

Academic Council Date –

Item No. –



Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**

**Arts, Commerce and Science College, New Panvel (Autonomous)**

Re-accredited A<sup>+</sup> Grade by NAAC (Third Cycle-CGPA-3.61)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**B. Sc. in Microbiology**

**(Faculty of Science)**

**Syllabus for F.Y. B. Sc. (Microbiology)**

**Semester I and II**

*(With effect from the academic year 2024-25)*



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**As per National Education Policy - 2020**

Sr. No.	Heading	Particulars
1	Title of program	<b>B. Sc. in Microbiology</b>
2	Eligibility	Must have passed H.S.C. Science or Equivalent.
3	Duration of program	3 Years for Degree & 4 Years for Honors
4	Intake Capacity	50
5	Scheme of Examination	Theory 100 Marks; Internal: External 40:60; Practical 50 Marks
6	Standards of Passing	40%
7	Semesters	I
8	Program Academic Level	4.5
9	Pattern	Revised as per NEP-2020
10	Status	Approved by BOS and Academic Council
11	To be implemented from Academic Year	Academic Year 2024-25

**Signature of**

**Signature of**

**Name**

Head, Department of Microbiology  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)

**Prof. (Dr.) S.K. Patil**

Principal  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

## **Preamble**

### **1) Introduction: -**

With the introduction of National Education Policy-2020 by the esteemed Changu Kana Thakur Arts, Commerce and Science College, New Panvel from the academic year 2023-2024, the existing syllabus of F.Y.B.Sc. Microbiology is restructured and revised according to the CBCS pattern for its implementation from 2024-2025. This syllabus is prepared to make students more knowledge oriented in Microbiology subject. The new and updated syllabus is based on interdisciplinary approach with vigor and depth taking care of the syllabus which is not heavy for the F.Y.B.Sc. students. The contents have been drawn to accommodate the widening horizons of the Microbiology discipline. It reflects the changing needs of the students, pertaining to the fields of Bio-Chemistry, Bacterial taxonomy and Molecular Biology. The well-organized curriculum including basic as well as advanced concepts progressively from first year to the third year and shall inspire the students for pursuing higher studies in Microbiology and for becoming an entrepreneur and also enable students to get employed in the Microbiology subject based industries.

### **2) Aims and Objectives: -**

**Aim-**Students will gain knowledge about the fundamental principles, techniques, and factors influencing microbial growth, enabling them to pursue further studies or employment in microbiology related fields.

#### **Objectives-**

**Develop** strong foundation in fundamental principles of Microbiology.

**Improve** the basic skills required for staining, isolation and cultivation of microbes.

**Unravel** the connection between the prokaryotic cell with eukaryotes.

### 3) Learning Outcomes: -

Upon successful completion of this course, learner will be able to:

- **Apply** your knowledge of staining to predict their morphology of microbes.
- **Interpret** correlation of prokaryotic cell with eukaryotes.
- **Understand** the working principle of microscopy and its application during staining.
- **Describes** the role of physicochemical factors required for the isolation of microbes.

### 4) Credit Structure of the F.Y.B. Sc. (Microbiology) Semester I and II

No. of Courses	Semester I	Credits	No. of Courses	Semester II	Credits
<b>A</b>	<b>Discipline Specific Courses</b>		<b>A</b>	<b>Discipline Specific Courses</b>	
1	Select from the subject combinations for F.Y.B. Sc.	04	1	Same as Sem I	04
2		04	2		04
3		04	3		04
<b>B</b>	<b>Indian Knowledge System</b>		<b>C</b>	<b>Open Elective (Any one from the OE List)</b>	
4	Indian Knowledge System (Generic)	02	4	Give your preference of choice to subjects from Basket of OE for F.Y.B.Sc.	02
<b>D</b>	<b>Skill Enhancement Course</b>		<b>D</b>	<b>Skill Enhancement Course</b>	
5	Select from the basket of SEC for F.Y.B.Sc.	02	5	Select from the basket of SEC for F.Y.B.Sc.	02
<b>E</b>	<b>Ability Enhancement Courses</b>		<b>E</b>	<b>Ability Enhancement Courses</b>	
6	Communication Skill – Hindi/ Marathi	02	6	Communication Skill – Hindi/ Marathi	02
<b>F</b>	<b>Value Education Course</b>		<b>F</b>	<b>Value Education Course</b>	
7	Give your preference of choice to subjects from Basket of Value Education Course	02	7	Give your preference of choice to subjects from Basket of Value Education Course	02
<b>G</b>	<b>Co-curricular Course</b>			<b>Co-curricular Course</b>	
8	Give your preference of choice to subjects from Basket of Co-curricular Course	02	8	Give your preference of choice to subjects from Basket of Co-curricular Course	02
<b>Total Credits</b>		<b>22</b>	<b>Total Credits</b>		<b>22</b>

## Abbreviations Used

- POs : Program Outcomes
- PS : Program Structure
- PSOs : Program Specific Outcomes
- COs : Course Outcomes
- TLP : Teaching-Learning Process
- AM : Assessment Method
- DSC : Discipline Specific Core
- DSE : Discipline Specific Elective
- GE : Generic Elective
- OE : Open Elective
- VSC : Vocational Skill Course
- SEC : Skill Enhancement Course
- IKS : Indian Knowledge System
- AEC : Ability Enhancement Course
- VEC : Value Education Course
- OJT : On Job Training (Internship)
- FP : Field project
- CEP : Community engagement and service
- CC : Co-curricular Courses
- RM : Research Methodology
- RP : Research Project
- MJ : Major Course
- MN : Minor Course



**Program Outcomes (POs)**

POs		
Sr. No.	Outcome for B.Sc. Program After completion of B.Sc. program students will acquire	Graduate Attribute
PO1	The knowledge of the disciplines and in-depth and extensive knowledge, understanding and skills in a specific field of interest.	Disciplinary knowledge
PO2	An ability to develop and conduct experiments, analyze, and interpret data and use scientific judgment to draw conclusions	Scientific reasoning
PO3	An ability to use current technology, and modern tools necessary for creation, analysis, dissemination of information.	Digital literacy
PO4	Innovative, professional, and entrepreneurial skills needed in various disciplines of science.	Life-long learning
PO5	An ability to achieve high order communication skills.	Communication skills
PO6	An ability to collect, analyze and evaluate information and ideas and apply them in problem solving using conventional as well as modern approaches	Problem solving
PO7	A sense of social responsibility; intellectual and practical skills and demonstration of ability to apply it in real-world settings.	Reflective thinking
PO8	An ability to engage in independent and life-long learning through openness, curiosity, and a desire to meet new challenges.	Life-long learning
PO9	A capacity to relate, collaborate, and lead others, and to exchange views and ideas to work in a team to achieve desired outcomes	Teamwork
PO10	An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	Leadership
PO11	An ability to understanding values, ethics, and morality in a multidisciplinary context.	Moral and ethical awareness



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**Program Specific Outcomes (PSOs)**

PSO No.	PSOs Statement
	<b>After completing the Bachelor of Science Program, students will be able to-</b>
PSO1	The program is aimed at equipping the students with basic knowledge in various branches of Microbiology such as Microbial Genetics, Molecular Biology, Virology, Medical Microbiology, Immunology, Microbial Biochemistry and Industrial Microbiology. Additionally, it also makes students aware of interdisciplinary sciences such as Bioinformatics and Bioinstrumentation
PSO2	At the end, student will have employability in food industry, pharmaceutical industry, Agricultural industry and fishery. Students will work as microbiologist in QA and production departments
PSO3	Students will develop basic understanding of the subject and will have developed life skills to solve environmental and hygiene related problems



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**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for F.Y.B. Sc. (Microbiology) Semester I and II**

**Choice Based Credit System**

**Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2024-2025)**

### **Course Structure**

**Course Code: USc1Mi1**

**Semester - I**

**Course Title: Fundamentals of Microbiology**

**Course Type: Major**

**No. of Credits: 3**

### **Course Outcomes (COs)**

<b>CO No.</b>	<b>COs Statement</b>
	<b>After completing the Bachelor of Science Program, students will be able to-</b>
CO-1	<b>Explain</b> the historical aspects of worlds of Microbiology.
CO-2	<b>Describe</b> the types of microscopy used in the subject of Microbiology.
CO-3	<b>Explain</b> the role of nutrients required for the isolation of bacteria.
CO-4	<b>Distinguish</b> the prokaryotic cells from eukaryotes.
CO-5	<b>Explain</b> the microbiological media used during cultivation of microbes.
CO-6	<b>Distinguish</b> the isolation techniques used during isolation of microbes.



**Course Code: USc1Mi1**

**Sem I**

**Course Title: Fundamentals of Microbiology**

**Unit I: Scope and History of Microbiology.**

**Unit II: Microscopy and Staining.**

**Unit III: Growth and Culturing of bacteria.**

<b>Unit. Subunit</b>	<b>Topics</b>	<b>Lectures</b>
<b>Unit 1</b>	<b>Scope and History of Microbiology</b>	<b>15</b>
<b>Unit 1</b>	<b>A. Scope of Microbiology-</b>	<b>03</b>
	The Microbes, The Microbiologists	
	<b>B. Historical Roots-</b>	<b>03</b>
	a) The Germ Theory of Disease, Early Studies	
	b) Pasteur's Further Contributions	
	c) Koch's Contributions, Work Toward Controlling Infections	
	<b>C. The Emergence of Special Fields of Microbiology-</b>	<b>03</b>
	a) Immunology, Virology, Chemotherapy	
	b) Genetics and Molecular Biology	
	c) Tomorrow's History	
	<b>D. Characteristics of Prokaryotic Cells and Eukaryotic Cells-</b>	<b>06</b>
	<b>D.1 Prokaryotic Cells-</b>	<b>03</b>
	a) Size, Shape, and Arrangement	
	b) An Overview of Structure	
	c) The Cell Wall, The Cell Membrane	
d) Internal Structure, External Structure		
<b>D.2 Eukaryotic Cells-</b>	<b>03</b>	
a) An Overview of Structure, The Plasma Membrane		
b) Internal Structure, External Structure		

<b>Unit 2</b>	<b>Microscopy and Staining</b>	<b>15</b>
	<b>A. History of Microscopy-</b>	<b>02</b>
	<b>B. Principles of Microscopy-</b>	<b>02</b>
	a) Metric Units, Properties of Light: Wavelength and Resolution	
	b) Properties of Light: Light and Objects	
	<b>C. Light Microscopy-</b>	<b>05</b>
	a) The Compound Light Microscope	
	b) Dark-Field Microscopy	
	c) Phase-Contrast Microscopy	
	d) Nomarski (Differential Interference Contrast)	
	e) Fluorescence Microscopy	
	f) Confocal Microscopy	
	g) Digital Microscopy	
	<b>D. Electron Microscopy-</b>	<b>03</b>
	a) Transmission Electron Microscopy	
	b) Scanning Electron Microscopy	
	<b>E. Techniques of Light Microscopy-</b>	<b>03</b>
	a) Preparation of Specimens for the Light Microscope	
	b) Principles of Staining, Monochrome, negative, Gram staining, Endospore	
	<b>Unit 2</b>	
<b>Unit 3</b>	<b>Growth and Culturing of Microbes</b>	<b>15</b>
<b>Unit 3</b>	<b>A. Growth and Cell Division-</b>	<b>04</b>
	a) Microbial Growth Defined	
	b) Cell Division, Phases of Growth	
	c) Measuring Bacterial Growth-Chemostat, Turbidostat	
	<b>B. Factors Affecting Bacterial Growth-</b>	<b>03</b>
	a) Physical Factors	
	b) Nutritional Factors	
	c) Bacterial Interactions Affecting Growth	
	<b>C. Sporulation-</b>	<b>02</b>
	<b>D. Isolation of microorganisms and pure culture techniques-</b>	<b>03</b>
	<b>E. Culture Media (Types and application)</b>	<b>03</b>



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**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Course Code: USc1MiP1 Semester - I**

**Course Title: Practical's based on the fundamentals of Microbiology**

**Course Type: Major**

**No. of Credits: 1**

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Conduct qualitative and quantitative analysis
CO-2	Employ the isolation techniques to separate the microbial cells.
CO-3	Demonstrate the morphology of microbial cell under compound microscope.
CO-4	Follow the Good Laboratory Practices during the practical.
CO-5	Analyze the effect of physicochemical factors onto the growth of microorganisms.
CO-6	Accurately count the microbial cell using different direct microscopic count techniques.

Sr No.	Experiment's	Hrs.
1.	Introduction to Lab Safety and Lab equipment	03
2.	Parts of Compound Microscope, Digital Microscopy	03
3.	Monochrome stationing	03
4.	Negative Staining	03
5.	Gram staining	03
6.	Endospore staining	03
7.	Methods of preparation of glassware for Sterilization (Pipettes, Petri Plates,	03
8.	Preparation of Nutrient medium (Plates, Slants, Broth).	03
9.	Inoculation Techniques: Spread plate and pour plate	03
10.	Growth curve (Demonstration) only in complex media.	03
11.	Breeds count, Brown's Opacity	03
12.	Effect of pH and temperature on growth	03
13.	Project: Isolation of bacteria from finger tips on NA and study colony characters, Gram staining.	03

## REFERENCE

1. Black, Jacquelyn G., and Laura J. Black. "Microbiology: Principles and Explorations." John Wiley & Sons, Inc., 2014.
2. Madigan, Michael T., and J.M. Martin. "Brock Biology of Microorganisms." Pearson Prentice Hall, 2009. (12th Edition)
3. Willey, Joanne, Linda Sherwood, and Christopher J. Woolverton. "Prescott's Microbiology." McGraw-Hill,
4. Talaro, Kathleen Park, and Arthur Talaro. "Foundations in Microbiology." McGraw Hill, 2012.



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**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for F.Y.B. Sc. (Microbiology) Semester II**  
**Choice Based Credit System**  
**Under New Education Policy (NEP) 2020**  
**(To be implemented from the academic year 2024-2025)**

**Course Code: USc2Mi2**

**Semester - II**

**Course Title: Basics of Microbiology**

**Course Type: Major**

**No. of Credits: 3**

**Course Outcomes (COs)**

CO. NO.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	<b>Explain</b> the preservation methods used to store the microbial culture.
CO-2	<b>Describe</b> the types of physicochemical methods used control the growth of microorganisms.
CO-3	<b>Explain</b> the role of microbial association among the living things for the survival.
CO-4	<b>Distinguish</b> the microbial flora found around as well as inside the human body.
CO-5	<b>Explain</b> the microbial diversity found around the globe.
CO-6	<b>Distinguish</b> the morphological, cultural and significance of microbes.

**Syllabus for F.Y.B. Sc. (Microbiology) Semester II**  
**Choice Based Credit System**  
**Under New Education Policy (NEP) 2020**

**Course Code: USc2Mi2 Semester - II**

**Course Title: Basics of Microbiology**

**Unit I: Preservation and Control of Microorganism**

**Unit II: Microbial Interactions**

**Unit III: Study of different groups of microbes.**

Unit. Subunit	Topics	Lectures
<b>Unit 1</b>	<b>Preservation and Control of Microorganisms</b>	<b>15</b>
	<b>A. Preservation of Microorganisms-</b>	<b>02</b>
	a) Preservation Techniques for microorganisms	
	b) Culture Collection Centre	
	<b>B. Control of Microorganisms-</b>	<b>02</b>
	a) Definition of frequently used terms	
	b) Rate of microbial death	
	c) Factors affecting the effectiveness of antimicrobial agents	
	d) Properties of an ideal disinfectant	
	<b>C. Physical methods of microbial control-</b>	<b>06</b>
	a) Dry & moist heat – mechanisms, instruments used and their operations	
	b) Electromagnetic radiations – Ionizing radiations, mechanisms – advantages & disadvantages	
	c) Bacteria proof filters	
	d) Low temperature	
	e) Osmotic pressure	
	f) Desiccation	
	<b>D. Chemical methods of microbial control - Mechanism, Advantages &amp; Disadvantages (if any) applications.</b>	<b>05</b>
	a) Phenolics	
	b) Alcohols	
	c) Heavy metals and their compounds	
	d) Halogens	
	e) Quaternary ammonium compounds	
	f) Halogens	
	g) Dyes	
	h) Surfactants active agents/Detergents	
	i) Aldehydes	
	j) Peroxygens	

<b>Unit 2</b>	<b>Microbial Interactions</b>	<b>15</b>
<b>Unit 2</b>	<b>A.Types of Microbial Interactions</b>	<b>02</b>
	Mutualism, Cooperation, Commensalisms, Predation Parasitism, Amensalism, Competition	
	<b>B. Human Microbe Interactions</b>	<b>07</b>
	a) Naso pharynx, Oropharynx, Respiratory tract, Eye	
	b) Normal flora of the human body: Skin, Nose	
	c) External ear, Mouth, Stomach, Small intestine, large intestine, Genito-urinary tract	
	d) Relationship between micro biota & the host	
	e) Gnotobiotic animals	
	<b>C.Microbial associations with vascular plants</b>	<b>06</b>
	a) Phyllosphere	
	b) Rhizosphere & Rhizoplane	
	c) Mycorrhizae	
	d) Nitrogen fixation: Rhizobia, Actinorhizae, Stem Nodulating <i>Rhizobia</i>	
e) Fungal & Bacterial endophytes		
f) <i>Agrobacterium</i> & other plant pathogens		
<b>Unit 3</b>	<b>Study of different groups of microbes.</b>	<b>15</b>
<b>Unit 3</b>	<b>A.Nature and Properties of Viruses-</b>	<b>04</b>
	a) Introduction: Discovery of viruses, nature and definition of virus	
	b) General properties of virus	
	c) Concept of viroids, virusoids, satellite viruses and Prions	
	d) Theories of viral origin	
	e) Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses	
	<b>B.Rickettsia, Coxiella, Chlamydia, Mycoplasma-</b>	<b>02</b>
	a) General features	
	b) Medical significance	
	<b>C. Actinomycetes-</b>	<b>02</b>
	a) General features of <i>Nocardia</i> species and <i>Streptomyces</i> species	
	b) Importance: Ecological, Commercial and Medical	
	<b>D.Protozoa-</b>	<b>02</b>
	a) Major Categories of Protozoa Based on motility, reproduction.	
	b) Medically important Protozoa	
	<b>E. Algae –</b>	<b>02</b>
	a) Characteristics of algae: Morphology, Pigments, Reproduction	
b) Cultivation of algae.		
c) Biological, Medical and economic importance of Algae.		

	d) Differences between Algae and Cyanobacteria	
	<b>F. Fungi and Yeast-</b>	<b>02</b>
	a) Characteristics: structure, Reproduction.	
	b) Cultivation of fungi and yeasts	
	c) Major fungal divisions- overview.	
	d) Economic importance	
	<b>G. Slime molds and Myxomycetes</b>	<b>01</b>

**Course Code: USc2MiP2**

**Semester - II**

**Course Title: Practical's based on the basics of Microbiology**

**Course Type: Major**

**No. of Credits: 1**

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	<b>Conduct</b> qualitative and quantitative analysis antimicrobial effect of physicochemical agents onto the growth of microorganism.
CO-2	<b>Employ</b> the preservation strategies used in the microbiology laboratory.
CO-3	<b>Demonstrate</b> the morphology of bacterial plaque
CO-4	<b>Understand</b> the Good Laboratory Practices followed during the practical's.
CO-5	<b>Analyze</b> the virulence factors produced by pathogens for exact diagnosis.
CO-6	<b>Accurately</b> count the microbial load of rhizosphere

Sr No.	Experiment's	Hrs.
1.	Sub culturing and Oil Overlay Method of Preservation	03
2.	Disinfection and evaluation of disinfection (Swab Method)	03
3.	Moist Heat Sterilization, Dry Heat Sterilization	03
4.	UV-Sterilization, Use of Phenolics and Halogens for control of microbes	03
5.	Phenol coefficient Method -Demo	03
6.	Isolation and study of Bacteroides from root nodules	03
7.	Isolation of normal flora of skin	03
8.	Isolation of PGPR	03
9.	Slide culture Technique	03
10.	Permanent slides of Algae, Protozoa	03
11.	Wet Mount of Lichen	03
12.	Cultivation of Algae	03
13.	Demonstration of coliphage assay	03

## REFERENCE

1. Black, Jacquelyn G., and Laura J. Black. "Microbiology: Principles and Explorations." 9th ed., John Wiley & Sons, Inc., 2014. ISBN 978-1-118-74316-4.
2. Prescott, Lansing M., John P. Harley, and Donald A. Klein. "Microbiology." 7th ed., International ed., McGraw-Hill, 2008.
3. Talaro, Kathleen Park, and Arthur Talaro. "Foundations in Microbiology." International ed., McGraw Hill, 2002.
4. Madigan, Michael T., John M. Martinko, et al. "Brock Biology of Microorganisms." 12th ed., International ed., Pearson Prentice Hall, 2009.
5. Stanier, Roger Y., J. L. Ingraham, et al. "General Microbiology." 4th & 5th ed., Macmillan Education Ltd, 1987.
6. Ananthanarayan, R., and Paniker, C.K.J. "Textbook of Microbiology." 10th ed., University Press Hyderabad, 2013.
7. Patil, U. K., Kulkarni, J. S., Chaudhari, A. B., and Chincholkar, S. B. "Foundations in Microbiology." Nirali Publications.
8. Pelczar, M. J. "Microbiology." McGraw-Hill, 1971.

