

**CBCS SYLLABUS**  
**FOR**  
**THREE YEARS UNDER-GRADUATE COURSE**  
**IN**  
**MICROBIOLOGY (PROGRAMME)**  
*(w.e.f. 2022-23)*



**BANKURA UNIVERSITY**  
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## INTRODUCTION

The syllabus for Microbiology at undergraduate level using the Choice Based Credit system has been framed in compliance with model syllabus given by UGC.

The main objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Microbiology.

The ultimate goal of the syllabus is that the students at the end are able to secure a job. Keeping in mind and in tune with the changing nature of the subject, adequate emphasis has been given on new techniques of mapping and understanding of the subject.

The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase.

It is essential that Microbiology students select their general electives courses Chemistry as compulsory and any one from the branch of Life Sciences disciplines.

While the syllabus is in compliance with UGC model curriculum, it is necessary that Microbiology students should learn “Microbial techniques, Microbes in Sustainable Agriculture and Development & Instrumentation and Biotechniques” as one of the core courses rather than as elective while. Course on “Concept of Genetics” has been moved to electives.

**PROGRAM OUTCOME (PO) & PROGRAM SPECIFIC OUTCOME (PSO)**

<b>PROGRAM OUTCOME (PO)</b>		
<b>PO</b>	<b>Summary</b>	<b>Description</b>
<b>PO A:</b>	Sound Domain Knowledge	Acquiring a strong, basic knowledge on origin, evolution and diversification in the applied field of Microbiology.
<b>PO B:</b>	Laboratory Skill	To develop good laboratory skills with latest advanced tools, sophisticated instruments and modern technologies to address emerging problems with scientific viewpoint.
<b>PO C:</b>	Team Work	To develop the spirit of teamwork, learn to harbor collaborative approach to explore new facts and facets of the subject.
<b>PO D:</b>	Academic and Scientific Endeavour	Students will gain cognitive development, innovative approach, technical maneuvering, entrepreneurship and managerial skills to set up a new start-up.
<b>PO E:</b>	Eco-friendly Approach	Futuristic approach to develop eco-friendly management practices to make socio-economic upliftment.
<b>PO F:</b>	Ethical Awareness	To develop ethical awareness among students regarding research & publications.
<b>PO G:</b>	Goal of life	To inculcate visions in students so that they can play a vital role for the advancement of the discipline in the greater benefits of the society.
<b>PROGRAM SPECIFIC OUTCOME (PSO)</b>		
<b>PSO</b>	<b>Summary</b>	<b>Description</b>
<b>PSO1:</b>	Rational analysis	Develops fundamental concepts, rational thinking & analytical skill.
<b>PSO2:</b>	Soft Skill Proficiency	Develops communication skill, attitudes, leadership quality, ethical values and social awareness.
<b>PSO3:</b>	Environmental Consciousness	Increases eco-friendly consciousness, waste-management practices.
<b>PSO4:</b>	Hygiene practices	Builds up good habit of hygienic practices.
<b>PSO5:</b>	Scientific attitude	Inculcates research mind & approach to develop eco-friendly bio-products.
<b>PSO6:</b>	Resource management	Develops the knowledge & skill on natural & renewable resource management.
<b>PSO7:</b>	Dry lab practices	Develops ability of sequence analysis & structure prediction.
<b>PSO8:</b>	Awareness against infectious diseases	Develops Awareness against infectious & fatal diseases.
<b>PSO9:</b>	Ecological Awareness	Develops Ecological Awareness among students through Mushroom diversity study in different forest areas of the district.
<b>PSO10:</b>	Skill Development	Students will gain knowledge through different Hands-on-training program on Agro-economic activities.
<b>PSO11:</b>	Social Interaction	Develops Community link up through regular survey on Health & Nutritional parameters of local villagers.



### Scheme for CBCS Curriculum Microbiology Programme

Credit Distribution across Courses			
Credits			
Course Type	Total Papers	Theory + Practical	Theory*
<b>Core Courses</b>	12	12*4 =48 12*2 =24	14*5 =70 14*1=14
<b>Discipline Specific Electives</b>	6	6*4=24 6*2=12	4*5=20 4*1=4
<b>Ability Enhancement Language Courses</b>	2	1*2=2 (ENG / MIL) 1*4=4 (ENVS)	1*2=2 (ENG / MIL) 1*4=4 (ENVS)
<b>Skill Enhancement Courses</b>	4	4*2=8	4*2=8
<b>Totals</b>	24	122	122

\*Tutorials of 1 Credit will be conducted in case there is no practical component

Note:

- Microbiology students will be encouraged to take at least one Chemistry course as General Elective along with others from any branch of Life Science
- The DSE, SE courses may be made compulsory



<b>Course Distribution</b>
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SEMESTER	COURSE	COURSE DETAIL	CREDITS
I	Ability Enhancement Compulsory Course – I	English communication / Environmental Science	2
	Core course C – 1A	Introduction and scope of Microbiology	4
	Core course – 1A Practical	Introduction and scope of Microbiology	2
	Core course – 2A	Discipline 2	4
	Core course – 2A Practical	Discipline 2	2
	Core course – 3A	Discipline 3	4
	Core course – 3A Practical	Discipline 3	2
	II	Ability Enhancement Compulsory Course – II	English communication / Environmental Science
Core course – 1B		Bacteriology and Virology	4
Core course – 1B Practical		Bacteriology and Virology	2
Core course – 2B		Discipline 2	4
Core course – 2B Practical		Discipline 2	2
Core course – 3B		Discipline 3	4
Core course – 3B Practical		Discipline 3	2
III		Core course – 1C	Microbial Metabolism
	Core course – 1C Practical	Microbial Metabolism	2
	Core course – 2C	Discipline 2	4
	Core course – 2C Practical	Discipline 2	2
	Core course – 3C	Discipline 3	4
	Core course – 3C Practical	Discipline 3	2
	Skill Enhancement Course – 1	Microbiological Analysis of Air and Water	2
	IV	Core course – 1D	Medical Microbiology and Immunology
Core course – 1D Practical		Medical Microbiology and Immunology	2
Core course – 2D		Discipline 2	4
Core course – 2D Practical		Discipline 2	2
Core course – 3D		Discipline 3	4
Core course – 3D Practical		Discipline 3	2
Skill Enhancement Course-2		Microbial Diagnosis in Health Clinics	2



V	Discipline Specific Elective –1A	Industrial and Food Microbiology or Microbial Biotechnology	4
	Discipline Specific Elective – 1A Practical	Industrial and Food Microbiology or Microbial Biotechnology	2
	Discipline Specific Elective – 2A	Discipline 2	4
	Discipline Specific Elective – 2A Practical	Discipline 2	2
	Discipline Specific Elective – 3A	Discipline 3	4
	Discipline Specific Elective – 3A Practical	Discipline 3	2
	Skill Enhancement Course-3	Food Fermentation Techniques	2
VI	Discipline Specific Elective –1B	Microbes in Environment or Microbes in Sustainable Agriculture and Development	4
	Discipline Specific Elective –1B Practical	Microbes in Environment or Microbes in Sustainable Agriculture and Development	2
	Discipline Specific Elective –2B	Discipline 2	4
	Discipline Specific Elective –2B Practical	Discipline 2	2
	Discipline Specific Elective –3B	Discipline 3	4
	Discipline Specific Elective –3B	Discipline 3	2
	Skill Enhancement Course-4	Management of Human Microbial Diseases	2

### Choices for Discipline Specific Electives

<b>DSE-1A</b>	Industrial and Food Microbiology or Microbial Biotechnology
<b>DSE-1B</b>	Microbes in Environment or Microbes in Sustainable Agriculture and Development

### Choices for Skill Enhancement Courses

<b>SEC-1</b>	Microbiological Analysis of Air and Water
<b>SEC-2</b>	Microbial Diagnosis in Health Clinics
<b>SEC-3</b>	Food Fermentation Techniques
<b>SEC-4</b>	Management of Human Microbial Diseases



## Semester wise Course Distribution in Detail

### **SEMESTER – I**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/MCB/101/C-1A	Introduction and Scope of Microbiology	6 (T 4+P 2)	10	40 (T 25+P 15)	50	4	N.A.	4
SP/SC/102/ C-2A	From another Discipline-2	6	10	40	50			
SP/SC/103/ C-3A	From another Discipline-3	6	10	40	50			
SP/ 104/ AECC-ENV	Environmental Studies	4	10	40	50	N.A	N.A.	N.A.
<b>Total in Semester - I</b>		<b>22</b>	<b>40</b>	<b>160</b>	<b>200</b>			

**N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week**

### **SEMESTER –II**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/MCB/201/C-1B	Bacteriology and Virology	6 (T 4+P 2)	10	40 (T 25+P 15)	50	4	N.A.	4
SP/SC /202/ C-2B	From another Discipline - 2	6	10	40	50			
SP/SC / 203/C-3B	From another Discipline - 3	6	10	40	50			
SP/SC /204/ AECC-E/MIL	English/Hindi/MIL	2	10	40	50	N.A	N.A.	N.A.
<b>Total in Semester - II</b>		<b>20</b>	<b>40</b>	<b>160</b>	<b>200</b>			

