B. Sc. (Microbiology) Semester – III

Course Code	US03CMIC51	Title of the Course	Fundamentals of Microbiology - I
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make the students familiar with: • Microbiology as a subject • Historical development and Scope of Microbiology • Ultra structure of a bacterial cell and its study using Different type of stains and staining techniques under Microscopes • Concepts of bacterial classification, identification and pure culture.

Course Content		
Unit	Description	Weightage* (%)
1.	**Scope and History of Microbiology** a) Discovery of Microorganisms b) Spontaneous generation versus Biogenesis. c) Germ theory of Fermentation d) Germ theory of disease e) Laboratory techniques and pure cultures f) Principles of Immunization g) Widening horizons of Microbiology: i. Medical microbiology ii. Agricultural and Industrial microbiology iii. Molecular biology h) Applied areas of Microbiology	25

2.	**Ultra structure of Bacterial cell** a) Morphology of bacteria b) Basic structure of Bacterial cell c) Structure external to the cell : i. Flagella (Structure and function), Pili, Capsules, Sheaths, Prosthecae and stalks. ii. Cell wall structure and chemical composition. d) Structure internal to the cell wall : i. Cytoplasmic membrane ii. Protoplasts and spheroplasts iii. Membranous intrusions and Intracellular membrane systems. iv. The cytoplasm v. Cytoplasmic inclusions and vacuoles vi. Nuclear material e) Spores and Cysts – structure.	25

3.	**Microscopic examination of microorganisms** (a) Stains and staining: i. Chemistry of dyes and stains, types of dyes. ii. Principles of staining technique in Bacteria. iii. Steps in staining process. iv. Role of intensifier, mordents and decolorizers. v. Types of staining: Simple staining, Negative staining, Differential staining :Gram staining and acid fast staining (b) Microscopy: i. Microscopes and microscopy: Bright field Microscopy, Resolving power, Numerical Aperture, Limit of Resolution, Magnification, Dark field Microscopy. ii. Principles and applications of fluorescent and phase contrast Microscopy. iii. Electron microscopy: Transmission Electron Microscopy, Scanning Electron Microscopy, Limitations of Electron Microscopy.	25
4.	**Characterization, Classification and Identification of Microorganisms** a) Place of microorganisms in living world. b) Whittaker's five kingdom concept. c) Bergey's Manual of Systematic Bacteriology. d) Major characteristics of Microorganisms. e) Microbial Classification: Taxonomic groups, General Methods of Classifying Bacteria- Intuitive method, Numerical Taxonomy and Genetic Relatedness. f) Nomenclature and Identification**.** g) Techniques for obtaining pure culture of bacteria.	25

Teaching-Learning Methodology	The major teaching- learning consists of lectures and discussions (large group) in which the teacher makes a use of chalk and talk as well as power point presentation to introduce the learning objectives related to the basic concepts of the subject. These sessions incorporate space for participation and involvement of students through questions. The student's participation in laboratory on related theoretical concept is also required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Projects, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the scope and History of Microbiology.
2.	Describe the ultra structure and organelles of a bacterial cell.
3.	Use the knowledge of staining techniques and microscopes in microscopic examination
4.	Describe the concepts of classification, identification of bacteria and isolation of pure culture.

Suggested References:	
Sr. No.	References 1. Microbiology - Michael J. Pelczar JR.; E.C.S.Chan; Noel R. Krieg. Fifth edition 2. Elementary Microbiology Vol : I – Dr. H.A. Modi 3. "Microbiology" Prescott L, Harley J P, and Klein D A, 6th edition. Wm C.Brown - McGraw Hill, Dubuque, IA ltd.
On-line resources to be used if available as reference material	

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B. Sc. - Microbiology Semester – III

Course Code	US03CMIC52	Title of the Course	Introduction to Microbial Physiology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make the students familiar with: • Basic knowledge of bio molecules and enzymes • The nutritional requirements and physical parameters needed for the Cultivation of bacteria. • Nutrient uptake and transport • Methods of reproduction in prokaryotes and concepts of bacterial growth. • Control of microorganisms both by physical and chemical agents. • Concepts of chemotherapy

