

KURUKSHETRA UNIVERSITY KURUKSHETRA

Syllabus for Under-Graduate Programme

**Subject: Industrial Microbiology
(3rd and 4th Semester)**

**Under Multiple Entry-Exit, Internship and
CBCS-LOCF in accordance to NEP-2020
w.e.f. 2023-24**

PLOs for Life Sciences

PLOs	UG Certificate in Life Sciences
After the completion of UG certificate in Life Sciences, the student should be able to:	
PLO_1: Knowledge and Understanding	<ul style="list-style-type: none"> • Demonstrate the knowledge of basic principles, concepts, facts and broad linkage of chosen subjects of Life sciences.
PLO_2: Skills And creativity	<ul style="list-style-type: none"> • Selecting and using relevant methods, tools, and materials to assess the appropriateness of approaches for solving problems associated with the chosen subjects of Life sciences.
PLO_3: Application of knowledge and Skills	<ul style="list-style-type: none"> • Apply the acquired operational or theoretical knowledge, and a range of practical skills to select and use basic methods, tools, materials, and information to generate solutions to specific problems relating to the chosen subjects of Life sciences.
PLO_4: Critical thinking	<ul style="list-style-type: none"> • Listen carefully, read texts, make judgments and take decisions based on analysis of data and evidences.
PLO_5: Ethics	<ul style="list-style-type: none"> • Put forward convincing arguments to respond to the ethical and moral issues associated with the chosen subjects, practice ethical and moral values in one's life.
PLO_6: Communication	<ul style="list-style-type: none"> • Express scientific thoughts and ideas effectively in writing and orally and communicate on scientific activities with others using appropriate media.
PLO_7:Life Long Learning	<ul style="list-style-type: none"> • Acquire knowledge and skills including learning 'How to learn' that are necessary for participating in learning activities throughout life.
PLO_8: Environmental Awareness	<ul style="list-style-type: none"> • Demonstrate knowledge of effects of environmental degradation, climate change and pollution, effective waste management.
PLO_9:Digital Literacy	<ul style="list-style-type: none"> • To use ICT in a variety of learning and work situations.

PLOs	UG Diploma in Life Sciences
After the completion of UG Diploma in Life Sciences, the student should be able to:	
PLO_1: Knowledge and Understanding	<ul style="list-style-type: none"> • Demonstrate the deeper knowledge and understanding of principles, concepts, facts and broad linkage of chosen subjects of Life sciences.
PLO_2: Skills And creativity	<ul style="list-style-type: none"> • Selecting and using relevant methods, tools, and materials to assess the appropriateness of approaches from a range of sources for solving complex problems associated with the chosen subjects of Life sciences.
PLO_3: Application of knowledge and Skills	<ul style="list-style-type: none"> • Apply the acquired operational or theoretical knowledge, and a range of practical skills to select and use appropriate methods, tools, materials, and information to generate solutions to specific problems relating to the chosen subjects of Life sciences.
PLO_4: Critical thinking	<ul style="list-style-type: none"> • Listen carefully, read texts, make judgments and take decisions based on analysis of data and evidences, present complex information in a clear, scientific and concise manner.
PLO_5: Ethics	<ul style="list-style-type: none"> • Formulate arguments in support of actions to address the ethical and moral issues associated with the chosen subjects, practice ethical and moral values in one's life.
PLO_6: Communication	<ul style="list-style-type: none"> • Express scientific thoughts and ideas effectively in writing and orally and communicate on scientific activities with others using appropriate media.
PLO_7:Life Long Learning	<ul style="list-style-type: none"> • Acquire knowledge and skills including learning 'How to learn' that are necessary for participating in learning activities throughout life.
PLO_8: Environmental Awareness	<ul style="list-style-type: none"> • Apply knowledge, skills and attitude to mitigate the effects of environmental degradation, climate change and pollution, effective waste management.
PLO_9:Digital Literacy	<ul style="list-style-type: none"> • To use ICT in a variety of learning and work situations.