**N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week**



**SEMESTER – III**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/MCB/ 301/C-1C	Microbial Metabolism	6 (T 4+P 2)	10	40 (T 25+P 15)	50	4	N.A.	4
SP/SC /302/C-2C	From another Discipline - 2	6	10	40	50			
SP/SC / 303/ C-3C	From another Discipline - 3	6	10	40	50			
SP/MCB/30 4/ SEC-1	Microbiological analysis of air and water	2 (P)	10	40	50	N.A.	N.A.	2
<b>Total in Semester - III</b>		<b>20</b>	<b>40</b>	<b>160</b>	<b>200</b>			

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

**SEMESTER – IV**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/MCB/ 401/C-1D	Medical Microbiology and Immunology	6 (T 4+P 2)	10	40 (T 25+P 15)	50	4	N.A.	4
SP/SC / 402/ C-2D	From another Discipline-2	6	10	40	50			
SP/SC / 403/ C-3D	From another Discipline-3	6	10	40	50			
SP/MCB/404 / SEC-2	Microbial Diagnosis in health clinic	2 (P)	10	40	50	N.A.	N.A.	2
<b>Total in Semester - IV</b>		<b>20</b>	<b>40</b>	<b>160</b>	<b>200</b>			

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

**SEMESTER – V**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/MCB/501/DS E-1A	Industrial and Food Microbiology or Microbial Biotechnology	6 (T 4+P 2)	10	40 (T 25+P 15)	50	4	N.A.	4
SP/SC / 502/DSE- 2A	From another Discipline - 2	6	10	40	50			
SP/SC / 503/DSE- 3A	From another Discipline - 3	6	10	40	50			
SP/MCB/504/SE C-3	Food Fermentation Techniques	2 (P)	10	40	50	N.A.	N.A.	2
<b>Total in Semester – V</b>		<b>20</b>	<b>40</b>	<b>160</b>	<b>200</b>			

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

**SEMESTER – VI**

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/MCB/601/DS E-1B	Microbes in Environment or Microbes in Sustainable Agriculture and Development	6 (T 4+P 2)	10	40 (T 25+P 15)	50	4	N.A.	4
SP/SC / 602/DSE-2B	From another Discipline - 2	6	10	40	50			
SP/SC / 603/DSE-3B	From another Discipline - 3	6	10	40	50			
SP/MCB/ 604/SEC-4	Management of Human Microbial Diseases	2 (P)	10	40	50	N.A.	N.A.	2
<b>Total in Semester – VI</b>		<b>20</b>	<b>40</b>	<b>160</b>	<b>200</b>			

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

[UGP= Under Graduate programme S.C.= Subject Code C= Core Course, E/H/MIL= English/ Hindi/ Modern Indian Language, H/MIL/E= Hindi/ Modern Indian Language/ English, AECC-E= Ability Enhancement Compulsory Course-English, AECC-ENV= Ability Enhancement Compulsory Course-Environmental Science, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.= Lecture, Tu.= Tutorial, and Pr.=Practical]



## Question Pattern

### Core and DSE papers (Theory F.M: 25 & Practical F.M: 15)

<b>Theory</b>	<b>F.M: 25</b>	<b>Practical</b>	<b>F.M: 15</b>
<b>UNIT-I</b>		1. Work out/Demonstration/Experiment:	10/9
1. Any five out of eight	5×1=5		
<b>UNIT-II</b>		2. Laboratory Record/ Field Report:	2/3
2. Any two out of four	2×5=10	3. Viva Voce:	3
<b>UNIT-III</b>			
3. Any one out of two	1×10=10		

### SEC papers (Practical: F.M: 40)

<b>Practical</b>	<b>F.M: 40</b>
1. Work out (Major):	15
2. Work out (Minor)/ Demonstration:	10
3. Laboratory Record/ Field Report:	5
4. Viva Voce:	10



# PROGRAMME CORE COURSES



# Semester - I

## CC-1A T: INTRODUCTION AND SCOPE OF MICROBIOLOGY

**Course Code: SP/MCB/101/C-1A**

**(Theory: Credits 4/ Lectures 60 /Marks 25)**

### Learning Outcome

- Students learn about history & development of microbiology.
- Students acquired a fairly good understanding of the Diversity of the microbes.
- Students get good understanding of the Microscope & other important instruments in laboratory.
- Students gather practical skills of handling microorganisms in the laboratory for study.

