Department of Microbiology

National Education Policy 2020 Frame work for Under Graduation Programme

Semester	Main Courses			Elective (DSE)	Open Elective	VSC	SEC	AEC	IKS	VEC	CC	OJT	FP/CEP	Total Credits	No. of Courses
	1	2	3												
F. Y. B. Sc. Level 4.5															
I	3 + 1	3 + 1	3 + 1	0	0	0	2	2	2	2	2	0	0	22	8
II	4	4	4	0	2	0	2	2	0	2	2	0	0	22	8
S. Y. B. Sc. Level 5.0															
	Major	Minor													
III	8 (3+3+2)	4 (2+2)		0	4/2+2	0	2	2	0	0	2	0	0	22	8/9
IV	8 (3+3+2)	4 (2+2)		0	4/2+2	0	0	2	0	0	2	0	0 CEP	22	8/9
T. Y. B. Sc. Level 5.5															
V	12	2		2	0	4	0	0	0	0	0	0	2 FP	22	7
VI	12	0		2	0	4	0	0	0	0	0	4	0	22	6
TOTAL	**48**	**18**	**8**	**4**	**10**	**8**	**6**	**8**	**2**	**4**	**8**	**4**	**4**	**132**	

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)

As per National Education Policy - 2020

Sr. No.	Heading	Particulars
1	**Title of program**	**B. Sc. in Microbiology**
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

Name
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)

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
A	***Discipline Specific Courses***		***A***	***Discipline Specific Courses***	
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	**Indian Knowledge System**		***C***	***Open Elective (Any one from the OE List)***	
4	Indian Knowledge System (Generic)	02	4	Give your preference of choice to subjects from Basket of OE for F.Y.B.Sc.	02
D	***Skill Enhancement Course***		***D***	***Skill Enhancement Course***	
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
E	***Ability Enhancement Courses***		**E**	***Ability Enhancement Courses***	
6	Communication Skill – Hindi/ Marathi	02	6	Communication Skill – Hindi/ Marathi	02
F	**Value Education Course**		**F**	**Value Education Course**	
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
G	**Co-curricular Course**			**Co-curricular Course**	
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
Total Credits		**22**	**Total Credits**		**22**

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

Program Specific Outcomes (PSOs)

PSO No.	PSOs Statement
	After completing the Bachelor of Science Program, students will be able to-
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

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)

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

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

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

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.

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	**Explain** the preservation methods used to store the microbial culture.
CO-2	**Describe** the types of physicochemical methods used control the growth of microorganisms.
CO-3	**Explain** the role of microbial association among the living things for the survival.
CO-4	**Distinguish** the microbial flora found around as well as inside the human body.
CO-5	**Explain** the microbial diversity found around the globe.
CO-6	**Distinguish** 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
Unit 1	**Preservation and Control of Microorganisms**	**15**
	A. Preservation of Microorganisms-	**02**
	a) Preservation Techniques for microorganisms	
	b) Culture Collection Centre	
	B. Control of Microorganisms-	**02**
	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	
	C. Physical methods of microbial control-	**06**
	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	
	D. Chemical methods of microbial control - Mechanism, Advantages & Disadvantages (if any) applications.	**05**
	a) Phenolics	
	b) Alcohols	
	c) Heavy metals and their compounds	
	d) Halogens	
	e) Quaternary ammonium compounds	
	f) Halogens	
	g) Dyes	
	h) Surfaces active agents/Detergents	
	i) Aldehydes	
	j) Peroxygens	

Unit 2	**Microbial Interactions**	**15**
Unit 2	**A. Types of Microbial Interactions**	**02**
	Mutualism, Cooperation, Commensalisms, Predation Parasitism, Amensalism, Competition	
	B. Human Microbe Interactions	**07**
	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	
	C. Microbial associations with vascular plants	**06**
	a) Phyllosphere	
	b) Rhizosphere & Rhizoplane	
	c) Mycorrhizae	
	d) Nitrogen fixation: Rhizobia, Actinorhizae, Stem Nodulating *Rhizobia*	
	e) Fungal & Bacterial endophytes	
	f) *Agrobacterium* & other plant pathogens	
Unit 3	**Study of different groups of microbes.**	**15**
Unit 3	**A. Nature and Properties of Viruses-**	**04**
	a) Introduction: Discovery of viruses, nature and definition of virus	
	b) General properties of virus	
	c) Conceptof viroids, virusoids, satellite viruses and Prions	
	d) Theories of viral origin	
	e) Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses	
	B. Rickettsia, Coxiella, Chlamydia, Mycoplasma-	**02**
	a) General features	
	b) Medical significance	
	C. Actinomycetes-	**02**
	a) General features of *Nocardia* species and *Streptomyces* species	
	b) Importance: Ecological, Commercial and Medical	
	D. Protozoa-	**02**
	a) Major Categories of Protozoa Based on motility, reproduction.	
	b) Medically important Protozoa	
	E. Algae –	**02**
	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	
	F. Fungi and Yeast-	**02**
	a) Characteristics: structure, Reproduction.	
	b) Cultivation of fungi and yeasts	
	c) Major fungal divisions- overview.	
	d) Economic importance	
	G. Slime molds and Myxomycetes	**01**

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	**Conduct** qualitative and quantitative analysis antimicrobial effect of physicochemical agents onto the growth of microorganism.
CO-2	**Employ** the preservation strategies used in the microbiology laboratory.
CO-3	**Demonstrate** the morphology of bacterial plaque
CO-4	**Understand** the Good Laboratory Practices followed during the practical's.
CO-5	**Analyze** the virulence factors produced by pathogens for exact diagnosis.
CO-6	**Accurately** 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
Objectives: - 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 **Subjective: -** Total Subjective Questions: -02 (05 Marks each) Total marks for subjective questions: -10 Marks	20 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

Theory question paper pattern
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

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

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

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

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)

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)

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.

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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

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

Title of the Programme

B. Sc. in Microbiology

(Faculty of Science)

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

Semester III and IV

Minor Course

(With effect from the academic year 2024-25)

As per National Education Policy - 2020

Sr. No.	Heading	Particulars
1	**Title of program**	**B. Sc. in Microbiology**
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 50 Marks; Internal: External 20:30
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 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)

Preamble

1) Introduction

This course is designed to equip learner with a strong foundation on history and innovations in earlier ages, microbial cell structure and functions, biosafety in microbiology and staining bacterial cells. Through lectures, discussions, and engaging activities, learner will gain a comprehensive understanding of essential biochemical concepts.

2) Aims and Objectives

- **Grasp the concept of microorganisms:** Understand their size, diversity, and ubiquity in the environment.
- **Differentiate between major groups:** Recognize the basic differences between bacteria, archaea, fungi, protists, and viruses.
- **Appreciate the historical journey:** Learn about the early discoveries in microbiology and the impact of key figures.
- **Explore their roles:** Understand how microorganisms influence our health (both beneficial and pathogenic), the environment, and various industries.
- **Develop safe handling techniques:** Learn aseptic practices to prevent contamination and ensure your safety while working with microbes.
- **Recognize biosafety principles:** Understand the concept of biosafety levels and appropriate practices for each level.
- **Demystify microbial structure:** Explore the basic components of a microbial cell (e.g., cell wall, membrane, cytoplasm) for different groups.
- **Relate structure to function:** Understand how different cellular components contribute to microbial growth, metabolism, and survival.

3) Learning Outcomes

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

- **Explain** contributions of scientists in the field of microbiology.
- **Apply** their knowledge of biosafety while working in microbiology laboratory.
- **Apply** knowledge to stain bacterial cells and visualize under microscope.
- **Apply** knowledge to cultivate microbes on growth medium.

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
A	***Discipline Specific Course (Major)***		***A***	***Discipline Specific Course (Major)***	
1	Introduction to microbial biochemistry	03	1	Introduction to microbial genetics and molecular biology	03
2	Advanced microbiology and soft skills	03	2	Introduction to medical microbiology & Immunology	03
	Practical	02		Practical	02
B	***Discipline Specific Course (Minor)*** ***(Select one, in continuation of Sem 2 minor)***		***B***	***Discipline Specific Course (Minor)*** ***(Select one, in continuation of Sem 2 minor)***	
3	Elementary Microbiology 1	02	3	Elementary Microbiology 2	02
	Practical	02		Practical	02
C	***Open Elective*** ***(Any one from the OE List)***		***C***	***Open Elective*** ***(Any one from the OE List)***	
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
D	***Vocational Skill Courses***		***D***	***Vocational Skill Courses***	
5	Biofertilizer Technology	02		xxxxxxxxxxxxxxxxxxxxx	x
E	***Skill Enhancement Course***		***E***	***Skill Enhancement Course***	
	xxxxxxxxxxxxxxxxxxxx	x	5	Microbial QC in Food and Pharma Industry	02
F	***Ability Enhancement Courses***		**F**	***Ability Enhancement Courses***	
6	Communication Skill – English	02	6	Communication Skill – English	02
G	**Foundation Course in NSS/ NCC/ PE / PA**		**G**	**Foundation Course in NSS/ NCC/ PE / PA**	
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
H	**OJT/FP/CEP/RP**			**OJT/FP/CEP/RP**	
8	Field Project (Major)	02	8	Community Engagement Project	02
Total Credits		**22**	**Total Credits**		**22**

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)

PO No.	POs Statement After completing the Bachelor of Science Program, students will be able to-	Knowledge and Skill
PO-1		
PO-2		
PO-3		
PO-4		
PO-5		

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Program Specific Outcomes (PSOs)

PSO No.	PSOs Statement After completing the Bachelor of Science Program, students will be able to-	Knowledge and Skill
PSO-1		
PSO-2		
PSO-3		
PSO-4		
PSO-5		

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: USc3MiEM1

Course Title: Elementary Microbiology-I

Course Type: Minor **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	**Explain** the contributions of scientists towards microbiology.
CO-2	**Apply** their skills to operate equipment in microbiology.
CO-3	**Demonstrate** their staining skills to study bacterial structures.
CO-4	**Apply** knowledge while working in microbiology laboratory.

Course Code: USc3MiEM1

Course Title: Elementary Microbiology - I

Unit I: History of microbiology and Introduction to types of Microorganisms

Unit II: Biosafety, Equipment and Staining in Microbiology

Unit. Subunit	Topic	Lectures
1	**History of microbiology and Introduction to types of Microorganisms (15)**	
	History of microbiology	2
	Spontaneous generation vs. biogenesis	1
	Contributions of 1. Antony von Leeuwenhoek 2. Edward Jenner 3. Louis Pasteur 4. Robert Koch 5. Ivanowski 6. Joseph Lister 7. Alexander Fleming 8. Martinus W. Beijerinck 9. Sergei N. Winogradsky.	5
	Introduction to types of Microorganisms a) General characteristics, distribution and occurrence, morphology, mode of reproduction and economic importance	2
	b) Acellular microorganisms-Viruses, Viroids, Prions	2
	c) Cellular microorganisms- Bacteria, Algae, Fungi and Protozoa	3
Unit 2	**Equipment and Staining in Microbiology (15)**	
	Prokaryotic and eukaryotic cells	2
	Comparison between prokaryotic and eukaryotic cells	1
	Classification of bacteria	1
	Study of the principle and applications of instruments used in the microbiology laboratory: a) biological safety cabinets b) autoclave, incubator	4

	c) hot air oven	
	Studying parts of Light compound microscope and its use and care.	1
	Microscopic observation of bacteria and its structures: 1. Monochrome staining 2. Negative staining 3. Gram's staining 4. Wet Mount 5. Cell wall staining (Chance's method) 6. Capsule staining (Maneval's method) Metachromatic granule staining (Albert' s method)	6

Reference:

1. Microbiology by Pelczar, M.J.Jr., Chan E.C.S., Krieq, 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, McMilan, London.
5. General Microbiology Vol I and II by Powar and Daginawala, Himalaya Publications.
6. Microbiology by Prescott, Herley and Klein, IInd edition.
7. Introduction to Microbial Techniques by Gunasekaran.
8. Biochemical methods by Sadasivam & Manickam
9. Elementary Microbiology Vol. I by Dr. H.A.Modi , Akta Prakashan, Nadiad, Gujrat.

Course Code: USc3MiEM1P

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 laboratory chemicals and glassware
CO-4	Demonstrate skills for preparing glassware for sterilization.