## MODALITY OF ASSESSMENT

### Theory Examination Pattern - Choice Based Credit System (CBCS)

#### Revised Scheme of Examination

The performance of the learners shall be evaluated into two components. The learner's Performance shall be assessed by Internal Assessment with 40% marks in the first component by conducting the Semester End Examinations with 60% marks in the second component. The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

#### A) Internal Assessment: 40 %

**40 Marks**

Sr. No.	Particular	Marks
01	One periodical class test	20 Marks
02	Internal Tool out of these (15 Marks each) 1. Group/ Individual Project 2. Presentation and write up on the selected topics of the subjects / Case studies. 3. Test on Practical Skills 4. Open Book Test 5. Quiz	15 Marks
03	Active Participation marks	05 Marks

#### Question Paper Pattern

(Periodical Class Test/ online examination for the Courses at Under Graduate Programmes)

❖ Maximum Marks: 20

❖ Duration: 40 Minutes

Particular	Marks
<b>Objectives: -</b> Match the Column / Fill in the Blanks / Multiple Choice Questions/ True/False/Answer in One or Two Lines (Concept based Questions) Total Objective Questions: -10 (01 Marks each) Total Marks for objectives questions: -10 Marks	20 Marks
<b>Subjective: -</b> Total Subjective Questions: -02 (05 Marks each) Total marks for subjective questions: -10 Marks	

**B) Semester End Examination: 60 %**

**60 Marks**

- **Undergraduate Programmes of F. Y. B.Sc. (Sem. I & II)**

Duration: The examination shall be of 02 hours duration.

### **Question Paper Pattern**

<b>Theory question paper pattern</b>	
1.	There shall be Four questions of 15 Marks each (30 marks with internal options).
2.	On each unit there will be one question and fourth question will be based on entire syllabus.
3.	All questions shall be compulsory with internal options.
4.	Question may be subdivided into sub-questions a, b, c... and the allocation of marks depends on the weightage of the unit.

### **Passing Standard**

The learners to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment and Semester End Examination. The learners shall obtain minimum of 40% marks (i.e. 16 out of 40) in the Internal Assessment and 40% marks in Semester End Examination (i.e. 24 Out of 60) separately, to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.

### **PRACTICAL EXAMINATION PATTERN**

<b>Sr. No.</b>	<b>Particulars</b>	<b>Total Marks</b>
<b>1.</b>	<b>Laboratory work (Section-I + Section-II)</b>	<b>35</b>
<b>2.</b>	<b>Journal</b>	<b>05</b>
<b>3.</b>	<b>Viva</b>	<b>05</b>
<b>4.</b>	<b>Assignment/Visit report/Case study/SOP writing/Quiz</b>	<b>05</b>

## **PRACTICAL BOOK/JOURNAL**

### **Semester I & Semester II**

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-Ordinator / Incharge of the department; failing which the student will not be allowed to appear for the practical examination.**

### **Overall Examination and Marks Distribution Pattern**

#### **Semester I & Semester II**

<b>Course</b>	<b>USC1MI-1</b>	<b>USC2MI-1</b>
<b>Theory</b>	<b>02</b>	<b>02</b>
<b>Practical's</b>	<b>01</b>	<b>01</b>
<b>Total Marks</b>	<b>150</b>	<b>150</b>
<b>Total Credits</b>	<b>04</b>	<b>04</b>

Academic Council Date –

Item No. –



Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**

**Arts, Commerce and Science College, New Panvel (Autonomous)**

Re-accredited A+ Grade by NAAC (Third Cycle-CGPA-3.61)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**B. Sc. in Microbiology**

**(Faculty of Science)**

**Syllabus for F.Y. B. Sc. (Microbiology)**

**Semester I and II**

*(With effect from the academic year 2024-25)*



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**As per National Education Policy - 2020**

Sr. No.	Heading	Particulars
1	Title of program	B. Sc.
2	Eligibility	H.S.C. (Science) Pass or equivalent
3	Duration of program	3 years Degree/ 4 Years Degree with Honors
4	Intake Capacity	50
5	Scheme of Examination	External : Practical 50 Marks
6	Standards of Passing	40%
7	Semesters	I and II
8	Program Academic Level	4.5
9	Pattern	Revised as per NEP 2020
10	Status	Approved in BOS and Academic Council
11	To be implemented from Academic Year	Academic Year 2024-25

**Signature of**

**Mr. N. C. Vadnere**  
Head, Department of Microbiology  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)

**Signature of**

**Prof. (Dr.) S.K. Patil**  
Principal  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)



Janardan Bhagat Shikshan Prasarak Sanstha's



## **CHANGU KANA THAKUR**

**Arts, Commerce and Science College, New Panvel (Autonomous)**

### **Preamble**

#### **1) Introduction**

This course is designed to provide learner with the fundamental skills and knowledge necessary to perform quality analysis in microbiology. Whether they are working in the food industry, pharmaceuticals, or environmental testing, a strong understanding of microbiological techniques is essential. This course will cover both theoretical concepts and practical applications, equipping you to handle samples safely, perform microbiological tests, and interpret results.

#### **2) Aims and Objectives**

The overall aim of this course is to enhance your skills in performing basic microbiological analysis for quality control purposes.

The specific learning objective is to enable you to:

- Apply good laboratory practices and ensure biosafety in a microbiology laboratory.
- Implement different culture and microscopic methods for microbial analysis of food, pharmaceutical, and environmental samples.
- Analyze water samples to determine their potability.
- Understand and implement control measures to minimize biohazards.

#### **3) Learning Outcomes**

Upon successful completion of this course, you will be able to:

- Explain the working principles of biosafety cabinets and the appropriate use of personal protective equipment (PPE).
- Differentiate between Biosafety Levels (BSL) 1, 2, and 3 and implement appropriate practices for each level.

- Employ various methods for the safe disposal of biohazardous waste.
- Discuss the principles of HACCP and its role in food safety.
- Identify microbial standards for different food and water samples.
- Perform standard plate count, most probable number (MPN) test, and direct microscopic count.
- Conduct sterility testing for pharmaceutical products.
- Utilize selective and differential media like XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar, and Sabouraud Agar to detect specific microorganisms.
- Ascertain microbial quality of milk using Methylene Blue Reduction Test (MBRT) and rapid detection methods like COB and 10-minute Resazurin assay.
- Explain the concept of air-microbiology and the impact of airborne microorganisms on human health, environment, and specific industries.
- Identify waterborne pathogens and waterborne diseases.
- Describe the procedures for collection, treatment, and safety of drinking water.
- Perform standard qualitative procedures for detecting faecal coliforms in water samples.
- Implement various control measures to minimize the spread of bioaerosols in air and water.



Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for F.Y.B. Sc. (Microbiology) Semester I**

**Choice Based Credit System**

**Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2024-2025)**

**Course Code : SEC - I**

**Course Title : Basic Skills For Analysis in Microbiology**

**Course Type: Skill Enhancement Course**

**No. of Credits: 2**

**Course Outcomes (Cos)**

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Examine microbial number in the given samples
CO-2	Observe microorganisms using microscope
CO-3	Apply knowledge to carry out aseptic techniques
CO-4	Analyse biochemical properties of microorganisms

**Syllabus for F.Y.B. Sc. (Microbiology) Semester I**  
**Choice Based Credit System**  
**Under New Education Policy (NEP) 2020**

**Course Code: USc1SECMic**  
**Course Title: Basic Skills for Analysis in Microbiology**

Sr. No.	Name of the Practical	Hours
1	Basic Microscopy (Use of Bright-Field Light Microscope)	3
2	Smear Preparation Simple Staining	3
3	Cell wall Staining	3
4	Capsule staining	3
5	Flagella staining	3
6	Micrometry	3
7	The Hanging Drop Slide and Bacterial Motility	3
8	Isolation and Maintenance of Pure Cultures (Streak Plate Technique)	3
9	Use of Selective Media and Differential Media	3
10	Determination of Bacterial Numbers_ Serial dilution & pour/spread plate Technique	3
11	Use of Colorimeter: Validation of Beers and Lambert's law	3
12	Use of pH Meter: Preparation of buffer using standard charts	3
13	Use of Laminar Air Flow Cabinet: Aseptic inoculation, components and Maintenance.	3
14	Preparation of Molar Solutions (NaOH), Normal Solutions (HCl), mg% (Glucose)_ (Interco versions and calculations- Theory)	3
15	Plotting of Standard Graph (Determination of Slope, Equation of straight line, Use) _Demo	3
16	Biochemical Activities of Bacteria – Carbohydrate Fermentation	3
17	Biochemical Activities of Bacteria – Starch hydrolysis, Catalase Activity	3

18	Qualitative Analysis of Carbohydrate	3
19	Qualitative Analysis of Amino acids	3
20	Qualitative Analysis of Proteins	3



Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

Re-accredited A+ Grade by NAAC (Third Cycle-CGPA-3.61)  
'College with Potential for Excellence' Status Awarded by UGC  
'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**Title of the Programme**

**B. Sc. in Microbiology**

**(Faculty of Science)**

**Syllabus for S.Y.B.Sc. (Microbiology)**

**Semester III and IV**

*(With effect from the academic year 2025-26)*



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**As per National Education Policy - 2020**

Sr. No.	Heading	Particulars
1	Title of program	<b>B. Sc. in Microbiology</b>
2	Eligibility	Students must have earned mandatory credits of Microbiology.
3	Duration of program	3 Years for Degree & 4 Years for Honors
4	Intake Capacity	50
5	Scheme of Examination	Theory 100 Marks; Internal: External 40:60; Practical 50 Marks
6	Standards of Passing	40%
7	Semesters	III
8	Program Academic Level	5.0
9	Pattern	Revised as per NEP 2020
10	Status	Approved by BOS and Academic Council
11	To be implemented from Academic Year	Academic Year 2025-26

**Signature of**

**Mr. N. C. Vadnere**  
Head, Department of Microbiology  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)

**Signature of**

**Prof. (Dr.) S.K. Patil**  
Principal  
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Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

## **Preamble**

### **1) Introduction**

The syllabus encompasses various aspects of microbiology, including screening techniques, fermentation processes, water and food microbiology, it covers a wide range of topics crucial for understanding microbial processes in different environments and applications.

### **2) Aims and Objectives**

- Students will be able to learn various techniques to screen and isolate the desired organisms from mixed population of organisms.
- Understand fermentation media, raw materials, sterilization and contamination control essential for optimizing microbial growth and production.
- Explore various factors influencing fermenter design, differentiate between different types of fermenters and fermentation process.
- Unravel different organisms in fresh water, food and milk products.

### **3) Learning Outcomes**

Upon successful completion of this course, learner will be able to:

- Understand practical skills in primary & secondary screening techniques for microbial analysis.
- Demonstrate knowledge of fermentation processes, including media preparation inoculum handling, and fermenter operation.
- Understand the role of microorganisms in water, food & dairy industries, including their impact on public health & food preservation.

#### 4) Credit Structure of the S.Y.B. Sc. (Microbiology) Semester III and IV

No. of Courses	Semester III	Credits	No. of Courses	Semester IV	Credits
<b>A</b>	<b>Discipline Specific Course (Major)</b>		<b>A</b>	<b>Discipline Specific Course (Major)</b>	
1	Introduction to microbial biochemistry	03	1	Introduction to microbial genetics and molecular biology	03
2	Applied Microbiology	02	2	Introduction to Medical Microbiology & Immunology	02
	Practical	01		Practical	01
<b>B</b>	<b>Discipline Specific Course (Minor) (Select one, in continuation of Sem 2 minor)</b>		<b>B</b>	<b>Discipline Specific Course (Minor) (Select one, in continuation of Sem 2 minor)</b>	
3	Elementary Microbiology 1	02	3	Elementary Microbiology 2	02
	Practical	02		Practical	02
<b>C</b>	<b>Open Elective (Any one from the OE List)</b>		<b>C</b>	<b>Open Elective (Any one from the OE List)</b>	
4	Give your preference of choice to subjects from Basket of OE	02	4	Give your preference of choice to subjects from Basket of OE	02
<b>D</b>	<b>Vocational Skill Courses</b>		<b>D</b>	<b>Vocational Skill Courses</b>	
5	Biofertilizer Technology	02		XXXXXXXXXXXXXXXXXXXXXXXXXXXX	x
<b>E</b>	<b>Skill Enhancement Course</b>		<b>E</b>	<b>Skill Enhancement Course</b>	
	XXXXXXXXXXXXXXXXXXXXXXXXXXXX	x	5	Microbial QC in Food and Pharma Industry	02
<b>F</b>	<b>Ability Enhancement Courses</b>		<b>F</b>	<b>Ability Enhancement Courses</b>	
6	Communication Skill – English	02	6	Communication Skill – English	02
<b>G</b>	<b>Foundation Course in NSS/ NCC/ PE / PA</b>		<b>G</b>	<b>Foundation Course in NSS/ NCC/ PE / PA</b>	
7	Give your preference of choice to subjects from Basket of Co-curricular Course	02	7	Give your preference of choice to subjects from Basket of Co-curricular Course	02
<b>H</b>	<b>OJT/FP/CEP/RP</b>			<b>OJT/FP/CEP/RP</b>	
8	Field Project (Major)	02	8	Community Engagement Project	02
<b>Total Credits</b>		<b>22</b>	<b>Total Credits</b>		<b>22</b>

## Abbreviations Used

- POs : Program Outcomes
- PS : Program Structure
- PSOs : Program Specific Outcomes
- COs : Course Outcomes
- TLP : Teaching-Learning Process
- AM : Assessment Method
- DSC : Discipline Specific Core
- DSE : Discipline Specific Elective
- GE : Generic Elective
- OE : Open Elective
- VSC : Vocational Skill Course
- SEC : Skill Enhancement Course
- IKS : Indian Knowledge System
- AEC : Ability Enhancement Course
- VEC : Value Education Course
- OJT : On Job Training (Internship)
- FP : Field project
- CEP : Community engagement and service
- CC : Co-curricular Courses
- RM : Research Methodology
- RP : Research Project
- MJ : Major Course
- MN : Minor Course



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for S.Y.B. Sc. (Microbiology) Semester III**

**Choice Based Credit System**

**Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2024-2025)**

## **Course Structure**

**Course Code: USc4 Mi2**

**Course Title: Introduction to Medical Microbiology and immunology**

<b>CO No.</b>	<b>COs Statement</b>
	<b>After completing the Bachelor of Science Program, students will be able to-</b>
CO-1	<b>Apply</b> practical skills for identifying organism.
CO-2	<b>Describe</b> the mechanism of infectious organism in causing disease.
CO-3	<b>Understand</b> role of immune system in protection against pathogen.
CO-4	<b>Explain</b> epidemiological terminologies.
CO-5	<b>Gain insights</b> of various diagnostic methods.
CO-6	<b>Understand</b> public health control measures during pandemic & epidemic.

**Course Code: USc3Mi1****Course Title: Introduction to Microbial Biochemistry****Unit I: Introduction to Biomolecules and Enzymes****Unit II: Introduction to Metabolism**

<b>Unit Subunit</b>	<b>Topic</b>	<b>Lectures</b>
<b>1</b>	<b>Introduction to Biomolecules (10) and Enzymology (05)</b>	
	<b>Biomolecules (10)</b>	
	a) Macromolecules as the major constituents of cells.	<b>01</b>
	b) <b>Carbohydrates:</b> Definition, Classification, Biological role. Monosaccharides, oligosaccharides (maltose, cellobiose, sucrose, lactose) and polysaccharide (starch, glycogen, peptidoglycan, cellulose)	<b>01</b>
	c) <b>Lipids:</b> Fatty acids as basic component of lipids and their classification (Lehninger), nomenclature, storage lipids and structural lipids. Types of lipids with general structure of each.	<b>02</b>
	d) <b>Amino acids:</b> General structure and features of amino acids (emphasis on amphoteric nature) Classification by R-group.	<b>02</b>
	e) <b>Peptides and proteins-</b> Definition and general features and examples with biological role. Primary, secondary, tertiary, quaternary structures of proteins- Brief outline.	<b>02</b>
	A. <b>Nucleic acids:</b> Nitrogenous bases- Purines, Pyrimidines Pentoses- Ribose, Deoxyribose, Nomenclature of Nucleosides and nucleotides, N- $\beta$ -glycosidic bond, polynucleotide chain to show bonding between nucleotides (Phosphodiester bonds). Basic structure of RNA and DNA	<b>02</b>
	<b>Enzymology (05)</b>	
	f) General properties of enzymes, Allosteric enzymes, how do enzymes accelerate reaction?	<b>01</b>
	g) Classification of enzymes	<b>01</b>
	h) Michaelis - Menten equation and it's derivation	<b>01</b>
	i) Lineweaver - Burk plot	<b>01</b>
	j) Effect of temperature and pH on enzyme activity	<b>01</b>

<b>Unit 2</b>	<b>Introduction to Bioenergetics and Metabolism</b>	
	<b>A. Introduction to Bioenergetics</b>	
	a) Concept of Bioenergetics - First and second laws of Thermodynamics.	<b>01</b>
	b) Definitions of Gibb's Free Energy, enthalpy and Entropy and mathematical relationship among them	<b>01</b>
	c) Standard free energy change and equilibrium constant Coupled reactions and additive nature of standard free energy change,	<b>01</b>
	d) Energy rich compounds, Structure and properties of ATP	<b>01</b>
	e) Phosphoryl group transfer and ATP	<b>01</b>
	<b>B. Introduction to Metabolism</b>	
	a) Methods of ATP Synthesis: Oxidative phosphorylation, Photophosphorylation and Substrate Level Phosphorylation	<b>01</b>
	b) Catabolism, Anabolism and the link between them	<b>01</b>
	c) Five Principles of metabolism	<b>01</b>
	d) Types of Metabolic Pathways	<b>01</b>
	e) Metabolic pathways: EMP pathway and TCA cycle	<b>02</b>
	f) Electron transport chain and ATP synthesis: Chemiosmotic hypothesis	<b>02</b>
	g) Gluconeogenesis	<b>01</b>
	h) Alcohol fermentation and Pasteur effect	<b>01</b>

**Course Code: USc3MiP1**

**Course Title: Practical based on Introduction to Microbial Biochemistry**

**Course Type: Major**

**No. of Credits: 1**

<b>Sr. No.</b>	<b>Experiment</b>	<b>Hrs.</b>
01	Qualitative analysis of Carbohydrates	03
02	Estimation of Reducing sugar by DNSA method	03
03	Separation of Amino acids by Paper Chromatography	03
04	Estimation of Amino Acids by Ninhydrin Method	03
05	Qualitative and Quantitative analysis of proteins by Biuret Method	03
06	Qualitative and Quantitative analysis of DNA by DPA Method	03
07	Qualitative and Quantitative analysis of RNA by Orcinol Method	03
08	Effect on substrate concentration on Enzyme activity	03
09	Effect of Temperature on Enzyme activity	03
10	Effect of pH on Enzyme activity	03
11	Problems on Thermodynamics	03

## References

<b>Sr. No.</b>	<b>Reference</b>
1.	Nelson, D. L. and M.M. Cox (2017), "Lehninger's Principles of biochemistry", 7th edition, W.H. Freeman and Company, New York
2.	Voet, D., & Voet, J. G. (2010). Biochemistry (4 <sup>th</sup> ed.). John Wiley & Sons.
3.	Conn, E., Stumpf, P. K., Bruening, G., & Doi, R. H. (2009). Outlines of biochemistry (5th ed.). John Wiley and Sons.
4.	Plummer, D. T. (2003). An introduction to practical biochemistry (3rd ed.). Tata McGraw-Hill Publishing Company Limited
5.	Jayaraman, J. (1981). <i>Laboratory Manual in Biochemistry</i> . New Age International (P) Ltd.

## Course Structure

**Course Code: USc3Mi2**

**Course Title: Applied Microbiology**

**Unit I: Introduction to fermentation Technology**

**Unit II: Water, Food & Dairy Microbiology**

**Course Type: Major**

**No. of Credits: 2+1**

### Course Outcomes (Cos)

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	<b>Apply</b> practical skills for screening of organisms.
CO-2	<b>Describe</b> the fermenter & fermentation process.
CO-3	<b>Understand</b> various treatment process of waste water
CO-4	<b>Apply</b> practical skills to determine portability of drinking water.
CO-5	<b>Explain</b> the role of microorganisms in dairy & food industries.