PLOs	Bachelor Degree in Life Sciences
After the completion of Bachelor degree in Life Sciences, the student should be able to:	
PLO_1: Knowledge and Understanding	<ul style="list-style-type: none"> • Demonstrate the comprehensive and specialized knowledge and deep understanding of principles, concepts, and facts about current and emerging issues relevant to chosen subjects of Life sciences.
PLO_2: Skills And creativity	<ul style="list-style-type: none"> • Selecting and using relevant methods, tools, and materials to assess the appropriateness of approaches for solving specific problems associated with the chosen subjects of Life sciences.
PLO_3: Application of knowledge and Skills	<ul style="list-style-type: none"> • Apply the acquired operational or theoretical knowledge, and a range of practical skills to analyze quantitative and qualitative data to assess the different approaches to generate solutions to specific problems related to the chosen subjects of Life sciences.
PLO_4: Critical thinking	<ul style="list-style-type: none"> • Listen carefully, read texts, make judgments and take decisions based on analysis of data and evidences, present complex information in a clear, scientific and concise manner.
PLO_5: Ethics	<ul style="list-style-type: none"> • Follow ethical practices in all aspects of research and development, including avoiding unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
PLO_6: Communication	<ul style="list-style-type: none"> • Able to communicate effectively on complex scientific activities with the scientific community and with society at large, such as, being able to comprehend and write effective scientific reports and design documentation, make effective presentations.
PLO_7: Life Long Learning	<ul style="list-style-type: none"> • Acquire knowledge and skills including learning ‘How to learn’ that are necessary for participating in learning activities throughout life.
PLO_8: Environmental Awareness	<ul style="list-style-type: none"> • Apply knowledge, skills and attitude to mitigate the effects of environmental degradation, climate change and pollution, effective waste management.
PLO_9: Digital Literacy	<ul style="list-style-type: none"> • To use ICT in a variety of learning and work situations, appropriate software to analysis the data.
PLO_10: Research Aptitude	<ul style="list-style-type: none"> • Ask relevant/appropriate questions, identifying, formulating and analyzing the research problems and to draw conclusion from the analysis.

CC-3/MCC-4

Session: 2024-25			
Part A - Introduction			
Subject	INDUSTRIAL MICROBIOLOGY		
Semester	III		
Name of the Course	BASICS OF MICROBIAL GENETICS		
Course Code	B23-IMB-301		
Course Type:	CC/MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To acquaint with Basic of Mendelian Genetics. 2. To impart knowledge of genetic material and its basic structure. 3. To give theoretical knowledge of DNA replication. 4. To understand about basic mutation and mutagenic agents. 5. Demonstrate proficiency in fundamental molecular biology techniques alongside problem-solving within Mendelian genetics.		
CLO5 is related to practical component			
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Exam Duration	3 hours	4 hours	
Maximum Marks 100			
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question			

from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	<p>Genetic Material and Its Structure: Milestones in history – Definition of nucleic acids - Experimental proofs of DNA as the genetic material (Griffith and Hershey Chase) – Chemistry and molecular structure of DNA double helix - Discovery of DNA structure Watson & Crick Model of DNA – Brief account on types and forms of DNA: A, B, Z, and H DNA conformations. Types of RNA</p>	13
II	<p>Replication of DNA Bidirectional and unidirectional replication, semi- conservative semi- discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase, helicase. Genetic code and Central Dogma Origin of Replication, Primers, and Templates. Replication Fork Brief idea about Transcription & Translation in Prokaryotes and Eukaryotes.</p>	12
III	<p>Genetic Recombination in Bacteria- Basics and Molecular Mechanism of gene transfer by conjugation, Transduction and transformation.</p>	10
IV	<p>Mutation Mutation and types, mutagenic agents. Molecular mechanism of gene mutation transition, transversion, frame-shift, silent, missense and non-sense mutations. Mutant types– lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Overview of mutagenic agents: physical agents (radiation), chemical agents (base analogues, alkylating agents), biological agents (viruses).</p>	10
V*	<p>PRACTICAL</p> <ul style="list-style-type: none"> • Replica plating technique for transfer of bacterial colonies • Isolation of genomic DNA from Bacteria • To detect DNA using agarose gel electrophoresis. • Estimation of DNA by diphenylamine method. • To check purity of DNA sample. • Isolation of streptomycin resistant strain of <i>E .coli</i> by gradient plate method. 	30

Suggested Evaluation Methods	
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.:5 • Mid-Term Exam: 10 <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: NA 	<p>End Term Examination:</p> <p>Theory -50</p> <p>Written Exam</p> <p>Practical-20</p> <p>Demonstration/Viva-voce/Lab records</p>
Part C-Learning Resources	
<p>Recommended Books/e-resources/LMS:</p> <ol style="list-style-type: none"> 1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication 2. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India 3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings. 4. Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers 	

PLO CLO MAPPING of B23-IMB-301									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	1	1	1	1	1	1	1	1.5	1
CLO2	1.5	1	2	1	1	1.5	1	1.5	1
CLO3	1	1	2	1.5	1.5	1.5	1	1.5	1
CLO4	1.5	1	2	1.5	1.5	1	1	1.5	1
CLO5	1	1	2	1.5	1.5	1	1	1.5	1