<b>Unit 1 History and Development of Microbiology</b>	<b>No. of Hours: 12</b>
History and Development of microbiology Theory of Spontaneous generation, Germ theory of disease Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Edward Jenner.	
<b>Unit 2 Diversity of Microorganisms</b>	<b>No. of Hours: 14</b>
Systems of classification : Binomial nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Prokarya: Archaea and Bacteria, Eukarya : Algae, Fungi and Protozoa)	
<b>Unit 3 Principle and Application of Important Instruments</b>	<b>No. of Hours: 6</b>
Biological Safety Cabinet, Autoclave, Incubator, Hot Air Oven, Light Microscope.	
<b>Unit 4 Media Type</b>	<b>No. of Hours: 8</b>
A brief idea regarding Media type (Natural, Synthetic, Semi-synthetic, Selective and Differential) and Preservation of Microorganisms.	
<b>Unit 5 Microscopy</b>	<b>No. of Hours: 8</b>
Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Transmission Electron Microscope, Scanning Electron Microscope	
<b>Unit 6 Microbes in Human Health &amp; Environment</b>	<b>No. of Hours: 12</b>
List of important human diseases and their causative agents of various human systems. Definitions of immunity (active/passive), primary and secondary immune response, antigen, antibody and their types Definitions and examples of important microbial interactions –mutualism, commensalism, parasitism, Definitions and microorganisms used as biopesticides, biofertilizer, biodegradation,	

**CC-1A P: INTRODUCTION AND SCOPE OF MICROBIOLOGY****(Practical: Credits 2/ Lectures 60/Marks 15)****List of Practical**

1. Microbiology Laboratory Management and Biosafety
2. To study the principle and applications of important instruments (autoclave, incubator, hot air oven, centrifuge, light microscope, pH meter) used in the microbiology laboratory
3. Preparation of Natural media for bacterial cultivation
4. Preparation of Culture media (Nutrient Broth and Nutrient Agar) for bacterial cultivation
5. Preparation of Semi-synthetic media (PDF).
6. Sterilization of medium using Autoclave and assessment for sterility
7. Sterilization of glassware using Hot Air Oven

**Reference Books**

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
4. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGrawHill International.
5. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W.M.T.Brown Publishers.
6. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.



## Semester - II

### CC-1B T: BACTERIOLOGY AND VIROLOGY

**Course Code: SP/MCB/201/C-1B**

(Theory: Credits 4/ Lectures 60 /Marks 25)

#### Learning Outcome

- Students acquired a fairly good understanding of the different types of bacteria and viruses.
- Students get good understanding of the different isolation technique of bacteria & virus.
- Students gather practical skills of handling bacteria & viruses in the laboratory for study.

<b>Unit 1 Cell Organization</b>	<b>No. of Hours: 10</b>
Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Gram staining mechanisms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial cell membranes. Cytoplasm: Ribosomes, mesosomes, nucleoid and plasmids Endospore: Structure, formation, stages of sporulation.	
<b>Unit 2 Bacteriological Techniques</b>	<b>No. of Hours: 8</b>
Pure culture isolation: Serial dilution, Streaking, Spreading and pour plating methods; Preservation of pure cultures by Slant and Stab methods.	
<b>Unit 3 Bacterial growth &amp; Control</b>	<b>No. of Hours: 10</b>
Growth: Binary fission, phases of growth , Diauxic growth , Physical methods of microbial control: heat, filtration, radiation Chemical methods of microbial	
<b>Unit 4 Introduction to Viruses</b>	<b>No. of Hours: 8</b>
Properties of viruses; general nature and important features Subviral particles; viroids, prions and their importance Isolation and cultivation of viruses	
<b>Unit 5 Structure, and multiplication of viruses</b>	<b>No. of Hours: 12</b>
Morphological characters: Capsid symmetry and different shapes of viruses with examples Viral multiplication in the Cell: Lytic and lysogenic cycle Description of important viruses: salient features of the viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses)	
<b>Unit 6 Role of Viruses in Disease and its prevention</b>	<b>No. of Hours: 12</b>
Viruses as pathogens: Role of viruses in causing diseases Prevention and control of viruses: Viral vaccines, interferons and antiviral compounds	

**CC-1B P: BACTERIOLOGY AND VIROLOGY****(Practical: Credits 2/ Lectures 60/Marks 15)****List of Practical**

1. Simple staining
2. Gram's staining
3. Endospore staining.
4. Isolation of pure cultures of bacteria by streaking method.
5. Preservation of bacterial cultures (slant / stab).
6. Estimation of CFU count by spread plate method/pour plate method.
10. Demonstration of Plaque assay

**Reference Books**

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers.
2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
5. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
6. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
9. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited





## Semester - III

### CC-1C T: MICROBIAL METABOLISM

**Course Code: SP/MCB/301/C-1C**

(Theory: Credits 4/ Lectures 60 /Marks 25)

#### Learning Outcome

- Students gather good understandings about microbial growth, their nutrition.
- Students will be acquainted with different metabolism and their energy generation.
- Students can have brief idea about Passive and facilitated diffusion & Nutrient uptake procedure.
- Students will analysis effect of temperature, pH & NaCl on bacterial growth.