**Course Code: USc3Mi2**

**Course Title: Applied Microbiology**

Module 1:	Title of Module Introduction to fermentation Technology	
Sr. No.	Units / Subunits (15)	Lectures
Unit 1	Screening <ul style="list-style-type: none"> <li>a. Primary screening-                             <ul style="list-style-type: none"> <li>i. Crowded plate technique</li> <li>ii. Auxanography</li> <li>iii. Enrichment culture techniques.</li> <li>iv. Use of indicator dye</li> </ul> </li> <li>b. Secondary screening.</li> </ul>	03
	<ul style="list-style-type: none"> <li>a. Fermentation media                             <ul style="list-style-type: none"> <li>i. Characteristics of ideal fermentation medium.</li> <li>ii. Types of fermentation media</li> </ul> </li> <li>b. Raw material                             <ul style="list-style-type: none"> <li>i. Carbon source</li> <li>ii. Nitrogenous material</li> <li>iii. Growth factors</li> <li>iv. Precursors</li> <li>v. Buffers</li> <li>vi. Antifoam</li> </ul> </li> <li>c. Media sterilization and contamination</li> <li>d. Screening for production media.</li> </ul>	04

	C. Preparation of inoculum	01
	D. Fermenter design 1. Factors involve in fermenter design 2. Parts of fermenter Impeller, baffles, inoculum port, sparger, sampling point, pH control device, temperature control system, foam control device, bottom drainage system. 3. Material used for fermenter 4. Fermenter configuration	04
	E. Types of Fermenters: Batch, Continuous, fermenter	03
<b>Module 2:</b>	<b>Title of Module Water, Food &amp; Dairy Microbiology</b>	
<b>S. N.</b>	<b>Units / Subunits (15)</b>	<b>Lectures</b>
<b>Unit 2</b>	A. Fresh water environments and micro-organisms found in Springs, rivers and streams, Lakes, marshes and bogs	01
	B. Modern Waste Water treatment: Primary, Secondary and Tertiary Treatment	02
	C. The nature of wastewater and Monitoring of waste water treatment process (BOD, COD)	02
	D. Removal of Pathogens by Sewage treatment Processes Oxidation Ponds and Septic tanks. Sludge Processing, Disposal of treated waste water and bio solids	02
	E. Methods to determine portability of water (MPN)	02
	F. General Principles of Food Preservation: (3) a. Preservation using High temperature (including TDT, TDP, Z Value, principle of canning b. Low temperature c. Drying d. Food preservatives (organic acids & their salts, Sugar & salt) e. Ionizing radiations	03
	G. Milk product a) Butter, b) Cheese (types and production of cheddar cheese and cottage cheese) c) Yogurt (Types and production). d) Other Milk products and names of organisms associated with them.	03

**Course Code: USc3MiP2**

**Course Title: Practical based on Applied Microbiology**

**Course Type: Major**

**No. of Credits: 1**

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Conduct screening techniques of microorganisms.
CO-2	Determine BOD & COD values
CO-3	Demonstrate the use of fermenter, bioinformatics tools & report writing.
CO-4	Calculate TDT, TPT curves & MIC of salt & sugar
CO-5	Analyse the quality control of milk.
CO-6	Accurately record observations and measurements during experiments.

Sr. No.	Name of Practical	Hrs.
1.	Basic design and operation features of the bioreactor (Demonstration from Vlab.co.in)	02
2.	Screening of antibiotic producer	03
3.	Screening of organic acid producer	03
4.	Determination of BOD, COD & Visit to Effluent treatment plant.	03
5.	MPN	03
6.	Determination of TDT and TDP	03
7.	MIC of Sugar and Salt tolerance	03
8.	Dye reduction test: RRT, MBRT	03
9.	Microbial quality of Milk: SPC, LPC, Thermophilic count, Psychrophilic count, coliform count	03
10.	Screening & Isolation of Probiotic organisms from curd and Milk Sample	03

## References

Sr. No.	Reference
1.	Environmental Microbiology, R. M. Maier, I.L. Pepper & C.P. Gerba (2010), Academic Press
2.	A Textbook of Microbiology by RC Dubey and DK Maheshwari, Revised Edition (2013).
3.	Introduction to Environmental Microbiology-By Barbara Kolawzan, Adamiak et al (2006)
4.	Casida L. E., "Industrial Microbiology" 2009 Reprint, New Age International (P) Ltd, Publishers, New Delhi.
6.	Stanbury P. F., Whitaker A. & Hall-S. J., 1997, "Principles of Fermentation, Technology", 2nd Edition, Aditya Books Pvt. Ltd, New Delhi.
7.	Prescott and Dunn's "Industrial Microbiology". 1982 4th Edition, McMillan Publishers
8.	H. A. Modi, 2009. "Fermentation Technology" Vol 2, Pointer Publications, India
9.	Text book of Biotechnology by R C Dubey. 4th edition



Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Course Code: USc4Mi1**

**Course Title: Introduction to Microbial Genetics and Molecular biology**

**Unit I: Nucleic Acid and Chromosome (15)**

**Unit II: Nucleic acid chemistry (15)**

Unit.	Topic	Lectures
<b>Unit 1</b>	<b>Nucleic Acid and Chromosome (15)</b>	
	i. Experimental evidences for nucleic acid as genetic material.	01
	ii. Nucleic Acid Structure (Watson and Crick Model)	02
	iii. DNA stores genetic information	01
	iv. DNA molecules have distinctive base composition	01
	v. DNA is a double helix	01
	vi. DNA can occur in different 3D forms	02
	vii. DNA sequences adopt unusual structures	01
	viii. Many RNAs have complex 3D structures	01
	ix. Structure of Chromosome	02
	x. Chromosomal Unit: Genes - Segments of DNA That Code for Polypeptide Chains and RNAs	01
	xi. Chromosome of Bacteria	01
	xii. Chromosome of Eukaryotes	02
<b>Unit 2</b>	<b>Nucleic acid chemistry and DNA Replication (15)</b>	
	Denaturation of double helical DNA and RNA	02
	Nucleic acid from different species can form hybrids	01
	Nucleotides and nucleic acids undergo non enzymatic transformations, DNA methylation	02
	Separation of nucleic acids by Agarose gel electrophoresis	01
	DNA sequencing	02
	Introduction to DNA Replication	
	Historical perspective— conservative, dispersive, semiconservative, Bidirectional and semi-discontinuous Prokaryotic DNA replication –molecular mechanism Involved in Initiation, Elongation and Termination	07

<b>Sr. No.</b>	<b>Experiment</b>	<b>Hrs.</b>
01	Extraction of Bacterial DNA and its detection- Estimation using UV spectrophotometer	06
02	Extraction of Plant DNA and its detection	03
03	Extraction of RNA and its detection	03
04	Denaturation of DNA and Determination of T <sub>m</sub> (determination of Absorbance of SS-DNA and DS-DNA)	03
05	Separation of DNA by Agarose Gel Electrophoresis and its detection	06
06	Separation of Proteins by Poly-acrylamide Gel Electrophoresis	06
07	DNA sequencing simulation (Virtual Lab: DNA sequencing by Sanger method (cuhk.edu.hk) (3D Science Simulations Catalog   PraxiLabs)	03
08	Western Blotting simulation (3D Science Simulations Catalog   PraxiLabs)	03

## References

<b>S. N.</b>	<b>Reference</b>
1.	Nelson, D. L. and M.M. Cox (2017), "Lehninger's Principles of biochemistry", 7th edition, W.H. Freeman and Company, New York
2.	Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2013). Molecular biology of the gene (7th ed.). Pearson Publishers.
3.	Russell, P. J. (2009). iGenetics: A molecular approach (3rd ed.). Benjamin Cummings.
4.	Freifelder, D. (1987). Molecular biology (2nd ed.). Jones & Bartlett Publishers.

**Course Code: USc4Mi2****Course Title: Introduction to Medical Microbiology and immunology****Unit I:** Introduction to Medical Microbiology & Epidemiology**Unit II:** Immunology

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Apply practical skills for identifying organism.
CO-2	Describe the mechanism of infectious organism in causing disease.
CO-3	Understand role of immune system in protection against pathogen.
CO-4	Explain epidemiological terminologies.
CO-5	Gain insights of various diagnostic methods.
CO-6	Understand public health control measures during pandemic & epidemic.

Paper/Unit	Title	Total lectures
	<b>Introduction to Medical Microbiology and Epidemiology</b>	(15)
Unit 1	Introduction to Medical Microbiology	
	<b>Part A: Medical Terminology</b>	<b>(11)</b>
	a. Definitions: Incubation period, Viability, Susceptibility, Pathogenicity, Virulence, Pathogenesis, Lab diagnosis, Chemotherapy, Disease, infection.	<b>02</b>
	b. Infections of Skin Study of structure and functions of Skin Study of <i>Staphylococcus</i> , <i>Streptococcus</i> .	<b>03</b>
	c. Infections of Respiratory systems Study of structure and function of respiratory system Study of Common Cold, <i>Corynebacterium diphtheriae</i>	<b>03</b>
	d. Infections of Digestive system Study of structure and function of Digestive system Study of <i>E. coli</i> & Amoebiasis	<b>03</b>
	<b>Part B: Epidemiology/Sampling Techniques</b>	04
	a. The Epidemiology of Infectious Diseases and Their Control Epidemiological terminology: Epidemiology, sporadic diseases, endemic diseases, Hyper endemic Diseases, Epidemic Diseases, Index Case, Pandemic Disease, Outbreak	2
	b. Introduction to Physiological sampling <ul style="list-style-type: none"> <li>• Types of specimens</li> <li>• Sample collection</li> <li>• Processing</li> <li>• Transportation &amp; Storage</li> </ul>	2

Unit 2	<b>Immunology</b>	(15)
	<b>Innate immunity and immune system</b>	<b>(11)</b>
	a. Classification of immune system (innate immunity & acquired immunity)	2
	b. Physical barriers in nonspecific innate resistance revision. Chemical barriers (Complement: principle & significance (no pathway), Cytokines: interferon, antimicrobial peptides, bacteriocins.	4
	c. Cells of immune system: Hematopoiesis, Lymphocytes, monocytes & macrophages, Granulocytes, Mast cells, dendritic cells & NK cells	2
	d. Phagocytosis & Inflammation	3
	<b>Vaccines</b>	<b>(4)</b>
	<ul style="list-style-type: none"> <li>• Active and Passive immunity</li> <li>• Attenuated, Killed</li> <li>• Subunit vaccine</li> </ul>	

**Course Code: USc4MiP2**

**Course Title: Practical based on Introduction to Medical Microbiology and Immunology**

**Course Type: Major**

**No. of Credits: 1**

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Apply various diagnostics techniques to identify causative agent.
CO-2	Determine blood, acid-fast & metachromatic staining.
CO-3	Demonstrate the phagocytosis phenomenon.
CO-4	Analyse the various isolation techniques.
CO-5	Accurately record observations and measurements during experiments.

<b>Sr. No.</b>	<b>Name of Practical</b>	<b>Hrs.</b>
1.	Isolation of skin infection causing microorganisms	03
2.	Case study on: i. Normal flora of - Respiratory system /Digestive system, ii. Immunization programs in India (role of CDC, WHO, ICMR, NICD, NARI)	03
3.	Study of blood cells using differential staining method	03
4.	Demonstration on Phagocytosis	03
5.	Acid fast staining for Mycobacterium strains	03
6.	Perform Metachromatic granules staining method	03
7.	Diagnosis of typhoid using Widal test	03
8.	Isolation of pathogens on specific media XLD, SS agar, SIBA, Cetrinide agar, MacConkey's agar	03
9.	Biochemical tests IMViC test, Sugar Fermentation test, TSI, Catalase, Oxidase, Lysine decarboxylase, PPA, Gelatinase, Urease, Coagulase.	03
10.	Visit to NIPER for epidemiological study	03

**Reference:**

<b>S. No</b>	<b>Reference</b>
1.	Microbiology, An Introduction by Tortora, Funke & Case 9th and 10th edition, Pearson education.
2.	Bailey and Scott's Diagnostic Microbiology, 11th edition Pub: Mosby
3.	Mackie and McCartney, Practical medical microbiology 14th edition. Pub:Churchill Livingstone.
4.	Brock biology of microorganism by Michael T Madigan. & John M Martino. Pearson education.
5.	Prescott, Harley Klein. Mc Graw, Text Book of Microbiology, international edition, 7th Ed
6.	Anantnarayan & Paniker's ed 10th. University press
7.	Kanai Mukherjee, Swarajit Ghosh 'Medical Laboratory Technology: Procedure manual for routine diagnostic tests, 3 <sup>rd</sup> Edition.



Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**

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Re-accredited A+ Grade by NAAC (Third Cycle-CGPA-3.61)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**Title of the Programme**

**B. Sc. in Microbiology**

**(Faculty of Science)**

**Syllabus for S.Y. B. Sc. (Microbiology)**

**Semester III and IV**

*(With effect from the academic year 2025-26)*



Janardan Bhagat Shikshan Prasarak Sanstha's  
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**Arts, Commerce and Science College, New Panvel (Autonomous)**

**As per National Education Policy - 2020**

Sr. No.	Heading	Particulars
1	<b>Title of program</b>	Indian Knowledge System : Microbiology
2	<b>Eligibility</b>	Students must have earned mandatory credits of Microbiology.
3	<b>Duration of program</b>	3 years for Degree & 4 Years for Honors
4	<b>Intake Capacity</b>	50
5	<b>Scheme of Examination</b>	Internal
6	<b>Standards of Passing</b>	40%
7	<b>Semesters</b>	III
8	<b>Program Academic Level</b>	5.0
9	<b>Pattern</b>	Revised as per NEP 2020
10	<b>Status</b>	Approved by BOS and Academic Council
11	<b>To be implemented from Academic Year</b>	Academic Year 2024-25

**Signature of**

**Signature of**

**Name**

Head, Department of Microbiology  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)

**Prof. (Dr.) S.K. Patil**

Principal  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)



Janardan Bhagat Shikshan Prasarak Sanstha's  
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**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for S.Y.B. Sc. (Microbiology) Semester III and IV**

**Choice Based Credit System**

**Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2025-2026)**

**Course Code :**

**Course Title : Indian Knowledge System: Microbiology**

**Course Type: IKS (Major 3) Sem III**

**No. of Credits: 2**

## **Preamble**

### **1) Introduction**

The Indian Knowledge System (IKS) has a long history of recognizing and utilizing microorganisms, even before the formal establishment of microbiology as a scientific discipline. Ancient Indian texts, such as the Ayurveda, Charaka Samhita, Sushruta Samhita, and Vrikshayurveda, provide insights into microbial activities related to health, food, agriculture, and the environment. While these texts do not explicitly describe microorganisms in the way modern microbiology does, they contain knowledge about disease-causing agents, fermentation processes, and antimicrobial treatments that align with contemporary microbiological concepts.

India's traditional knowledge emphasized the role of Sukshma Krimi (microscopic organisms) in diseases, the use of fermented foods for gut health, and herbal formulations with antimicrobial properties. Practices such as maintaining hygiene (Shuddhi), using plant-based medicines (Rasayana), and promoting natural farming techniques indicate an early understanding of microbial interactions in human health and ecosystems.

Modern microbiology can benefit from integrating this traditional wisdom with scientific advancements, leading to sustainable solutions in medicine, agriculture, and environmental management. By exploring the Indian Knowledge System in microbiology, we can bridge ancient wisdom with contemporary science to develop holistic approaches to microbial research and applications

## 2) Aims and Objectives

Aim: The aim of **Indian Knowledge System (IKS) in Microbiology** is to explore, document, and integrate traditional Indian microbiological knowledge with modern scientific advancements.

### Objectives:

1. To understand the Foundations of IKS in Microbiology.
2. To investigate Traditional Antimicrobial and Medicinal Practices
3. To examining Traditional Food Microbiology and Fermentation.

## Course Structure

CO.No	COs Statement	
	After completing the Bachelor of Science Program, students will be able to-	
CO1	<b>Interpret</b> the microbial basis of fermentation in Indian traditional food systems and its health benefits.	<b>BTL: Understand</b>
CO2	<b>Examine</b> the effectiveness of ancient water purification methods in controlling microbial contamination..	<b>BTL: Evaluate</b>
CO3	<b>Demonstrate</b> traditional food fermentation techniques and assess their microbial impact.	<b>BTL: Apply</b>
CO4	<b>Apply</b> knowledge of traditional antimicrobial agents ( <i>Neem, Turmeric, Tulsi</i> ) to develop eco-friendly microbial control solutions..	<b>BTL: Apply</b>
CO5	<b>Assess</b> the scientific validity of traditional Indian microbiological practices through modern microbiological research.	<b>BTL: Evaluate</b>



Janardan Bhagat Shikshan Prasarak Sanstha's  
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**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for S.Y.B. Sc. (Microbiology) Semester III and IV**

**Choice Based Credit System**

**Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2025-2026)**

**Course Structure**

Course Code : USc3Mi3

Course Title : Indian Knowledge System :Microbiology

Course Type: IKS (Major) Sem 2

No. of Credits: 2

<b>Unit I: Ethnic Fermented Foods and Beverages 15 L</b>	<b>Lectures/ Semester</b>
<b>1. History and Culture of Indian Ethnic Foods</b> a. History of Indian Food Culture b. Diversity of Ethnic Fermented Foods of India	(08 L)
<b>2. Alcohol Fermentation Techniques in Early Indian Traditions</b> a. Vedic Period b. Post-Vedic Period (600 BC to 100 AD) c. Period of Scientific and Technical Literature (100 AD onwards) d. Manufacturing of Spirituous Alcoholic Fermentation e. Manufacturing of special Sura– for purification	(07L)
<b>Unit 2: Traditional methods to control microorganisms 15 L</b>  <b>Traditional water purification method</b> a) Filtration b) Sedimentation c) Disinfection	08L
<b>1. Antimicrobial agents used in Ayurveda</b> 1 Turmeric ( <i>Curcuma longa</i> ) 2 Neem ( <i>Azadirachta indica</i> ) 3 Tulsi ( <i>Ocimum tenuiflorum</i> ) 4 Bhasma (Heavy metals)	07 L

References

Sr. No.	Reference
1.	Tamang, J. P. (Ed.). (2020). <i>Ethnic Fermented Foods and Beverages of India: Science History and Culture</i> . doi:10.1007/978-981-15-1486-9
2.	Mishra, Pradeep. (2010). Alcoholic Fermentation Techniques in Early Indian Tradition. <i>Indian Journal of History of Science</i> . 45.2 (2010) 163-173.
3.	Supriya N. Traditional Water Purification Methods.
4.	Durie M. 2005. Indigenous knowledge within a global knowledge system. <i>High Educ Policy</i> 18:301–312. <a href="https://biologyreader.com/traditional-water-purification-methods.html">https://biologyreader.com/traditional-water-purification-methods.html</a>
5.	Rishi Kanva Vedic Microbiology Research Institute (2013) Vedic microbiology. Rishi Kanva Vedic Microbiology Research Institute. <a href="http://eai.eu/organization/rishi-kanva-vedicmicrobiology-research-institute">http://eai.eu/organization/rishi-kanva-vedicmicrobiology-research-institute</a> . Accessed Dec 2019
6	Saini S, Porte SM. Ayurvedic aspect of bacteria and bacterial food poisoning. <i>Int. J Pharm Sci Res</i> . 2015;6:2281–2290



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PANVEL (AUTONOMOUS)**

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'College with Potential for Excellence' Status Awarded by UGC  
'Best College Award' by University of Mumbai

## Syllabus

Programme:	B. Sc.
Class:	S. Y. B. Sc.
Semester:	III & IV
Course Type:	Minor
Course Title:	Industrial and Food Microbiology
Course Code:	

Revised as per National Education Policy 2020 &  
Choice Based Credit System (60:40)  
w. e. f. Academic Year 2025-26  
Approved in the Academic council meeting held on \_\_\_\_\_

## **Introduction:**

This syllabus outlines a Minor course in Industrial and Food Microbiology, a 4-credit offering designed for Semester III students. The course provides a comprehensive introduction to the vital role of microorganisms in both industrial processes and food production. It is structured into two core modules, complemented by a robust practical component, to ensure students gain both theoretical knowledge and hands-on experience.

Module 1, "Industrial Microbiology," delves into the fundamental principles of fermentation, exploring various types of fermentation processes (solid state, liquid state, batch, and continuous) and the diverse range of fermenter designs (laboratory, pilot-scale, and production). Students will also learn about the essential components of a continuously stirred tank bioreactor, as well as the critical screening methods (primary and secondary) employed to identify industrially relevant microbial strains. The module concludes with an examination of techniques for the preservation and maintenance of these strains, crucial for consistent industrial application.

Module 2, "Downstream Processing, Fermentation Products, and Food Packaging," shifts focus to the practical applications of microbial processes, particularly in the food industry. Students will explore the production of various fermented dairy products, including yogurt, acidophilus milk, kefir, dahi, and cheese. A significant portion of this module is dedicated to downstream processing, covering essential techniques like filtration, centrifugation, cell disruption, and solvent extraction, which are vital for isolating and purifying desired products. Furthermore, the module addresses various methods of food preservation, encompassing both physical (high and low temperature, irradiation) and chemical (salt, sugar, benzoates, ethylene) approaches.