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction to bio molecules and enzymes** a) Introduction to Bio molecules: i) Water ii) Carbohydrates iii) Lipids iv) Proteins v) Nucleic acids b) Introduction to Enzymes: i) Characteristics, chemical and physical properties of enzymes ii) Nomenclature of enzymes iii) The nature and mechanism of enzyme action iv) Conditions affecting enzyme activity.	25

2.	**Principles of Microbial nutrition** a) Introduction b) Modes of Uptake of nutrients c) Nutritional requirements of microorganisms: Bioelements, Energy requirements, Carbon requirements, Nitrogen requirements, Oxygen, hydrogen, sulphur, phosphorus, minerals, growth factors and water requirements. d) Diversity in microbial nutrition e) Nutritional classification of microorganisms. f) Transport systems g) Culture media	25
3.	**Microbial growth** a) Growth in prokaryotes and Modes of reproduction(cell division) in bacteria b) Mathematical nature and expression of growth c) Normal growth curve of microbial population in batch culture system: lag phase, exponential phase, stationary phase, death phase and transitional periods between growth phases. d) Diauxic growth, continuous culture, Synchronous growth e) Measurements of microbial growth f) Physical conditions required for growth: temperature, gaseous requirements, oxygen toxicity, pH and miscellaneous physical requirements	25

4.	**Microbial control and chemotherapy** a) physical control of microorganisms: High temperature, Low temperature, Radiation, Filtration, Desiccation b) Chemical control of microorganisms: Disinfectants, Food preservatives, Antiseptics. c) Antibiotics and other chemotherapeutic agents: Chemotherapeutic agents and chemotherapy, Historical highlights of chemotherapy, Characteristics of antibiotics that qualify them as chemotherapeutic agents. d) Antibiotics and their mode of action: i. Inhibition of cell wall synthesis: penicillins, bacitracin ii. Damage to cytoplasmic membrane iii. Inhibition of nucleic acid and protein synthesis: streptomycin iv. Inhibition of specific enzyme systems: sulphonamides	25

Teaching-Learning Methodology	The teaching- learning process will consist of lectures (large group) in which the teacher will use aids such as chalk as well as make power point presentation to introduce the topics encompassing the basic concepts of the subject. These sessions incorporate space for interactive sessions encouraging the participation and involvement of students. The student's involvement and participation in the laboratory experiments on related theoretical concepts is also required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Projects, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Use the knowledge of nutritional requirements and various conditions for cultivation and isolation of bacteria at laboratory level as an applied aspect. Can comment and explain regarding various bio molecules and their significance.
2.	Have a better understanding about fundamentals of control and various terms such as sanitizers, disinfectants, germicidal agents etc.
3.	Have understanding of growth of prokaryotes in batch culture, continuous culture and their applications.

Suggested References:	
Sr. No.	References
	1. Principles of Microbiology, Ronald M. Atlas, 2nd Edition, Wm. C. Brown publishers, 1995
	2. "Microbiology" – Michael J. Pelczar JR., E.C.S.Chan and Noel R. Krieg , 5th edition, Tata McGRAW –HILL Edition,1993.
	3. A handbook of elementary Microbiology by H.A. Modi, Shanti Prakashan, Rohtak Haryana.
On-line resources to be used if available as reference material	

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B.Sc. (Microbiology) Semester III

Course Code	US03CMIC53	Title of the Course	Practicals: Fundamentals of Microbiology - I and Introduction to Microbial Physiology
Total Credits of the Course	04	Hours per Week	8

Course Objectives:	To demonstrate: • Understanding of various laboratory equipments and use of microscope. • Microbial handling techniques and disposal of laboratory waste. • Basic skills like preparation of smear, culture media & reagents as well as illustrating staining techniques to visualize bacterial cell and their organelles. • The use of nutritional requirements and various conditions for cultivation and isolation of bacteria as an applied aspect. • An understanding of effect of environmental factors, antibiotics, chemical microbial agents and heavy metals on the growth of bacteria. • The concept of contamination.