<b>Unit 1 Microbial Growth</b>	<b>No. of Hours: 12</b>
Definitions of growth, measurement of microbial growth, Generation time, Kinetics of Growth, Batch culture, Phases of Growth, Continues culture, Chemostat, Turbidostat. Synchronous growth, Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe).	
<b>Unit 2 Microbial Nutrition</b>	<b>No. of Hours: 12</b>
Define Nutrition, Nutritional types (Definition with example only) – Autotroph/Phototroph, heterotroph, Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrate, Sulphur, Hydrogen, Iron oxidizing bacteria), Chemoorganotrophs.	
<b>Unit 3 Nutrient uptake and Transport</b>	<b>No. of Hours: 8</b>
Passive and facilitated diffusion, Primary and secondary active transport, concept of uniport, symport and antiport Group translocation Iron uptake	
<b>Unit 4 Aerobic Respiration</b>	<b>No. of Hours: 12</b>
Concept of aerobic respiration. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway. TCA cycle. Brief concept of Electron transport chain: components of respiratory chain.	
<b>Unit 4 Anaerobic Respiration</b>	<b>No. of Hours: 12</b>
Brief description regarding Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction. Fermentation - Alcohol fermentation; Lactate fermentation (homofermentative and heterofermentative Pathways).	

**CC-1C P: MICROBIAL METABOLISM****(Practical: Credits 2/ Lectures 60/Marks 15)****List of Practical**

1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
3. Effect of temperature on growth of *E. coli*
4. Effect of pH on growth of *E. coli*
5. Effect of salt on growth of *E. coli*

**Reference Books**

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
6. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.



## Semester - IV

### CC-1D T: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

**Course Code: SP/MCB/401/C-1D**

(Theory: Credits 4/ Lectures 60 /Marks 25)

#### Learning Outcome

- Students will have fundamental concept on innate & adaptive immunity, immune cells and organs.
- Students will have concept on different microbial diseases.
- Students will have knowledge on types, structure, and functions of antibodies.
- Students will gain knowledge on various types of Immunological techniques

<b>Unit 1 Normal microflora of the human body and host pathogen interaction</b>	<b>No. of Hours: 14</b>
Normal microflora of skin, respiratory tract, gastrointestinal tract, urogenital tract Host pathogen interaction: Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers, reservoir, Opportunistic infections, Nosocomial infections, Epidemic, Endemic, Pandemic	
<b>Unit 2 Microbial diseases</b>	<b>No. of Hours: 8</b>
Transmission, pathogenicity, prevention and treatment of following diseases: <b>Bacterial:</b> Typhoid <b>Viral:</b> AIDS <b>Fungal:</b> Candidiasis	
<b>Unit 3 Immune Cells and Organs</b>	<b>No. of Hours: 12</b>
Structure, Functions and Properties of: Immune Cells – B cell, T cell, NK cell, Macrophage, Dendritic cell, Stem cell Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen	
<b>Unit 4 Antigens and Antibodies</b>	<b>No. of Hours: 10</b>
Characteristics of an antigen, Concept of Epitopes, Adjuvants, Haptens, Carrier Types , Structure and Functions of antibodies.	
<b>Unit 5 Generation of Immune Response</b>	<b>No. of Hours: 8</b>
Generation of Humoral and Cell Mediated Immune Response Antibody dependent cellular cytotoxicity (ADCC)	
<b>Unit 6 Immunological Techniques</b>	<b>No. of Hours: 8</b>
Principles of Precipitation, Agglutination, Immunoelectrophoresis, ELISA, ELISPOT	

**CC-1D P: MEDICAL MICROBIOLOGY AND IMMUNOLOGY****(Practical: Credits 2/ Lectures 60/Marks 15)****List of Practical**

1. Identify bacteria on the basis of cultural, morphological and biochemical characteristics:  
IMViC, nitrate reduction, acid & gas production and catalase tests
2. Study of composition and use of important differential media for identification of bacteria:  
EMB Agar/McConkey agar, Mannitol salt agar.
3. Study of bacterial flora of skin by swab method
4. Perform antibacterial sensitivity by Kirby-Bauer method
5. Identification of human blood groups
6. To separate serum from the blood sample (demonstration).