The practical component of the course is designed to reinforce theoretical concepts and provide students with essential laboratory skills. This includes hands-on experience with fermenter components, screening for antibiotic and organic acid producers, microbial fermentation for the production and estimation of enzymes, amino acids, organic acids, and alcohols, and the microbiological analysis of milk and food spoilage. Students will also learn to determine salt and sugar tolerance in microorganisms and will have the opportunity to visit an industrial facility to observe real-world applications of fermentation and downstream processing.

## Course Outcomes

**After the completion of course, the learner will be able to**

<b>CO1</b>	Explain fermentation process and fermenters	<b>BTL: Understand</b>
<b>CO2</b>	Demonstrate skills to screen microbes for potential products	<b>BTL: Apply</b>
<b>CO3</b>	Apply knowledge to prepare fermented foods	<b>BTL: Apply</b>

Course Type:	Minor	Course code:	Sem III	Credits	04
Course Title:	Industrial and Food Microbiology				

<b>Module 1: Industrial microbiology</b>		
S. N.	Units / Subunits	No. of Hours
1	Types of fermentation processes 1. Solid state fermentation 2. Liquid state fermentation 3. Batch fermentation and 4. Continuous fermentation Types of fermenters – 1. Laboratory fermenter 2. Pilot-scale fermenter and 3. Production fermenter	07
2	Components of a typical continuously stirred tank bioreactor	03
3	Screening methods 1. Primary screening and 2. Secondary screening Preservation and maintenance of industrial strains	05
<b>Module 2: Downstream Processing, Fermentation Products and Food Packaging</b>		
S. N.	Units / Subunits	No. of Hrs.
1	Fermented dairy products 1. Yogurt 2. Acidophilus milk 3. Kefir 4. Curd 5. Cheese	05
2	Downstream processing 1. Filtration	05

	<ol style="list-style-type: none"> <li>2. Centrifugation</li> <li>3. Cell disruption</li> <li>4. Solvent extraction.</li> </ol>	
3	<p>Methods of preservation</p> <p>Physical methods</p> <ol style="list-style-type: none"> <li>1. High temperature</li> <li>2. Low temperature</li> <li>3. Irradiation</li> </ol> <p>Chemical methods</p> <ol style="list-style-type: none"> <li>1. Salt</li> <li>2. Sugar</li> <li>3. Benzoates</li> <li>4. Ethylene</li> </ol>	05

### Practical

Sr. No.	Content	Hours
1.	Study of different parts of fermenter	03
2.	Primary and Secondary screening of antibiotic producer.	06
3.	Primary and Secondary screening of organic acid producer.	06
4.	Microbial fermentation for the production and detection (qualitative) of A. Enzymes: Amylase and Protease	06
	B. Amino acid: Glutamic acid;	06
	C. Organic acid: Citric acid;	06
	D. Alcohol: Ethanol	06
5.	MBRT of milk samples and their standard plate count.	04
6.	Alkaline phosphatase test to check the efficiency of pasteurization of milk.	03
7.	Isolation of spoilage microorganisms from spoiled vegetables/fruits	06
8.	Determination of salt tolerance	04
9.	Determination of sugar tolerance	04
10.	A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.	

## References

S. N.	Reference
1.	Stanbury P. F., Whitaker A. & Hall S. J 3 <sup>rd</sup> edition (2017) "Principles of Fermentation Technology"
2.	A. Modi, (2009). ‘‘Fermentation Technology’’ Vol. 1 & 2, Pointer Publications, India.
3.	Casida L. E., "Industrial Microbiology" (2009) Reprint, New Age International (P) Ltd, Publishers, New Delhi.
4.	Practical Fermentation Technology by Brian Mcneil & Linda M. Harvey (2008).
5.	Okafor Nduka (2007) ‘‘Modern Industrial Microbiology and Biotechnology’’, Science Publications Enfield, NH, USA.

Course Type:                      Minor (Sem IV)                      Course code: \_\_\_\_\_

Course Title:                      Medical Microbiology and Immunology

### Introduction

This syllabus outlines a Minor course in Medical Microbiology and Immunology, a 4-credit offering designed for Semester IV students. This course provides a comprehensive understanding of the roles microorganisms play in human health and disease, as well as the intricate workings of the human immune system. The curriculum is structured into two main modules, complemented by a practical component, to ensure students acquire both theoretical knowledge and hands-on laboratory skills.

Module 1, "Medical Microbiology," begins by exploring the normal microflora of the human body, emphasizing their importance and distribution across various anatomical sites, including the skin, throat, gastrointestinal tract, and urogenital tract. Students will also delve into host-pathogen interactions and the significance of gnotobiotic animals in research. The module further defines key terminologies such as infection, invasion, pathogenicity, virulence, and toxigenicity, and examines the concepts of opportunistic and nosocomial infections. A significant portion of this module focuses on the symptoms, modes of transmission, prophylaxis, and control of diseases

caused by clinically relevant microorganisms, including *Escherichia coli*, *Haemophilus influenzae*, *Mycobacterium tuberculosis*, HIV, and *Salmonella Typhi*.

Module 2, "Immune System," transitions to the study of human defense mechanisms against infections. Students will explore the first, second, and third lines of defense, as well as the structure and function of the cells, tissues, and organs of the immune system. The module differentiates between various types of immunity, including humoral, cell-mediated, innate, and acquired immunity. A detailed examination of antigens, immunogens, and immunoglobulins, including their structure, types, properties, and functions, is provided. The theory of antibody production and antigen-antibody interactions is also covered, along with an introduction to vaccines. Finally, the module delves into specific antigen-antibody interactions, such as agglutination, precipitation, and complement fixation tests, and introduces the concept of hypersensitivity reactions.

The practical component of this course is designed to reinforce theoretical concepts and provide students with essential laboratory skills. This includes the identification of bacteria based on cultural, morphological, and biochemical characteristics, the study of virulence factors, and the examination of skin bacterial flora. Students will also perform antibacterial sensitivity tests, study disease symptoms using photographs, and examine malarial parasite stages in RBCs. Additionally, the practical component includes acid-fast staining, blood grouping, and serological tests such as Widal and SRID. Assignments on ELISA and hypersensitivity reactions are also included to enhance their understanding of these important immunological concepts.

## Course Outcomes

**After the completion of course, the learner will be able to**

<b>CO1</b>	Explain details of normal microbial flora of human body	<b>BTL: Understand</b>
<b>CO2</b>	Construct knowledge on transmission and control of diseases	<b>BTL: Create</b>
<b>CO3</b>	Summarize details of immune system of human	<b>BTL: Understand</b>

Course Type:	Minor	Course code:	Sem IV	Credits	04
Course Title:	Medical Microbiology and Immunology				

<b>Module 1:</b>	<b>Medical Microbiology</b>	
<b>S. N.</b>	<b>Units / Subunits</b>	<b>No. of Hours</b>
1	Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract. Host pathogen interaction, Gnotobiotic animals.	06
2	Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity  Opportunistic infections and Nosocomial infections with examples	04
3	Symptoms, mode of transmission, prophylaxis and control of the diseases caused by <i>Escherichia coli</i> , <i>Haemophilus influenzae</i> , <i>Mycobacterium tuberculosis</i> , <i>HIV</i> , <i>Salmonella Typhi</i>	05
<b>Module 2:</b>	<b>Immune system</b>	
<b>S. N.</b>	<b>Units / Subunits</b>	<b>No. of Hrs.</b>
1	Host defense against infection (First, Second and Third line of defense), Structure and function of the cells, tissues and organs of immune system. Types of immunity - Humoral and cell-mediated, innate immunity, acquired immunity	05

2	Antigens and Immunogens, Immunoglobulins: Structure types, Properties and their function - Theory of antibody production. Antigen Antibody Interactions, Vaccines	05
3	Antigen Antibody Interactions, Agglutination, Precipitation, Complement fixation test, Hypersensitivity reactions; Types and introduction	05

### Practical

1.	Biochemical characteristics of bacteria ( <i>E.coli</i> , <i>Salmonella typhi</i> , <i>Staphylococcus aureus</i> )
2.	Study of virulence factor: Haemolysin, coagulase, Oxidase, Catalase
3.	Study of bacterial flora of skin by swab method
4.	Perform antibacterial sensitivity by Kirby-Bauer method
5.	Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chickenpox
6.	Study of various stages of malarial parasite in RBCs using permanent mounts
7.	Diagnosis of heat fixed smear for the presence of Mycobacterium species by acid fast staining
8.	Determination of blood group of a given blood sample
9.	Determination of <i>Salmonella typhi</i> titre in a given sample using Widal method
10.	Determination of the antibody/antigen concentration in a given sample using single radial immune-diffusion method
11.	Assignment on : Enzyme Linked Immuno-Sorbent Assay
12.	Assignment on : Vaccines

## References

S. N.	Reference
1.	Bernard, Davis B. Dulbecco, Eisen and Ginsberg. Microbiology including immunology and molecular Genetics. 3rd Edition
2.	Roitt I. Essential Immunology. 10th Ed. Blackwell Science.
3.	Kuby. Immunology. 4th edition. W. H. Free man & company.
4.	Ananthanarayan and Paniker. Text book of microbiology. University press. 8th edition
5.	Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.
6.	Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson
7.	Tom Besty, D. C Jim Koegh. Microbiology Demystified McGRAW - HILL.
8.	Willey, Sherwood, Woolverton. Prescott, Harley, and Klein's Microbiology McGraw-Hill publication
9.	Tortora, Funke, Case. Microbiology. Pearson Benjamin Cummings.
10.	Jacquelyn G. Black. Microbiology Principles and explorations. John Wiley & Sons, Inc.



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'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**Title of the Programme**

**B.Com**

**(Faculty of Commerce)**

**Syllabus for S.Y. B. Com (Open Elective: 1)**

**(Commerce)**

**Semester III and IV**

*(With effect from the academic year 2025-26)*



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**As per National Education Policy - 2020**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Title of program</b>	<b>B.Com</b>
<b>2</b>	<b>Eligibility</b>	Learner who has secured admission in S.Y.B.Com
<b>3</b>	<b>Duration of program</b>	3 years of Degree & 4 years of Honors
<b>4</b>	<b>Scheme of Examination</b>	Theory External:50 Marks
<b>5</b>	<b>Standards of Passing</b>	40%
<b>6</b>	<b>Semesters</b>	III and IV
<b>7</b>	<b>Program Academic Level</b>	5.0
<b>8</b>	<b>Pattern</b>	Revised as per NEP 2020
<b>9</b>	<b>Status</b>	Approved by BOS and Academic council
<b>10</b>	<b>To be implemented from Academic Year</b>	Academic Year 2025-26

**Signature of**

**Mr.N.C.Vadnere**  
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**Signature of**

**Prof. Dr. S. B. Yadav**  
**In-charge, Faculty of**  
**Commerce.**

**Signature of**

**Prof. (Dr.) S.K. Patil**  
Principal  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)



Janardan Bhagat Shikshan Prasarak Sanstha's



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## **Preamble**

### **1) Introduction**

This course provides an exploration of microbial agents responsible for human diseases, their pathogenesis, and clinical management. Students will gain an understanding of the diagnosis, treatment, and control strategies for infectious diseases, with a focus on antimicrobial resistance, emerging infections, and public health measures. Additionally, the course examines the production, applications, and commercialization of microbial products, including dairy, fermented foods, biofuels, and biofertilizers. Key topics include microbial fermentation processes, large-scale production, and the economic, regulatory, and ethical factors involved in bringing these products to market. The course also emphasizes the role of microbial biotechnology in sustainable practices and introduces strategies for success in the microbial biotechnology industry through case studies.

### **2) Aims and Objectives**

- To provide a understanding of microbial agents and their role in human diseases.
- To explore microbial biotechnology applications in various industries, including food, biofuels, and agriculture.
- To develop skills for managing infectious diseases and understanding the economic and regulatory aspects of microbial products.



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**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for S.Y.B.Com. (Open Elective 1) Semester III**  
**Choice Based Credit System**  
**Under New Education Policy (NEP) 2020**  
**(To be implemented from the academic year 2025-2026)**

## **Course Structure**

**Course Code: UCM3MiOE1**

**Course Title: HUMAN MICROBIAL DISEASE MANAGEMENT**

**Course Type: Open Elective**

**No. of Credits: 4**

### **Course Outcomes (Cos)**

<b>CO No.</b>	<b>COs Statement</b>
	<b>After completing the course, students will be able to-</b>
CO-1	<b>Describe</b> the terminologies used in health and diseases.
CO-2	<b>Explain</b> the basic concept of microbial infection and its prevention.
CO-3	<b>Identify</b> sources of infection and mode of transmission.
CO-4	<b>Justify</b> the benefits of prophylaxis using vaccination.
CO-5	<b>Explore</b> global health challenges, emerging infectious diseases, and antimicrobial resistance.



Janardan Bhagat Shikshan Prasarak Sanstha's



## CHANGU KANA THAKUR

Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for S.Y.B.Com. (Open Elective 1) Semester III  
Choice Based Credit System  
Under New Education Policy (NEP) 2020  
(To be implemented from the academic year 2025-2026)

**Course Code: UCM3MiOE1**

**Course Title: HUMAN MICROBIAL DISEASE MANAGEMENT**

Sr. No.	TITLE OF MODULE	LECTURES
<b>Unit 1</b>	<b>Human health and diseases</b>	<b>15</b>
1.1	<b>Important terminology:</b> Infection, disease, Primary infection, secondary infection. Contagious infection, occupational disorder, Zoonoses , genetic disorder, vector borne infection, mortality rate	02
1.2	<b>Concept of Immunity:</b> Natural and acquired immunity	02
1.3	<b>Normal microbial flora of human body</b>	03
1.4	<b>Cause of disease</b> Contact transmission, Vehicle Transmission	02
1.5	<b>Sign and Symptoms of common diseases</b>	02
1.6	Common diagnostic methods	02
1.7	<b>Concept of epidemiology</b>	02
<b>Unit 2</b>	<b>Microbial diseases</b>	<b>15</b>
2.1	<b>Types and sources of infection:</b> Bacterial, viral , fungal and parasitic	02
2.2	<b>Respiratory microbial diseases:</b> Tuberculosis	02
2.3	<b>Gastrointestinal microbial diseases:</b> Typhoid	02
2.4	<b>Skin diseases :</b> Wound infection	02
2.5	<b>Urinary tract diseases</b>	02
2.6	<b>Sexually transmitted diseases:</b> AIDS	02
2.7	<b>Mosquito borne disease:</b> Malaria	02
2.8	<b>Cancer</b>	01
<b>Unit 3</b>	<b>Therapeutics and prevention of Microbial diseases</b>	<b>15</b>
3.1	<b>Chemotherapy :</b> Treatment using antibiotics	02
3.2	Concept of HAART	02

3.3	Concept of DOTS	02
3.4	General preventive measures	02
3.5	Importance of personal hygiene	02
3.6	General preventive measures	02
3.7	Importance of personal hygiene	02
3.8	Vaccination	01
<b>Unit 4</b>	<b>Case study of following diseases with respect to disease management</b>	<b>15</b>
4.1	SARS Cov-19	05
4.2	Swine flue	05
4.3	Chikungunya	05

### References

S. N.	Reference
1.	Ananthanarayan, R., & Paniker, C. K. J. (2017). <i>Ananthanarayan and Paniker's textbook of microbiology</i> (10th ed.). Universities Press.
2.	Brooks GF, Carroll KC, Butel JS and Morse SA. Jawetz, Melnick and Adelberg's Drexler M; What You Need to Know About Infectious Disease. National Academies Press (US); 2010.
3.	Medical Microbiology. 24th edition. McGraw Hill Publication. (2007).
4.	Willey, J. M., Sandman, K., & Wood, D. (2011). <i>Prescott's Microbiology</i> (12th ed.). McGraw-Hill Education.



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for S.Y.B. Com. (Open Elective 1) Semester IV**  
**Choice Based Credit System**  
**Under New Education Policy (NEP) 2020**  
**(To be implemented from the academic year 2025-2026)**

## **Course Structure**

**Course Code: UCM4MiOE1**

**Course Title: MICROBIAL PRODUCTS AND THEIR COMMERCIAL ASPECTS**

**Course Type: Open Elective**

**No. of Credits: 4**

### **Course Outcomes (Cos)**

<b>CO No.</b>	<b>COs Statement</b>
	<b>After completing the course, students will be able to-</b>
CO-1	<b>Classify</b> Different Types of Microbial Products
CO-2	<b>Explain</b> the Production Methods for Microbial Products
CO-3	<b>Describe</b> the Role of Microbial Products in Sustainable Development
CO-4	<b>Investigate</b> Case Studies of Microbial Product Commercialization
CO-5	<b>Apply</b> Knowledge of Marketing and Distribution Strategies for Microbial Products



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for S.Y.B.Com (Open Elective 1) Semester IV**  
**Choice Based Credit System**  
**Under New Education Policy (NEP) 2020**  
**(To be implemented from the academic year 2025-2026)**

**Course Code: UCM4MiOE1**

**Course Title: MICROBIAL PRODUCTS AND THEIR COMMERCIAL ASPECTS**

S.N.	TITLE OF MODULE	NO. OF HRS.
<b>Unit 1</b>	<b>Dairy and fermented Products</b>	<b>15</b>
1.1	<b>Fermented Foods :</b> Definition, types, advantages and health benefits, fermented foods used by Common public, domestication.	05
1.2	<b>Milk Based Fermented Foods:</b> Curd, Yogurt, Kefir, Paneer, Buttermilk and cheese: Preparation of inoculums, types of microorganisms and production process.	05
1.3	<b>Other household fermentation techniques :</b> Idli, Dhokla, Jalebi, Sauerkraut fermentation	03
1.4	<b>Preventive measures in spoilage of milk products</b>	02
<b>Unit 2</b>	<b>Biofertilizer</b>	<b>15</b>
2.1	<b>Biofertilizers:</b> General account of the microbes used as biofertilizers Advantages over chemical fertilizers	02
2.2	<b>N<sub>2</sub> fixers:</b> Symbiotic N <sub>2</sub> fixers: <i>Rhizobium</i> Nonsymbiotic N <sub>2</sub> fixers : <i>Azotobacter</i>	03
2.3	<b>Phosphate Solubilizers:</b> Phosphate solubilizing microbes -Field applications	03
2.4	<b>Mycorrhizal Bio-fertilizers:</b> Importance of mycorrhizal inoculum Types of mycorrhizae and associated plants Field applications of Ectomycorrhiza and VAM.	05
2.5	Limitation /Challenges in biofertilizer production	01
2.6	Area for future research focus	01
<b>Unit 3</b>	<b>Biofuel</b>	<b>15</b>
3.1	<b>Renewable and nonrenewable resources</b>	02

3.2	<b>Conventional fuels and their impact on the environment:</b> Oil ,Coal, Natural gas	02
3.3	<b>Energy crops:</b> Wood, Sugar and Starch crops, Hydrocarbon producing crops	02
3.4	<b>Biogas production:</b> The Substrate, Process of production, Factors affecting biogas yield	02
3.5	<b>Bio-ethanol production:</b> Commercial production from lignocellulose waste and algal biomass Ethanol recovery	02
3.6	<b>Bio-diesel production:</b> Lipids as a source of biodiesel Biodiesel from hydrocarbon	02
3.7	<b>Biohydrogen:</b> Anaerobis bacteria Photosynthetic algae	02
3.8	Area for future research focus	01
<b>Unit 4</b>	<b>Case study of following products with respect to commercial aspects</b>	<b>15</b>
4.1	Dairy product	05
4.2	Biofuel	05
4.3	Biofertilizer	05

### References

Sr. No.	Reference
1.	Prescott, S. C., Dunn, C. G., & Reed, G. (1982). <i>Prescott &amp; Dunn's industrial microbiology</i> (4th ed.). AVI Publishing Company.
2.	Singh, B. D. (2023). <i>Biotechnology: Expanding Horizons</i> (5th ed.). Medtech Science Press.
3.	Crueger, W., & Crueger, A. (1990). <i>Biotechnology: A Textbook of Industrial Microbiology</i> (T. D. Brock, Ed.). Sinauer Associates.
4.	Sharma, A., Gupta, R., & Patel, M. (2022). <i>New strategies for commercialization of microbial technologies</i> . In <b>Microbial Biotechnology: Approaches to Combat Emerging Challenges</b> (pp. 321-340). Springer. <a href="https://link.springer.com/chapter/10.1007/978-981-16-2922-8_23">https://link.springer.com/chapter/10.1007/978-981-16-2922-8_23</a>
5.	<i>Singh, P., &amp; Kumar, V. (2023). Microbial product commercialization from lab to industry. In Advances in Industrial Microbiology (pp. 1-15). Springer. https://link.springer.com/chapter/10.1007/978-981-99-1737-2_1</i>
6.	<i>Bailey, K. L., &amp; Boyetchko, S. M. (2005). Turning research on microbial bioherbicides into commercial products: A Phoma story. Plant Pathology Journal, 5(S11), 73-79. https://www.globalsciencebooks.info/Online/GSBOonline/images/2011/PT_5%28S11%29/PT_5%28S11%2973-79o.pdf</i>



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**

**Arts, Commerce and Science College, New Panvel (Autonomous)**

Re-accredited A+ Grade by NAAC (Third Cycle-CGPA-3.61)  
'College with Potential for Excellence' Status Awarded by UGC  
'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**Title of the Programme**

**B. Sc. in Microbiology**

**(Faculty of Science)**

**Syllabus for S.Y. B. Sc. (Microbiology)**

**Semester III**

*(With effect from the academic year 2025-26)*



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**As per National Education Policy - 2020**

Sr. No.	Heading	Particulars
1	<b>Title of program</b>	Vocation skill course in Biofertilizer
2	<b>Eligibility</b>	Students must have earned mandatory credits in Microbiology.
3	<b>Duration of program</b>	3 years for a Degree & 4 Years for Honors
4	<b>Intake Capacity</b>	50
5	<b>Scheme of Examination</b>	60:40
6	<b>Standards of Passing</b>	40%
7	<b>Semesters</b>	III
8	<b>Program Academic Level</b>	5.0
9	<b>Pattern</b>	Revised as per NEP 2020
10	<b>Status</b>	Approved by BOS and Academic Council
11	<b>To be implemented from Academic Year</b>	Academic Year 2024-25

**Signature of**

**Signature of**

**Name**

Head, Department of Microbiology  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)

**Prof. (Dr.) S.K. Patil**

Principal  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)



## **Preamble**

### **1) Introduction**

The purpose of a Skill Enhancement Course in Bio-fertilizer is to introduce students to the techniques of Bio-fertilizer production. This field requires experts who are well-equipped with cutting-edge technologies, applied research ideas, and the highest ethical standards. The course focuses on providing vocational training to students and empowering them with the appropriate knowledge to make their products related to microorganisms. There are many benefits to a **Skills Enhancement Course in Bio-fertilizer**. One of the most important is the opportunity to become part of the industry's future. The production of Bio-fertilizers is an increasingly popular industry in the developed world. Biofertilizers are sustainable and ecologically friendly, many farmers are choosing to use them over chemical fertilizers. The Bio-fertilizers are cost-effective and environmentally friendly, and they ensure sustainable farming.