Course Content		
No.	Practicals	Weight age* (%)
	SECTION-1	
1.	Introduction to Laboratory apparatus.	
2.	Cleaning and Preparation of Glassware for Sterilization.	
3.	Preparation of Reagents – Preparation of normal, molar and % solution of HCl, NaOH.	
4.	Simple staining - Monochrome staining (i) Positive staining (ii) Negative staining	

5.	Gram's staining of bacteria	100 %
6.	Cell wall staining by Dyar's/ Ringer's method	
7.	Capsule staining by Hiss/Maneval's method.	
8.	Endospore staining by Dorner's / Snyder's method	
9.	Metachromatic granule staining by Albert's method	
10.	Motility of bacteria by hanging drop preparation	
11.	Preparation of media – Nutrient broth / agar and Disposal of Laboratory waste and media	
	SECTION:2	
1.	Isolation ,cultivation and preservation of bacteria in pure culture by: (i) Streak plate and (ii) Spread plate method.	
2.	Effect of environmental factors on the growth of Bacteria – (i)Temperature (ii) pH	
3.	Study of Oligodynamic action of Heavy Metal on bacteria	
4.	Spectrum Study of an antibiotic by Agar ditch method	
5.	Effect of antimicrobial agents on the growth of bacteria by paper disc/ cup borer method (Antibiotic, Phenol, Crystal Violet, sterile distilled water).	
.	**SECTION-3 ONLINE / IN PRESENCE DEMONSTRATIONS**	
1	(i) To show microbes are universal by exposures/ inoculation of nutrient agar plates by air, water, skin, soil etc. (ii) Incubation of N-broth with and without cotton plug to show importance of plugging.	

2	Qualitative analysis of Carbohydrates and Proteins	
3	Study of biochemical reactions based on carbohydrates, proteins, lipids and other tests to understand metabolic and enzymatic diversity of bacteria. At least following tests should be included: carbohydrate based: M.R., V.P, citrate utilization, sugar fermentation, starch hydrolysis Protein based: indole production, H_2S production, gelatine hydrolysis, casein hydrolysis Others: catalase, dehydrogenase, urea utilization	

Teaching-Learning Methodology	• By briefing them with the theoretical aspects as well as providing them with the protocol (Aim, Requirements and Procedure) of the experiment to be performed using chalk and duster as well as power point presentation. • Students are trained for microscope observations and its handling. • Demonstrations of the practical are also carried out and care is taken for aseptic handling and skill development for microbiological work in the laboratory. • Possibility of various results and their interpretation is also discussed.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weight age
1.	University Examination: there should be at least two exercises for performance; it should be two days practical examination of total 6 (six) hours. Student should have a certified journal duly signed by head of department and the teacher in charge at the time of examination.	100 %

Course Outcomes: Having completed this course, the learner will be able to:	
1.	Get acquatinted with the use of microscope for viewing stained specimen.
2.	Use common laboratory equipments.

3.	Become proficient at safety procedures & microbial handling techniques.
4.	Acquire requisite laboratory skills in preparing stained smear and identify the morphology and arrangement as well as various organelles of bacteria.
5.	Comprehend the basic fundamental knowledge of how microorganisms grow, react with specific types of growth media and growth conditions.
6.	Interpret the use of antibiotics and chemicals in microbial control.
7.	Become competent in culture work.

Suggested References:

Sr. No.	References
1.	Experimental Microbiology - Rakesh J.Patel & Kiran R. Patel, Volume I
2.	Practical Microbiology- Dr. R.C. Dubey and Dr. D.K. Maheshwari (Revised edition), S. Chand publication
3.	Microbiology : A Practical Approach – Dr Bhavesh Patel and Dr Nandini Phanse

On-line resources to be used if available as reference material

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B. Sc. (Microbiology) Semester IV

Course Code	US04CMIC51	Title of the Course	Fundamentals of Microbiology-II
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	• To know about diversity in microorganisms. • To know general characteristics and significance of eukaryotic microbes: fungi, algae and protozoa. • To understand about viruses as acellular microbes. • To know about sub viral entities like PRIONS and viroids. • To make student know about bacteria with unusual properties. • To make students know about normal microbiota found in healthy human and what is their significance. • Students can know the process of microbial infection. Also come to know properties of microbes that make them virulent. • Students understand about non specific defence mechanisms of human and know about role of blood components in immune system.