MCC-5

Session: 2024-25			
Part A - Introduction			
Subject	INDUSTRIAL MICROBIOLOGY		
Semester	III		
Name of the Course	MICROBIAL DIVERSITY		
Course Code	B23-IMB-302		
Course Type:	MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes(CLO): CLO5 is related to practical component	After completing this course, the learner will be able to: 1. To acquaint with History and Scope of microorganisms 2. To give theoretical knowledge of isolation and growth of microorganisms 3. To impart knowledge of maintenance of cultures and sterilization techniques 4. To give detailed knowledge about structure of bacteria 5. To impart practical knowledge of isolation culturing maintenance, Sterilization and staining of microorganisms		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Exam Duration	3 hours	4 hours	
Maximum Marks 100			
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting			

one question from each unit. All questions carry equal marks.		
Unit	Topics	Contact Hours
I	Microbial Classification and History: Whittaker's five-kingdom concept. Three-domain concept of Carl Woese. Characters used in microbial taxonomy (morphological, physiological, ecological, genetics protein content, nucleic acid sequence and base composition, Spontaneous Generation Controversy, Germ theory of fermentation, Germ theory of disease. Different groups of Microorganisms and their general characteristics, Prokaryotic vs. Eukaryotic Organisation.	10
II	Classification of bacteria: based on nutrition: lithotrophs, organotrophs, phototrophs, chemotrophs. Diversity based on physiological factors: solutes, pH, temperature, oxygen, pressure, radiation. Eubacteria, Archaeobacteria, Cyanobacteria–General comparison, Morphology and structure of a typical Bacterium (Eubacterium). Gram staining (Gram- positive and Gram negative Bacteria) with reference to cell wall, Capsular, Endospore and Flagellar staining techniques.	10
III	Classification & nomenclature of Viruses: Origin and development of Virology, General structure of Viruses, Detailed structure of animal viruses (pox Virus, Polio Virus, Human Immunodeficiency Virus : AIDS), Plant virus (TMV) & Bacteriophage, Differences between the structures of different types of Bacteriophages. Importance of Viruses (as Disease causing agents and use in Biotechnology).	12
IV	General characteristics of Fungi; Range of thallus organization and Reproduction. Classification according to Alexopoulos, Mims and Blackwell. Important genera of Fungi (Synchytrium, Phytophthora, Albugo, Mucor, Rhizopus, Aspergillus, Penicillium, Alternaria, Ustilago, Puccinia); Economics Importance of Fungi. Important genera of Algae (Chlamydomonas, Volvox Cladophora, Oedogonium, Vaucheria, Polysiphonia). Protozoa and Nematodes (Elementary Idea with only outline Classification and importance).	13
V*	PRACTICAL <ol style="list-style-type: none"> 1. Diagrammatic representation and ultrastructure of some typical viruses like TMV, Bacteriophage, Cyanophage. 2. Viral diseases of plants and animals (Specimens, Diagrams only). 3. General morphology (permanent slides and live materials) e. g. I. Coccoid II. Rod – shaped (Bacillus etc) III. Vibrio IV. Spirillum 4. Thallus range with class representatives (Volvox, Cladophora, Oedogonium, Vaucheria, Spirogyra) 5. Thallus range with class representatives (Puccinia, Aspergillus, Penicillium, Mucor, Ustilago, Alternaria). 6. Study with the help of permanent slides. (Amoeba, paramecium) 7. Study with the help of permanent slides (Plasmodium, Entamoeba) 8. Study with the help of permanent slides (Meloidogyne, Ascaris) 9. Method of simple staining to observe bacteria. 10. Methylene blue staining to observe fungal species. 	30

Suggested Evaluation Methods	
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.:5 • Mid-Term Exam: 10 <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: NA 	<p>End Term Examination:</p> <p>Theory -50 Written Exam Practical-20 Demonstration/Viva-voce/Lab records</p>
Part C-Learning Resources	
<p>Recommended Books/e-resources/LMS:</p> <ol style="list-style-type: none"> 1. Microbiology by M. J. Pelczar, E. C. S. Chan and N. R. Krieg. 5th edition. McGraw Hill, USA. 1993. 2. Prescott's Microbiology by J. M. Willey, K. Sandman and D. Wood. 11th edition. McGrawHill Higher Education, USA. 2019. 3. Microbiology: An Introduction by G.J. Tortora, B.R. Funke, and C.L. Case. 13th edition. Pearson, USA. 2018 	

PLO CLO MAPPING of B23-IMB-302									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	1	1	1	1	1	1.5	1	1.5	1
CLO2	1.5	1	2	1	1.5	1.5	1	1.5	1
CLO3	1	1	2	1.5	1	1.5	1	1.5	1.5
CLO4	1.5	1	1	1	1	1.5	1	1.5	1
CLO5	1	1	1	1	1	1.5	1	1.5	1.5

MDC-3

Session: 2024-25			
Part A - Introduction			
Subject	INDUSTRIAL MICROBIOLOGY		
Semester	III		
Name of the Course	MICROBES IN HUMAN WELFARE		
Course Code	B23-IMB-303		
Course Type:	MDC-3		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes(CLO): CLO5 is related to practical component	After completing this course, the learner will be able to: 1. To acquaint with History and Scope of microorganisms in human welfare. 2. To give theoretical knowledge of food microorganisms. 3. To impart knowledge of agricultural microorganisms. 4. To give detailed knowledge about industrial microorganisms. 5. To impart practical knowledge of isolation culturing maintenance of food ,agriculture and industrial microorganisms.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Internal Assessment Marks	15	5	20
End Term Exam Marks	35	20	55
Exam Duration	3 hours	4 hours	
Maximum Marks 75			
Part B-Contents of the Course			
<u>Instructions for Paper- Setter:</u> Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.			