Sr No.	Experiment (30Hrs)	Hrs.
01	Microbiology Good Laboratory Practices	2
02	Preparation of glassware for sterilization	2
03	Use of biological safety cabinets, autoclave, incubator, hot air oven	4
04	Studying parts of Light compound microscope and its use and care	2
05	Permanent slides: Algae, Protozoa	2
06	Fungal wet mount method (Lactophenol Cotton Blue Staining)	2
07	Staining and microscopic observation of bacteria: 1. Monochrome staining 2. Negative staining 3. Gram's staining 4. Motility by hanging drop technique 5. Cell wall staining (Chance's method) 6. Capsule staining (Maneval's method)	12
08	Case study on History of Microbiology	2
09	Assignment on Viruses	2

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

Course Structure

Course Code: USc4MiEM2

Course Title: Elementary Microbiology-II

Course Type: Minor **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	**Explain** the bacterial structures and their functions.
CO-2	**Apply** their knowledge to prepare media for cultivation of microbes.
CO-3	**Apply** their knowledge to cultivate microorganisms

Course Code: USc4MiEM2

Course Title: Elementary Microbiology - II

Unit I: Microbial Structures and Function

Unit II: Study of microorganisms

Unit. Subunit	Topic	Lectures
1	**Microbial Structures and Function (15)**	
1.1	A. Bacterial Cell organization 1) Cell size, shape and arrangement 2) Cytology of Bacteria : a) Cell-wall : Composition and detailed structure of Gram-positive and Gram-negative bacterial cell walls b) Cell Membrane: Structure, function and chemical composition of bacterial cell membranes. c) Structure and functions of Capsule and slime layer. d) Structure and functions of Flagella Structure and functions of Pili.	08
1.2	B. Structure and functions of Cytoplasmic components a) Ribosomes b) Mesosomes c) Inclusion bodies d) Nucleoid e) Chromosome f) Plasmids Endospore	07
Unit 2	**Study of microorganisms (15)**	
2.1	Isolation of Microorganisms from natural habitats.	**1**
2.2	Pure culture techniques a) Streak plate b) Spread plate Pour Plate	**3**
2.3	Simple media: a) Peptone water b) Nutrient broth Nutrient agar	**2**

	Selective media: a) Sabouraud's agar Glucose yeast extract agar	**2**
2.4	Differential and selective media: MacConkey's agar.	**2**
2.5	Sterilization of culture medium using Autoclave and assessment for sterility	**3**
2.6	Sterilization of glassware using Hot Air Oven and assessment for sterility	**2**

Reference:

1. Microbiology by Pelczar, M.J.Jr., Chan E.C.S., Krieq, N.R. 5th edition,1986 (McGraw Hills Publication).
2. Fundamental Principles of bacteriology by A. J. Salle, Tata McGraw Hill.
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6. Microbiology by Prescott, Herley and Klein, IInd edition.
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8. Biochemical methods by Sadasivam & Manickam
9. Elementary Microbiology Vol. I by Dr. H.A.Modi , Akta Prakashan, Nadiad, Gujrat.

Course Code: USc4MiEM2

Course Title: Practical based on Elementary Microbiology - II

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 to prepare media for cultivation of microbes
CO-2	Employ skills to prepare glassware for sterilization
CO-3	Demonstrate skills to cultivate water and air microbes

Sr No.	Experiment	Hrs.
01	Preparation of liquid and solid culture media and their sterilization. a) Preparation of - agar plates, buts and slants b) Inoculation in agar plates, buts and slants	4
02	Isolation of Microorganisms from natural habitats and study of colony characteristics on solid media	2
03	Pure culture techniques a) Streak plate b) Spread plate c) Pour Plate	4
04	Cell wall staining	1
05	Sterilization of culture medium using Autoclave and assessment for sterility	1
06	Sterilization of glassware using Hot Air Oven and assessment for sterility	1
07	Demonstration of presence of microflora in water and air by solid impaction technique on nutrient agar plates and in water by direct cultivation method.	2

Academic Council Date –
Item No. –

Janardan Bhagat Shikshan Prasarak Sanstha's

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As per National Education Policy - 2020

B. Sc. in Microbiology

(Faculty of Science)

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

Semester III and IV

(With effect from the academic year 2024-25)

As per National Education Policy - 2020

Sr. No.	Heading	Particulars
1	**Title of program**	**B. Sc. in Microbiology**
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 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)

Preamble

1) Introduction

This course is designed to equip learner with a strong foundation in the chemical principles that drive life itself. Learner will explore the building blocks of living things – biomolecules – and study the energetic processes that fuel the metabolism of cells. Through lectures, discussions, and engaging activities, learner will gain a comprehensive understanding of essential biochemical concepts.

2) Aims and Objectives

- **Become familiar with** the major biomolecules, such as carbohydrates, lipids, proteins, and nucleic acids, and learn how to **classify** them based on their structure.
- **Unravel the connection** between the structure and function of these fascinating biomolecules.
- **Master the basics** of thermodynamics and see how these principles govern energy transformations within living systems.
- **Demystify the role of ATP** – the universal currency of cellular energy – and understand how it fuels various processes.
- **Distinguish** between catabolism, the breakdown of molecules, and anabolism, the building up of molecules, recognizing their vital interplay in metabolism.
- **Unlock the secrets** of enzymes: how they work, how they're regulated, and their crucial role in countless cellular reactions.

3) Learning Outcomes

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

- **Apply** your knowledge of biomolecules to predict their biological roles.
- **Interpret** data related to cellular energetics and enzyme activity.
- **Communicate** your understanding of biochemical concepts clearly and concisely.

- **Critically evaluate** the importance of biochemistry in various biological processes.

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
A	***Discipline Specific Course (Major)***		***A***	***Discipline Specific Course (Major)***	
1	Introduction to microbial biochemistry	03	1	Introduction to microbial genetics and molecular biology	03
2	Advanced microbiology and soft skills	03	2	Introduction to medical microbiology & Immunology	03
	Practical	02		Practical	02
B	***Discipline Specific Course (Minor)*** ***(Select one, in continuation of Sem 2 minor)***		***B***	***Discipline Specific Course (Minor)*** ***(Select one, in continuation of Sem 2 minor)***	
3	Elementary Microbiology 1	02	3	Elementary Microbiology 2	02
	Practical	02		Practical	02
C	***Open Elective*** ***(Any one from the OE List)***		***C***	***Open Elective*** ***(Any one from the OE List)***	
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
D	***Vocational Skill Courses***		***D***	***Vocational Skill Courses***	
5	Biofertilizer Technology	02		xxxxxxxxxxxxxxxxxxxxx	x
E	***Skill Enhancement Course***		***E***	***Skill Enhancement Course***	
	xxxxxxxxxxxxxxxxxxxx	x	5	Microbial QC in Food and Pharma Industry	02
F	***Ability Enhancement Courses***		**F**	***Ability Enhancement Courses***	
6	Communication Skill – English	02	6	Communication Skill – English	02
G	**Foundation Course in NSS/ NCC/ PE / PA**		**G**	**Foundation Course in NSS/ NCC/ PE / PA**	
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
H	**OJT/FP/CEP/RP**			**OJT/FP/CEP/RP**	
8	Field Project (Major)	02	8	Community Engagement Project	02
Total Credits		**22**	**Total Credits**		**22**

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

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 : USc3Mi1

Course Title : Introduction to Microbial Biochemistry

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	**classify** biomolecules based on structure
CO-2	**describe** the basic structure of RNA and DNA
CO-3	**explain** the role of ATP in biological processes.
CO-4	**distinguish** between catabolism and anabolism.
CO-5	**explain** the general properties of enzymes, including allosteric enzymes.
CO-6	**distinguish** between different types of enzyme inhibitors

Course Code: USc3Mi1

Course Title: Introduction to Microbial Biochemistry

Unit I: Chemical Foundations and Biomolecules

Unit II: Introduction to Bioenergetics and Thermodynamics

Unit III: Introduction to Metabolism and Enzymology

Unit. Subunit	Topic	Lectures
1	**Chemical Foundations and Biomolecules (15)**	
	A. Chemical Foundations (05)	
	a) Biomolecules as compounds of carbon with a variety of functional groups.	**01**
	b) Macromolecules as the major constituents of cells.	**01**
	c) Configuration and Conformation with definitions and suitable examples only.	**01**
	d) Types of Stereoisomers and importance of stereoisomerism in biology.	**01**
	e) Types of bonds and their importance: Electrovalence, covalent, ester, phosphodiester, thioester, peptide, glycosidic	**01**
	B. **Biomolecules (10)**	
	f) **Carbohydrates**: Definition, Classification, Biological role. Monosaccharides, oligosaccharides (maltose, cellobiose, sucrose, lactose) and polysaccharide (starch, glycogen, peptidoglycan, cellulose)	**02**
	g) **Lipids**: 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.	**02**
	h) **Amino acids**: General structure and features of amino acids (emphasis on amphoteric nature) Classification by R-group.	**02**
	i) **Peptides and proteins**- Definition and general features and examples with biological role. Primary, secondary, tertiary, quaternary structures of proteins- Brief outline.	**02**
	j) **Nucleic acids**: Nitrogenous bases- Purines, Pyrimidines Pentoses-Ribose, Deoxyribose, Nomenclature of Nucleosides and nucleotides, N-β-glycosidic bond, polynucleotide chain to show bonding between nucleotides	**02**

	(Phosphodiester bonds). Basic structure of RNA and DNA	
Unit 2	**Introduction to Bioenergetics and Thermodynamics (15)**	
	a) Biological Energy Transformations Obey the Laws of Thermodynamics	**02**
	b) Gibbs free energy, Enthalpy, Entropy	**01**
	c) The Standard Free-Energy Change Is Directly Related to the Equilibrium Constant	**02**
	d) Standard Free-Energy Changes Are Additive	**01**
	e) Structure of ATP	**01**
	f) Phosphoryl group transfer and ATP	**01**
	g) Types of energy–rich compounds,	**02**
	h) Assembly of Informational Macromolecules Requires Energy	**01**
	Living Organisms Exist in a Dynamic Steady State, Never at Equilibrium with Their Surroundings	**03**
Unit 3	**Introduction to Metabolism and Enzymology (15)**	
	Catabolism, Anabolism and the link between them	**02**
	Five Principles of metabolism	**01**
	Metabolic pathways: EMP pathway and TCA cycle	**03**
	Introduction of Enzymes:	**09**
	i. General properties of enzymes, Allosteric enzymes, how do enzymes accelerate reaction? ii. Rate law for a simple catalyzed reaction, iii. Michaelis-Menten equation and it's derivation iv. Lineweaver Bruck plot v. Classification of enzymes vi. Effect of temperature and pH vii. Effect of Inhibitors- Reversible and irreversible, viii. Effect of Inhibitors- competitive, Non competitive and uncompetitive inhibitors ix. Multisubstrate reactions- Ordered, Random and Ping-Pong reactions	

Course Code : USc3MiP1

Course Title : Practical based on Introduction to Microbial Biochemistry

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 of Biomolecules
CO-2	Employ paper chromatography to separate amino acids
CO-3	Demonstrate proper handling of laboratory chemicals and glassware
CO-4	Calculate concentrations of biomolecules based on experimental data and standard curves
CO-5	Analyze how changes in substrate concentration, temperature, and pH affect enzyme activity.
CO-6	Accurately record observations and measurements during experiments.

Sr No.	Experiment	Hrs.
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

S. N.	Reference
1.	Nelson, D. L., & Cox, M. M. (2005). Lehninger's principles of biochemistry (4th ed.). W. H. Freeman & Co.
2.	Voet, D., & Voet, J. G. (1995). Biochemistry (2nd ed.). John Wiley & Sons.
3.	Conn, E., Stumpf, P. K., Bruening, G., & Doi, R. H. (1987). 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). *Laboratory Manual in Biochemistry*. New Age International (P) Ltd.

Course Structure

Course Code: USc4Mi1

Course Title: Introduction to Microbial Genetics and Molecular biology

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	**Recall and describe** the key features of the Watson-Crick model of DNA structure.
CO-2	**Distinguish** between chromosomes of bacteria, viruses, and eukaryotes.
CO-3	**Explain** the stages of protein synthesis
CO-4	**Identify** different types of DNA structures (e.g., B-DNA, Z-DNA).