Course Content		
Unit	Description	Weightage* (%)
1.	**Eukaryotic Microbes and acellular microorganisms** a) Fungi: Introduction, Importance, morphology, reproduction, physiology and cultivation. b) Algae: introduction, occurrence, Biological and economical importance, morphology, pigments, motility, reproduction. c) Protozoa: occurrence, ecology, symbiotic protozoa, importance, morphology, reproduction. d) Acellular microorganisms: i. Viruses: General properties of viruses: Introduction, Morphology, chemical properties, viral multiplication and cultivation of viruses. ii. Sub viral particles: Introduction to PRIONS and Viroids.	25%

2.	**Procaryotes with different / unusual properties** a) Bacteria with unusual morphology i. Budding and appendaged bacteria ii. Filamentous bacteria: actinomycetes iii.Sheathed bacteria iv. Mycoplasma v. Cyanobacteria vi. Spirochaetes b) Bacteria with gliding motility: introduction, Myxobacters and Baggiotoa c) Rickettsia and Chlamydia d) Archaebacteria	25%
3.	**Introduction to medical microbiology: Human Microbe interactions** a) Microbiota of Human body: i. Origin of the normal flora, Normal Flora and human host. ii. Germfree and Gnotobiotic life, Effect of Antimicrobial Agents. Characteristics of normal flora organisms. iii. Distribution and occurrence of normal flora of skin, eye, respiratory tract, mouth, Intestinal tract, Genitourinary tract. b) The process of Infection: i. Pathogenicity, Virulence and infection. ii. Microbial Adherence: Examples of Adherence of pathogenic bacteria, Examples of adherence of viruses. iii. Penetration of epithelial cell layers: Passive penetration into the body Active penetration into the body. iv. Events in infection following penetration: Growth in underlying Tissue, Infection of the lymphatic system, Infection of the blood. v. Microbial virulence factors: Antiphagocytic factors, Exotoxins, Endotoxins, Other virulence factors.	25%

4.	**Introduction to Immunology** a. Natural resistance and its types : species resistance, Racial resistance, individual resistance, External defense mechanisms b. Non specific defenses against Microbial Infections: Physical barriers, Chemical defense, Phagocytosis, Inflammatory response, Fever. c. Components of blood and their functions	25%

Teaching-Learning Methodology	The teaching- learning process will consist of lectures (large group) in which the teacher will use aids such as chalk as well as make power point presentation to introduce the topics encompassing the basic concepts of the subject. Growing fungi in labs, observing protozoa and algae in hay infusion and other natural samples. Can also arrange photography sessions and can have albums of various fungi and mushrooms in rainy season at their natural habitat.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Projects, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Gain knowledge of general characteristics and importance of fungi, algae, protozoa, viruses, PRIONS and viroids.
2.	Give examples of bacteria with unusual properties and can get knowledge of diverse groups of bacteria with distinguish characteristics.
3.	Understand importance of normal microbiota of human body and can give examples of

	bacteria and other microbes present in various parts of the healthy human body.
4.	Understand types of infections, differentiate infection and disease, and have idea of process of infection.
5	Understand what immunity is and get idea regarding natural immunity and non specific defence mechanisms of human. Get idea about various components of blood and their functions.

Suggested References:	
Sr. No.	References
1.	"Microbiology" – Michael J. Pelczar, E.C.S.Chan and Noel R. Krieg , 5th edition, Tata McGRAW –HILL Edition,1993
2.	Text book of Microbiology –Anantnarayan and Paniker 10th Edition, University Press:2017
3.	Principles of Microbiology, Ronald m. Atlas, 2nd Edition, Wm. C. Brown publishers, 1995
4.	Prescott L, Harley J P, and Klein D A, Microbiology, 7th edition. Wm C.Brown - McGraw Hill, Dubuque, IA ltd.
5.	Medical laboratory technology, KI Mukherjee VOL-1

On-line resources to be used if available as reference material
On-line Resources

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B. Sc. (Microbiology) Semester IV

Course Code	US04CMIC52	Title of the Course	Applied Microbiology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To make the students familiar with : • The normal flora of soil, interaction of microbes in soil and their role in transformation of nutrients. • Types of water and its purification • Disposal of sewage • To make student know involvement of microbes in food making, spoilage and food borne diseases. • To impart knowledge of microbiology of milk, importance and concepts of food and milk preservation techniques.