Unit	Topics	Contact Hours
I	Microbes and Human Health- Pathogenic Microorganisms, Mechanisms of microbial pathogenicity, Major microbial diseases and their control. Microbiota and Human Health-Human microbiome and its significance, Probiotics and prebiotics in health management. Antibiotics and Resistance, Mechanisms of action and resistance, Strategies to combat antibiotic resistance	8
II	Microbes in Industry- Industrial Microbiology, Fermentation technology, Production of antibiotics, enzymes, and bioactive molecules Food and Dairy Microbiology- Role of microbes in food production (bread, beer, yogurt, cheese), Probiotics and fermented foods Biotechnological Applications- Microbes in genetic engineering, Microbial production of biofuels and bioplastics	8
III	Microbes in Agriculture and Environment- Agricultural Microbiology, Soil microbiology and plant-microbe interactions, Biofertilizers and biopesticides. Environmental Microbiology, Microbial roles in biogeochemical cycles, Bioremediation and waste management, Microbes in Sustainable Development, Microbial applications in sustainable agriculture, Microbes in environmental conservation	7
IV	Microbes in Pharmaceuticals- Drug Discovery and Development, Role of microbes in discovering new drugs, Production of pharmaceuticals using microbial systems Vaccines-Development of microbial vaccines, Advances in vaccine technology	7
V*	PRACTICAL <ul style="list-style-type: none"> • Laboratory equipment's: Autoclave, Hot air oven, Laminar Air flow, Incubator • Microscope, parts and handling • Staining: Simple, Differential, endospore • Medium: Nutrient agar, Potato dextrose agar, Nutrient broth • Isolation of microorganism by Streaking, spread plate method and pour plate method. • Isolation of lipolytic microorganisms from butter • Determination of lactose /calcium/magnesium/phosphorus in milk • Demonstration of vinegar production in laboratory 	30
Suggested Evaluation Methods		

<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.:4 • Mid-Term Exam: 7 <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:5 • Mid-Term Exam: NA 	<p>End Term Examination:</p> <p>Theory -35</p> <p>Written Exam</p> <p>Practical-20</p> <p>Demonstration/Viva-voce/Lab records</p>
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PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Ananthnarayanan, R and Jeyaram Panicker, C. K. 2010. Textbooks of Microbiology, Orient Longman.
2. Dubey, R.C. and Maheshwari, D.K. 2013. A Textbook of Microbiology –2 nd edition (S chand & Co. N. Delhi).
3. Michael, J. Pelczar, Jr. E.C.S., Chan, Noel R. 1998. Krieg Microbiology Tata McGraw- Hill Publisher.
4. Pelczar, M.J., Chan E.C.S. and Kreig, N.R. 1993. Microbiology 5th edition (Tata McGraw-Hill, New Delhi)
5. Prescott, L.M., Harley, J.P. and Klein, D.A., 2007. Microbiology –7 th edition (Wm. C. Brown Publishers, USA) Elementary Microbiology – Modi, HA (vol. I), 1st edition (Ekta Pakashan, Nadiad).
6. Prescott, M.J., Harly, J.P. and Klein 2002. Microbiology 5ft Edition, WCB McGraw Hill, New York.

PLO CLO MAPPING of B23-IMB-303

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	1	1.5	1	1	1	1.5	1	1.5	1.5
CLO2	1.5	1	2	1	1	1.5	1	1.5	1
CLO3	1	1.5	2	1	1	1.5	1	1.5	1.5
CLO4	1.5	1	1	1	1	1.5	1	1.5	1
CLO5	1	1.5	1	1	1	1.5	1	1.5	1.5