### **2) Aims and Objectives**

Aim: To make students skilled for production of biofertilizers.

#### **Objectives:**

1. To make the students understand the role of bio-fertilizers and their mechanism of action in agriculture
2. To make the students understand the basic principles of the production of different biofertilisers as per the needs of agriculture.
3. To develop the concept of biofertilizers and develop the skills for handling microbial inoculants

### **3) Learning Outcomes**

<b>CO1</b>	Explain the isolation and role of various soil bacteria in bio-fertilizer production.	<b>BTL: Understand</b>
<b>CO2</b>	Design production steps and specific requirements for each bio-fertilizer.	<b>BTL: Create</b>
<b>CO3</b>	Analyze the efficiency of biofertilizers	<b>BTL: Analyze</b>



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for S.Y.B. Sc. (Microbiology) Semester III**  
**Choice Based Credit System**  
**Under New Education Policy (NEP) 2020**  
**(To be implemented from the academic year 2025-2026)**

### **Course Structure**

**Course Code : SEC 3BF**

**Course Title: Skill Enhancement Course in Biofertilizer**

**Course Type: Minor**

**No. of Credits: 2**

<b>Module 1:</b>	<b>Title of Module: Biofertilizer</b>	
<b>S. N.</b>	<b>Biofertilizer(Practical)</b>	<b>No. of Hrs.</b>
1	Sampling and Enrichment of Nitrogen Fixing Bacteria	04 Hrs
2	Sampling and Enrichment of Phosphate Solubilizing Bacteria	04 Hrs
3	Sampling and Enrichment of Potassium Mobilizing Bacteria	04 Hrs
4	Isolation of Nitrogen Fixing Bacteria	04 Hrs
5	Isolation of Phosphate solubilizing bacteria	04 Hrs
6	Isolation of Potassium Mobilizing Bacteria	04 Hrs
7	Preparation for Seed Culture for Each Biofertilizer	04 Hrs
8	Preparation of Lab-scale production media for each biofertilizer	04 Hrs
9	Determination of Cell count and its adjustment to the appropriate level	04 Hrs
10	Preparation of Carrier-based solid formulation of biofertilizer	04 Hrs
11	FCO specifications and quality control of biofertilizers.	04 Hrs
12	Efficiency determination of the efficiency of biofertilizer using pot assay	04 Hrs
13	Packaging of Biofertilizer Liquid Formulation and Solid Formulation	04 Hrs
14	Biofertilizers -Storage, shelf life, quality control	04 Hrs
15	Cost determination, field applications and marketing	04 Hrs

## References

S. N.	Reference
1.	A Textbook of Biotechnology- Dubey, R.C., (2005) S.Chand & Co, New Delhi.
2.	Biotechnology Kumaresan, V. (2005), Saras Publications, New Delhi.
3.	Vermiculture and Organic Farming Sathe, T.V., (2004) Daya publishers.
4.	Soil Microbiology Subha Rao, N.S. (2000), Oxford & IBH Publishers, New Delhi.
5.	Bio-fertilizers and organic _Farming Vayas, S.C, Vayas, S. and Modi, H.A. (1998) Akta Prakashan, Nadiad.
6.	Biotechnology of Biofertilizers Kannaiyan, S., (2003), CHIPS, Texas.
7.	Handbook of Microbial Biofertilizers Rai, M.K., (2005), The Haworth Press, Inc. NewYork.

Academic Council Date –  
Item No. –



Janardan Bhagat Shikshan Prasarak Sanstha's  
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**Arts, Commerce and Science College, New Panvel (Autonomous)**

Re-accredited A+ Grade by NAAC (Third Cycle-CGPA-3.61)  
'College with Potential for Excellence' Status Awarded by UGC  
'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**Title of the Programme**

**B.Com**

**(Faculty of Commerce)**

**Syllabus for S.Y. B. Com (Open Elective:1)**

**(Commerce)**

**Semester III and IV**

*(With effect from the academic year 2025-26)*



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**As per National Education Policy - 2020**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Title of program</b>	<b>B.Com</b>
<b>2</b>	<b>Eligibility</b>	Learner who has secured admission in S.Y.B.Com
<b>3</b>	<b>Duration of program</b>	3 years of Degree & 4 years of Honors
<b>4</b>	<b>Scheme of Examination</b>	Theory External:60 Marks Internal 40 Marks
<b>5</b>	<b>Standards of Passing</b>	40%
<b>6</b>	<b>Semesters</b>	III and IV
<b>7</b>	<b>Program Academic Level</b>	5.0
<b>8</b>	<b>Pattern</b>	Revised as per NEP 2020
<b>9</b>	<b>Status</b>	Approved by BOS and Academic council
<b>10</b>	<b>To be implemented from Academic Year</b>	Academic Year 2025-26

**Signature of**

**Signature of**

**Signature of**

**Mr.N.C.Vadnere**  
Head, Department of  
Microbiology  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)

**Prof. Dr. S. B. Yadav**  
**In-charge, Faculty of**  
**Commerce.**

**Prof. (Dr.) S.K. Patil**  
Principal  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)



Janardan Bhagat Shikshan Prasarak Sanstha's



**CHANGU KANA THAKUR**

**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for S.Y.B.Com. (Open Elective 1) Semester III**

**Choice Based Credit System**

**Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2025-2026)**

## **Course Structure**

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**Course Code: UCM3MiOE1**

**Course Title: HUMAN MICROBIAL DISEASE MANAGEMENT**

**Course Type: Open Elective**

**No. of Credits: 4**

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## **Preamble**

### **1) Introduction**

This course, "Human Microbial Disease Management," provides a foundational understanding of how microorganisms impact human health. It explores disease mechanisms, immune responses, and the characteristics of various microbial diseases. Students will learn about overview of treatment strategies and prevention strategies, equipping them to basic information of microbial disease effectively.

The curriculum covers key areas: basic infection terminology, immunity, normal flora, disease transmission, symptoms, diagnostics, and epidemiology. It then examines specific diseases (bacterial, viral, fungal, parasitic), including respiratory, gastrointestinal, skin, urinary tract, sexually transmitted, and mosquito-borne illnesses, and cancer. The course further addresses treatment and preventive measures. Finally, it includes case studies of recent outbreaks like SARS-CoV-19, swine flu, and chikungunya, demonstrating strategies of disease management.

**Course Code: UCM3MiOE1**

**Course Title: HUMAN MICROBIAL DISEASE MANAGEMENT**

**Course Type: Open Elective Sem III**

**No. of Credits: 4**

**Course Outcomes (Cos)**

<b>CO No.</b>	<b>COs Statement</b>
	<b>After completing the course, students will be able to-</b>
CO-1	<b>Describe</b> the terminologies used in health and diseases.
CO-2	<b>Explain</b> the basic concept of microbial infection and its prevention.
CO-3	<b>Identify</b> sources of infection and mode of transmission.
CO-4	<b>Justify</b> the benefits of prophylaxis using vaccination.
CO-5	<b>Evaluate</b> global health challenges, emerging infectious diseases, and antimicrobial resistance.



Janardan Bhagat Shikshan Prasarak Sanstha's



## CHANGU KANA THAKUR

Arts, Commerce and Science College, New Panvel (Autonomous)

Syllabus for Other Faculty (B.Com.) (Open Elective 1) Semester III  
Choice Based Credit System  
Under New Education Policy (NEP) 2020  
(To be implemented from the academic year 2025-2026)

**Course Code: UCM3MiOE1**

**Course Title: HUMAN MICROBIAL DISEASE MANAGEMENT**

S.N.	TITLE OF MODULE	NO. OF HRS.
<b>Unit 1</b>	<b>Human health and diseases</b>	<b>15</b>
1.1	<b>Important terminology:</b> Infection, disease, Primary infection, secondary infection. Contagious infection, occupational disorder, Zoonoses , genetic disorder, vector borne infection, mortality rate	02
1.2	<b>Concept of Immunity:</b> Natural and acquired immunity	02
1.3	<b>Normal microbial flora of human body</b>	03
1.4	<b>Cause of disease</b> Contact transmission, Vehicle Transmission	02
1.5	<b>Sign and Symptoms of common diseases</b>	02
1.6	Common diagnostic methods	02
1.7	<b>Concept of epidemiology</b>	02
<b>Unit 2</b>	<b>Microbial diseases</b>	<b>15</b>
2.1	<b>Types and sources of infection:</b> Bacterial, viral , fungal and parasitic	02
2.2	<b>Respiratory microbial diseases:</b> Tuberculosis	02
2.3	<b>Gastrointestinal microbial diseases:</b> Typhoid	02

2.4	<b>Skin diseases</b> : Wound infection	02
2.5	<b>Urinary tract diseases</b>	02
2.6	<b>Sexually transmitted diseases:</b> AIDS	02
2.7	<b>Mosquito borne disease:</b> Malaria	02
2.8	<b>Cancer</b>	01
<b>Unit 3</b>	<b>Therapeutics and prevention of Microbial diseases</b>	<b>15</b>
3.1	<b>Chemotherapy</b> : Treatment using antibiotics	02
3.2	Concept of HAART	02
3.3	Concept of DOTS	02
3.4	General preventive measures	02
3.5	Importance of personal hygiene	02
3.6	General preventive measures	02
3.7	Importance of personal hygiene	02
3.8	Vaccination	01
<b>Unit 4</b>	<b>Case study of following diseases with respect to disease management</b>	<b>15</b>
4.1	SARS Cov-19	05
4.2	Swine flue	05
4.3	Chikungunya	05

### References

S. N.	Reference
1.	Ananthanarayan, R., & Paniker, C. K. J. (2017). <i>Ananthanarayan and Paniker's textbook of microbiology</i> (10th ed.). Universities Press.
2.	Brooks GF, Carroll KC, Butel JS and Morse SA. Jawetz, Melnick and Adelberg's Drexler M; What You Need to Know About Infectious Disease. National Academies Press (US); 2010.
3.	Medical Microbiology. 24th edition. McGraw Hill Publication. (2007).
4.	Willey, J. M., Sandman, K., & Wood, D. (2011). <i>Prescott's Microbiology</i> (12th ed.). McGraw-Hill Education.



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for Other Faculty (B.Com.) (Open Elective 1) Semester IV**

**Choice Based Credit System**

**Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2025-2026)**

## **Course Structure**

**Course Code: UCM4MiOE1**

**Course Title: MICROBIAL PRODUCTS AND THEIR COMMERCIAL ASPECTS**

**Course Type: Open Elective**

**No. of Credits: 4**

### **Introduction:**

This course, "Microbial Products and Their Commercial Aspects," explores the diverse applications of microorganisms in producing commercially valuable products. It covers fermented foods, biofertilizers, and biofuels, analyzing their production processes, benefits, and commercial potential. Unit 1 focuses on dairy and fermented products, detailing the production of items like yogurt, cheese, and traditional Indian foods. It also addresses spoilage prevention. Unit 2 examines biofertilizers, including nitrogen fixers (*Rhizobium*, *Azotobacter*) and phosphate solubilizers, highlighting their advantages and commercial challenges. Unit 3 delves into biofuel production, covering biogas, bioethanol, biodiesel, and biohydrogen, exploring their environmental impact and future research. Unit 4 provides case studies on the commercial aspects of dairy products, biofuels, and biofertilizers, focusing on their market dynamics and industrial applications.

### **Course Outcomes (Cos)**

<b>CO No.</b>	<b>COs Statement</b>
	<b>After completing the course, students will be able to-</b>
CO-1	<b>Classify</b> different types of microbial products
CO-2	<b>Explain</b> the production methods for microbial products
CO-3	<b>Describe</b> the role of microbial products in sustainable development
CO-4	<b>Investigate</b> case studies of microbial product commercialization

S.N.	TITLE OF MODULE	NO. OF HRS.
<b>Unit 1</b>	<b>Dairy and fermented Products</b>	<b>15</b>
1.1	<b>Fermented Foods :</b> Definition, types, advantages and health benefits, fermented foods used by Common public, domestication.	05
1.2	<b>Milk Based Fermented Foods:</b> Curd, Yogurt, Kefir, Paneer, Buttermilk and cheese: Preparation of inoculums, types of microorganisms and production process.	05
1.3	<b>Other household fermentation techniques :</b> Idli, Dhokla, Jalebi, Sauerkraut fermentation	03
1.4	<b>Preventive measures in spoilage of milk products</b>	02
<b>Unit 2</b>	<b>Biofertilizer</b>	<b>15</b>
2.1	<b>Biofertilizers:</b> General account of the microbes used as biofertilizers Advantages over chemical fertilizers	02
2.2	<b>N<sub>2</sub> fixers:</b> Symbiotic N <sub>2</sub> fixers: <i>Rhizobium</i> Nonsymbiotic N <sub>2</sub> fixers : <i>Azotobacter</i>	03
2.3	<b>Phosphate Solubilizers:</b> Phosphate solubilizing microbes -Field applications	03
2.4	<b>Mycorrhizal Bio-fertilizers:</b> Importance of mycorrhizal inoculum Types of mycorrhizae and associated plants Field applications of Ectomycorrhiza and VAM.	05
2.5	Limitation /Challenges in biofertilizer production	01
2.6	Area for future research focus	01
<b>Unit 3</b>	<b>Biofuel</b>	<b>15</b>
3.1	<b>Renewable and nonrenewable resources</b>	02
3.2	<b>Conventional fuels and their impact on the environment:</b> Oil ,Coal, Natural gas	02

3.3	<b>Energy crops:</b> Wood, Sugar and Starch crops, Hydrocarbon producing crops	02
3.4	<b>Biogas production:</b> The Substrate, Process of production, Factors affecting biogas yield	02
3.5	<b>Bio-ethanol production:</b> Commercial production from lignocellulose waste and algal biomass Ethanol recovery	02
3.6	<b>Bio-diesel production:</b> Lipids as a source of biodiesel Biodiesel from hydrocarbon	02
3.7	<b>Biohydrogen:</b> Anaerobis bacteria Photosynthetic algae	02
3.8	Area for future research focus	01
<b>Unit 4</b>	<b>Case study of following products with respect to commercial aspects</b>	<b>15</b>
4.1	Dairy product	05
4.2	Biofuel	05
4.3	Biofertilizer	05

## References

S. N.	Reference
1.	Prescott, S. C., Dunn, C. G., & Reed, G. (1982). <i>Prescott &amp; Dunn's industrial microbiology</i> (4th ed.). AVI Publishing Company.
2.	Singh, B. D. (2023). <i>Biotechnology: Expanding Horizons</i> (5th ed.). MedTech Science Press.
3.	Crueger, W., & Crueger, A. (1990). <i>Biotechnology: A Textbook of Industrial Microbiology</i> (T. D. Brock, Ed.). Sinauer Associates.
4.	Sharma, A., Gupta, R., & Patel, M. (2022). <i>New strategies for commercialization of microbial technologies</i> . In <b>Microbial Biotechnology: Approaches to Combat Emerging</b>

	<b>Challenges</b> (pp. 321-340). Springer. <a href="https://link.springer.com/chapter/10.1007/978-981-16-2922-8_23">https://link.springer.com/chapter/10.1007/978-981-16-2922-8_23</a>
5.	<i>Singh, P., &amp; Kumar, V. (2023).</i> Microbial product commercialization from lab to industry. In <b><i>Advances in Industrial Microbiology</i></b> (pp. 1-15). Springer. <a href="https://link.springer.com/chapter/10.1007/978-981-99-1737-2_1">https://link.springer.com/chapter/10.1007/978-981-99-1737-2_1</a>
6.	<i>Bailey, K. L., &amp; Boyetchko, S. M. (2005).</i> Turning research on microbial bioherbicides into commercial products: A Phoma story. <b><i>Plant Pathology Journal</i></b> , 5(SI1), 73-79. <a href="https://www.globalsciencebooks.info/Online/GSBOnline/images/2011/PT_5%28SI1%29/PT_5%28SI1%2973-79o.pdf">https://www.globalsciencebooks.info/Online/GSBOnline/images/2011/PT_5%28SI1%29/PT_5%28SI1%2973-79o.pdf</a>



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**

**Arts, Commerce and Science College, New Panvel (Autonomous)**

Re-accredited A<sup>+</sup> Grade by NAAC (Third Cycle-CGPA-3.61)  
'College with Potential for Excellence' Status Awarded by UGC  
'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**Title of the Programme**

**B. Sc. in Microbiology**

**(Faculty of Science)**

**Syllabus for T.Y. B. Sc. (Microbiology)**

**Semester V and VI**

*(With effect from the academic year 2025-26)*



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**  
Arts, Commerce and Science College, New Panvel (Autonomous)



As per National Education Policy - 2020

Sr. No.	Heading	Particulars
1	Title of program	<b>B. Sc. in Microbiology</b>
2	Eligibility	Students must have earned mandatory credits of Microbiology.
3	Duration of program	3 Years for Degree & 4 Years for Honours
4	Intake Capacity	50
5	Scheme of Examination	Theory 100 Marks; Internal: External 40:60;
6	Standards of Passing	40%
7	Semesters	V and VI
8	Program Academic Level	5.5
9	Pattern	Revised as per NEP 2020
10	Status	Approved by BOS and Academic Council
11	To be implemented from Academic Year	Academic Year 2025-26

Signature of

Signature of

Name

Head, Department of Microbiology  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)

**Prof. (Dr.) S.K. Patil**

Principal  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**  
Arts, Commerce and Science College, New Panvel (Autonomous)



Syllabus for T.Y.B. Sc. (Microbiology) Semester V and VI  
Choice Based Credit System  
Under New Education Policy (NEP) 2020  
(To be implemented from the academic year 2025-2026)

## T. Y. B. Sc. Semester V Syllabus

### Course Structure

Course Code: USc5Mi1

Semester V

Course Title: Microbial Genetics and Medical Microbiology

Course Type: Major 1

No. of Credits: 4

#### Introduction:

This syllabus delves into the intricate world of microbial genetics and infectious diseases, providing a comprehensive overview of fundamental concepts and their clinical applications.

It is structured to equip students with a robust understanding of mutation, genetic exchange in bacteria, bacterial pathogenesis, and the study of various infectious diseases affecting major organ systems.

The syllabus begins by exploring the mechanisms of **mutation and repair**, laying the groundwork for understanding genetic variation. It then transitions to **genetic exchange and homologous recombination** in bacteria, crucial processes for bacterial evolution and adaptation. Following this, the focus shifts to **bacterial strategies for evasion** and the detailed study of **respiratory, urinary, and skin infectious diseases**, emphasizing the cultural characteristics, pathogenesis, clinical features, laboratory diagnosis, treatment, and prevention of these diseases. Finally, the syllabus covers **gastrointestinal, sexually transmitted, and central nervous system infectious diseases**, alongside an introduction to

**clinical research**, including ethical considerations and career pathways. This syllabus aims to bridge the gap between theoretical knowledge and practical applications in microbiology and clinical settings.