Course Content		
Unit	Description	Weightage* (%)
1.	**Soil microbiology** (a) Introduction (b) Physical characteristics of soil. (c) Microbial flora of soil. (d) Functions of microorganisms in soil, Rhizosphere. (e) Humus. (f) Interactions among soil microorganisms: mutualism, synergism, commensalism, competition, amensalism, parasitism. (g) Biogeochemical role of soil microorganisms: i. Nitrogen cycle: nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. ii. Sulphur cycle, microbes involved in sulphur cycle. iii. Carbon cycle, microbial degradation of cellulose, hemicelluloses, lignin and chitin. iv. phosphorus cycle.	25%

2.	**Water and waste water Microbiology** a) Types of natural waters b) Marine microbiology c) Bacteriological examination of domestic water: presumptive test/MPN test, confirmed and completed test for faecal coliforms, IMViC test, membrane filter technique. d) Purification of water (sedimentation, filtration and disinfection) Waste water microbiology: chemical characteristics, BOD, COD, microbiological characteristics. e) Wastewater treatment and disposal: i. Waste water treatment processes: single dwelling units, Municipal treatment processes (primary treatment-sedimentation, secondary (biological) treatment: trickling filter, the activated sludge process, oxidation ponds; advanced treatment, final treatment. ii. Solids waste management: sources and types of solid waste; Solids processing: anaerobic sludge digestion,, composting, sanitary landfills	25%
3.	**Food Microbiology** a) Food as a substrate for Microorganisms. b) Microbial flora of food. c) Factors affecting kinds and numbers of microorganisms : intrinsic and extrinsic parameters of food. d) Microbial Spoilage of food and Food Poisoning, Role of *Clostridium botulinum* and *Salmonella* spp. e) Preservation of food and Milk A. General principles B. Methods of preservation: i. Use of aseptic handling ii. High temperature: Sterilization, canning iii. Low temperature: Refrigeration and freezing iv. Dehydration	25%

	v. Osmotic pressure vi. Preservatives vii. Radiations: Ionizing and non-ionizing radiation f) Indian Fermented food products: Pickles and Idli. g) Microbes as food: Mushrooms and Spirulina.	
4.	**Microbiology of milk and milk products** a) Sources of microorganism in milk b) Types of microorganisms in milk c) Milk borne diseases d) Microbiological examination of milk e) Pasteurization of milk, Phosphatase test, MBRT and Resazurin test f) Some dairy milk products: Butter, Cheese. g) Introduction to probiotics, prebiotics, Synbiotics.	25%

Teaching-Learning Methodology	The teaching- learning process will consist of lectures (large group) in which the teacher will use aids such as chalk as well as make power point presentation to introduce the topics encompassing the basic concepts of the subject. Arranging competition of preparation of various fermentation food dishes and enlisting role of microbes in that food dish. Performing Experiments related to food and milk quality analysis.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Projects, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Demonstrate the significance of microbes in soil and their role in agriculture and also study microbial interactions and biogeochemical cycles
2.	Use the information of water microbiology for microbiological analysis at laboratory level and thereby determine the quality of water samples Use the knowledge and its application for liquid waste management as well as solid waste management
3.	Understand the significance of Microbial spoilage of food, food borne diseases and the methods of preservation of food. Correlate microbial food spoilage and proper handling of food at home
4.	Learn the microbiology of milk and other dairy products and microbes involved in dairy food fermentations. Understand the concept Microbiological Examination and pasteurization of Milk.