CC-4/MCC-6

Session: 2024-25			
Part A - Introduction			
Subject	INDUSTRIAL MICROBIOLOGY		
Semester	IV		
Name of the Course	BASICS OF DIFFERENT DISCIPLINES OF MICROBIOLOGY		
Course Code	B23-IMB-401		
Course Type:	CC/MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To acquaint with History and Scope of microorganisms 2. To give theoretical knowledge of isolation and growth of microorganisms 3. To impart knowledge of maintenance of cultures and sterilization techniques 4. To give detailed knowledge about structure of bacteria <hr style="width: 20%; margin-left: 0;"/> 5. To impart practical knowledge of isolation culturing maintenance, Sterilization and staining of microorganisms		
CLO5 is related to practical component			
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Exam Duration	3 hours	4 hours	
Maximum Marks 100			
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question			

from each unit. All questions carry equal marks.		
Unit	Topics	Contact Hours
I	<p>Soil Microbiology – Soil as a Major Component of Environment: Composition and types of soil. Physical, chemical, and biological properties of soil, Soil as a habitat for microorganisms. Factors influencing microbial distribution, Role of soil microorganisms in nutrient cycling, Nitrogen-fixing bacteria, Phosphate-solubilizing bacteria, Mycorrhizal fungi., Harmful Microorganisms in Soil: Soilborne pathogens, Plant diseases caused by soil microorganisms.</p>	10
II	<p>Food Microbiology Food Infection and Food Intoxication: Differences between infection and intoxication. Pathogens involved in foodborne illnesses. Staphylococcal Food Intoxication, Clostridium Food Intoxication, Shigella Food Infections, Common Fermented Foods: e.g., yogurt, sauerkraut). Probiotics and Prebiotics:</p>	10
III	<p>Water Microbiology Types of Water: Atmospheric water, Surface water, Stored water. Aquatic Environment: Physical factors: temperature, light, pressure. Chemical factors: pH, turbidity, inorganic and organic constituents. Microflora of Aquatic Environment: Freshwater microbiology, Marine microbiology. Impact of Environmental Factors on Aquatic Microorganisms Adaptations to different environmental conditions, Role of aquatic microorganisms in ecosystem functioning.</p>	12
IV	<p>Air Microbiology Distribution of Microorganisms in Air-Sources of airborne microorganisms, Seasonal variations in air microflora. Outdoor and Indoor Microflora: Differences in microbial populations, Common indoor air contaminants. Allergic Disorders by Air Microflora: Airborne allergens and their impact, Common allergic reactions caused by microorganisms. Collection and Enumeration of Microflora of Air: Sampling techniques: air samplers, impingement methods. Quantitative and qualitative analysis of air samples.</p>	13
V*	<p>PRACTICAL</p> <ol style="list-style-type: none"> 1. Microbiology Good Laboratory Practices and Biosafety. 2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory. 3. Study of Air, Water, Soil And food Microflora. 4. Study of different shapes of bacteria using permanent slides. 5. Study of <i>Rhizopus</i>, <i>Penicillium</i>, <i>Aspergillus</i> using temporary mounts. 6. Preparation of culture medium for growth of Archaea. 7. Preparation of different types of growth medium for the growth of fungi and yeast. 8. Study of <i>Spirogyra</i> and <i>Chlamydomonas</i>, <i>volvox</i> using temporary Mounts. 9. Study of the following protozoans using permanent mounts/photographs: <i>Amoeba</i>, <i>Entamoeba</i>, <i>Paramecium</i> and <i>Plasmodium</i> 	30

Suggested Evaluation Methods	
<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.:5 • Mid-Term Exam: 10 <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: NA 	<p>End Term Examination:</p> <p>Theory -50</p> <p>Written Exam</p> <p>Practical-20</p> <p>Demonstration/Viva-voce/Lab records</p>

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Flint, S.J., Enquist, L.W., Drug, R.M., Racaniello, V.R. and Skalka, A.M. 2000. Principles of Virology- Molecular Biology, Pathogenesis and Control. ASM Press, Washington,D.C
2. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition 2008, McGraw Hill
3. Vashishta B.R, Sinha A.K and Singh V. P. Botany – Fungi 2005, S. Chand and Company Limited, NewDelhi
4. Kotpal R.L Protozoa 5th Edition 2008, Rastogi Publications, Meerut, New Delhi. 8 Brock Biology of Microorganisms, M.T. Madigan, J.M. Martinko, P. V. Dunlap, D. P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings

PLO CLO MAPPING of B23-IMB-401

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	1	1	1	1.5	1	1	1	1.5	1.5
CLO2	1.5	1	2	1	1.5	1.5	1	1.5	1
CLO3	1	1	2	1.5	1	1.5	1	1.5	1.5
CLO4	1.5	1	1	1	1.5	1	1	1.5	1
CLO5	1	1	1	1.5	1	1	1	1.5	1.5