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

Choice Based Credit System

Under New Education Policy (NEP) 2020

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 III: Transcription and Translation (15)

Unit. Subunit	Topic	Lectures
1	**Nucleic Acid and Chromosome (15)**	
	i. Nucleic Acid Structure (Watson and Crick Model)	02
	ii. DNA stores genetic information	01
	iii. DNA molecules have distinctive base composition	01
	iv. DNA is a double helix	01
	v. DNA can occur in different 3D forms	02
	vi. DNA sequences adopt unusual structures	01
	vii. Many RNAs have complex 3D structures	01
	viii. Structure of Chromosome	02
	ix. Chromosomal Unit: Genes - Segments of DNA That Code for Polypeptide Chains and RNAs	01
	x. Chromosome of Bacteria	01
	xi. Chromosome (Genome) of Virus	01
	xii. Chromosome of Eukaryotes	01
Unit 2	**Nucleic acid chemistry (15)**	
	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	02

	methylation	
	Separation of nucleic acids by Agarose gel electrophoresis	01
	DNA sequencing	02
	Introduction to DNA Replication	07
	Historical perspective— conservative, dispersive, semiconservative, Bidirectional and semi-discontinuous Prokaryotic DNA replication –molecular mechanism Involved in Initiation, Elongation and Termination	
Unit 3	**Transcription and Translation (15)**	**08**
	Transcription (RNA Synthesis) RNA Metabolism: DNA dependent synthesis of RNA RNA polymerase (Bacterial cell, Eukaryotic cell) Promoters, Initiation, and Elongation Specific sequences signal termination of RNA synthesis. Protein factors required for RNA polymerase II. Inhibition of DNA dependent RNA polymerase RNA dependent synthesis of RNA	
	Translation (Protein Synthesis) Stages of Protein synthesis: - a. Activation of amino acids b. Initiation c. Elongation d. Termination and release e. Folding and post translational processing	07

Course Code : USc4MiP1

Course Title : Practical based on Introduction to Microbial Genetics and Molecular biology

Course Type: Major **No. of Credits: 1**

CO No.	COs Statement
	After completing the Course, students will be able to-
CO-1	**Perform** and **describe** the protocols for isolating DNA from bacteria and plants.
CO-2	**Explain** the principles behind RNA extraction and detection methods.
CO-3	**Operate** agarose gel electrophoresis equipment for separation of DNA fragments based on size.
CO-4	**Access** and **utilize** virtual lab simulations for DNA sequencing and Western blotting techniques.

Sr No.	Experiment	Hrs.
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 Tm (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

S. N.	Reference
1.	Nelson, D. L., & Cox, M. M. (2005). Lehninger's principles of biochemistry (4th ed.). W. H. Freeman & Co.
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.

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

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 2024-25)

As per National Education Policy - 2020

Sr. No.	Heading	Particulars
1	**Title of program**	Vocation skill course in Biofertilizer
2	**Eligibility**	Students must have earned mandatory credits in Microbiology.
3	**Duration of program**	3 years for a Degree & 4 Years for Honors
4	**Intake Capacity**	50
5	**Scheme of Examination**	Internal
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 2024-25

Signature of

Name
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)

Preamble

1) Introduction

The purpose of a Vocational skill 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 **vocational skills 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 conscious of the major biofertilizers and their production.

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

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

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

ssChoice Based Credit System
Under New Education Policy (NEP) 2020
(To be implemented from the academic year 2024-2025)

Course Structure

Course Code : VSC3BF

Course Title: Vocational Skill Course in Biofertilizer

Course Type: Minor **No. of Credits: 2**

Module 1:	**Title of Module: Biofertilizer**	
S. N.	**Biofertilizer(Practical)**	**No. of Hrs.**
1	Sampling and Enrichment of Nitrogen Fixing Bacteria	02 Hrs
2	Sampling and Enrichment of Phosphate Solubilizing Bacteria	02 Hrs
3	Sampling and Enrichment of Potassium Mobilizing Bacteria	02 Hrs
4	Isolation of Nitrogen Fixing Bacteria	02 Hrs
5	Isolation of Phosphate solubilizing bacteria	02 Hrs
6	Isolation of Potassium Mobilizing Bacteria	02 Hrs
7	Preparation for Seed Culture for Each Biofertilizer	02 Hrs
8	Preparation of Lab-scale production media for each biofertilizer	02 Hrs
9	Determination of Cell count and its adjustment to the appropriate level	02 Hrs
10	Preparation of Carrier-based solid formulation of biofertilizer	02 Hrs
11	FCO specifications and quality control of biofertilizers.	02 Hrs
12	Efficiency determination of the efficiency of biofertilizer using pot assay	02 Hrs
13	Packaging of Biofertilizer Liquid Formulation and Solid Formulation	02 Hrs
14	Biofertilizers -Storage, shelf life, quality control	02 Hrs

15	Cost determination, field applications and marketing	02 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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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 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**	Students must have earned mandatory credits of FYBSc.
3	**Duration of program**	3 years for Degree & 4 Years for Honors
4	**Intake Capacity**	50
5	**Scheme of Examination**	Internal
6	**Standards of Passing**	40%
7	**Semesters**	IV
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 2024-25

Signature of

Name
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)

Skill enhancement Course
Microbial Quality Control in Industries (Food & Pharmaceuticals)
Preamble

1) Introduction

Microbiological quality control is an essential part of the pharmaceutical manufacturing process and food industry. Pharmaceutical companies must safeguard the quality and safety of their products by thoroughly testing raw materials, equipment, environmental surfaces, and final preparations for microbial contaminants that may have been introduced inadvertently during or after the manufacturing process. Currently, there are several microbiological quality control assays recommended, including growth promotion testing, microbial enumeration testing, and antimicrobial effectiveness testing. Through this course, learners can learn the quality control systems used in the food and pharmaceutical industries. Learners can handle various instruments present in the laboratory as well they can learn the handling and disinfection methods of different food and pharmaceutical samples

2) Aims and Objectives

Aim: To make students.

Objectives:

1. To gain concepts in QC and QA for food processing and validation of processed food products.
2. To Gain knowledge about aseptic operation, containment levels, biosafety, GMP, and HACCP in foods, cosmetics and pharmaceuticals.
3. To make the students understand the food quality systems.

3) Learning Outcomes

After completion of this course, the student will be able to:

CO1	Explain to the students about all kinds of biosafety levels in laboratories.	**BTL: Understand**
CO2	Evaluate the students to be competent working professionals in the food industry and pharmaceutical industry.	**BTL: Evaluate**
CO3	Describe the Quality management -Quality control and quality assurance in Pharma industries.	**BTL: Understand**
CO4	Demonstrate the concept of containment levels, biosafety, GMP, and HACCP in foods and pharmaceuticals.	**BTL: Apply**

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 2024-2025)

Course Structure

Course Code : SEC3MQC

Course Title : Microbial Quality Control in Industries (Food & Pharmaceuticals)

Course Type: Skill Enhancement Course **No. of Credits: 2**

Module 1:	**Title of Module:** Microbial Quality Control in Industries	
S. N.	**(Practical)**	**No. of Hrs.**
1	Safe Working Procedures in a Biosafety Cabinet (emphasizes proper use of protective clothing and basic cabinet operations)	02 Hrs
2	To study the principles and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.	02 Hrs
3	Testing of efficiency of sterilization by autoclave	02 Hrs
4	Testing of efficiency of sterilization by hot air oven	02 Hrs
5	Demonstrating Disinfection and Autoclaving Techniques for Laboratory Equipment (highlights disinfection and sterilization methods)	02 Hrs
6	Safe Handling and Discarding of Biohazardous Waste (emphasizes disposal procedures and safety measures)	02 Hrs
7	Assessment of microbiological quality of water used in pharmaceuticals and food industry	02 Hrs
8	Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water	02 Hrs
9	Determining Microbes in Food Samples culture and microscopic methods - Standard plate count,	02 Hrs
10	Document preparation for QA/QC norms of food and pharmaceutical industries	02 Hrs
11	Quality control in Microbiology laboratory, assessment of aseptic condition, evaluation of possible channels of contamination, QA/QC norms for handling pathological samples.	02 Hrs
12	Determining Microbes in Pharmaceutical Samples culture and microscopic methods - Standard plate count,	02Hrs
13	SOP designing and hands-on practice of instruments used in the microbiology lab.	02 Hrs

14	Bioburden test, sterility test, environmental monitoring	02 Hrs
15	Detection of specific pathogens, personal hygiene monitoring	02 Hrs

References

S. N.	Reference
1.	Quality Control in the Food Industry V1, S Herschdoerfer,ISBN: 9780323152068,: Academic Press, 1967
2.	Principles of Sensory Evaluation of Food- 1965 MA Amerine, RM , Pangborn and EB Roessler, Elsevier
3.	Benson's Microbiological Applications: A Laboratory Manual in General Microbiology (Alfred Brown)
4.	Laboratory Exercises in Microbiology (John Parker)
5.	Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
6	Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
7	Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
8	Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
9	Guidelines of
a)	Centers for Disease Control and Prevention (CDC) Biosafety in Microbiological and Biomedical Laboratories (BMBL) (US)
a)	Public Health England (PHE) Advisory Committee on Dangerous Pathogens (ACDP) Guidance (UK)
b)	The Australian Government Department of Health and Aged Care National Guidelines for Working with Laboratory Animals and Biological Agents (Australia)
c)	Food and Drug Administration (FDA) Food Safety Standards (US)
d)	Codex Alimentarius International Food Standards (International)
e)	European Commission Food Safety Standards (EU)

Academic Council Date –

Item No. –

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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 2024-25)

As per National Education Policy - 2020

Sr. No.	Heading	Particulars
1	**Title of program**	**B.Com**
2	**Eligibility**	FYBCom passed students having Open Elective subject in Microbiology
3	**Duration of program**	3 years of Degree & 4 years of Honors
4	**Intake Capacity**	50
5	**Scheme of Examination**	Theory External:30 Marks Practical Internal : 20Marks
6	**Standards of Passing**	40%
7	**Semesters**	III and IV
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 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)

Preamble

1) Introduction

Introducing a health and diseases course to students provides a foundation for understanding the complexities of the human body, the causes of diseases, and strategies for maintaining optimal health. This course will feature a combination of lectures, interactive discussions, case studies, multimedia presentations, and hands on practical. A course is also focused on the control of microorganisms through physical and chemical methods would cover a range of learning outcomes related to the principles and applications of various techniques used to manage microbial populations.

2) Aims and Objectives

- **Gain** a comprehensive understanding of human diseases and biocontrol.
- **Identify** factors influencing health and well-being.
- **Explore** the etiology, transmission, prevention, and management of infectious and non-communicable diseases.
- **Develop** critical thinking skills to analyse effect of biocontrol agent on growth of microorganisms.
- **Promote** personal and community health through the application of evidence-based practices.

3) Learning Outcomes

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

- **Understand** ethical principles in healthcare, terminologies used in medical microbiology and biocontrol mechanisms.
- **Explain** the etiology, physiology, and mechanisms underlying various infectious and non-communicable diseases.
- **Identify** the risk factors associated with the development of common diseases, including genetic predisposition, lifestyle choices and bacterial infections.

- **Analyze** strategies for the prevention, control, and management of infectious and non-communicable diseases, including vaccination, lifestyle modifications, and public health interventions.
- **Learn** about physical and chemical methods used in control of microoganisms

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 2024-2025)

Course Structure

Course Code: UCM3MiOE1

Course Title: HUMAN HEALTH AND DISEASES

Course Type: Open Elective **No. of Credits: 2**

Course Outcomes (Cos)

CO No.	COs Statement
	After completing the course, students will be able to-
CO-1	**Distinguish** between infection and disease.
CO-2	**Describe** the terminologies used in health and diseases.
CO-3	**Explain** the basic concept of microbial infection and its prevention.
CO-4	**Identify** sources of infection and mode of transmission.
CO-5	**Justify** the benefits of prophylaxis using vaccination.