Suggested References:	
Sr. No.	References
1.	"Microbiology" – Michael J. Pelczar, E.C.S.Chan and Noel R. Krieg , 5th edition, Tata McGRAW –HILL Edition,1993
2.	"General Microbiology", by C.B. Powar and H.F. Daginawala, volume-II, Himalaya Publishing House, Reprint-2002
3	'Microbiology" Prescott L, by Harley J P, and Klein D A, 6th edition. Wm C. Brown - McGraw Hill, Dubuque, IA ltd.
4	Food and Dairy Microbiology by Vivek Upasani, Nirav Prakashan, Ahmedabad

On-line resources to be used if available as reference material
On-line Resources

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B.Sc. (Microbiology) Semester IV

Course Code	US04CMIC53	Title of the Course	Practicals: Fundamentals of Microbiology – II and Applied Microbiology
Total Credits of the Course	04	Hours per Week	08

Course Objectives:	To demonstrate: • The existence of microorganisms in different environment. • Study of Microbial flora of Air: qualitatively and quantitatively. • Microbiological examination of milk for its quality check. • Qualitative and quantitative analysis of drinking water. • Study of soil micro organisms. • Study of various other types of microorganisms like yeast, moulds and bacteriophage. • Cultivation and study of Nitrogen fixing bacteria.

Course Content		
No.	Practicals	Weight age* (%)
	SECTION-1	
1.	Study of eukaryotic microbes in hay infusion	
2.	Isolation and cultivation of yeast.	
3	Study of morphological and colony characters of fungi: *Aspergillus, Penicillium, Rhizopus* and *Mucor.* (mounting from ready plates)	
4	Cultivation of Actinomycetes : filamentous bacteria	
5	Study of skin flora and mouth flora (Gram staining of teeth and tongue surface bacteria)	
6	Spirochaete staining by Fontana's method (as mouth flora and as prokaryotes with different morphology)	

7.	Study of air flora	100%
	SECTION-2	
1.	Microbiological analysis of water: (i) Standard plate count (ii) Presumptive test confirmed and completed tests. iii) Detection of coli forms in water by MPN test.	
2.	Microbiological analysis of milk : (i) Standard plate count ii) Determination of microbial load by use of MBRT iii) Detection of acid fast bacteria in milk.	
3.	Study of soil bacteria: isolation and cultivation of symbiotic nitrogen fixing bacteria: *Rhizobium*	
4.	Study of soil bacteria: isolation and cultivation of non symbiotic nitrogen fixing bacteria: *Azotobacter*.	
5.	Demonstration: Measurement of microscopic object by use of micrometry.	
6.	Demonstration: Study of types of white blood cell by showing differential count of WBC by Field's method.	
7.	Study of pigment producing bacteria	
	SECTION-3 ONLINE / IN PRESENCE DEMONSTRATIONS	
1.	Study of viral and fungal diseases of plants (online/ in presence demonstrations of slides of diseased plant parts to get knowledge of : (i) TMV, Potato virus Y, Tomato spotted wilt virus (ii) Rust, smut, powdery mildew	

Teaching-Learning Methodology	• By briefing them with the theoretical aspects as well as providing them with the protocol (Aim, Requirements and Procedure) of the

	experiment to be performed using chalk and duster along with power point presentation. • Demonstration of the practical is also carried out to develop proper skills required in microbiological experiments. • Possibility of various results and their interpretation is also discussed.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weight age
1.	University Examination: there should be at least two exercises for performance; it should be two days practical examination of total 6 (six) hours. Student should have a certified journal duly signed by head of department and the teacher in charge at the time of examination.	100 %

Course Outcomes: Having completed this course, the learner will be able to:	
1.	Comprehend the occurrence, abundance and distribution of microorganisms from different sources.
2.	Conceptualize microbial diversity as well as the omnipresence of microorganisms.
3.	Enumerate the bacteria in the original sample.
4.	Determine the quality of milk and water for consumption.
5.	Apply the concept in different fields like dairy, pharmaceutical, cosmetics, water purification plants as a quality control measure.
6.	Understand the necessity of bacteriological assessment of indoor air at hospitals, pharmaceutical, food industries etc.

Suggested References:	
Sr. No.	References:
1.	Experimental Microbiology - Rakesh J. Patel and Kiran R. Patel, Volume I
2.	Practical Microbiology- Dr. R.C. Dubey and Dr. D.K. Maheshwari (Revised edition), S. Chand publication
3.	Microbiology : A Practical Approach – Dr Bhavesh Patel and Dr Nandini Phanse

On-line resources to be used if available as reference material

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