MCC-7

Session: 2024-25			
Part A - Introduction			
Subject	INDUSTRIAL MICROBIOLOGY		
Semester	IV		
Name of the Course	FOOD AND DAIRY MICROBIOLOGY		
Course Code	B23-IMB-402		
Course Type:	MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To acquaint with History and Scope of microorganisms 2. To give theoretical knowledge of isolation and growth of microorganisms 3. To impart knowledge of maintenance of cultures and sterilization techniques 4. To give detailed knowledge about structure of bacteria 5. To impart practical knowledge of isolation culturing maintenance, Sterilization and staining of microorganisms		
CLO5 is related to practical component			
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Exam Duration	3 hours	4 hours	
Maximum Marks 100			
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question			

from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	Introduction to Food microbiology Types of microorganisms, microbial cell's structure, microbial growth and metabolism. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general. Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods	10
II	Methods of food preservation: pasteurization, appreciation, aseptic packaging; use of high temperatures, freezing, dehydration, ionizing radiation, osmotic pressure; use of chemicals - organic acids, esters, sulphur-dioxide, salts and high sugar concentration (sweets etc.)	10
III	Microbiology of fermented products Microbiology of milk, Dairy starter cultures, Kinema; fermented dairy products: yogurt, acidophilus milk, kumis, kefir, dahi and cheese, other fermented foods: dosa, idli, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.	12
IV	Food Borne Diseases Definition of food poisoning, food infections and toxications. Causative agents, foods involved, symptoms and preventive measures. Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Escherichia coli, Shigella, Listeria monocytogenes.	13
V*	PRACTICAL 1. MBRT of milk samples and their standard plate count. 2. Isolation of food borne bacteria from food products. 3. Isolation of food borne fungi from food products. 4. Isolation of spoilage microorganisms from bread. 5. Microbiological examination of canned foods. 6. Isolation of spoilage bacteria from fruits and vegetables. 7. Effect of temperature on the spoilage of food products.	30
Suggested Evaluation Methods		

<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.:5 • Mid-Term Exam: 10 <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: NA 	<p>End Term Examination:</p> <p>Theory -50 Written Exam Practical-20 Demonstration/Viva-voce/Lab records</p>
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Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Frazier W.C. and Westhoff D.C. (2008) Food Microbiology, 4th Edn. Tata McGraw Hill Publishing Co., New Delhi.
2. Bamforth C.W. (2005) Food, Fermentation and Microorganisms, Blackwell Science
3. Doyle M.P. and Buchanan R.L. (Ed.) (2013) Food Microbiology: Fundamentals and Frontiers, 4th Edn. ASM press.
4. Jay J.M., Loessner M.J. and Golden D.A. (2005) Modern Food Microbiology, 7th Edn. Springer Publishers.
5. Robinson R.K. (2002) Dairy Microbiology: Milk and Milk Products, 3rd Edn. Wiley Publishers

PLO CLO MAPPING of B23-IMB-402

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	1	1.5	1	1	1.5	1	1	1.5	1.5
CLO2	1.5	1	2	1	1	1.5	1	1.5	1
CLO3	1	1.5	2	1	1.5	1.5	1	1.5	1.5
CLO4	1.5	1	1	1	1	1	1	1.5	1
CLO5	1	1.5	1	1	1.5	1	1	1.5	1.5

MCC-8

Session: 2024-25			
Part A - Introduction			
Subject	INDUSTRIAL MICROBIOLOGY		
Semester	IV		
Name of the Course	VIROLOGY		
Course Code	B23-IMB-403		
Course Type:	MCC		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes(CLO): CLO5 is related to practical component	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. To understand the history, properties, nomenclature and classification of viruses and development of virology. 2. To learn about methods used for isolation, cultivation, and purification of viruses. 3. To acquire knowledge about the methods used for quantitation of viruses and major characteristics of important virus families. 4. To acquire knowledge about bacteriophages, algal and fungal viruses, subviral agents, importance of viruses in human welfare _____. 5. To understand competence in virology laboratory techniques. 		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Exam Duration	3 hours	4 hours	
Maximum Marks 100			
Part B- Contents of the Course			

Instructions for Paper- Setter:

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	History: Discovery of viruses and development of Virology (contributions of pioneers). Nature, origin and evolution of viruses. General properties, concept of viroids, virusoids, satellite viruses and Prions. Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses, Isolation, purification and cultivation of viruses Nomenclature and classification of viruses: Criteria used for naming and classification. Current ICTV classification of viruses of bacteria, plants and animals and humans.	10
II	Isolation, cultivation, assay and maintenance of bacterial, plant and animal viruses: Experimental plants and tissue cultures. Experimental animals, embryonated eggs, organ cultures, primary and secondary cell cultures, suspension and monolayer cell cultures, cell strains, cell lines. Purification of viruses: Need for virus purification. Extraction of viruses from tissues, clarification, concentration of viruses in clarified extracts by physical and chemical methods, further purification of viruses by rate zonal / equilibrium density gradient centrifugation.	10
III	Properties of viruses: Physical- morphology and structure, sedimentation, electrophoretic mobility, buoyant density. Biochemical- chemical composition, nucleic acids, proteins, enzymes, lipids, carbohydrates, polyamines, cations. Antigenic nature of viruses. Biological host range, transmission (vector and non-vector), virus stability. Quantitation of viruses: Infectivity assay methods (plaque, pock, end point, local / systemic assay of plant viruses), physical (EM), serological (HA, HI, immunofluorescence, ELISA) and chemical (viral protein and nucleic acid based) approaches. Insect Viruses: Biology of major RNA and DNA viruses of insects and their applications.	12
IV	The viral replication cycle- attachment, penetration, uncoating, types of viral genome and their replication, assembly, maturation and release. Life cycle of T4 phage, TMV, Influenza Virus and HIV in detail Bacteriophages: Biology of major RNA (MS2, Q β , ϕ 6) and DNA (T-even and T-odd, lambda, Mu, ϕ x174, M13) bacteriophages. Biology of Cyanophages. Algal and fungal viruses. Biology of sub-viral agents: Satellite viruses, sat-RNAs, viroid virusoids and prions. Concept of molecular parasitism. Importance of viruses in human welfare with suitable examples.	13