**Reference Books**

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition  
Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition  
Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and  
Company, New York.



# **DISCIPLINE SPECIFIC ELECTIVES COURSES**



# Semester - V

## DSE-1A T: INDUSTRIAL AND FOOD MICROBIOLOGY

Course Code: SP/MCB/501/DSE-1A

(Theory: Credits 4/ Lectures 60 /Marks 25)

### Learning Outcome

- Students gather fairly knowledge of how microbes are used in the fermentative production of organic acids, alcohols, enzymes, antibiotics and various foods in industry.
- Students get knowledge of various physical parameters which affect production of industrial products by the microorganisms and the safety aspects of the production.
- Students gather practical skills in producing alcohol and enzymes by fermentative process using bacteria/yeast.

<b>Unit 1 Introduction to Industrial Microbiology</b>	<b>No. of Hours: 10</b>
Brief history and developments in industrial microbiology Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous Types of fermenters – laboratory, pilot-scale and production fermenters Components of a typical continuously stirred tank bioreactor	
<b>Unit 2 Isolation of Industrial Strains and Fermentation Medium</b>	<b>No. of Hours: 6</b>
Primary and secondary screening Preservation and maintenance of industrial strains Ingredients used in fermentation medium - molasses, corn steep liquor, whey & Yeast extract	
<b>Unit 3 Microbial Fermentation Processes</b>	<b>No. of Hours: 8</b>
Downstream processing - filtration, centrifugation, solvent extraction. Microbial production of industrial products - ethanol Industrial production and uses of the enzymes – amylases	
<b>Unit 4 Food as a Substrate for Microbial Growth</b>	<b>No. of Hours: 6</b>
Intrinsic and extrinsic parameters that affect microbial growth in food Microbial spoilage of food - milk, egg.	
<b>Unit 5 Principles and Methods of Food Preservation and Food Sanitation</b>	<b>No. of Hours: 10</b>
Physical methods - high temperature, low temperature, irradiation, aseptic packaging Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite Food sanitation and control – HACCP	
<b>Unit 6 Food Born Diseases</b>	<b>No. of Hours: 10</b>
Food intoxication by <i>Clostridium botulinum</i> and <i>Staphylococcus aureus</i> Food infection by <i>Salmonella</i> and <i>E.coli</i>	

**DSE-1A P: INDUSTRIAL AND FOOD MICROBIOLOGY****(Practical: Credits 2/ Lectures 60/Marks 15)****List of Practical**

1. Microbial fermentation for the production and estimation of amylase
2. Microbial fermentation for the production and estimation of ethanol (DEMONSTRATION)
3. Determination of the microbiological quality of milk sample by MBRT
4. Isolation of fungi from spoiled bread/fruits/vegetables
5. Preparation of Yogurt/Dahi

**Reference Books**

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2<sup>nd</sup> Edition. Panima Publishing Company, New Delhi
2. Patel AH. (1996). Industrial Microbiology .1<sup>st</sup> Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9<sup>th</sup> Edition. Pearson Education
4. Willey JM, Sherwood LM AND Woolverton CJ (2013), Prescott, Harley and Klein's Microbiology.9<sup>th</sup> Edition. McGraw Hill Higher education
5. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
6. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
7. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
8. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
9. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
10. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7<sup>th</sup> edition, CBS Publishers and Distributors, Delhi, India.

**DSE-1A T: MICROBIAL BIOTECHNOLOGY****Course Code: SP/MCB/501/DSE-1A****(Theory: Credits 4/ Lectures 60 /Marks 25)**

<b>Unit 1 Microbial Biotechnology and its Applications</b>	<b>No. of Hours: 12</b>
Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes for industrial application: Bacteria and yeast	
<b>Unit 2 Therapeutic and Industrial Biotechnology</b>	<b>No. of Hours: 10</b>
Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine) Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics Microbial biosensors	
<b>Unit 3 Applications of Microbes in Biotransformations</b>	<b>No. of Hours: 12</b>
Microbial based transformation of steroids and sterols Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute	
<b>Unit 4 Microbial Products and their Recovery</b>	<b>No. of Hours: 12</b>
Microbial product purification: filtration, ion exchange & affinity chromatography techniques Immobilization methods and their application: Whole cell immobilization	
<b>Unit 5 Microbes for Bio-energy and Environment</b>	<b>No. of Hours: 14</b>
Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents	



**DSE-1A P: MICROBIAL BIOTECHNOLOGY****(Practical: Credits 2/ Lectures 60/Marks 15)****List of Practical**

1. Study yeast cell immobilization in calcium alginate gels
2. Study enzyme immobilization by sodium alginate method
3. Pigment production from fungi (Trichoderma / Aspergillus / Penicillium)
4. Isolation of xylanase or lipase producing bacteria
5. Study of algal Single Cell Proteins

**Reference Books:**

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
2. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press.
3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.
4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
5. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications,
6. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press
7. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
8. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science
9. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc.



