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: Based on 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: Based on US03 CMIC51 :Fundamentals of Microbiology - I	
1.	Introduction to Laboratory apparatus.	100 %
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	
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	

	SECTION:2 Based on US03CMIC52: Introduction to Microbial Physiology	
1.	Preparation of media – Nutrient broth / agar and Disposal of Laboratory waste and media	
2.	Isolation ,cultivation and preservation of bacteria in pure culture by: (i) Streak plate and (ii) Spread plate method.	
3.	Effect of environmental factors on the growth of Bacteria – (i)Temperature (ii) pH	
4.	Study of Oligodynamic action of Heavy Metal on bacteria	
5.	Spectrum Study of an antibiotic by Agar ditch method	
6.	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 acquainted 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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