**Course Code: USc5Mi1**

**Course Title: Microbial Genetics and Medical Microbiology**

**Unit I:** Mutation and Repair

**Unit II:** Genetic Exchange

**Unit III:** Bacterial Strategies for Evasion and Study of Respiratory, Urinary & Skin Diseases infectious Diseases

**Unit IV:** Study of infectious Diseases of Gastrointestinal Tract, sexually transmitted diseases and Central nervous system

**Course Outcomes (Cos)**

CO No.	COs Statement
	After completing the course, the students will be able to-
CO-1	<b>Explain</b> fundamental principles of central dogma of life.
CO-2	<b>Describe</b> the basic principles of genetic exchange.
CO-3	<b>Explain</b> the correlation of mutation with phenotypic expression of cell.
CO-4	<b>Elaborate</b> modern alternatives to Koch's Postulates, Genetic modification and pathogen evolution.
CO-5	<b>Explain</b> the correlation these virulence factors with the pathogenesis and clinical features of the disease.
CO-6	<b>Distinguish</b> the mode of transmission, diagnosis, prophylaxis and treatment of various diseases.

Title	Lectures	Notional Periods
<p style="text-align: center;"><b>Unit I: Mutation and Repair</b></p> <p><b>1.1. Brief over view onto DNA mutation</b></p> <p><b>1.2. Fluctuation test</b></p> <p><b>1.3. Expression of mutations –</b>  a) Time course of phenotypic expression.  b) Conditional expression of mutation.</p> <p><b>1.4. Causes of mutation:</b>  Natural/spontaneous mutation-- replication error, depurination, deamination. Induced mutation: principle and mechanism with illustrative diagrams for:</p> <p><b>1.4.1. Chemical mutagens - base analogues, nitrous acid, hydroxyl amine, intercalating agents and alkylating agents.</b></p> <p><b>1.4.2. Physical mutagen</b></p> <p><b>1.4.3. Biological mutagen (only examples)</b></p> <p><b>1.5. Ames Test</b></p> <p><b>1.6. Detection of mutants</b></p> <p><b>1.7. Molecular mechanism and sequence of changes leading to oncogenesis-</b>  <b>1.7.1. Mutations,</b>  <b>1.7.2. Activation of proto-oncogenes,</b>  <b>1.7.3. Loss of function of tumor suppressor (anti-cancer) genes</b>  <b>1.7.4. Molecular details of mode of DNA repair (Base Excisions repair)</b></p>	<p><b>(Total 15L)</b></p> <p><b>02L</b></p> <p><b>01L</b></p> <p><b>03L</b></p> <p><b>04L</b></p> <p><b>01L</b></p> <p><b>01L</b></p> <p><b>03L</b></p>	<p><b>15 L</b></p>
<p><b>Unit II: Genetic Exchange &amp; Homologous Recombination</b></p>	<p><b>(Total 15 L)</b></p>	<p><b>15</b></p>
<p><b>2.1 Genetic analysis of Bacteria</b></p>	<p><b>01L</b></p>	
<p><b>2.2 Gene transfer mechanisms in bacteria</b></p> <p><b>2.2.3 Transformation</b>  2231 Introduction and History  2232 Types of transformation in prokaryotes-- Natural transformation in <i>Streptococcus pneumoniae</i>, <i>Haemophilus</i></p>	<p><b>03L</b></p>	



Title & Content	Lectures/ Semester	Notional Periods
<p><b>Unit III: Bacterial Strategies for Evasion and Study of Respiratory, Urinary &amp; Skin Diseases infectious Diseases (wrt. Cultural Characteristics of the etiological agent, pathogenesis &amp; clinical features, laboratory diagnosis, treatment and prevention)</b></p> <p><b>3.1. Study of virulence mechanisms in bacteria</b></p> <p>3.1.1. Pathogenicity islands</p> <p>3.1.2. Bacterial virulence factors: Adherence factors, Invasion of host cells and tissues</p> <p>3.1.3. Toxins: Exotoxins, Endotoxin</p> <p>3.1.4. Enzymes: Tissue degrading enzymes, IgA1 proteases</p> <p>3.1.5. Antiphagocytic factors</p> <p>3.1.6. Intracellular pathogenicity</p> <p>3.1.7. Antigenic heterogeneity</p> <p>3.1.8. The requirement for iron</p> <p><b>3.2 Study of Respiratory tract infections</b></p> <p>3.2.1 Tuberculosis</p> <p>3.2.2 Emerging infection –COVID-19</p> <p>3.2.3 Influenza</p> <p><b>3.3 Study of urinary tract infections</b></p> <p><b>3.4 Study of Skin infections</b></p> <p>3.4.1 Leprosy</p> <p>3.4.2 Fungal infections -Candidiasis</p> <p>3.4.3 Viral infections -Herpes Simple</p>	<p>15L</p> <p>5L</p> <p>4L</p> <p>2L</p> <p>4L</p>	<p>15 L</p>
<p><b>Unit IV: Study of infectious Diseases of Gastrointestinal Tract, sexually transmitted diseases and Central nervous system (w.r.to Cultural Characteristics of the etiological agent, pathogenesis &amp; clinical features, laboratory diagnosis, treatment and prevention) &amp; Clinical Research</b></p> <p><b>4.1 Study of Gastrointestinal tract infections</b></p> <p>2.1.3 Rota Virus</p> <p>2.1.4 Dysentery due to <i>Entamoeba histolytica</i></p> <p>2.1.5 Enteric Fever-Salmonella</p> <p>2.1.6 Shigellosis</p> <p><b>4.2 Study of sexually transmitted diseases.</b></p>	<p>15</p> <p>4L</p> <p>4L</p>	



**Text books:**

1. Peter J. Russell (2006), "I Genetics-A molecular approach", 2<sup>nd</sup> edition.
2. Benjamin A. Pierce (2008), "Genetics a conceptual approach", 3<sup>rd</sup> edition, W. H. Freeman and company.
3. R. H. Tamarin, (2004), "Principles of genetics", Tata McGraw Hill.
4. D.,Nelson and M.Cox, (2005), "Lehninger's Principles of biochemistry", 4<sup>th</sup> edition, Macmillan worth Publishers.
5. M.Madigan, J.Martinko, J.Parkar, (2009), "Brock Biology of microorganisms", 12<sup>th</sup> edition, Pearson Education International.
6. Fairbanks and Anderson, (1999), "Genetics", Wadsworth Publishing Company.
7. Prescott, Harley and Klein, "Microbiology", 7<sup>th</sup> edition Mc Graw Hill international edition.
8. Robert Weaver, "Molecular biology", 3<sup>rd</sup> edition. Mc Graw Hill international edition.
9. Nancy Trun and Janine Trempy, (2004), "Fundamental bacterial genetics", Blackwell Publishing
10. Snustad, Simmons, "Principles of genetics", 3<sup>rd</sup> edition. John Wiley & sons, Inc.
11. Roger Y. Stanier, (1987) "General Microbiology", 5<sup>th</sup> edition, Macmillan Publishing.
12. Jawetz, Melnick and Adelberg's Medical Microbiology, 26<sup>th</sup> Edition, Lange publication
13. Ananthanarayan and Panicker's, Textbook of Microbiology, 10<sup>th</sup> edition
14. Baron Samuel, Medical Microbiology, 4<sup>th</sup> edition

**Reference books:**

1. Benjamin Lewin, "Genes XI", Jones and Bartlett publishers.
2. JD Watson, "Molecular biology of the gene", 6<sup>th</sup> edition.
3. Molecular Biology of the Cell by Alberts and others, Garland Publishing, NY.
4. Molecular Biology by P. C. Turner and others, Bioscientific Publishers.

## Course Structure

Course Code: USc5Mi2

Semester V

Course Title: Bioenergetics and Fermentation technology

Course Type: Major 2

No. of Credits: 4

### Introduction

This comprehensive course covers the fundamental and advanced concepts crucial to understanding bioenergetics, metabolism, fermentation, and bioprocess engineering. Beginning with the mechanisms of energy generation, such as ATP synthesis and the electron transport chain, students will explore the detailed molecular pathways and their variations in different organisms. The course then progresses to carbohydrate and lipid metabolism, detailing the breakdown and synthesis of essential biomolecules and their energetic implications.

Further, the curriculum delves into fermentation processes, emphasizing strain improvement, culture preservation, sterilization, aseptic techniques, and various types of bioreactors to facilitate efficient microbial production. The final segment focuses on fermentation process control and downstream processing, including instrumentation and methods for recovery and purification of products.

Through 60 lectures, this course equips learners with a robust understanding of biochemical pathways and practical bioprocess technologies essential for industrial microbiology, biotechnology, and related fields. It bridges theoretical knowledge with applied techniques, preparing students for innovation and problem-solving in microbial and biochemical production systems.

CO. No	COs Statement	
	After completing the course, the students will be able to-	
CO1	<i>Illustrate</i> the mechanism and inhibition of ATP synthase in mitochondria	<b>BTL:</b> Remembering
CO2	<i>Calculate</i> the energy yield from Palmitic acid oxidation.	<b>BTL:</b> Applying
CO3	<i>Apply</i> the principles of mutant selection to improve the production of primary and secondary metabolites.	<b>BTL:</b> Applying
CO4	<i>Describe</i> the methods of downstream processing	<b>BTL:</b> Understanding

## Course Structure

Course Code: USC5MI2

Course Title: Bioenergetics and Fermentation Technology

Course Type: Major (Microbiology) Paper 2      Sem V      No. of Credits: 4

Title and Content		Lecture/Semester
<b>Unit 1: ETC and ATP Synthesis</b>		
1.1	ATP Generation: Substrate-level, Oxidative, Photophosphorylation	01 L
1.2	Electron Transport Chain Electron Acceptors Carriers: Hydrogen (Flavoproteins, Quinones), Electron (Fe-S proteins, Cytochromes) Mitochondrial ETC: Anatomy, Complexes, Schematic	03L
1.3	Prokaryotic ETC (02L) Organization: Pathway, Oxidases Branched ETC Electron Flow: E. coli, A. vinelandii	02L
1.4	ATP Synthesis Terms: PMF, Proton Pump, Coupling, P:O Ratio, Redox Potential NADH to O <sub>2</sub> Energy Chemiosmosis ATP Synthase: Mitochondrial, Bacterial; Mechanism, Inhibition	03L
1.5	Other Electrochemical Energy ATP Hydrolysis, Oxalate-Formate Exchange, End product Efflux, Bacteriorhodopsin	2L
1.6	Bioluminescence: Systems, Biochemistry, Diagram, Significance	2L
1.7	Energetics: Glycolysis, TCA, ED Pathways (Balance Sheets)	2L
<b>Unit 2: Carbohydrate and Lipid Metabolism</b>		
2.1	Polysaccharide Breakdown: Glycogen, Starch, Cellulose	01 L
2.2	Oligosaccharide/Monosaccharide Breakdown: Lactose, Maltose, Sucrose, Cellobiose/Fructose, Galactose	01 L
2.3	Major Pathways: Glycolysis, HMP, ED, TCA (PDH, Significance, Anaerobic), Anaplerotic Reactions, Glyoxylate Bypass	06 L
2.4	Fatty Acid Catabolism: $\beta$ -Oxidation, Palmitic Acid Energetics, Propionyl CoA Oxidation	03 L
2.5	Fatty Acid Anabolism: Palmitic Acid Biosynthesis	01 L
2.6	PHB Metabolism: Reserve, Degradation, Biosynthesis	01 L
2.7	Hydrocarbon Catabolism: Organisms, Uptake, $\omega$ -Oxidation ( <i>Corynebacterium</i> , Yeast, <i>Pseudomonas</i> )	02 L

<b>Unit 3-Fermentation Processing (Upstream and downstream)</b>		
3.1	Strain improvement 3.2.1 Objective of strain improvement 3.2.2 The improvement of industrial microorganisms 3.2.3 Methods for strain improvement: 3.2.3.1 Selection of different types of mutants a) The selection of induced mutants synthesizing improved levels of primary metabolites b) The isolation of induced mutants producing improved yields of secondary metabolites. c) The improvement of strains by modifying properties other than the yield of product d) Application of rDNA technology for strain improvement	05 L
3.2	Preservation of cultures 3.2.1 Preservation of industrially important organisms 3.2.2 Quality control of preserved stock 3.2.3 Key Criteria's 3.2.4 Development of a master culture bank (MCB) 3.2.5 Variability test to ensure reproducibility of the MCB.	02L
3.3	Sterilization and achievement of aseptic conditions 3.3.1. Introduction 3.3.2. Medium sterilization (concept of Nabla factor) 3.3.3. Methods of batch sterilization 3.3.4. The design of continuous sterilization process 3.3.5. Sterilization of the Fermenter 3.3.6. Sterilization of the Feeds 3.3.7. Sterilization of the liquid wastes 3.3.8. Filter Sterilization 3.3.8.1. Filter sterilization of fermentation media, 3.3.8.2. Filter sterilization of air 3.3.8.3. Filter sterilization of fermenter exhaust air 3.3.9. Achievement of aseptic conditions	05 L
3.4	Types of bioreactors – <ul style="list-style-type: none"> <li>○ Stirred Tank Reactor</li> <li>○ Air Lift fermenter</li> <li>○ Deep Jet Fermenter</li> <li>○ Photo bioreactor</li> </ul>	03 L

<b>Title and Content</b>		<b>Lecture/ Semester</b>
<b>Unit 4:-Fermentation Process control and Downstream processing</b>		<b>15</b>
4.1	Instrumentation process control 4.1.1. Introduction to sensors and its types Measurement and control of pH, temperature, pressure, foam sensing, dissolved oxygen, inlet and exit gas analysis.	05
4.2	Downstream Processing-Recovery Recovery and purification 4.2.1 Introduction 4.2.2 Methods of Downstream processing a) Precipitation, Filtration, Centrifugation b) Cell Disruption c) Liquid-Liquid Extraction d) Solvent Recovery e) Chromatography f) Membrane Processes g) Drying h) Crystallization i) Whole Broth Processing	10

**Practical based on bioenergetics and Bioprocess technology**

<b>Sr. No.</b>	<b>Name of the Experiment</b>
01	Isolation of mitochondria and study of its electron transport chain
02	Isolation of Bioluminescent bacteria
03	Isolation of PHB and cellulase producing bacteria
04	Isolation of hydrocarbon degraders
05	Primary and Secondary Screening of Antibiotic producer
06	Short term methods for preservation of pure culture
07	Sterilization of lab scale fermenter.
08	Isolation of lactic acid bacteria and its cultivation in fermenter.
09	Extraction by Liquid-Liquid Extraction.
10	Sterilizing fermentation media by filter sterilization.
11	Isolation of amylase producing bacteria from soil
12	Industrial visit

## References

1. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2004). *Lehninger principles of biochemistry* (4th ed.). W. H. Freeman.
2. Stanier, R. Y., Doudoroff, M., & Adelberg, E. A. (1987). *General microbiology* (5th ed.). Macmillan Education UK.
3. Conn, E. E., Stumpf, P. K., Bruening, G., & Doi, R. Y. (1987). *Outlines of biochemistry* (5th ed.). John Wiley & Sons.
4. Voet, D., & Voet, J. G. (2011). *Enzymatic catalysis*. In *Biochemistry*. John Wiley & Sons, Inc.
5. White, D. (2011). *The physiology and biochemistry of prokaryotes* (3rd ed.). Oxford University Press.
6. Gottschalk, G. (1986). *Bacterial metabolism* (2nd ed.). Springer-Verlag.
7. Casida L. E., "Industrial Microbiology" (2009) Reprint, New Age International (P) Ltd, Publishers, New Delhi.
8. Stanbury P. F., Whitaker A. & Hall S. J 3rd edition (2017) "Principles of Fermentation Technology"
9. Pepler, H. J. and Perlman, D. (1979), "Microbial Technology". Vol. 1 & 2, Academic Press
10. A. Modi, (2009). 'Fermentation Technology' Vol. 1 & 2, Pointer Publications, India.
11. Okafor Nduka (2007) "Modern Industrial Microbiology and Biotechnology", Science Publications Enfield, NH, USA.
12. Crueger W. and Crueger A. (2000) "Biotechnology -"A Textbook of Industrial
13. Microbiology", 2nd edition, Panima Publishing Corporation, New Delhi.
14. Prescott and Dunn's 'Industrial Microbiology' (1982) 4th edition, McMillan Publishers

## T. Y. B. Sc. Semester VI Syllabus

### T. Y. B. Sc. Semester VI Syllabus

#### Introduction:

This syllabus provides a comprehensive exploration of virology and immunology, bridging the gap between fundamental principles and advanced applications. It is designed to equip students with a deep understanding of viral replication, immune responses, and the therapeutic interventions used to combat infectious diseases.

The syllabus is structured into four distinct units. **Unit I** lays the foundation by examining the regulation of viral pathways using the lambda phage as a model, followed by an introduction to basic viral architecture, classification, and replication cycles. **Unit II** delves into advanced virology, covering the structure and life cycles of specific viruses like TMV, T4, and Influenza, along with techniques for viral cultivation, visualization, and enumeration. This unit also explores the role of viruses in cancer, and introduces prions and viroids.

The syllabus then transitions to immunology, beginning with **Unit III**, which focuses on general immunology. It covers the concepts of antigens and immunoglobulins, including their structure, classes, and biological activities. It further explores cytokines, the major histocompatibility complex (MHC), and antigen-presenting cells (APCs). Finally, **Unit IV** builds upon the foundational immunology by detailing T-cell and B-cell responses, various antigen-antibody reactions, and the principles of chemotherapy, including the mechanisms of action of antibiotics and their applications in treating viral, fungal, and parasitic diseases. This syllabus aims to provide a robust understanding of the intricate interactions between viruses, the immune system, and therapeutic interventions.

**Syllabus for T.Y.B. Sc. (Microbiology) Semester V and VI**  
**Choice Based Credit System**  
**Under New Education Policy (NEP) 2020**  
**(To be implemented from the academic year 2025-2026)**

**Course Structure**

**Course Code: USc6Mi1**

**Course Title: Virology and Immunology**

**Course Type: Major**

**No. of Credits: 4**

**Course Outcomes (Cos)**

<b>CO No.</b>	<b>COs Statement</b>
	<b>After completing the course, students will be able to-</b>
CO-1	<b>Explain</b> the basic structure and life cycle of different viruses and their cultivation.
CO-2	<b>Describe</b> the basic knowledge on Prions, Virioids and cancer causing viruses.
CO-3	<b>Explain</b> the the importance of cytokines, MHC, APCs, and its mechanism in formation of adaptive immunity.
CO-4	<b>Explain</b> the the mechanism of antigen –antibody reactions and it application in diagnosis of various infections
CO-5	<b>Distinguish</b> the structure & functions of immunoglobulin and its role in immune response.