V*	PRACTICAL <ul style="list-style-type: none"> • Isolation of Bacteriophage from sewage water. • Determination of phage titer from water/sewage sample. • Virus inclusion bodies (slides) • Estimation of virus yields - plaque assay • Hemagglutination test • ELISA test • Study of virus infected plant material 	30
Suggested Evaluation Methods		
Internal Assessment: <ul style="list-style-type: none"> ➤ Theory <ul style="list-style-type: none"> • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.:5 • Mid-Term Exam: 10 ➤ Practicum <ul style="list-style-type: none"> • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: NA 		End Term Examination: Theory -50 Written Exam Practical-20 Demonstration/Viva-voce/Lab records
Part C-Learning Resources		
Recommended Books/e-resources/LMS: <ol style="list-style-type: none"> 1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd. 2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons. 3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC. 4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey 		

PLO CLO MAPPING of B23-IMB-403									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	1	1.5	1	1	1	1	1	1.5	1
CLO2	1.5	1	2	1	1	1.5	1	1.5	1.5
CLO3	1	1.5	2	1	1	1.5	1	1.5	1
CLO4	1.5	1	1	1	1	1	1	1.5	1.5
CLO5	1	1.5	1	1	1	1	1	1.5	1

DSE-1

Session: 2024-25			
Part A - Introduction			
Subject	INDUSTRIAL MICROBIOLOGY		
Semester	IV		
Name of the Course	FERMENTATION TECHNOLOGY		
Course Code	B23-IMB-404		
Course Type:	DSE-1		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes(CLO): CLO5 is related to practical component	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1. Design of various reactors used in Industries. 2. Criteria for selection of media for microbial growth 3. Methods for strain improvement and preservation of cultures. 4. Upstream as well as downstream processing involved in fermentation industries <hr/> <ol style="list-style-type: none"> 5. Will be able to establish production of different metabolites under different cultural conditions. 		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Exam Duration	3 hours	4 hours	
Maximum Marks 100			
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions			

from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	Introduction to Fermentation technology History, Scope and Development of Fermentation technology; Isolation and screening of industrially important microorganisms – primary and secondary screening; Maintenance of Strains; Strain improvement: Mutant selection and Recombinant DNA technology.	12
II	Fermentation media Natural and Synthetic media; Basic components of an media (Carbon sources; Nitrogen sources; Vitamins; Minerals; Anti-foaming agents); Role of buffers in media; Process of aeration, and agitation	13
III	Fermentor design Basic designs of Fermentor; Type of fermentors: Waldhof, Tower, Deepjet, Cyclone column, Packed tower and airlift fermenter; Scale up study and Product development; Down-stream processing and Product recovery; Regulation and safety	10
IV	Production of Microbial Products Production of alcohol; Organic acid – Citric acid; Antibiotic – Penicillin, Amino acid – Glutamic acid; Vitamin – B1; Single Cell Protein (SCP)..	10
V*	PRACTICAL <ul style="list-style-type: none"> • Isolation of antibiotic producing microorganisms from soil • Isolation of enzyme producing microorganisms from soil • Isolation of organic acid producing microorganisms from soil • Production of Alcohol • Production of Citric acid 	30

Suggested Evaluation Methods

<p>Internal Assessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.:5 • Mid-Term Exam: 10 <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: NA 	<p>End Term Examination:</p> <p>Theory -50</p> <p>Written Exam</p> <p>Practical-20</p> <p>Demonstration/Viva-voce/Lab records</p>
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Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Crueger, W. and Crueger, A. Biotechnology: A textbook of Industrial Microbiology. Panima Publishing Company, New Delhi.
2. Patel, A.H. Industrial Microbiology. MacMillan India Limited Publishing3. Company Ltd. New Delhi, India
3. Casida, L.E. Industrial Microbiology. Wiley Eastern Limited.
4. Stanbury, P.F., Whitaker, A. and Hall, S.J. Principles of Fermentation Technology. Elsevier Science Ltd