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 2024-2025)

Course Code :UCM3MiOE1
Course Title: HUMAN HEALTH AND DISEASES

S.N.	Title of Module	No. of Hrs.
Unit 1:	**Human health and diseases**	**15**
1.1	**Important terminology:** Infection, disease, Primary infection, secondary infection. Contagious infection, occupational disorder, Zoonoses , genetic disorder, vector borne infection	03
1.2	**Types of infection:** Bacterial, viral , fungal and parasitic	02
1.3	**Sources of infection** Reservoirs of infection - Human reservoir, Animal reservoir, non-living reservoir	03
1.4	**Cause of disease** Contact transmission, Vehicle Transmission	02
1.5	**Precautions and control** Hygiene and Vaccination	02
1.6	**Diagnosis and Treatment methods**	03
Unit 2:	**Common diseases**	**15**
2.1	**Bacterial diseases :** Typhoid, Pneumonia	03
2.2	**Viral diseases :** Common cold, Covid 19	03
2.3	**Fungal diseases** Ringworm, Candidiasis	03
2.4	**Parasitic diseases :** Amoebic dysentery, Malaria	03
2.5	**AIDS and Cancer**	03

References

S. N.	Reference
1.	Prescott, Hurley. Klein-Microbiology, 7th edition, International edition, McGraw Hill.
2.	Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. Adisson Wesley Longman Inc. 1998.
3.	Microbiology TMH 5th Edition by Michael J.Pelczar Jr., E.C.S. Chan ,Noel R. Krieg

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 2024-2025)

Course Structure

Course Code: UCM4MiOE1

Course Title: Biocontrol : Physical and Chemical methods

Course Type: Open Elective **No. of Credits: 2**

Course Outcomes (Cos)

CO No.	COs Statement
	After completing the course, students will be able to-
CO-1	**Understand** the applications of antimicrobial agents
CO-2	**Understand** mechanisms to control microorganisms
CO-3	**Explain** the basic terminologies used during control of microorganisms
CO-4	**Explain** the mechanisms of antimicrobial agents
CO-5	**Describe** the basic applications of biocontrol agents available in market

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 2024-2025)

Course Code : UCM4MiOE1
Course Title : Biocontrol: Physical and Chemical methods

Unit 1:	**Title of Module**	**No. of Hrs.**
S. N.	**Control of Microorganisms**	**15**
1.1	**Definition of Frequently Used Terms** : Sterilization, Sanitization, Sanitizer, Disinfection, Disinfectant, Antisepsis, Antiseptic , Chemotherapy, Antibiotic	03
1.2	**The Pattern of Microbial Death**	02
1.3	**Conditions Influencing the Effectiveness of Antimicrobial Agent Activity**	03
1.4	**Basic principles of control of microorganisms** Killing , Inhibition, Removal	02
1.5	**Evaluation of Antimicrobial Agent Effectiveness**	03
1.6	**Types of antimicrobial agents**	02
Unit 2:	**Physical and chemical methods**	**15**
2.1	**The use of physical methods in control** 1. Heat 2. Radiation 3. Filtration	05
2.2	**The use of chemical agents in control** 1. Alcohol 2. Phenol 3. Detergent	05
2.3	**Examples of control agents available in market** Sanitizer, disinfectants , Antiseptic agent, Antibiotics	05

References

S. N.	Reference
1.	Prescott, Hurley. Klein-Microbiology, 7th edition, International edition, McGraw Hill.
2.	Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. Adisson Wesley Longman Inc. 1998.
3.	Microbiology TMH 5th Edition by Michael J.Pelczar Jr., E.C.S. Chan ,Noel R. Krieg

Janardan Bhagat Shikshan Prasarak Sanstha's

Changu Kana Thakur

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

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'Best College Award' by University of Mumbai

Program: T. Y. B. Sc.

Revised Syllabus of T. Y. B. Sc.

Course: Microbiology

Choice Based Semester Grading System (75:25)

With effect from Academic Year 2021-22

Choice Based Credit, Grading and Semester System (CBCGS)

T. Y. B. Sc. Microbiology Syllabus

Sr. No.	Heading	Particulars
1	Title of Course	T. Y. B. Sc.
2	Course Code for Theory and Practical Semester I	USc5Mi1, USc5Mi2, USc5Mi3, USc5Mi4, USc5Mi5 USc5MiPR1, USc5MiPR2, USc5MiPR3, USc5MiPR4, USc5Mi PAC
3	Course Code for Theory and Practical Semester II	USc6Mi1, USc6Mi2, USc6Mi3, USc6Mi4, USc6Mi5 USc6MiPR1, USc6MiPR2, USc6MiPR3, USc6MiPR4, USc6Mi PAC
3	Eligibility for Admission	S. Y. B. Sc. Microbiology
4	Passing marks	40%
5	Ordinances/Regulations (if any)	-
6	No. of Semesters	Two
7	Level	U. G.
8	Pattern	Semester (75:25)
9	Status	Revised
10	To be implemented from Academic year	2021-2022

Preamble of the Syllabus

With the introduction of Autonomy in the Choice Based Credit, Grading and Semester System, the syllabus in Microbiology has been revised for T. Y. B.Sc. Semester - V and Semester - VI. This syllabus is implemented with effect from 2021-22. The revised syllabus has been approved by the concerned authorities of the Autonomous College, Committees formed by the college, BOS members and Head/ senior teachers from Department of Microbiology. B. Sc. Microbiology Programme is of THREE years with three parts F. Y. B. Sc, S. Y. B. Sc and T. Y. B. Sc . Each part has two semesters. Each semester will have four theory papers of 75 Marks and practical paper based on theory paper of 250 Marks (including applied component). The syllabus has been designed in such a theory is related with the practicals thus enabling students to develop professional skillsets of a Microbiologist. The topics included will give hands on practice of microbiology experiments. Each paper has been designed emphasizing the need to develop Critical thinking/reasoning in the students. This will aid the students in their specific area of their interest/ specialization in particular. This revised syllabus is aimed at equipping students with theoretical foundations and practical techniques required in genetics, biochemistry, medical, R & D, quality control, advances in Molecular Biology. Areas covered in Semester V & Semester VI will boost employability of students. As mentioned in the syllabus, all the courses of theory & practical's are compulsory to T. Y. B. Sc. microbiology.

T. Y. B. Sc. Microbiology Syllabus

Objectives of the Course

- To help the learners understand the depth of microbiology
- To provide base for the students them succeed in competitive examination (NET, SET)
- To help them opt job and develop career in the field of microbiology

Course Outcome: By the end of the course

- The learners will have hands training of various microbiology techniques which will be helpful for them to opt job in industries and research related to microbiology.
- The theory syllabus will provide a basement and is also related to various competitive examination like CSIR NET, SET, GATE, PET and it will be helpful for them to acquaint with these examination in future
- Learners will gain knowledge about genetics, immunology, medical microbiology, cancer immunology, advance techniques in diagnostics, emerging infections, pathways of biochemistry, industrial microbiology.
- Plant, animal and marine biotechnology as well as human and animal health care concepts covered in applied component (Paper V) boosts the knowledge of the students.

T. Y. B. Sc. Microbiology

For the subject of Microbiology there shall be five papers for 60 lectures each comprising of four units of 15 L each.

Semester-V	
Paper-I	Microbial Genetics
Paper- II	Medical Microbiology & Immunology: Part - I
Paper- III	Microbial Biochemistry: Part - I
Paper- IV	Bioprocess Technology: Part - I
Semester-VI	
Paper-I	rDNA Technology, Bioinformatics & Virology
Paper- II	Medical Microbiology & Immunology: Part - II
Paper- III	Microbial Biochemistry: Part - II
Paper- IV	Bioprocess Technology: Part - II

T. Y. B. Sc. Microbiology Syllabus

Choice Based Semester Grading System (CBSGS)

T. Y. B. Sc. Microbiology Syllabus

To be implemented from the Academic year 2021-22

T. Y. B. Sc. Microbiology Semester V Theory

Course Code	:	USc5Mi-1	Title of the Paper	:	Microbial Genetics
Credits	:	2.5	Lectures/Week	:	01 (On each unit)

UNIT	TOPIC HEADINGS
I	DNA Replication
II	Transcription, Genetic Code & Translation
III	Mutation and Repair
IV	Genetic Exchange & Homologous Recombination

Course Code	:	USc5Mi-2	Title of the Pape:		Medical Microbiology & Immunology: Part - I
Credits	:	2.5	Lectures/Week	:	01 (On each unit)

UNIT	TOPIC HEADINGS
I	Bacterial Strategies for Evasion and Study of a Few Diseases
II	Study of a Few Diseases with Emphasis on Cultural Characteristics of the Etiological agent, Pathogenesis, Laboratory Diagnosis and Prevention
III	General Immunology – I
IV	General Immunology - II

Course Code	:	USc5Mi-3	Title of the Paper	:	Microbial Biochemistry: Part - I
Credits	:	2.5	Lectures/Week	:	01 (On each unit)

UNIT	TOPIC HEADINGS
I	Biological Membranes & Transport
II	Bioenergetics & Bioluminescence
III	Methods of Studying Metabolism & Catabolism of Carbohydrates
IV	Fermentative Pathway & Anabolism of Carbohydrates

Course Code	:	USc5Mi-4	Title of the Paper	:	Bioprocess Technology: Part - I
Credits	:	2.5	Lectures/Week	:	01 (On each unit)

UNIT	TOPIC HEADINGS
I	Upstream Processing - I
II	Upstream Processing - II
III	Fermentation Modes, Equipments and Instruments
IV	Traditional Industrial Fermentations

T. Y. B. Sc. Microbiology Semester V Practical

Paper Code	Title of the Paper	Practical/Week	Credits
USc5MiPR1	Microbial Genetics	01	1.5
USc5MiPR2	Medical Microbiology & Immunology: Part - I	01	1.5
USc5MiPR3	Microbial Biochemistry: Part - I	01	1.5
USc5MiPR4	Bioprocess Technology: Part - I	01	1.5

T. Y. B. Sc. Microbiology Semester VI Theory

Course Code	:	USc6Mi1	Title of the Paper	:	rDNA Technology, Bioinformatics & Virology
Credits	:	2.5	Lectures/Week	:	01 (On each unit)

UNIT	TOPIC HEADINGS
I	Recombinant DNA Technology
II	Applications of rDNA Technology & Bioinformatics
III	Regulation & Basic Virology
IV	Advanced Virology

Course Code	:	USc6Mi2	Title of the Paper	:	Medical Microbiology & Immunology: Part - II
Credits	:	2.5	Lectures/Week	:	01 (On each unit)

UNIT	TOPIC HEADINGS
I	Study of a Few Diseases with Emphasis on Cultural Characteristics of the Etiological Agent, Pathogenesis, Laboratory Diagnosis and Prevention
II	Chemotherapy of Infectious Agents
III	Immunology - I
IV	Immunology - II

Course Code	:	USc6Mi3	Title of the Paper	:	Microbial Biochemistry: Part - II
Credits	:	2.5	Lectures/Week	:	01 (On each unit)

UNIT	TOPIC HEADINGS
I	Lipid Metabolism & Catabolism of Hydrocarbons
II	Metabolism of Proteins and Nucleic Acids
III	Metabolic Regulation
IV	Prokaryotic Photosynthesis & Inorganic Metabolism

Course Code	:	USc6Mi1	Title of the Paper	:	Bioprocess Technology: Part - II
Credits	:	2.5	Lectures/Week	:	01 (On each unit)

UNIT	TOPIC HEADINGS
I	Downstream Processing
II	Advances in Bioprocess Technology
III	Quality Assurance, Quality Control, Instrumentation and Bioassay
IV	Industrial Fermentations

Semester II Practical

Paper Code	Title of the Paper	Practical/Week	Credits
USc6MiPR1	rDNA Technology, Bioinformatics & Virology	01	1.5
USc6MiPR2	Medical Microbiology & Immunology: Part - II	01	1.5
USc6MiPR3	Microbial Biochemistry: Part - II	01	1.5
USc6MiPR4	Bioprocess Technology: Part - II	01	1.5

N.B.

I. Each theory period shall be of 48 minutes duration. Theory component shall have 240 instructional periods plus 240 notional periods per semester which is equal to 384 learning hours. For theory component the value of One Credit is equal to 38.40 learning hours.

II. Each practical period shall be of 48 minutes duration. Practical component shall have 240 instructional periods plus 60 notional periods per semester which is equal to 240 learning hours. For practical component the value of One Credit is equal to 40 learning hours.

T. Y. B. Sc. (Semester – V & Semester - VI)

Microbiology Syllabus Revised According To Choice Based Semester Grading System to be implemented from the Academic year 2021-2022

T. Y. B. Sc. Semester V Syllabus

USc5Mi1 (Microbial Genetics)

Course Code	**: USc5Mi1**	**Title of the Paper**	**: Microbial Genetics**
No. of Lectures	**: 60**	**Credits**	**: 2.5**

Learning Objectives:

The learning objectives include the following:

1. DNA Replication: The learner will understand the events occurring in both Prokaryotic and Eukaryotic DNA replication, with a focus on the involvement of Proteins and Enzymes at the cellular level. The topic will also include the assembly of Eukaryotic chromosome.
2. Transcription, Genetic Code and Translation: This module aims at the learner understanding the basis of gene expression and the Central Dogma and the molecular basis of protein synthesis in Prokaryotes and Eukaryotes. The module deals with the structure and properties of different forms of RNA, maturation of RNA and RNA splicing.
3. Mutation and DNA repair: The molecular basis and types of mutation, their cause, effect and DNA repair is studied. The basic concepts related to molecular biology are explained.
4. Genetic exchange: This module includes the study of various mechanisms of gene transfer in bacteria. It also provides insight into the mechanisms of genetic recombination. The module deals with the Genetics of bacteria and bacteriophages, development of new strains and genetic mapping.
5. Practicals The laboratory techniques and experiments based on these topics will give students hands on competence in fundamental molecular biology experiments.

Learning Outcomes:

DNA Replication: The learner will understand the concept of genome organization as well as the sequence of fidelity, events, mechanism, enzymes and proteins involved in replication of DNA in eukaryotes.

Transcription, Genetic Code and Translation: The student will know the genetic code and central dogma of biology its two-step transcription and translation, types and maturation of RNA in both prokaryotes and eukaryotes.