Title & Content	Lectures / Semester
<p><b>Unit I: Basic Virology &amp; Regulation</b></p> <p>1.1 Introduction to viruses</p> <p>1.2 Viral architecture - Capsid, Viral genome and Envelope</p> <p>1.3 Viral classification (Baltimore classification)</p> <p>1.4 Viral replication cycle – Attachment, Penetration, Uncoating, Types of viral genome, their Replication, Assembly, Maturation &amp; Release.</p> <p>1.5 One step growth curve</p> <p>1.6 Regulation of lytic and lysogenic pathway of lambda phage</p>	<p><b>(Total 15 L)</b></p> <p><b>02</b></p> <p><b>03</b></p> <p><b>02</b></p> <p><b>04</b></p> <p><b>01</b></p> <p><b>03</b></p>
<p><b>Unit II: Advanced Virology</b></p> <p><b>1. Structure of TMV, T4, Influenza virus.</b></p> <p><b>2. Life cycle of T4 phage, TMV, Influenza Virus in detail.</b></p> <p><b>3. Cultivation of viruses-</b> Cell culture techniques, Embryonated egg, Laboratory animals, Cell culture methods: Equipment required for animal cell culture, Isolation of animal tissue.</p> <p><b>4. Visualization and enumeration of virus particles</b></p> <p><b>5. Measurement of infectious units</b> Plaque assay Fluorescent focus assay Infectious center assay Transformation assay Endpoint dilution assay.</p> <p><b>6. Measurement of virus particles and their components</b> Electron microscopy Atomic force microscopy Hemagglutination Measurement of viral enzyme activity.</p> <p><b>7. Role of viruses in Cancer:</b> Important definitions, characteristics of cancer cell, Human DNA tumor viruses- EBV, Kaposi sarcoma virus, Hepatitis B and C virus, Papiloma Virus.</p> <p><b>8. Prions:</b> Definition, Examples of diseases caused by prions, Kuru, PrP protein and protein only hypothesis</p> <p><b>9. Viroid</b></p>	<p><b>(Total 15 L)</b></p> <p><b>02 L</b></p> <p><b>03 L</b></p> <p><b>03 L</b></p> <p><b>03 L</b></p> <p><b>01 L</b></p> <p><b>01 L</b></p>

<p><b>Unit III: General Immunology</b></p> <p><b>1. Antigenes</b></p> <p>1.1 Immunogenicity versus antigenicity: Concepts - Immunogenicity, Immunogen, Antigenicity, Antigen, Haptens</p> <p>1.2 Factors that influence immunogenicity - Foreignness, Molecular size, Chemical composition, Heterogeneity, Susceptibility of antigen to be processed and presented, Contribution of the biological system to immunogenicity Genotype of the recipient, Immunogen dosage, Route of administration</p> <p><b>2. Immunoglobulins</b></p> <p>2.1 Immunoglobulins –Basic structure of Immunoglobulins, heterodimer; types of heavy and light chains; constant and variable regions, Immunoglobulin domains-hinge region. Basic concepts - hypervariable region, complementarity - determining regions (CDRs), framework regions (FRs) and their importance.</p> <p>2.2 Immunoglobulin classes and biological activities - Immunoglobulin G, Immunoglobulin M, Immunoglobulin A, Immunoglobulin E, Immunoglobulin D, (including diagrams)</p> <p>2.2.3 Monoclonal antibodies</p> <p><b>3. Cytokines</b></p> <p>3.1 Concepts cytokines, lymphokines, monokines, interleukins, chemokines.</p> <p>3.2 Properties &amp; Biological</p> <p><b>4. Major histocompatibility complex</b></p> <p>4.1 Introduction</p> <p>4.2 Three major classes of MHC encoded molecules</p> <p>4.3 The basic structure and functions of Class I and Class II MHC</p> <p><b>5. Antigen presenting cells</b></p> <p>5.1 Types of APC's</p> <p>5.2 Endogenous antigens: The Cytosolic pathway</p> <p>5.3 Exogenous antigens: The Endocytic pathway</p>	<p><b>15L</b></p> <p><b>4L</b></p> <p><b>4L</b></p> <p><b>2L</b></p> <p><b>2L</b></p> <p><b>3L</b></p>
<p><b>Unit IV Advance Immunology</b></p> <p><b>2. T cell Response</b></p> <p>2.1 T cell receptor &amp; CD3 Complex</p> <p>2.1.2 T Cell activation, differentiation &amp; Cell mediated Response</p> <p><b>2.2 B cell Response</b></p> <p>2.2.1 B cell Receptor</p> <p>2.2.2 B cell activation, differentiation &amp; humoral response</p> <p><b>3. Antigen antibody reactions</b></p> <p>3.1 Precipitation reaction -Immuno-electrophoresis</p> <p>3.2 Agglutination reaction, hemagglutination, Passive agglutination, agglutination inhibition assay</p> <p>3.3 Radioimmunoassay</p> <p>3.4 Enzyme linked immunosorbent assay (Competitive, Sandwich)</p> <p>3.5 Immuno-fluorescence Western Blotting</p>	<p><b>15 L</b></p> <p><b>3L</b></p> <p><b>3L</b></p> <p><b>4L</b></p>

<p><b>4. Chemotherapy</b></p> <p><b>4.1 Attributes of an ideal chemotherapeutic agent</b> - Selective toxicity, Bioavailability of drug, routes of drug administration, LD50, MBC, etc.</p> <p><b>4.2 Mode of action of antibiotics</b></p> <p><i>Cell wall (Beta-lactams- Penicillin and Cephalosporin 's, Carbapenems)</i></p> <p><i>Cell Membrane (Polymyxin and Imidazole)</i></p> <p><i>Protein Synthesis (Streptomycin, Tetracycline and Chloramphenicol)</i></p> <p><i>Nucleic acid (Quinolones, Nalidixic acid, Rifamycin)</i></p> <p><i>Enzyme inhibitors (Sulfa drugs, Trimethoprim)</i></p> <p><b>4.3 List of common antibiotics</b> - used for treating viral, fungal and parasitic diseases.</p>	<b>5L</b>
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Sr.No.	Title of practical's
1	Isolation of genomic DNA of E. coli and measurement of its concentration by UV-VIS
2	Enrichment of coliphages, phage assay (pilot & proper).
3	Restriction digestion of lambda phage /any plasmid DNA (Demo
4	Determination of one step growth curve of the given lysate
5	Selection and testing of antibiotics using Kirby-Bauer Method
6	Demonstration of E test.
7	Perform VDRL Test
8	Determination of MBC of an antibiotic
9	Determination of antigen/antibody concentration using single radial immuno-diffusion method

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14. A textbook of biotechnology R. C. Dubey 4<sup>th</sup> edition. S. Chand.
15. Prescott's microbiology 10<sup>th</sup> edition 2017
16. Kuby Immunology, 4<sup>th</sup> and 6<sup>th</sup> edition, W H Freeman and Company
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18. Fahim Khan, Elements of Immunology, Pearson Education
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## Reference books:

1. Flint, Enquist, Racanillo and Skalka, "Principles of virology", 2<sup>nd</sup> edition. ASM press.
2. T. K. Attwood & D. J. Parry-Smith, (2003), "Introduction to bioinformatics", Pearson education
3. Benjamin Lewin, (9<sup>th</sup> edition), "Genes IX", Jones and Bartlett publishers.
4. JD Watson, "Molecular biology of the gene", 5<sup>th</sup> edition.

## Course Structure

<b>Course Code: USc6Mi2</b>	<b>Paper 2</b>	
<b>Course Title:</b>	<b>Intermediary Metabolism and Industrial Products</b>	
<b>Course Type: Major</b>	<b>Paper 2</b>	<b>No. of Credits: 4</b>

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### Introduction:

This syllabus outlines a comprehensive study of metabolic pathways and industrial fermentation processes, focusing on the biochemistry of proteins and nucleotides, the regulation of metabolism, and the production of various commercially important products.

**Unit 1: Protein and Nucleotide Metabolism** delves into the intricate biochemical processes governing the breakdown (catabolism) and synthesis (anabolism) of proteins and nucleotides. Students will explore enzymatic degradation of proteins, general reactions of amino acids, their metabolic fates, and the fermentation of amino acid pairs. The unit further examines nucleotide biosynthesis and catabolism, including purine and pyrimidine metabolism, and the role of nucleotides in cellular energy transfer.

**Unit 2: Regulation of Metabolism and Inorganic Metabolism** focuses on the mechanisms that control metabolic pathways. This includes the study of enzyme regulation through noncovalent and covalent modifications, transcriptional regulation via operon systems (like the lactose operon), and the light and dark reactions of photosynthesis. Additionally, this unit explores the assimilation and dissimilation of inorganic compounds, such as nitrate, ammonia, sulfate, and the critical process of biological nitrogen fixation.

**Unit 3: Traditional Fermentation** transitions from cellular metabolism to applied microbiology, specifically traditional fermentation processes. Students will gain in-depth knowledge of the production of various fermented products, including wine (red, white, champagne, and sherry), beer (ale and lager), alcohol from molasses, vinegar (acetic acid), baker's yeast, and fungal amylase. This unit covers the microorganisms involved, the biochemical transformations, and the technological aspects of each fermentation process.

**Unit 4: Industrial Fermentation** expands on the principles of fermentation to industrial-scale production of valuable compounds. This unit explores the production of penicillin and semi-synthetic penicillins, aminoglycoside antibiotics like streptomycin, vitamin B12, citric acid, glutamic acid, and mushroom cultivation (*Agaricus*). Students will learn about strain development, biosynthesis, production methods, and recovery processes for these industrial products.

This syllabus aims to provide students with a strong foundation in metabolic biochemistry and industrial microbiology, equipping them with the knowledge and understanding necessary for further studies or careers in related fields.

CO. No	COs Statement	
	After completing the Bachelor of Science Program, students will be able to-	
CO1	Describe the enzymatic processes involved in protein and nucleotide degradation.	<b>BTL:</b> Remembering
CO2	Explain the mechanisms of enzyme activity regulation, including allosteric inhibition and covalent modification.	<b>BTL:</b> Understanding
CO3	Explain the principles and processes involved in the production of various traditional fermented products	<b>BTL:</b> Understanding
CO4	Explain strain development, biosynthesis, production methods, and recovery processes for industrial products.	<b>BTL:</b> Apply

Title and Content		Lecture/ Semester
<b>Unit 1: Protein, amino acid and Nucleotide metabolism</b>		
1.1	<b>Protein metabolism</b> 1.1.1 Enzymatic degradation of proteins	01 L
1.2	<b>General reactions of amino acids catalyzed by</b> 1.2.1 Amino acid decarboxylases 1.2.2 Amino acid deaminases 1.2.3 Amino acid transaminases	02 L
1.3	<b>Metabolic fate of amino acids –</b> Glucogenic and ketogenic amino acids	01 L
1.4	<b>Fermentation of pair of amino acids –</b> Stickland reaction (include enzymes)	01 L
1.5	<b>Anabolism of amino acids</b> 1.5.1 Schematic representation of amino acid families 1.5.2 Biosynthesis of amino acids of Serine family (Serine, Glycine and Cysteine)	03 L
1.6	<b>Catabolism of Nucleotides</b> 1.6.1 Degradation of purine nucleotides up to uric acid formation 1.6.2 Salvage pathway for purine and pyrimidine nucleotides	02 L
1.7	<b>Biosynthesis of nucleotides</b> 1.7.1 Nomenclature and structure of nucleotides 1.7.2 Role of nucleotides (high energy triphosphates) 1.7.3 Biosynthesis of pyrimidine nucleotides 1.7.4 Biosynthesis of purine nucleotides 1.7.5 Biosynthesis of deoxyribonucleotides 1.7.6 Mechanism of ribonucleotide reductase	05 L

	<b>Unit 2: Inorganic Metabolism and Regulation of Metabolism</b>	15
2.1	<b>Definition of terms and major modes of regulation</b>	01 L
2.2	<b>2.2 Regulation of enzyme activity</b> <b>2.2.1 Noncovalent enzyme inhibition</b> 2.2.1.1 Allosteric enzymes and feedback inhibition 2.2.1.2 Patterns of FBI, combined activation and inhibition <b>2.2.2 Covalent modification of enzymes</b> 2.2.2.1 Monocyclic cascades 2.2.2.2 Examples of covalent modification (without structures) 2.2.2.3 Regulation of Glutamine synthetase	05 L
2.3	<b>Regulation at the level of transcription</b> 2.3.1 Concept of Positive & Negative control, Inducible and Repressible Operon 2.3.2 Regulation of Lactose Operon: Negative Regulation 2.3.3 Catabolite repression	03 L
2.4	<b>Light reactions in:</b> (Schematic) 2.4.1 Purple photosynthetic bacteria 2.4.2 Green Sulphur bacteria 2.4.3 Cyanobacteria	01L
2.5	<b>Dark reaction</b> 2.5.1 Calvin Benson cycle 2.5.2 Reductive TCA cycle	02L
2.6	<b>Inorganic Metabolism</b> <b>2.6.1 Assimilatory pathways:</b> 2.6.1.1 Assimilation of nitrate, 2.6.1.2 Ammonia fixation – Glutamate dehydrogenase, Glutamine synthetase, GS-GOGAT, Carbamoyl phosphate synthetase 2.6.1.3 Biological nitrogen fixation (Mechanism for N <sub>2</sub> fixation and protection of nitrogenase) 2.6.1.4 Assimilation of sulphate <b>2.6.2 Dissimilatory pathways:</b> 2.6.2.1 Nitrate as an electron acceptor (Denitrification in <i>Paracoccus denitrificans</i> ) 2.6.2.2 Sulphate as an electron acceptor	05 L

<b>Unit 3-Traditional fermentation</b>		
3.1	<p><b>Wine –</b>  Red, White, Champagne and Sherry:  Alcoholic fermentation,  Composition of grape juice,  Sulphur dioxide addition,  Factors affecting wine fermentation,  Examples and role of yeasts involved in fermentation, Malolactic fermentation,  Technological aspects of wine making- red, white, champagne, sherry  Examples of aroma compounds of wine, types and examples of wine.</p>	03L
3.2	<p><b>Beer –</b>  Ale and Lager: Elements of brewing process,  Process details,  Use of cylindro-conical vessel,  Primary fermentation,  Continuous fermentation,  Aging and finishing,  Yeasts involved in fermentation</p>	03L
3.3	<p><b>Alcohol from Molasses:</b>  Introduction,  Biosynthesis of ethanol,  Production process-  preparation of nutrient solution,  Fermentation,  Recovery by distillation.</p>	03L
3.4	<p><b>Vinegar (acetic acid):</b>  Introduction,  Biosynthesis,  Production using generator,  Production using submerged fermenter,  Recovery.</p>	02L
3.5	<p><b>Baker's Yeast:</b>  Outline of production,  Yeast strains and their properties,  Factors important in production-oxygen requirement and aeration,  <ul style="list-style-type: none"> <li>○ Concentration of sugar,</li> <li>○ pH,</li> <li>○ Temperature,</li> <li>○ Preparation of substrate,</li> </ul> Fermentation,  Harvesting of yeast cells, and production of compressed and active dry yeast.</p>	03L
3.6	<p><b>Soya sauce</b></p>	01L

Title and Content	Lecture/ Semester	
<b>Unit 4-Industrial fermentation</b>		
4.1	<b>Penicillin and semisynthetic Penicillin:</b> <ul style="list-style-type: none"> <li>○ Introduction</li> <li>○ Biosynthesis and regulation</li> <li>○ Strain development</li> <li>○ Production methods.</li> <li>○ Semisynthetic penicillin: Examples, production, advantages</li> </ul>	03L
4.2	<b>Aminoglycoside: Streptomycin:</b> <ul style="list-style-type: none"> <li>○ Aminoglycoside antibiotic</li> <li>○ Biosynthesis</li> <li>○ Regulation of biosynthesis</li> <li>○ Strain development</li> <li>○ Production method</li> <li>○ Recovery</li> </ul>	04L
4.3	<b>Vitamin B 12:</b> <ul style="list-style-type: none"> <li>○ Occurrence and economic significance,</li> <li>○ Structure,</li> <li>○ Biosynthesis,</li> <li>○ Production based on media containing carbohydrates by <i>Propionibacterium</i> and <i>Pseudomonas</i>,</li> <li>○ Recovery</li> </ul>	02L
4.4	<b>Citric acid:</b> <ul style="list-style-type: none"> <li>○ Introduction,</li> <li>○ Strains used for production,</li> <li>○ Biosynthesis,</li> <li>○ Nutrient media,</li> <li>○ Production processes- surface and submerged,</li> <li>○ Product recovery</li> </ul>	04L
4.5	<b>Glutamic acid:</b> <ul style="list-style-type: none"> <li>○ Production strains,</li> <li>○ Biosynthesis,</li> <li>○ Effect of permeability on production,</li> <li>○ Production process and recovery.</li> </ul>	02L
4.6	<b>Fungal amylase production:</b> <ul style="list-style-type: none"> <li>○ Amylase production – bacteria and Fungi</li> <li>○ Amylase and glucoamylase, concentration and purification</li> </ul>	02L

**Practical based on paper 2    Credit 1    Number of hrs. / weeks    04**

Sr. No	Name of the Practical
	<ol style="list-style-type: none"><li>1) Isolation of protease producing bacteria and determination of protease activity.</li><li>2) Estimation of uric acid</li><li>3) Demonstration of catabolite repression (diauxic growth curve).</li><li>4) Oxidative and fermentative metabolism</li><li>5) Isolation of chloroplast and determine its presence.</li><li>6) Demonstration of laboratory alcohol production using jaggery medium, calculation of efficiency of fermentation.</li><li>7) Chemical estimation of sugar by Cole's ferricyanide method</li><li>8) Chemical estimation of alcohol by dichromate method.</li><li>9) Bioassay of an antibiotic – Penicillin (Tube method)</li><li>10) Bioassay of Cyanocobalamin (Vitamin B12)</li></ol>

#### **References**

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10. Dubey, R. C., A textbook of biotechnology, 4th edition, S. Chand.

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15. Stanbury P. F., Whitaker A. & Hall S. J., (2017) "Principles of Fermentation Technology", 3rd Edition.



Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**

**Arts, Commerce and Science College, New Panvel (Autonomous)**

Re-accredited A++ Grade by NAAC (Fourth Cycle-CGPA-3.52)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**Title of the Programme**

**B. Sc. in Microbiology**

**(Faculty of Science)**

**Syllabus for T.Y.B.Sc. (Microbiology)**

**Semester V**

*(With effect from the academic year 2025-26)*

## Course Structure

**Course Code: USC5VSC**

**Course Title: Essential Skills in Microbiology**

**Course Type: VSC**

**No. of Credits: 4**

### Introduction

The field of microbiology encompasses the study of microorganisms, including bacteria, viruses, fungi, and protozoa. These tiny organisms play crucial roles in various ecosystems, human health, and industrial processes. To understand and manipulate these microorganisms effectively, it is essential to acquire a diverse set of skills and techniques. This course is designed to provide students with hands-on experience in essential microbiological, molecular biology, biochemical, and biophysical techniques. Through a series of carefully structured experiments, students will gain practical knowledge and proficiency in preparing media, isolating and analyzing biomolecules, and utilizing advanced analytical instruments.

### Objectives

The primary objectives of this course are to:

#### 1. Develop Fundamental Microbiological Skills:

- Equip students with the ability to prepare and sterilize different types of media, ensuring the growth and maintenance of microbial cultures.
- Train students in the use of microscopy techniques, including digital imaging, to observe and document microbial structures and behaviors.
- Introduce students to the study of biofilm formation and degradation, highlighting its significance in medical and industrial contexts.

#### 2. Enhance Molecular Biology Competence:

- Provide hands-on experience in isolating and purifying extracellular proteins, utilizing techniques such as centrifugation, salting out, dialysis, and electrophoresis.
- Teach students the methods for extracting, fragmenting, and analyzing DNA from various sources, including bacterial, plant, and animal cells.
- Familiarize students with polymerase chain reaction (PCR) techniques for DNA amplification and the extraction and separation of lipids using advanced apparatus.

#### 3. Strengthen Biochemical Methodologies:

- Enable students to prepare various chemical solutions and buffers, using precise laboratory equipment and techniques.

- Guide students through enzyme kinetics studies, focusing on enzyme inhibition and its implications.
- Instruct students in the estimation of organic nitrogen content using the Micro-Kjeldahl method, a fundamental biochemical analysis.

#### 4. Master Biophysical Analytical Techniques:

- Teach students to verify Beer's Law and determine absorption maxima using spectrophotometry.
- Introduce the identification of microbial metabolites using Fourier Transform Infrared Spectroscopy (FTIR).
- Train students in measuring metal ion concentrations in microbial cultures using Atomic Absorption Spectroscopy (AAS).
- Provide experience in analyzing volatile organic compounds (VOCs) produced by microbes using Gas Chromatography (GC).
- Demonstrate the use of High-Performance Liquid Chromatography (HPLC) for analytical purposes.
- Guide students in the purification of microbial enzymes and the separation of plant pigments using column chromatography.

By the end of this course, students will have acquired a comprehensive set of skills and techniques essential for advanced studies and careers in microbiology, molecular biology, biochemistry, and related fields. This practical knowledge will enable them to conduct independent research, contribute to scientific advancements, and apply their expertise in various professional settings.

