C.E, Jayaram Panikar, 2020. Ananthnarayan and Panikar's Textbook of Microbiology, 10th edition, Universities Press.
4. Cruickshank K.R., 2005, Medical Microbiology Vol I & II Livingstone, Longman. (Topic II AND IV)
5. Chakraborty P. 2009, Textbook of Medical Parasitology, Central Publications, Kolkata, India.

F. Y. B. Sc. Semester II				
Evaluation Criteria for				
Skill Enhancement Course 1				
MIC1032: Techniques in Haematology				
Credits: 2				
Hours: 30				
Sr. No.	Course Outcome	Blooms Taxonomy level	Weightage in %	Exam type
1	CO-1: Describe steps involved in blood collection and storage, define different blood components and state their uses.	Remember	16	Only CE
2	CO-2: Identify and interpret different blood groups in human beings, Summarize different blood group systems in human	Understand	16	Only CE
3	CO-3: Demonstrate hemoglobin estimation, determination of ESR, PCV and blood group classification	Apply	20	Only CE
4	CO-4: Explain biochemistry of blood group antigens.	Analyze	16	Only CE

F. Y. B. Sc. Semester II		
MIC 1032	Skill Enhancement Course 1:Techniques in Haematology	Credits: 2 Hours: 30
Course Outcome (COs)		Bloom's cognitive level
On completion of the course, the students will be able to:		
CO1	Describe steps involved in blood collection and storage, define different blood components and state their uses	1
CO2	Identify and interpret different blood groups in human beings, Summarize different blood group systems in humans	2
CO3	Demonstrate hemoglobin estimation, determination of ESR, PCV and blood group classification	3
CO4	Explain biochemistry of blood group antigens	4
CO5	Assess and analyze presence of pathogens from body fluids using rapid diagnostic tests	5
CO6	Compile the hematological data and prepare the report	6

Unit No.	Title of Unit and Contents	No. of lectures
I	Principles of immunohematology: A. Blood group antigens B. Biochemistry of blood group antigens C. Human Blood group systems -ABO, Rh system of blood grouping D. Other blood group systems E. Components of blood F. ESR, PCV, Hemoglobin estimation	15

II	Routine practices during blood collection A. Preparation for blood collection B. Blood transportation after collection C. Storage of blood D. Preparation and use of blood components E. Tests for pathogens after blood collection	15
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Learning Resources:

1. Chakraborty, P., 2003. A textbook of Microbiology, 2nd Edition New Central Book Agency, India.
2. R.S. Satoskar, S.D. Bhandarkar, 2007. Pharmacology and pharmacotherapeutics, Popular Prakashan, 20th edition.
3. Kanai L. Mukherjee, 2006. Medical laboratory technology.
4. Medical Physiology by John E. Hall and Michel E. Hall 3rd South Asia Edition, Elsevier Publications.