Mutation and DNA repair: The learner will know the concept of mutation, its types, causes and their effects. This module will also make them understand types of mutagens, damage to DNA due to mutagenesis, various mechanisms of DNA repair as well as the mechanisms leading to oncogenesis

Genetic exchange: The student shall understand the various mechanisms of gene transfer in bacteria and genetic recombination.

Practicals: The students will acquire skill to perform the laboratory techniques and experiments based on the above topics.

Title	Lectures/ Semester	Notional Periods
Unit I: DNA Replication	**(Total 15 L)**	**15L**
1.1 Over view of DNA replication (Fundamental rules and prokaryotic replication)	**02L**	
1.2 Structural organization of *E. coli* chromosome - Folded Fibre model and its genetic map.	**02L**	
1.3 Processivity and fidelity of DNA replication		
1.4 Enzymes and proteins associated with DNA replication- Primase, Helicase, Topoisomerase and their type, SSB, DNA polymerases, Ligases, Telomerases, Ter and Tus proteins.	**01L**	
1.5 Chromosome characteristics :- Chromosome structure, Euchromatin and Heterochromatin, Coding	**03L**	
and Non-coding sequences.	**02L**	
1.6 Eukaryotic DNA replication – Molecular details of DNA synthesis, replicating the ends of the chromosomes assembling newly replicated DNA into nucleosome**.**	**04L**	
1.7 Rolling circle mode of DNA replication	**01L**	

	Unit II: Transcription, Genetic Code and Translation	(Total 15 L)	15
2.1	**Central Dogma: An Overview, Transcription process, Transcription in bacteria -** Initiation of transcription at promoters, elongation of an RNA chain, termination of an RNA chain	03L 01L	
2.2	**Brief introduction about types of RNA**	01L	
2.3	**One gene –One polypeptide hypothesis**	04L	
2.4	**Transcription in Eukaryotes –** Eukaryotic RNA polymerase and types, Transcription of protein-Coding genes by RNA polymerase II, Transcription initiation, The structure and production of Eukaryotic mRNAs, Production of mature mRNA in Eukaryotes, Processing of Pre-mRNA to mature mRNA. Self-splicing of Introns, RNA editing	02L	
2.5	**Genetic code -** Nature of genetic code and characteristics of genetic code.	04L	
2.6	**Translation process -** Transfer RNA, structure of tRNA, tRNA genes, Recognition of the tRNA anticodon by the mRNA codon, Adding of amino acid to tRNA , Ribosomal RNA and Ribosomes, Ribosomal RNA Genes, Initiation of translation, Initiation in Bacteria, Initiation in eukaryotes, Elongation of the polypeptide chain, termination of translation, protein sorting in the cell.		

Unit III: Mutation and Repair	**(Total 15L)**	**15**
3.1 Brief over view onto DNA mutation	**02L**	
3.2 Fluctuation test	**01L**	
3.3 Expression of mutations – a) Time course of phenotypic expression. b) Conditional expression of mutation.	**03L**	
3.4 Causes of mutation: Natural/spontaneous mutation-- replication error, depurination, deamination. Induced mutation: principle and mechanism with illustrative diagrams for: 3.4.1 Chemical mutagens - base analogues, nitrous acid, hydroxyl amine, intercalating agents and alkylating agents. 3.4.2 Physical mutagen 3.4.3 Biological mutagen (only examples)	**04L**	
3.5 Ames test	**01L**	
3.6 Detection of mutants	**02L**	
3.7 Molecular mechanism and sequence of changes leading to oncogenesis- 3.7.1 Mutations, 3.7.2 Activation of proto-oncogenes, 3.7.3 Loss of function of tumour suppressor (anti-cancer) genes	**02L**	
Unit IV: Genetic Exchange & Homologous Recombination	**(Total 15 L)**	**15**
4.1 Genetic analysis of Bacteria	**01L**	
4.2 Gene transfer mechanisms in bacteria	**03L**	
4.2.1 Transformation 4.2.1.1 Introduction and History 4.2.1.2 Types of transformation in prokaryotes-- Natural transformation in *Streptococcus pneumoniae, Haemophilus influenzae,* and *Bacillus subtilis*. 4.2.1.3 Mapping of bacterial genes using transformation. 4.2.1.4 Problems based on transformation.	**05 L**	
4.2.2 Conjugation 4.2.2.1 Discovery of conjugation in bacteria 4.2.2.2 Properties of F plasmid/Sex factor 4.2.2.3 The conjugation machinery		

EMPLOYABILITY

4.2.2.4	Hfr strains, their formation and mechanism of conjugation		
4.2.2.5	F' factor, origin and behavior of F' strains, Sexduction		
4.2.2.6	Mapping of bacterial genes using conjugation (Wolman and Jacob experiment).	**03L**	
4.2.2.7	Problems based on conjugation		
4.2.3	**Transduction**		
4.2.3.1	Introduction and discovery		
4.2.3.2	Generalized transduction		
4.2.3.3	Use of Generalized transduction for mapping genes	**03L**	
4.2.3.4	Specialized transduction		
4.2.3.5	Problems based on transduction		
4.3	**Recombination in bacteria**		
4.3.1	General/Homologous recombination		
4.3.2	Molecular basis of recombination		
4.3.3	Holliday model of recombination (Single strand DNA break model only)		
4.3.4	Enzymes required for recombination		
4.3.5	Site –specific recombination		

Paper Code	Title of the Paper	Practical/Week	Credits
USc5Mi1	Microbial Genetics	1	1.5

Sr. No.	Name of the Practical
1	UV survival curve – determination of exposure time leading to 90% reduction
2	Isolation of mutants using UV mutagenesis
3	Gradient plate technique (dye resistant mutant)
4	Replica plate technique for selection & characterization of mutants – auxotroph & antibiotic resistant
5	Isolation and detection of plasmid DNA

SKILL DEVELOPMENT

Reference: Course Code: USc5Mi1

Text books:

1. Peter J. Russell (2006), "I Genetics-A molecular approach", 2nd edition.
2. Benjamin A. Pierce (2008), "Genetics a conceptual approach", 3rd 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", 4th edition, Macmillan worth Publishers.
5. M.Madigan, J.Martinko, J.Parkar, (2009), "Brock Biology of microorganisms", 12th edition, Pearson Education International.
6. Fairbanks and Anderson, (1999), "Genetics", Wadsworth Publishing Company.
7. Prescott, Harley and Klein, "Microbiology", 7th edition Mc Graw Hill international edition.
8. Robert Weaver, "Molecular biology", 3rd edition. Mc Graw Hill international edition.
9. Nancy Trun and Janine Trempy, (2004), "Fundamental bacterial genetics", Blackwell Publishing
10. Snustad, Simmons, "Principles of genetics", 3rd edition. John Wiley & sons, Inc.
11. Roger Y. Stanier, (1987) "General Microbiology",5th edition, Macmillan Publishing.

Reference books:

1. Benjamin Lewin, "Genes IX", Jones and Bartlett publishers.
2. JD Watson, "Molecular biology of the gene", 5th 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.

USc5Mi2 (Medical Microbiology and Immunology Part I)

Course Code	**: USc5Mi2**	**Title of the Paper**	**: Medical Microbiology and Immunology Part I**
No. of Lectures	**: 60**	**Credits**	**: 2.5**

Learning Objectives:

The course in medical microbiology has been designed to help students to understand the mechanism of various diseases. The study of Etiology, transmission, pathogenesis, clinical manifestations, laboratory diagnosis, prophylaxis, and treatment of various diseases tells us about the detailed insight of pathogen. The course also includes one of the most important areas of modern medical microbiology that -understands genetic modification and pathogen evolution.

The students have achieved a basic understanding of Innate Immunity and Host Defense mechanisms in their lower classes and Immunology that forms an integral part of Medical Microbiology has been designed to help to understand the ability of our immune system to defend against invading pathogens in a logical fashion. The study of structure and classifications of antibodies, role of cytokines, and function of MHC complex will clear the concepts of formation of immune response and ability of our body to defend against pathogens.

Learning Outcomes:

The students will be able to:

- Give details of the virulence factors and other features of the pathogen.
- Understand modern alternatives to Koch‘s Postulates, Genetic modification and pathogen evolution.
- Correlate these virulence factors with the pathogenesis and clinical features of the disease.
- Comment on the mode of transmission, diagnosis, prophylaxis and treatment of various diseases.
- Understand the structure & functions of immunoglobulin and its role in immune response.
- Understand the importance of cytokines, MHC, APCs, and its mechanism in formation of adaptive immunity.
- Explain the mechanism of antigen –antibody reactions and it application in diagnosis of various infections.

Title & Content	Lectures/ Semester	Notional Periods
Unit I: Bacterial Strategies for Evasion and Study of a Few Diseases	**15L**	**15**
1.1. Study of virulence mechanisms in bacteria	**4 L**	
1.1.1. Pathogenicity islands		
1.1.2. Bacterial virulence factors: Adherence factors, Invasion of host cells and tissues		
1.1.3. Toxins: Exotoxins, Endotoxin		
1.1.4. Enzymes : Tissue degrading enzymes, IgA1proteases		
1.1.5. Antiphagocytic factors		
1.1.6. Intracellular pathogenicity		
1.1.7. Antigenic heterogeneity		
1.1.8. The requirement for iron		
1.2 Study of A Few Infectious Diseases of the Respiratory Tract (wrt. Cultural Characteristics of the etiological agent, pathogenesis & clinical features, laboratory diagnosis, treatment and prevention only)	**8L**	
1.2.1.*S. pyogenes* infections		
1.2.2 Influenza		
1.2.3 Tuberculosis		
1.2.4 Pneumonia caused by *K. pneumoniae*		
1.2.4 Emerging infection –COVID-19	**2L**	
1.3 Study of urinary tract infections		
Unit II: Study of few diseases (wrt. Cultural characteristics of the etiological agent, pathogenesis & clinical features, laboratory diagnosis, treatment and prevention only)	**15**	**15**
2.1 Study of skin infections	**7L**	
2.1.1. Pyogenic skin infections caused by *Pseudomonas* and *S. aureus*		
2.1.2. Leprosy		
2.1.3 Fungal infections-Candidiasis		
2.1.4 Viral Infections- Herpes simplex		
2.2. Study of gastrointestinal tract infections	**8L**	
2.2.1.Infections due to Entero-pathogenic *E.coli* strains		
2.2.2.Enteric fever-*Salmonella*		
2.2.3Shigellosis		
2.2.4.Rotavirusdiarrhoea		
2.2.5 Dysentery due to *Entamoeba histolytica*		

Unit III: General Immunology – I	**15L**	**15**
3.1 Organs and tissues of the immune system: 3.1.1 Primary lymphoid organs - structure and function of Thymus and Bone marrow 3.1.2 Secondary lymphoid organs – structure and function of Spleen**,** Lymph node**,** Mucosa associated lymphoid tissues, Bronchus associated lymphoid tissue, Gut associated lymphoid tissue, Cutaneous associated lymphoid tissue	**4L**	
3.2 Antigens 3.2.1. Immunogenicity versus antigenicity: Concepts - Immunogenicity, Immunogen, Antigenicity, Antigen, Haptens: Haptens as valuable research and diagnostic tools 3.2.2 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 3.2.3 Epitopes / antigen determinants - General concept, Characteristic properties of B - cell epitopes, concepts of sequential and non-sequential epitopes (with only one example each). Properties of B - cell and T - cell epitopes. Comparison of antigen recognition by T cells and B cells 3.2.4 Types of antigens – heterophile antigens, isophile antigens, sequestered antigens, super antigens, bacterial and viral antigens	**5L**	
3.3 Immunoglobulins 3.3.1. Immunoglobulins –Basic structure of Immunoglobulins, heterodimer; types of heavy and light chains; constant and variable regions, Immunoblobulin domains-hinge region. Basic concepts - hypervariable region, complementarity - determining regions (CDRs), framework regions (FRs) and their importance. 3.3.2. Immunoglobulin classes and biological activities - Immunogloublin G, Immunogloublin M, Immunogloublin A, Immunogloublin E, Immunogloublin D, (including diagrams) 3.3.3 Monoclonal antibodies	**4 L** **2L**	

Unit IV: General Immunology – I	**15 L**	**15**
4.1 Cytokines		
4.1.1. Concepts cytokines, lymphokines, monokines, interleukines, chemokines.	**2 L**	
4.1.2 Properties of cytokines		
4.1.3. Attributes of cytokines		
4.1.4 Biological functions of cytokines		
4.2 Major histocompatibility complex	**3 L**	
4.2.1 Introduction		
4.2.2 Three major classes of MHC encoded molecules		
4.2.3 The basic structure and functions of Class I and Class II MHC Molecules		
4.2.4 Peptide binding by Class I and Class II MHC molecule	**3 L**	
4.3 Antigen presenting cells		
4.3.1 Types of APC's		
4.3.2 Endogenous antigens: The Cytosolic pathway		
4.3.3. Exogenous antigens: The Endocytic pathway		
4.4 Antigen Antibody reactions	**7 L**	
4.4.1. Precipitation reaction –Immuno-electrophoresis		
4.4.2. Agglutination reaction hemagglutination, bacterial agglutination, passive agglutination, agglutination inhibition.		
4.4.3. Radioimmunoassay (RIA),		
4.4.4. Enzyme Linked Immunosorbent Assay indirect, competitive and sandwich ELISA		
4.4.5. Immunofluorescence- Direct and indirect.		
4.4.6 Western blotting.		