### Course Outcomes (Cos)

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Demonstrate Proficiency in Microbiological Techniques
CO-2	Apply Molecular Biology Methods
CO-3	Execute Biochemical Procedures
CO-4	Utilize Biophysical Techniques

## Course Structure

**Course Code: USC5VSC**

**Course Title: Essential Skills in Microbiology**

**Course Type: VSC**

**No. of Credits: 4**

Unit.	Topic	Hours
<b>Unit 1</b>	<b>Essential Skills in Microbiology</b>	
	<ul style="list-style-type: none"> <li>Preparation of complex media, synthetic media (Simple and Differential), Sterilization by Autoclave, Sterilization by filtration.</li> <li>SOPs for media preparation and sterilization</li> </ul>	08
	<ul style="list-style-type: none"> <li>Microscopy using <b>camera and software</b>.</li> </ul>	04
	<ul style="list-style-type: none"> <li>Study of Bacterial Biofilm formation detection by Crystal violet staining assay.</li> </ul>	04
	<ul style="list-style-type: none"> <li>Production of enzymes/secondary metabolite/cells using fermenter (bioreactor), sampling, analysis and downstream processing.</li> </ul>	08
	<ul style="list-style-type: none"> <li>Rapid Diagnostic Serological Tests (Dengue, Tridot)</li> </ul>	04
	<b>Unit 2 Essential Skills in Molecular biology</b>	
	<p><b>Proteins:</b></p> <ul style="list-style-type: none"> <li>Isolation and Purification of Extracellular Protein (enzymes): Centrifugation, Salting Out, Dialysis, Polyacrylamide Gel Electrophoresis</li> </ul>	12
	<p><b>Nucleic Acids:</b></p> <ul style="list-style-type: none"> <li>Extraction of Bacterial/Plant cell/animal cell DNA.</li> <li>DNA fragmentation using restriction endonucleases and</li> <li>Separation by agarose gel electrophoresis.</li> <li>Determination of size of fragments.</li> <li>Polymerization of DNA fragment using PCR.</li> </ul>	12
	<p><b>Lipids</b></p> <ul style="list-style-type: none"> <li>Extraction of lipid from herbal plants using Soxhlet apparatus.</li> <li>Separation of TLC.</li> </ul>	06

<b>Essential Skills in Biochemistry</b>		
	Preparation of solutions (Molar, Normal, ppm, ppb, % V/V, %wt/Vol), Phosphate, Tris-HCl and acetate Buffer preparation (Use of Volumetric Flasks, Balance, Pipetting aids, distillation assemble, pH meter)	08
	Study of enzyme inhibition using Enzyme Kinetics	12
	Estimation of Organic Nitrogen using Micro-Kjeldahl method.	04
<b>Essential skills in Biophysical techniques</b>		
	Verification of Beer's law and determination of Absorption Maxima.	04
	Identification of metabolites produced by microbes using Fourier Transform Infrared Spectroscopy (FTIR)	04
	Determination of Metal Ion Concentration in Microbial Cultures using Atomic Absorption Spectroscopy (AAS)	04
	Analysis of Volatile Organic Compounds (VOCs) Produced by Microbes using Gas-Chromatography (GC)	04
	HPLC (Demonstration)	04
	Extraction of intracellular proteins using ultra sonicator.	04
	Purification of Microbial Enzymes / Separation of plant pigments using Column Chromatography.	04
	Photo bioreactor	02



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**As per National Education Policy - 2020**

**Title of the Programme**

**B. Sc. in Microbiology**

**(Faculty of Science)**

**Syllabus for T. Y. B. Sc. (Microbiology)**

**Elective Course**

**Semester V and VI**

*(With effect from the academic year 2025-26)*



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**As per National Education Policy - 2020**

Sr. No.	Heading	Particulars
1	Title of program	<b>B. Sc. in Microbiology</b>
2	Eligibility	Students must have earned mandatory credits of Microbiology.
3	Duration of program	3 Years for Degree & 4 Years for Honors
4	Intake Capacity	45
5	Scheme of Examination	60:40 for theory; 100 for practical
6	Standards of Passing	40%
7	Semesters	02
8	Program Academic Level	5.5
9	Pattern	Revised as per NEP 2020
10	Status	Approved by BOS and Academic Council
11	To be implemented from Academic Year	Academic Year 2025-26

**Signature of**

**Mr. N. C. Vadnere**  
Head, Department of Microbiology  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)

**Signature of**

**Prof. (Dr.) S.K. Patil**  
Principal  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

## **Preamble**

### **1) Introduction**

This course is designed to equip learner with a basic knowledge on basic techniques used in biotechnology, gene transfer techniques to develop transgenic animals for human welfare and the microbial products and their commercialization for benefit of the society. This course also provides insights on development of plants resistant to biotic and abiotic stress conditions as well as modification of plant nutrient content for human consumption. This course also provides details on diagnostic as well as therapeutic molecules for human/animal application. Through lectures, discussions, and engaging activities, demonstration (if possible) learner will gain a comprehensive understanding of essential concepts.



Janardan Bhagat Shikshan Prasarak Sanstha's  
**CHANGU KANA THAKUR**



**Arts, Commerce and Science College, New Panvel (Autonomous)**

**Syllabus for T.Y.B. Sc. (Microbiology) Semester V**

**Choice Based Credit System**

**Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2025-2026)**

**Course Structure**

**Course Code: USC5E1**

**Semester: V**

**Course Title: Introduction to Biotechnology**

**Course Type: Elective**

**No. of Credits: 04**

**(03 Theory & 01 Practical)**

**Course Outcomes (Cos)**

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	<b>Explain</b> principle and application of molecular techniques in biotechnology
CO-2	<b>Describe gene transfer techniques and application in animals</b>
CO-3	<b>Apply knowledge to synthesize industrially important products</b>

Unit	Topic Name	No. of Lectures
<b>Basic Techniques in Biotechnology - I</b>	Principle and application	
	1. Agarose gel electrophoresis	01
	2. Polyacrylamide gel electrophoresis – Types	01
	3. Two dimensional gel electrophoresis	01
	4. Pulse field gel electrophoresis	01
	5. DNA sequencing methods	02
	6. DNA Microarrays	02
	7. Fluorescent <i>in situ</i> hybridization	01
	8. Genomic <i>in situ</i> hybridization	01
	9. Southern blotting	01
	10. Northern blotting	01
	11. Western blotting	01
	12. Polymerase chain reaction	01
<b>Animal Biotechnology - II</b>	Transgenic Mice	
	1. Methodology: The retroviral Vector method	02
	2. The DNA microinjection method	01
	3. The engineering embryonic stem cell method	02
	4. Genetic modification with the Cre-lox P recombination system	02
	5. RNA interference	01
	6. Transgenesis with high capacity vectors.	02
Transgenic mice applications		
1. Transgenic disease models: Alzheimer disease	02	

	2. Using Transgenic mice as test systems	01
	3. Conditional regulation of transgene expression	01
	4. Conditional control of cell death.	01
<b>Industrial and Marine Biotechnology - III</b>	Industrial Biotechnology	
	1. Synthesis of Novel Antibiotics – Engineering polykatid antibiotics	01
	Production of SCP –	
	1. Yeast	01
	2. Spirulina	01
	3. Mushroom	01
	Production of Biopolymers	
	1. Xanthan Gum	01
	2. Melanin	01
	3. Adhesive Protein	01
	4. Rubber	01
5. Polyhydroxyalkanoates	01	
6. Hyaluronic Acid	01	
Marine Biotechnology		
1. Marine Microbial Habitats and Their Biotechnologically relevant Microorganisms	02	
2. Methods for Microbial Bio-prospecting in Marine Environments	02	
3. Biotechnological Potential of Marine Microbes	01	

#### Practical

1. Separation and detection of DNA fragments using Agarose gel electrophoresis
2. Separation of proteins using SDS- Polyacrylamide gel electrophoresis (Demonstration)
3. Polymerase chain reaction - Demonstration
4. Production of Microbial polysaccharide and determination of yield
5. Cultivation of Edible mushroom, yeast
6. Isolation of marine microorganisms
7. Research project (Proposal Writing)/Case studies

#### References

1. Upadhyay, Upadhyay and Nath, 2012, Biophysical Chemistry: Principles and Techniques, Mumbai, Himalaya Publishing House
2. Skoog, Holler and Nieman, Principles of Instrumental Analysis, 5th Ed. Australia, Thomson Brock/Cole
3. Elements of Biotechnology: 2009 PK Gupta, Rastogi Publications Edition 2nd ,
4. Bernard R Glick and Jack J Pasternak. Molecular Biotechnology: Principles and Applications of recombinant DNA. 4th Edition.
5. Primrose and others. Principles of Gene manipulations. 7th edition. 2004 Blackwell Science.
6. Peter J. Russell 2006, "Genetics-A molecular approach", 3rd edition.
7. R. C. Bubey. A Taxy book of Biotechnology. 2006 S. Chand and Company Ltd.
8. B. D. Singh. Biotechnology. Kalyani Publishers.
9. Marine biotechnology in the twenty-first century-Problems, promise, and products, National academy press



**Syllabus for T.Y.B. Sc. (Microbiology) Semester VI**

**Choice Based Credit System**

**Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2025-2026)**

**Course Structure**

**Course Code:**

**Semester: VI**

**Course Title: Applied Biotechnology**

**Course Type: Elective**

**No. of Credits: 04**

**(03 Theory & 01 Practical)**

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	<b>Explain</b> genetic engineering techniques in plants
CO-2	<b>Apply</b> knowledge of molecular techniques in diagnostics
CO-3	<b>Describe</b> the role of nucleic acids and proteins in therapeutics

Unit	Topic Name	No. of Lectures
<b>Plant Biotechnology - I</b>	Genetic engineering of Plants	
	1. Plant transformation with Ti plasmids of <i>A. tumefaciens</i>	02
	2. Physical methods of transferring genes to plants	
	Uses of genetically engineered plants	02
	1. To overcome Biotic and abiotic stress	
	2. Insect resistance: Increasing expression of the <i>Bacillus thuringiensis</i> protoxin	01
	3. Other strategies for protecting plants against insects,	01
	4. Preventing the development of <i>Bacillus thuringiensis</i> resistant insects	02
	5. Herbicide resistant plants	
	6. Oxidative stress	02
7. Salt and drought stress	01	
8. Modification of plant nutritional content: Vitamin A	02	
<b>Molecular Diagnostics - II</b>	<b>Monoclonal antibodies</b>	01
	1. Formation and Selection of Hybrid Cells	
	2. Identification of Specific Antibody Producing Hybrid Cell Lines	01
	<b>Biofluorescent and Bioluminescent systems</b>	
	1. Luciferase	
	2. Microbial Biosensors	01
	<b>Nucleic acid diagnostic systems</b>	01
	1. Hybridization Probes	
	2. Diagnosis of Malaria	01

	3. Detection of <i>T. cruzi</i> 4. Nonradioactive Hybridization Procedures 5. Molecular Beacons 6. DNA Fingerprinting 7. RAPD 8. Real Time Polymerase chain reaction <b>Molecular Diagnosis of Genetic Disease</b> 1. Screening for Cystic Fibrosis 2. Sickle-Cell Anemia	01 01 01 01 01 01 01 01 01
<b>Nucleic acid and Protein Therapeutics - III</b>	<p style="text-align: center;">Nucleic acids as therapeutics</p> 1. Antisense Oligonucleotides 2. Ribozymes 3. Aptamers 4. Interfering RNA 5. Human gene therapy <p style="text-align: center;">Proteins as therapeutics</p> Pharmaceuticals 1. Isolation of Interferon cDNAs 2. Human Interferons 3. Human Growth Hormone 4. Monoclonal antibodies Enzymes 1. DNase I 2. Alginate Lyase 3. Phenylalanine Ammonia Lyase	01 02 02 02 01  01 02 01 01  01 01 01

#### Practical

1. Isolation of cellulase producing microorganisms and determination of cellulase activity
2. Plant tissue culture callus formation - Demonstration
3. Immobilization of *Saccharomyces cerevisiae* using alginate and invertase assay
4. Isolation of bioluminescent bacteria
5. Isolation of halo tolerant bacteria from mangrove ecosystem
6. Diagnosis of malaria parasite
7. Assignment on Molecular Diagnostics
8. Research project (Report Writing)/Case studies

#### References

1. Elements of Biotechnology: 2009 PK Gupta, Rastogi Publications Edition 2nd ,
2. Bernard R Glick and Jack J Pasternak. Molecular Biotechnology: Principles and Applications of recombinant DNA. 4th Edition.
3. Primrose and others. Principles of Gene manipulations. 7th edition. 2004 Blackwell Science.
4. Peter J. Russell 2006, "Genetics-A molecular approach", 3rd edition.
5. R. C. Bubey. A Taxy book of Biotechnology. 2006 S. Chand and Company Ltd.
6. B. D. Singh. Biotechnology. Kalyani Publishers.



Janardan Bhagat Shikshan Prasarak Sanstha's

**CHANGU KANA THAKUR**

**Arts, Commerce and Science College, New Panvel (Autonomous)**

Re-accredited A++ Grade by NAAC (Fourth Cycle – CGPA - 3.52)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

**As per National Education Policy - 2020**

**Title of the Programme**

**B. Sc. in Microbiology**

**(Faculty of Science)**

**Syllabus for T. Y. B. Sc. (Microbiology)**

**Minor Course**

**Semester V and VI**

*(With effect from the academic year 2025-26)*



**Janardan Bhagat Shikshan Prasarak Sanstha's  
CHANGU KANA THAKUR  
Arts, Commerce and Science College, New Panvel (Autonomous)**



**As per National Education Policy - 2020**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Title of program</b>	<b>B. Sc. in Microbiology</b>
<b>2</b>	<b>Eligibility</b>	Students must have earned mandatory credits of Microbiology.
<b>3</b>	<b>Duration of program</b>	3 Years for Degree & 4 Years for Honors
<b>4</b>	<b>Intake Capacity</b>	25
<b>5</b>	<b>Scheme of Examination</b>	60:40
<b>6</b>	<b>Standards of Passing</b>	40%
<b>7</b>	<b>Semesters</b>	V & VI
<b>8</b>	<b>Program Academic Level</b>	5.5
<b>9</b>	<b>Pattern</b>	Revised as per NEP 2020
<b>10</b>	<b>Status</b>	Approved by BOS and Academic Council
<b>11</b>	<b>To be implemented from Academic Year</b>	Academic Year 2025-26

**Signature of**

**Mr. N. C. Vadnere**  
Head, Department of Microbiology  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)

**Signature of**

**Prof. (Dr.) S.K. Patil**  
Principal  
Changu Kana Thakur  
A.C.S. College, New Panvel  
(Autonomous)



**Janardan Bhagat Shikshan Prasarak Sanstha's  
CHANGU KANA THAKUR  
Arts, Commerce and Science College, New Panvel (Autonomous)**



**Preamble**

**1) Introduction**

This course is designed to equip learner with a basic knowledge on genetics, biochemistry, medical microbiology and industrial microbiology. This course provides detailed insights on chromosomal arrangement, structures of DNA, metabolic process, medical and industrial processes. Through lectures, discussions, and engaging activities, demonstration (if possible) learner will gain a comprehensive understanding of essential concepts.

**Course Structure  
(Credits – 02 Theory and 02 Practical)**

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	<b>Recall and describe</b> the structural organization of chromosomes
CO-2	<b>Identify</b> different types of DNA structures (e.g., B-DNA, Z-DNA).
CO-3	<b>Distinguish</b> between anabolism and catabolism
CO-4	<b>Explain</b> the mechanism of enzyme action and factors influencing it

Unit	Topic Name	No. of Lectures
<b>Introduction to Genetics - I</b>	DNA is the genetic material	01
	Nucleic acid structure (Watson and Crick Model)	02
	DNA can occur in different 3D forms (A, B, Z)	02
	RNA and its types	01
	Structural organization of chromosomes 1. Centromeres, telomeres and repetitive DNA 2. Packaging DNA molecules into chromosomes 3. Concept of euchromatin and heterochromatin	05
	Central dogma	01
	Genetics in the World: Applications of Genetics to Human Endeavours	03

<b>Introduction to Biochemistry - II</b>	Metabolism – Anabolism and Catabolism and the link between them	01
	Five principles of metabolism	01
	Types of metabolic pathways	01
	Metabolic pathways: EMP pathway and TCA cycle	02
	Structure and properties of ATP	01
	First and second laws of Thermodynamics.	02
	Definitions of Gibb's Free Energy, enthalpy and Entropy	
	General properties of enzymes	01
	Structure of enzyme: apoenzyme, cofactors, prosthetic group, coenzyme and metal	02
	Classification of enzymes	01
Mechanism of action of enzymes	01	
Effect of pH and temperature on enzyme activity	02	

### Practical

Name of Practical	Hours
1. Isolation of DNA from <i>E. coli</i> / Onion and detect its presence by DPA method	6
2. Resolution and visualization of DNA by Agarose Gel Electrophoresis	6
3. Estimation of DNA by UV-Visible spectrophotometer	4
4. Estimation of RNA by Orcinol method	4
5. Qualitative tests for carbohydrates - reducing sugars and non-reducing sugars	3
6. Estimation of reducing sugar by DNSA method.	3
7. Study the effect of pH on enzyme activity	4
8. Study the effect of temperature on enzyme activity	4
9. Production and partial purification of amylase enzyme	8
10. Production of citric acid and its estimation.	8
11. Estimation of protein by Lowry's method.	4
12. Problems on Thermodynamics	4

### Reference

- Jocelyn E. Krebs University of Alaska, Anchorage Elliott S. Goldstein, (2018), Lewin's Genes XII.
- Terry Brown (2012), Introduction to genetics – A Molecular Approach.
- Snustad and Simmons, (2012), Principles of Genetics, Sixth Edition
- Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10<sup>th</sup> Edition.
- Campbell, MK (2012) Biochemistry, 7<sup>th</sup> ed., Published by Cengage Learning.
- David L. Nelson and Michael M. Cox (2021) Lehninger Principles of Biochemistry: International Edition. 8<sup>th</sup> Edition.
- Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
- Jeremy Berg, Gregory Gatto Jr., Justin Hines, John L. Tymoczko, Lubert Stryer, (2023), Biochemistry, Tenth Edition.

**Syllabus for T.Y.B. Sc. (Microbiology) Semester VI**

**Choice Based Credit System  
Under New Education Policy (NEP) 2020**

**(To be implemented from the academic year 2025-2026)**

**Course Structure**

**Course Code: USC6MIN**

**Course Title: Introduction to Medical and Industrial Microbiology**

**Course Type: Minor**

**No. of Credits: 4  
(Theory 2; Practical 2)**

**Course Outcomes (Cos)**

<b>CO No.</b>	<b>COs Statement</b>
	<b>After completing the Bachelor of Science Program, students will be able to-</b>
CO-1	<b>Describe</b> the basic concept of host defense against pathogens.
CO-2	<b>Analyze</b> microbial factors contributing to infection, including adherence, invasion, and the role of virulence factors.
CO-3	<b>Explain</b> the methods used for isolating industrially important microorganisms.
CO-4	<b>Explain</b> the production processes of selected primary and secondary metabolites.

**Course Code: USc6MiEM2**

**Course Title: Introduction to Medical and Industrial Microbiology**

**Unit I: Introduction of Medical Microbiology**

**Unit II: Introduction to Industrial Microbiology**

<b>Unit. Subunit</b>	<b>Topic</b>	<b>Lectures</b>
<b>1</b>	<b>Introduction of Medical Microbiology</b>	<b>15</b>
<b>Unit 1</b>	<b>Difference between infection &amp; Disease.</b> Important terminology: Primary infection, secondary infection. Contagious infection, occupational disorder, clinical infection, subclinical infection, Zoonoses, genetic disorder, vector borne infection, virulence, pathogen & herd immunity.	02
	<b>Factors affecting infection:</b> i) Microbial factors: adherence, invasion, role of virulence factors in invasion, microbial enzymes & toxins, bacterial colonization & its effects. ii) Host factors: natural resistance, species resistance, racial resistance.	03
	<b>Individual resistance:</b> Factors influencing individual resistance: Age, nutrition, personal hygiene, stress, hormones, Addiction to drugs/ alcohol. Interaction between Microbes & host is dynamic.	03
	<b>Host defense against infection: Overview</b> i) First line of Defense: for skin, respiratory tract, gastrointestinal tract, genitourinary tract, eyes. ii) Second line of defense: Biological barriers: Phagocytosis, Inflammation iii) Third line of defense: Brief introduction to antibody mediated & cell mediated immunity.	07

<b>Unit 2</b>	<b>Introduction to Industrial Microbiology</b>	
	<b>Microbial Strains used for fermentations: -</b>	03
	i) Isolation of industrially important microorganisms ii) Improvement of industrial microorganisms	
	<b>Introduction to the concept of media sterilization: -</b>	02
	<b>Design and types of fermenter: -</b>	05
	i. Acetator ii. Stirred tank fermenter iii. Cavitator iv. Air lift fermenters v. Photobioreactor	
	<b>Production of primary and secondary metabolites-</b> i. Antibiotics- Penicillin & Semisynthetic Penicillin ii. Bioethanol production iii. Organic acids- Citric acid iv. Lactic acid starter cultures, Probiotics, Prebiotics and Synbiotics	05

**References: -**

1. Microbiology by Pelczar, M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hills Publication).
2. Fundamental Principles of bacteriology by A. J. Salle, Tata McGraw Hill.
3. Fundamentals of Microbiology by Frobisher, Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition.
4. General Microbiology by Stanier R. Y. Vth edition, McMillan, London.
5. Microbiology by Prescott, Herley and Klein, IInd edition.
6. Crueger W. and Crueger A. (2000) "Biotechnology -"A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing Corporation, New Delhi.
7. Casida L. E., "Industrial Microbiology 2009 Reprint, New Age International (P) Ltd, Publishers, New Delhi
8. H. A. Modi, 2009. 'Fermentation Technology ' 'Vol: 1 & 2, Pointer Publications, India
9. Prescott and Dunn's 'Industrial Microbiology' (1982) 4th Edition, McMillan Publishers
10. Hugo & Russell's, Pharmaceutical Microbiology Blackwell Science, Seventh Edition

**Course Code: USc6MiEM1P**

**Course Title: Practical based on Elementary Microbiology - I**

**Course Type: Minor**

**No. of**

**Credits: 1**

CO No.	COs Statement
	After completing the Bachelor of Science Program, students will be able to-
CO-1	Apply knowledge for enhancing laboratory skills while working in microbiology.
CO-2	Employ skills to stain and observe microbes under microscope.
CO-3	Demonstrate proper handling of microbial cultures and pathogens.
CO-4	Demonstrate skills for production fermented food products.

Sr. No.	Experiment (30 Hours)	Hrs.
01	Isolation of normal flora of the Skin & Saliva	4
02	Isolation of <i>E. coli</i> , <i>S. aureus</i> , and <i>Salmonella</i> on suitable media	4
03	Study of virulence factors – Enzyme Hemolysin	4
04	Study of virulence factors – Enzyme Lecithinase	4
05	Study of virulence factors – Peroxidase	4
06	Rapid detection of infection from blood sample	4
07	Alcohol tolerance for yeast	6
08	Sugar tolerance for yeast	6
09	Bioassay of an antibiotic penicillin (tube method)	12
10	Alcohol fermentation: Determination of fermentation efficiency	6
12	Production of fungal Citric Acid	6