## Semester - VI

### DSE-1B T: MICROBES IN ENVIRONMENT

**Course Code: SP/MCB/501/DSE-1B**

(Theory: Credits 4/ Lectures 60 /Marks 25)

#### Learning Outcome

- Students will get knowledge about ecosystems & different habitats of microbes & their interactions.
- Students acquired idea about solid & liquid waste management processes.
- Students will enhance their practical skills in qualitative assessment of water

Unit 1 Microorganisms and their Habitats	No. of Hours: 12
Structure and function of ecosystems Terrestrial Environment: Soil profile and soil microflora Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aeromicroflora and dispersal of microbes Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, and salinity.	
Unit 2 Microbial Interactions	No. of Hours: 10
Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, Predation. Microbe-Plant interaction: Symbiotic and non symbiotic interactions. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria.	
Unit 3 Biogeochemical Cycling	No. of Hours: 10
Carbon cycle: Microbial degradation of cellulose, hemicelluloses. Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction Phosphorus cycle: Phosphate immobilization and solubilisation	
Unit 4 Waste Management	No. of Hours: 16
Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill) Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment	

**Unit 5 Water Potability****No. of Hours: 12**

Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique.

**DSE-1B P: MICROBES IN ENVIRONMENT****(Practical: Credits 2/ Lectures 60/Marks 15)****List of Practical**

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C).
3. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
4. Assessment of microbiological quality of water.
5. Determination of BOD of waste water sample.
6. Isolation of *Rhizobium* from root nodules.

**Reference Books**

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2<sup>nd</sup> edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1<sup>st</sup> edition, Springer, New York
5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
6. Barton LL & Northup DE (2011). Microbial Ecology. 1<sup>st</sup> edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
9. Martin A. (1977). An Introduction to Soil Microbiology. 2<sup>nd</sup> edition. John Wiley & Sons Inc. New York & London.
10. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
11. Subba Rao NS. (1999). Soil Microbiology. 4<sup>th</sup> edition. Oxford & IBH Publishing Co. New Delhi.
12. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9<sup>th</sup> edition.

**DSE-1B T: MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT****Course Code: SP/MCB/501/DSE-1B**

(Theory: Credits 4/ Lectures 60 /Marks 25)

**Learning Outcome**

- Students will learn about microbes for sustainable development of agriculture.
- Students will have knowledge on biofertilization, phyto-stimulation, bioinsecticides, bio-manure, biogas, biofuels and on GM crops.

<b>Unit 1 Soil Microbiology</b>	<b>No of Hours: 8</b>
Soil as Microbial Habitat Diversity and distribution of microorganisms in soil	
<b>Unit 2 Mineralization of Organic &amp; Inorganic Matter in Soil</b>	<b>No of Hours: 8</b>
Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium	
<b>Unit 3 Microbial Activity in Soil and Green House Gases</b>	<b>No of Hours: 5</b>
Carbon dioxide, methane – production and control	
<b>Unit 4 Microbial Control of Soil Borne Plant Pathogens</b>	<b>No of Hours: 8</b>
Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial Plant pathogens, Insects, Weeds	
<b>Unit 5 Biofertilization, Phyto-stimulation, Bioinsecticides</b>	<b>No of Hours: 15</b>
General concept of Biofertilizers – Phosphate solubilizing Microorganism Nitrogen fixing Microorganism (Symbiotic and Non Symbiotic)	
<b>Unit 6 Secondary Agriculture Biotechnology</b>	<b>No of Hours: 10</b>
Bio-manure, biogas, biofuels – Principle, advantages and processing parameters	
<b>Unit 7 GM crops</b>	<b>No of Hours: 6</b>
Advantages, social and environmental aspects of Bt crops, golden rice, transgenic animals	
<b>Reference Books</b>	
<ol style="list-style-type: none"> <li>1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,</li> <li>2. Singh RS.(1998). Plant Diseases Management. 7th edition. Oxford &amp; IBH, New Delhi.</li> <li>3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,</li> <li>4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals &amp; Applications. 4th edition. Benjamin/Cummings Science Publishing, USA</li> <li>5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press</li> <li>6. Barton LL &amp; Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA</li> </ol>	