EMPLOYABILITY

Paper Code	Title of the Paper	Practical/Week	Credits
USc5Mi2	Medical Microbiology and Immunology Part I	1	1.5

Sr. No.	Name of the Practical
1	Acid fast staining
2	Identification of *Candida* species using the germ tube test and growth on Chrom agar
3	Study of standard cultures *E. coli, Klebsiella spp., Proteus spp., Pseudomonas spp., Salmonalla typhi, S. paratyphi A, S. paratyphi B, Shigella spp., S .pyogenes, S.aureus*
4	Identification of isolates obtained from pus, sputum, stool and urine by morphological, cultural and biochemical properties
5	Antigen preparation "O and H antigen preparation of Salmonella. Confirmation by slide agglutination test SKILL DEVELOPMENT
6	Demonstration of ELISA test

Reference: Course Code: USc5Mi2

Text books:

1. Jawetz, Melnick and Adelberg's Medical Microbiology, 26th Edition, Lange publication
2. Ananthanarayan and Panicker's, Textbook of Microbiology, 10thedition
3. Ananthanarayan and Panicker's, Textbook of Microbiology, 9thedition
4. Ananthanarayan and Panicker's, Textbook of Microbiology, 8thedition
5. Kuby Immunology, 6th Edition, W H Freeman and Company
6. Pathak & Palan, Immunology: Essential & Fundamental, 1st& 3rd Edition, Capital Publishing Company
7. Fahim Khan, Elements of Immunology, Pearson Education

Reference books / Internet references:

1. Kuby Immunology, 7th edition, W H Freeman and Company
2. Ananthanarayan and Panicker's, Textbook of Microbiology, 8ththedition
3. Baron Samuel , Medical Microbiology, 4thedition
4. http://www.ncbi.nlm.nih.gov/books/NBK7627/
   http://www.macmillanlearning.com/catalog/static/whf/kuby

USc5Mi3 (Microbial Biochemistry: Part-I)

Course Code	**: USc5Mi3**	**Title of the Paper**	**: Microbial Biochemistry: Part-I**
No. of Lectures	**: 60**	**Credits**	**: 2.5**

Learning Objectives:

This course is designed for T. Y .B. Sc. students who choose to major in Microbiology. Biochemistry is the branch of science that explores the chemical processes that take place inside all living things, from bacteria to plants and animals. It is a laboratory-based science that brings together biology and chemistry, by using chemical knowledge and techniques to help understand and solve biological problems. Microbial physiology is best understood with knowledge of biochemistry.

The course thus focuses on the need to study various intermediary metabolic processes and methods to study metabolism both invitro as well as in vivo. The course is designed to expose students to carbohydrate and lipid metabolism as also understand the principles of energy generation by different physiological groups of organisms. The advanced area of bioenergetics unfolds the universal mechanisms of energy generation by using electron transport systems and gaining knowledge of energy conservation. The student is also learning anabolic processes through concepts of biosynthesis, and polymerization namely glycogen and peptidoglycan biosynthesis.

Course specific objective: (CSO USc5Mi3)

1. Learners will understand mechanism of oxidative phosphorylation
2. Learners will be able to differentiate between bacterial and mitochondrial etc
3. Learners will understand various modes of generation of electrochemical energy
4. Learners will understand pathways for degradation of carbohydrates
5. Learners will understand pathways for synthesis of carbohydrates
6. Learners will understand regulation and energetics of carbohydrate metabolism pathways
7. Learners will understand catabolism and anabolism of fatty acids and PHB
8. Learners will understand catabolism of hydrocarbons
9. Learners will understand biosynthesis of phosphoglycerides
10. Learners will understand various methods of studying metabolism
11. Learners will understand mechanism of various fermentative pathways

T. Y. B. Sc. Microbiology Syllabus

	Title & Content	Lectures/ Semester	Notional Periods
	Unit I: Bioenergetics & Bioluminescence	**15**	**15**
1.1	**Biochemical mechanism of generating ATP:** Substrate-Level Phosphorylation, Oxidative Phosphorylation & Photophosphorylation	01L	
1.2	**Electron transport chain** 1.2.1 Universal Electron acceptors that transfer electrons to E.T.C. 1.2.2 Carriers in E.T.C. 1.2.2.1 Hydrogen carriers – Flavoproteins, Quinones 1.2.2.2 Electron carriers – Iron Sulphur proteins, Cytochromes. 1.2.3 Mitochondrial ETC 1.2.3.1 Biochemical anatomy of mitochondria 1.2.3.2 Complexes in Mitochondrial ETC 1.2.3.3 Schematic representation of Mitochondrial ETC.	03L	
1.3	**Prokaryotic ETC** 1.3.1 Organization of electron carriers in bacteria 1.3.1.1 Generalized electron transport pathway in bacteria 1.3.1.2 Different terminal oxidases 1.3.2 Branched bacterial ETC 1.3.3 Pattern of electron flow in E. coli - aerobic and anaerobic 1.3.4 Pattern of electron flow in Azotobacter vinelandii	03L	
1.4	**ATP synthesis** 1.4.1 Explanation of terms – Proton motive force, Proton pump, Coupling sites, P:O ratio, Redox potential (definition of Standard reduction potential) 1.4.2 Free energy released during electron transfer from NADH to O2 1.4.3 Chemiosmotic theory (only explanation) 1.4.4 Structure & function of Mitochondrial ATP synthase 1.4.5 Structure of bacterial ATP synthase 1.4.6 Mechanism by Rotational catalysis 1.4.7 Inhibitors of ETC, ATPase and uncouplers	04L	
1.5	**Other modes of generation of electrochemical energy** 1.5.1 ATP hydrolysis 1.5.2 Oxalate formate exchange 1.5.3 End product efflux, Definition, Lactate efflux 1.5.4 Bacteriorhodopsin: - Definition, function as proton pump and significance	02L	
1.6	**Bioluminescence** 1.6.1 Brief survey of bioluminescent systems 1.6.2 Biochemistry of light emission 1.6.3 Schematic diagram 1.6.4 Significance / Application	02L	

Title & Content		Lectures/ Semester	Notional Periods
Unit II: Carbohydrate metabolism and energetics of pathways		15L	15L
2.1	**Breakdown of polysaccharides** – Glycogen, Starch, Cellulose	01L	
2.2	**Breakdown of oligosaccharides** - Lactose, Maltose, Sucrose, Cellobiose.	01L	
2.3	**Utilization of monosaccharides** - Fructose, Galactose	01L	
2.4	**Major pathways – (with structure and enzymes)** 2.4.1 Glycolysis (EMP) 2.4.2 HMP Pathway - Significance of the pathway 2.4.3 ED pathway 2.4.4 TCA cycle - Action of PDH, Significance of TCA 2.4.5 Incomplete TCA in anaerobic bacteria 2.4.6 Anaplerotic reactions 2.4.7 Glyoxylate bypass	05L	
2.5	Amphibolic role of EMP; Amphibolic role of TCA cycle	01L	
2.6	Energetics of Glycolysis, TCA and ED pathway – Balance sheet only. Format as in Lehninger (2.5 ATP/NADH and 1.5 ATP /FADH2) (Based on this format make balance sheet for Glycolysis -Lactic acid and Alcohol fermentation and for ED pathway)	02L	
2.7	2.7.1 General pattern of metabolism leading to synthesis of a cell from glucose 2.7.2 Sugar nucleotides 2.7.3 Gluconeogenesis (only bacterial) 2.7.3 Biosynthesis of glycogen 2.7.4 Biosynthesis of Peptidoglycan	04L	

T. Y. B. Sc. Microbiology Syllabus

	Title & Content	Lectures/ Semester	Notional Lectures
	Unit III: Lipid Metabolism & Catabolism of Hydrocarbons	15L	15L
3.1	**Introduction to lipids** 1.1.1 Lipids –Definition, classification & functions 1.1.2 Types and role of fatty acids found in bacteria 1.1.3 Common phosphoglycerides in bacteria 1.1.4 Action of lipases on triglycerides /tripalmitate	02L	
3.2	**Catabolism of Fatty Acids** 3.2.1 Oxidation of saturated fatty acid by β oxidation pathway 3.2.2 Energetics of β oxidation of Palmitic acid 3.2.3 Oxidation of propionyl CoA by acrylyl- CoA pathway and methyl citrate pathway	04L	
3.3	**Anabolism of fatty acids** 3.3.1 Biosynthesis of straight chain even carbon saturated fatty acid (palmitic acid)	02L	
3.4	**PHB metabolism** 3.4.1 PHB as a food reserve and its degradation 3.4.2 Biosynthesis of PHB	02L	
3.5	1.3.2 Biosynthesis of phosphoglycerides in bacteria	02L	
3.6	**Catabolism of aliphatic hydrocarbons** 3.6.1 Organisms degrading aliphatic hydrocarbons 3.6.2 Hydrocarbon uptake mechanisms 3.6.3 Omega oxidation pathway 3.6.3.1 Pathway in Corynebacterium and yeast 3.6.3.2 Pathway in Pseudomonas	03L	

	Title & Content	Lectures/ Semester	Notional Lectures
	Unit IV: Methods of Studying Metabolism & Fermentative Pathway	15L	15L
4.1	**Experimental Analysis of metabolism** 4.1.1 Goals of the study 4.1.2 Levels of organization at which metabolism is studied 4.1.3 Metabolic probes. 4.1.4 Use of radioisotopes in biochemistry 4.1.4.1 Pulse labelling 4.1.4.2 Assay and study of radio respirometry to differentiate EMP & ED 4.1.5 Use of biochemical mutants 4.1.6 Sequential induction	05L	
4.2	**Fermentative pathways (with structures and enzymes)** 4.1.1 Lactic acid fermentation 4.1.1.1 Homo-fermentation 4.1.1.2 Hetero-fermentation 4.1.2 Bifidum pathway 4.1.3 Alcohol fermentation 4.1.3.1 By ED pathway in bacteria 4.1.3.2 By EMP in yeasts	05L	
4.3	**Other modes of fermentation in microorganisms** 4.2.1 Mixed acid 4.2.2 Butanediol 4.2.3 Butyric acid 4.2.4 Acetone-Butanol 4.2.5 Propionic acid (Acrylate and succinate propionate pathway)	05L	

T. Y. B. Sc. Microbiology Syllabus

Paper Code	Title of the Paper	Practical/Week	Credits
USc5Mi3	Microbial Biochemistry: Part-I	1	1.5

Sr. No.	Name of the Practical
1	Isolation and study of Bioluminescent organisms
2	Study of oxidative and fermentative metabolism
3	Qualitative and Quantitative assay of Phosphatase
4	Study of Homo & Hetero-fermentations
5	Isolation and detection of Mitochondria
6	Glucose detection by GOD/POD
7	Detection of PHB producing bacteria
8	Qualitative detection of Lipase

Reference: Course Code: USc5Mi3

1. Stanier, R. Y., M. Doudoroff and E. A. Adelberg. General Microbiology, 5th edition, The Macmillan press Ltd
2. Conn, E.E., P. K. Stumpf, G. Bruening and R. Y. Doi. 1987. Outlines of Biochemistry, 5th edition, 1987. John Wiley &Sons. New York.
3. Gottschalk., (1985), Bacterial Metabolism, 2nd edition, Springer Verlag
4. White, D., (1995), The Physiology and Biochemistry of Prokaryotes, 3rd edition, Oxford University Press
5. Nelson, D. L. and M.M. Cox (2005), Lehninger, Principles of biochemistry. 4th edition, W. H. Freeman and Company
6. Rose, A.H. (1976) Chemical Microbiology, 3rd edition. Butterworth-Heinemann
7. Zubay, G. L (1996), Biochemistry, 4th edition, Wm. C. Brown publishers
8. Mathews, C.K., K.E. van Holde, D.R. Appling, S, J, Anthony-Cahill (2012) Biochemistry, 4th edition. Pearson
9. Wilson and Walker, 4th edition Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University press.
10. Cohen, G.N. (2011). Microbial Biochemistry. 2nd edition, Springer

USc5Mi4 (Bioprocess Technology: Part-I)

Course Code	**: USc5Mi4**	**Title of the Paper**	**: Bioprocess Technology: Part-I**
No. of Lectures	**: 60**	**Credits**	**: 2.5**

Learning Objectives:

Bioprocess Technology Part I course is designed to develop the learner's ability to study the techniques used in the different phases of industrial microbiology such as strain improvement, basic fermentation equipment & its sterilization aspects. A bioprocess technology is a specific process that uses complete living cells or their components to obtain desired products. It gives an in depth focus of the different types of fermenters used in industry for production of different products and emphasizes its process parameters. It includes the principles and describes the main steps and processes in the industrial production of beverages and enzymes. The downstream process and the environmental aspects of the final product are also included.