PLO CLO MAPPING of B23-IMB-404

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	1	1	1	1	1.5	1	1	1.5	1
CLO2	1.5	1	2	1	1.5	1.5	1	1.5	1
CLO3	1	1	2	1	1.5	1.5	1	1.5	1.5
CLO4	1.5	1	1	1	1	1	1	1.5	1.5
CLO5	1	1	1	1	1	1	1	1.5	1.5

DSE-I

Session: 2024-25			
Part A - Introduction			
Subject	INDUSTRIAL MICROBIOLOGY		
Semester	IV		
Name of the Course	MEDICAL LAB TECHNOLOGY		
Course Code	B23-IMB-405		
Course Type:	DSE-1		
Level of the course (As per Annexure-I)	200-299		
Pre-requisite for the course (if any)	---		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. To acquaint with basic cell structure and its functioning. 2. To give theoretical knowledge about blood, role of blood and its disorder. 3. To impart knowledge of clinical biochemistry and safety measure. 4. To give detailed knowledge about collection and transportation of specimen.		
CLO5 is related to practical component	5. To impart practical knowledge about general medical lab technology.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Exam Duration	3 hours	4 hours	
Maximum Marks 100			
Part B– Contents of the Course			
<u>Instructions for Paper- Setter:</u> Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question			

from each unit. All questions carry equal marks.		
Unit	Topics	Contact Hours
I	Cells: Structure, function and location, Prokaryotic and eukaryotic cells, Cell organelles, Cell division Tissue, Types, Structure, Location and Function of Epithelial Tissue, Connective Tissue, Muscle Tissue, Nerve Tissue, Membranes, Glandular tissue. The Integumentary System: structure and function of The Skin, Subcutaneous Tissue	10
II	Blood-composition, function, cellular component & their function, haemoglobin & anaemia, blood groups and coagulation Lymphatic system-Composition & function of lymph, lymphatic tissue, Immunity with the role of thymus	10
III	Introduction to Clinical Biochemistry and role of Medical Lab Technologist , ethics, responsibility, safety measure and hazards in clinical biochemistry lab and first aid in laboratory accidents. Glassware's & plastic ware's used in lab, calibration of volumetric apparatus, cleaning& care and maintenance	12
IV	Collection and Transportation of specimen general principles, Containers, Rejection, Samples-Urine, Faeces, Sputum, Pus, Body fluids, Swabs, Blood. Care and handling of laboratory animals' fluid, diet, cleanliness, cages, ventilation, temperature, humidity, handling of animals, prevention of disease. Comparative study of type I-V hypersensitivity with examples	13
V*	PRACTICAL <ul style="list-style-type: none"> • Laboratory rule • WIDAL Test • Detection of bacteraemia and uraemia. • General test for identification of bacteria from Clinical samples, including IMViC Test, carbohydrate fermentation test, Nitrate reduction test, Triple sugar agar test, Urease test, Catalase test, Oxidase test. • Study of human blood group and Rh factor. 	30
Suggested Evaluation Methods		

<p>InternalAssessment:</p> <p>➤ Theory</p> <ul style="list-style-type: none"> • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.:5 • Mid-Term Exam: 10 <p>➤ Practicum</p> <ul style="list-style-type: none"> • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: NA 	<p>End Term Examination:</p> <p>Theory -50</p> <p>Written Exam</p> <p>Practical-20</p> <p>Demonstration/Viva-voce/Lab records</p>
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Part C- Learning Resources

<p>Recommended Books/e-resources/LMS:</p> <ol style="list-style-type: none"> 1. Cappuccino JG and Welsh CT. Microbiology: A Laboratory manual 11 edition. Pearson. 2. P.D. Sharma: Microbiology 3. D M Vasudevan, (2011), Text book of Medical Biochemistry,6th edition Jaypee Publishers 2. M N Chatterjee& Rana Shinde, (2012), Text book of Medical Biochemistry,8th edition,Jaypee Publications 4. Prescott, L.M. et al. (2005 & 2007). Microbiology, McGraw Hill International Edition, USA. 5. Gerard J. Tortora and Bryan Derrickson, (Principles of Anatomy and Physiology,14th edition, Wiley publications

PLO CLO MAPPING of B23-IMB-405

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	1	1	1	1.5	1	1.5	1	1.5	1
CLO2	1.5	1	2	1	1	1.5	1.5	1.5	1
CLO3	1	1	2	1.5	1	1.5	1	1.5	1
CLO4	1.5	1	1	1	1	1.5	1.5	1.5	1
CLO5	1	1	1	1.5	1	1.5	1	1.5	1