**DSE-1B P: MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT****(Practical: Credits 2/ Lectures 60/Marks 15)****List of Practical**

1. Study microflora of different types of soils
2. Isolation and characteristics of *Rhizobium* from leguminous plant
3. A visit to biogas plant
4. Isolation of cellulose degrading microorganisms
5. Isolation of phosphate solubilizing microorganisms

**Reference book**

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, 1st edition, Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG



**SKILL  
ENHANCEMENT  
COURSES**



## Semester - III

### SEC-1: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

**Course Code: SP/MCB/304/SEC-1**

**(Practical: Credits 2 / Marks 40/ Lecture 30)**

#### Learning Outcome

- Students can have the knowledge about microbiological analysis of air and water.

MICROBIOLOGICAL ANALYSIS OF AIR AND WATER	
Unit 1:	
	Bioaerosol sampling, growth on culture media and CFU counting
Unit 2:	
	Standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests of water potability
Unit 3	
	Isolation and morphological characterization of bacteria from aquatic water
Unit 4	
	Analysis of water sample by Membrane filter technique
Unit 5	
	Demonstration on the function of UV light, HEPA filters, desiccation, Incineration, Precipitation , chemical disinfection and filtration

Reference Books	
	1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and Water A Laboratory Manual, CRC Press
	2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4 <sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA
	3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2 <sup>nd</sup> edition, Academic Press
	4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3 <sup>rd</sup> edition, ASM press



## Semester - IV

### SEC-2: MICROBIAL DIAGNOSIS IN HEALTH CLINIC

**Course Code: SP/MCB/404/SEC-2**

(Practical: Credits 2 / Marks 40/ Lecture 30)

#### Learning Outcome

- Students will gain knowledge and training regarding diagnostic procedures in health clinics.

<b>Unit 1:</b>
Collection of clinical samples (Sputum, Skin, Blood, Urine and Stool) with proper precautions
<b>Unit 2:</b>
Method of transport and storage of clinical samples
<b>Unit 3:</b>
Examination of sample by staining - Gram staining, Ziehl-Neelson staining
<b>Unit 4:</b>
Preparation and use of culture media - Blood agar, Chocolate agar, TCBS Agar, MacConkey agar
<b>Unit 5:</b>
Rapid Detection of Typhoid
<b>Unit 6:</b>
Determination of resistance/sensitivity of bacteria against antibiotic (Penicillin/Streptomycin) using disc diffusion method
<b>Unit 7:</b>
Determination of minimal inhibitory concentration (MIC) of an antibiotic (Penicillin/Streptomycin)

#### Reference Books

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Collee JG, Duguid JP, Fraser AG, Marmion BP(1989) Practical Medical Microbiology, 13th edition, Churchill Livingstone
4. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology





## Semester - V

### SEC-3: FOOD FERMENTATION TECHNIQUES

Course Code: SP/MCB/504/SEC-3

(Practical: Credits 2 / Marks 40/ Lecture 30)

#### Learning Outcome

- Students will study fermenting organisms from different foods
- Students will gain knowledge on preparation of fermented foods

#### List of Practical

##### Unit 1:

Isolation and characterization of microorganisms from a fermented food

##### Unit 2:

Preparation of Milk Based fermented foods (Buttermilk, Dahi vada)

##### Unit 3:

Preparation of Grain Based fermented foods (Bread, Idli, Dosa)

##### Unit 4:

Preparation of vegetable based fermented foods (Pickels, Saeurkraut)

#### Reference Books

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press
2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.
3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan
4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer



## Semester - VI

### SEC-4: MANAGEMENT OF HUMAN MICROBIAL DISEASES

**Course Code: SP/MCB/604/SEC-4**

(Practical: Credits 2 / Marks 40/ Lecture 30)

#### Learning Outcome

- Students will gain knowledge and training regarding diagnostic procedures in health clinics.

Unit 1
Study of Respiratory microbial diseases
Unit 2
Study of gastrointestinal microbial diseases
Unit 3
Study of skin, eye and urinary tract diseases
Unit 4
Study of Sexually transmitted diseases
Unit 5
Study of DOTS therapy
Unit 6
Study of HAART therapy
Unit 7
A visit to Pharma Industry
<b>Reference Books</b>
1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8 <sup>th</sup> edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26 <sup>th</sup> edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4 <sup>th</sup> edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9 <sup>th</sup> edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14 <sup>th</sup> edition. Pearson International Edition

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