Industrial microbiology becomes an important application-based paper covering microbial fermentations. Thus, it becomes a laboratory to market scenario where the entire products reach. Bioprocess Technology I is designed to develop the learner's ability to study the techniques use in the downstream process used for the final product and industrial effluent treatment. The learner is provided with the details of productions of important products like antibiotics, vitamins, organic acid, and enzymes. Thus, this paper readies the learner to understand and apply the knowledge of fermentation technology.

This course aims to enable graduates to enter industry with an appropriate level of understanding of the need for both the science and business aspects to be achievable to make a viable product and enhance their entrepreneur skills.

Learning Outcomes:

At the end of the course, learner will be able to

1. Describe the applications of microbes and its strain improvement in Industrial Microbiology.
2. Describe the design of bioreactors for different applications and its process parameters.
3. Recognize the importance of monitoring and control of parameters during a fermentation and correlate the same with the entire process.
4. Explain methods of heat and filter sterilization.
5. Design media, growth conditions and techniques for producing and recovering different types of products of commercial value.
6. Connect downstream processing with upstream processing and explain the various processes used in the recovery and purification of industrial products.
7. Understand the actual process involved in fermentations of important products.

T. Y. B. Sc. Microbiology Syllabus

Title & Content		Lectures/ Semester	Notional Lectures
Unit I: Upstream Processing – I		**15L**	**15L**
1.1	**Introduction** 1.1.1. An introduction to fermentation processes 1.1.2. The range of fermentation processes 1.1.3. The Component parts of a fermentation process	**03L**	
1.2	**Strain improvement** SKILL DEVELOPMENT 1.2.1 Objective of strain improvement 1.2.2 The improvement of industrial microorganisms 1.2.3 Methods for strain improvement: 1.2.3.1 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	**06L**	
1.3	**Preservation of cultures** SKILL DEVELOPMENT 1.3.1 Preservation of industrially important organisms 1.3.2 Quality control of preserved stock 1.3.3 Key Criteria's 1.3.4 Development of a master culture bank (MCB) 1.3.5 Variability test to ensure reproducibility of the MCB.	**03L**	
1.4	**The development of inocula for industrial fermentations** 1.4.1. Introduction 1.4.2. Development of inocula for unicellular bacterial process 1.4.3. Development of inocula for mycelial process	**03L**	

Title & Content		Lectures/ Semester	Notional Lectures
Unit II: Upstream Processing – II		**15L**	**15L**
2.1	**Sterilization and achievement of aseptic conditions** 2.1.1. Introduction SKILL DEVELOPMENT 2.1.2. Medium sterilization (concept of nabla factor) 2.1.3. Methods of batch sterilization 2.1.4. The design of continuous sterilization process 2.1.5. Sterilization of the Fermenter 2.1.6. Sterilization of the Feeds 2.1.7. Sterilization of the liquid wastes 2.1.8. Filter Sterilization 2.1.8.1. Filter sterilization of fermentation media, 2.1.8.2. Filter sterilization of air 2.1.8.3. Filter sterilization of fermenter exhaust air 2.1.9. Achievement of aseptic conditions	**06L**	
2.2	**2.2 Scale up and scale down of fermentation.** 2.2.1. Objective of scale-up 2.2.2. Levels of fermentation (laboratory, pilot-plant and production levels) 2.2.3. Criteria of scale-up for critical parameters (aeration and agitation, broth rheology and sterilization) 2.2.4. Scale-down	**02L**	
2.3	**Design of fermenter** ENTREPRENEURSHIP 2.3.1. Basic functions 2.3.2. Aseptic operation & Containment 2.3.3. Body construction 2.3.4. Agitator (impeller) – function, types, mechanical seal, and magnetic drive 2.3.5. Baffles 2.3.6. The aeration system (sparger) - function and types 2.3.7. Valves (Globe, piston & needle) 2.3.8. Steam traps 2.3.9. Examples of fermenters - Stirred Tank Reactor, Air Lift, Deep Jet, Photobioreactor	**07L**	

T. Y. B. Sc. Microbiology Syllabus

Title & Content		Lectures/ Semester	Notional Lectures
Unit III: Instrumentation control and Downstream processing		**15L**	**15L**
3.1	**Instrumentation and control** **3.1.1.** Introduction to sensors and its types SKILL DEVELOPMENT Measurement and control of pH, temperature, pressure, foam sensing, dissolved oxygen, inlet and exit gas analysis.	**05L**	
3.2	**Downstream Processing-Recovery** SKILL DEVELOPMENT **Recovery and purification** 3.2.1 Introduction 3.2.2 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	**10L**	

	Title & Content	Lectures/ Semester	Notional Lectures
	Unit IV: Traditional Fermentations EMPLOYABILITY	**15L**	**15L**
1.1	**Wine** – 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.	**03**	
1.2	**Beer –** 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.	**03**	
1.3	**Alcohol from Molasses**: Introduction, biosynthesis of ethanol, production process- preparation of nutrient solution, fermentation, recovery by distillation.	**03**	
1.4	**Vinegar (acetic acid):** Introduction, biosynthesis, production using generator, production using submerged fermenter, recovery.	**02**	
1.5	**Baker's yeast:** Outline of production, yeast strains and their properties, factors important in production-oxygen requirement and aeration, concentration of sugar, pH, temperature, preparation of substrate, fermentation, harvesting of yeast cells, production of compressed and active dry yeast.	**02**	
1.6	**Fungal amylase production**: amylase- production from bacteria and fungi, amylase and glucoamylase, concentration and purification.	**02**	

T. Y. B. Sc. Microbiology Syllabus

Paper Code	Title of the Paper	Practical/Week	Credits
USc5Mi4	Bioprocess Technology: Part-I	1	1.5

Sr. No.	Name of the Practical
1	Alcohol Fermentation 1. Preparation and standardization of yeast inoculums for alcohol fermentation 2. Laboratory Alcohol fermentation using jaggery medium, calculation of efficiency of fermentation
2	Determine the alcohol tolerance for yeast
3	Determine the sugar tolerance for yeast.
4	Chemical estimation of sugar by Cole's ferricyanide method
5	Chemical estimation of alcohol
6	Production of amylase- detection, shake flask or solid substrate cultivation and detection (Qualitative).
7	Determination of antibiotic spectrum using agar strip / streak method.
8	Industrial Visit

Reference: Course Code: USc5Mi4

Textbooks

1. Casida L. E., "Industrial Microbiology" (2009) Reprint, New Age International (P) Ltd, Publishers, New Delhi.
2. Stanbury P. F., Whitaker A. & Hall S. J., (1997), "Principles of Fermentation Technology", 2nd edition, Aditya Books Pvt. Ltd, New Delhi.
3. Stanbury P. F., Whitaker A. & Hall S. J 3rd edition (2017) "Principles of Fermentation Technology"
4. Peppler, H. J. and Perlman, D. (1979), "Microbial Technology''. Vol. 1 & 2, Academic Press
5. A. Modi, (2009). ''Fermentation Technology'' Vol. 1 & 2, Pointer Publications, India.
6. Okafor Nduka (2007) ''Modern Industrial Microbiology and Biotechnology'', Science Publications Enfield, NH, USA.
7. Crueger W. and Crueger A. (2000) "Biotechnology -"A Textbook of Industrial
8. Microbiology", 2nd edition, Panima Publishing Corporation, New Delhi.
9. Prescott and Dunn's ''Industrial Microbiology''(1982) 4th edition, McMillan Publishers

Reference books

1. R. C. Dubey, 2005 A Textbook of ''Biotechnology'' S. Chand and Company, New Delhi.
2. A. Modi, 2009. ''Fermentation Technology'' Vol: 1 & 2, Pointer Publications, India
3. Practical Fermentation Technology by Brian Mcneil & Linda M. Harvey (2008).

T. Y. B. Sc. Semester VI Syllabus

Course Code : USc6Mi1 Title of the Paper : rDNA Technology, Bioinformatics & Virology
Credits : 2.5 Lectures/Week : 01 (On each unit)

UNIT	TOPIC HEADINGS
I	Recombinant DNA Technology
II	Applications of rDNA Technology & Bioinformatics
III	Regulation & Basic Virology
IV	Advanced Virology

Course Code : USc6Mi2 Title of the Paper : Medical Microbiology & Immunology: Part - II
Credits : 2.5 Lectures/Week : 01 (On each unit)

UNIT	TOPIC HEADINGS
I	Study of a Few Diseases with Emphasis on Cultural Characteristics of the Etiological Agent, Pathogenesis, Laboratory Diagnosis and Prevention
II	Chemotherapy of Infectious Agents
III	Immunology - I
IV	Immunology - II

Course Code : USc6Mi3 Title of the Paper : Microbial Biochemistry: Part - II
Credits : 2.5 Lectures/Week : 01 (On each unit)

UNIT	TOPIC HEADINGS
I	Lipid Metabolism & Catabolism of Hydrocarbons
II	Metabolism of Proteins and Nucleic Acids
III	Metabolic Regulation
IV	Prokaryotic Photosynthesis & Inorganic Metabolism

Course Code	:	USc6Mi1	Title of the Paper	:	Bioprocess Technology: Part - II
Credits	:	2.5	Lectures/Week	:	01 (On each unit)

UNIT	TOPIC HEADINGS
I	Downstream Processing
II	Advances in Bioprocess Technology
III	Quality Assurance, Quality Control, Instrumentation and Bioassay
IV	Industrial Fermentations

T. Y. B. Sc. Microbiology Semester VI Practical

Paper Code	Title of the Paper	Practical/Week	Credits
USc6MiPR1	rDNA Technology, Bioinformatics & Virology	01	1.5
USc6MiPR2	Medical Microbiology & Immunology: Part - II	01	1.5
USc6MiPR3	Microbial Biochemistry: Part - II	01	1.5
USc6MiPR4	Bioprocess Technology: Part - II	01	1.5

USc6Mi1 (rDNA Technology, Bioinformatics & Virology)

Course Code	**:**	**USc6Mi1**	**Title of the Paper:**	**rDNA Technology, Bioinformatics & Virology**	
No. of Lectures	**:**	**60**	**Credits**	**:**	**2.5**

Learning Objectives:

1. The rDNA technology: This module deals with the basic steps in gene cloning, vectors, model organisms, methods of transformation and screening and identification of recombinant cells.
2. Application of rDNA technology and Bioinformatics: This module will empower the student to understand the basic techniques in Recombinant DNA technology along with their applications. Bioinformatics is the basic tool in understanding Cells at the genomic and proteomic levels. Inclusion of Bioinformatics in this module will empower the learner with insilico analytical techniques.
3. Gene Regulation and Basic Virology: This module will make the students understand the genetic basis of regulation and operon control through the involvement of regulatory proteins. The study of Basic Virology will emphasise on the structure, classification and general modes of replication of viruses.
4. Advanced Virology: This module deals with basic structure and life cycle of different viruses and cultivation of viruses. It also comprises of basic study on Prions, Viriods and viruses causing cancer.

Learning Outcomes:

Recombinant DNA technology: This module will make the student understand the methods to construct recombinant DNA molecules, also know the tools required like vectors, restriction enzymes and model organism etc.

Application of rDNA technology and Bioinformatics: The learner will know about applications of r DNA technology, through bioinformatics the student will understand the use of databases and software tools for understanding biological data.

Gene Regulation and Basic Virology: The student will know about gene expression in prokaryotes, operon as a unit of gene regulation, regulation of gene expression in prokaryotes and bacteriophages. The student will also understand about general structure, life cycle and classification of viruses.

Advanced Virology: The learner will understand the basic structure and life cycle of different viruses and their cultivation. The student will get basic knowledge on Prions, Viriods and cancer causing viruses.

Practicals: The students will acquire skill to perform the laboratory techniques and experiments based on the above topics. The students will understand computational biology and In-Silico analytical techniques.

Title & Content	Lectures / Semester	Notional Periods
Unit I: Recombinant DNA Technology	**(Total 15 L)**	**15**
1.1 Branches of Genetics EMPLOYABILITY	**01L**	
1.1.1 Transmission genetics		
1.1.2 Molecular genetics		
1.1.3 Population genetics		
1.1.4 Quantitative genetics		
1.2 Model Organisms	**02L**	
1.2.1 Characteristics of a model organism		
1.2.2 Examples of model organisms used in study		
1.2.3 Examples of studies undertaken using prokaryotic and eukaryotic model organisms		
1.3 Plasmids	**02L**	
1.3.1 Physical nature		
1.3.2 Detection and isolation of plasmids		
1.3.3 Plasmid incompatibility and Plasmid curing		
1.3.4 Cell to cell transfer of plasmids		
1.3.5 Types of plasmids		
1.3.6 Resistance Plasmids, Plasmids encoding Toxins and other Virulence characteristics, Col factor, Degradative plasmids		
1.4 Transposable Elements in Prokaryotes	**02L**	
1.4.1 Insertion sequences		
1.4.2 Transposons: Types, Structure and properties, Mechanism of transposition, Integrons		
1.5 Basic steps in Gene Cloning.	**01L**	
1.6 Cutting and joining DNA molecules - Restriction and modification systems, restriction endonucleases, DNA ligases	**03L**	
1.7 Vectors	**03L**	
1.7.1 Plasmids as cloning vectors. plasmid vectors, pBR322 vector		
1.7.2 Cloning genes into pBR322		
1.7.3 Phage as cloning vectors, cloning genes into phage vector		
1.7.4 Cosmids		
1.7.5 Shuttle vectors		
1.7.6 YAC		
1.7.7 BAC		
1.8 Methods of transformation	**01L**	

	Unit II: Applications of rDNA Technology & Bioinformatics	**(Total 15L)**	**15**
2.1	**PCR**- Basics of PCR technique and different types of PCR (Reverse transcriptase PCR, Real time quantitative PCR)	**02L**	
2.2	**Basic techniques** 2.2.1 Southern, Northern and Western blotting. 2.2.2 Autoradiography (explain the term)	**02L**	
2.3	**Screening and selection methods for identification and isolation of recombinant cells**	**02L**	
2.4	**Applications of recombinant DNA technology:-** Site specific mutagenesis of DNA, Uses of DNA polymorphism, STRS and VNTRS, DNA molecular testing for human genetic diseases (Only RFLP), DNA typing, gene therapy, Genetic Engineering of plants and animals.	**04L**	
2.5	**Bioinformatics** 2.5.1 Introduction 2.5.2 Definition, aims, tasks and applications of Bioinformatics. 2.5.3 Database, tools and their uses – 2.5.3.1 Importance, Types and classification of databases 2.5.3.2 Nucleic acid sequence databases- EMBL, DDBJ, GenBank, GSDB, Ensembl and specialized Genomic resources. 2.5.3.3 Protein sequence databases-PIR, SWISS-PROT, TrEMBL NRL-3D.Protein structure databases- SCOP, CATH, PROSITE, PRINTS and BLOCKS. KEGG. 2.5.4 **Explain the terms**:- Transcriptome, Metabolomics, Pharmacogenomics, Phylogenetic analysis, Phylogenetic tree, Annotation, Genomics- structural, functional and comparative genomics, Proteomics - structural and functional proteomics, Sequence alignment - global v/s local alignment, FASTA, BLAST (Different types of BLAST)	**05L**	

	Unit III: Regulation & Basic Virology	**(Total 15 L)**	**15**
3.1	**A) Lac operon and problems on Lac operon**	**06L**	
	B) Trp operon		
3.2	**Regulation of lytic and lysogenic pathway of lambda phage**	**03L**	
3.3	**Viral architecture -** Capsid, Viral genome and Envelope	**02L**	
3.4	**Viral classification (Baltimore classification)**	**01L**	
3.5	**Viral replication cycle** – Attachment, Penetration, Uncoating, Types of viral genome, their Replication, Assembly, Maturation & Release.	**03L**	
	Unit IV: Advanced Virology	**(Total 15 L)**	
4.1	Structure of TMV, T4, Influenza virus.	**02 L**	
4.2	Life cycle of T4 phage, TMV, Influenza Virus in detail**.**		
4.3	**Cultivation of viruses**- Cell culture techniques, Embryonated egg, Laboratory animals, Cell culture methods: Equipment required for animal cell culture, Isolation of animal tissue.	**03 L**	
4.4	**Visualization and enumeration of virus particles**	**03 L**	
	4.4.1 Measurement of infectious units		
	4.4.1.1 Plaque assay		
	4.4.1.2 Fluorescent focus assay		**15**
	4.4.1.3 Infectious center assay		
	4.4.1.4 Transformation assay		
	4.4.1.5 Endpoint dilution assay.		
	4.4.2 Measurement of virus particles and their components	**03 L**	
	4.4.2.1 Electron microscopy		
	4.4.2.2 Atomic force microscopy		
	4.4.2.3 Haemagglutination		
	4.4.2.4 Measurement of viral enzyme activity.		
4.5	**Role of viruses in Cancer:** Important definitions, characteristics of cancer cell, Human DNA tumor viruses- EBV, Kaposis sarcoma virus, Hepatitis B and C virus, Papiloma Virus.	**02 L**	
4.6	**Prions:** Definition, Examples of diseases caused by prions, Kuru, PrP protein and protein only hypothesis	**01 L**	
4.7	**Viroids**	**01 L**	

T. Y. B. Sc. Microbiology Syllabus

Paper Code	Title of the Paper	Practical/Week	Credits
USc6Mi1	rDNA Technology, Bioinformatics & Virology	1	1.5

Sr. No.	Name of the Practical
1	Isolation of genomic DNA of *E. coli* and measurement of its concentration by UV-VIS
2	Enrichment of coliphages, phage assay (pilot & proper). SKILL DEVELOPMENT
3	Restriction digestion of lambda phage /any plasmid DNA (Demo) SKILL DEVELOPMENT
4	Beta galactosidase assay
5	Bioinformatics Online Practical's:- SKILL DEVELOPMENT 1. Visiting NCBI and EMBL websites & list services available, software tools available and databases maintained. 2. Visiting & exploring various databases mentioned in syllabus and i. Using BLAST and FASTA for sequence analysis. ii. Fish out homologs for given specific sequences (by teacher – decide sequence of some relevance to their syllabus and related to some biological problem e.g. evolution of a specific protein in bacteria, predicting function of unknown protein from a new organism based on its homology) iii. Six frame translation of given nucleotide sequence iv. Restriction analysis of given nucleotide sequence v. Pair-wise alignment and multiple alignment of a given protein sequences vi. Formation of phylogenetic tree
6	Animal cell culture (Demo)

Text books:

1. Peter J. Russell (2006), "I Genetics-A molecular approach", 2nd edition.
2. Benjamin A. Pierce (2008), "Genetics a conceptual approach", 3rd edition, W. H. Freeman and company.
3. R. H. Tamarin, (2004), "Principles of genetics", Tata McGraw Hill.
4. M. Madigan, J. Martinko, J. Parkar, (2009), "Brock Biology of microorganisms", 12th edition, Pearson Education International.
5. Fairbanks and Anderson, (1999), "Genetics", Wadsworth Publishing Company.
6. Prescott, Harley and Klein, "Microbiology",. 7th edition Mc Graw Hill international edition.
7. Edward Wagner and Martinez Hewlett, (2005) "Basic Virology", 2nd edition, Blackwell Publishing
8. Teri Shors. (2009), "Understanding viruses", Jones and Bartlett publishers.
9. S.Ignacimuthu, (2005), "Basic Bioinformatics", Narosa publishing house.
10. Robert Weaver, (2008), "Molecular biology", 3rd edition, Mc Graw Hill international edition.
11. Primrose and Twyman, (2001), "Principles of gene manipulation and genomics", 6th edition, Blackwell Publishing
12. Arthur Lesk, (2009), "Introduction to Bioinformatics", 3rd Edition, Oxford University Press
13. Snustad, Simmons, "Principles of genetics", 3rd edition. John Wiley & sons, Inc.
14. A textbook of biotechnology R. C. Dubey 4th edition. S. Chand.

Reference books:

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

USc6Mi2 (Medical Microbiology & Immunology: Part - II)

Course Code	**:**	**USc6Mi2**	**Title of the Paper:**	**Medical Microbiology & Immunology: Part - II**	
No. of Lectures	**:**	**60**	**Credits**	**:**	**2.5**

Learning Objectives:

Medical microbiology covers etiology, transmission, pathogenesis, clinical manifestations, laboratory diagnosis, prophylaxis, and treatment of various diseases that are most common to humans, through which the students can build on the basic information of various diseases. . An separate unit on chemotherapy explains the drugs available for treating infectious agent and the misuse of antibiotic which gives rises to occurrence of multiple resistance strains

Immunology is an integral part of Medical Microbiology and this course is designed for T. Y. B. Sc. Microbiology students on the assumption that the students have achieved a basic understanding of Innate Immunity and Host Defense mechanisms. The course has been designed to help understand the ability of our immune system to defend against invading pathogens in a logical fashion. This includes our innate ability to defend against microorganisms (innate immunity); should this first line of defense fail, how we can fight infections (acquired immunity); the role of immune hematology in blood transfusion and very importantly, can we prevent pathogens from infecting us (vaccination).

Learning Outcomes:

The students will be able to :

- Comment on the mode of transmission, and modes of prophylaxis of these diseases.
- Comment on the methods of diagnosis of the disease.
- Understand the structure and role of T and B cells in generating adaptive immunity and thereby study effector responses in both Humoral & Cell Mediated Immunity. Acquire an understanding of the role of immune system in disease:
- Understand the activation of complement system.
- Describe the importance and role of vaccine in disease prevention
- Understand the concept of Clinical research and drug development.

T. Y. B. Sc. Microbiology Syllabus

Title & Content	Lectures / Semester	Notional Periods
Unit I: Study of a Few Diseases with Emphasis on Cultural Characteristics of the Etiological Agent, Pathogenesis, Laboratory Diagnosis and Prevention EMPLOYABILITY	**15L**	**15**
1.1 Study of vector-borne infections -Malaria	**2L**	
1.2 Study of sexually transmitted infectious diseases 1.2.1 Syphilis 1.2.2 AIDS 1.2.3 Gonorrhoea	**8L**	
1.3 Study of central nervous system infectious diseases 1.3.1.Tetanus 1.3.2 Polio 1.3.3.Meningococcalmeningitis	**5L**	
Unit II: Chemotherapy of Infectious Agents	**15L**	**15**
2.1 Attributes of an ideal chemotherapeutic agent - Selective toxicity, Bioavailability of drug, routes of drug administration, LD50, MBC, etc.	**2 L**	
2.2. Mode of action of antibiotics on- Cell wall (Beta-lactams- Penicillin and Cephalosporins, Carbapenems) Cell Membrane (Polymyxin and Imidazole) Protein Synthesis (Streptomycin, Tetracycline and Chloramphenicol) Nucleic acid (Quinolones, Nalidixic acid, Rifamyicn) Enzyme inhibitors (Sulfa drugs, Trimethoprim)	**7 L** **1 L**	
2.3 List of common antibiotics - used for treating viral, fungal and parasitic diseases.	**3 L**	
2.4 Mechanisms of drug resistance - Its evolution, pathways and origin for ESBL, VRE, MRSA	**2 L**	
2.5 Selection and testing of antibiotics for bacterial isolates by Kirby-Bauer method (ii) Methods that detect *S. aureus* resistance to methicillin, and determination of ESBL strains		

Unit III: Immunology – I	**15L**	**15**
3.1 T cells 3.1.1 T Cell Receptor-structure (alpha-beta, gamma-delta TCR) 3.1.2 TCR-CD_3 complex - structure and functions. Accessory molecules 3.1.3 T cell activation TCR mediated signaling –Overview Co-stimulatory signals T cell differentiation (Memory and Effector cells)	**4L** **3L**	
3.2 Cell mediated effector response 3.2.1 General properties of effector T-cells 3.2.2 Cytotoxic T Cells and destruction of target cell by perforin/granzyme pathway and Fas pathway 3.2.3 Killing mechanism of NK cells 3.2.4 Antibody mediated cell cytotoxicity (ADCC)	 **4L**	
3.3 B Cells 3.3.1 B cell receptor and co-receptor-structure and function 3.3.2 B cell activation and Differentiation 3.3.3 Thymus dependent and independent antigens 3.3.4.Signal transduction pathway activated by BCR- overview 3.3.5.Role T_H cell in B cell response-Formation of T-B conjugates, CD40/CD40L interaction, T_H cells cytokine signals		
3.4 Humoral Response 3.4.1 Primary and secondary responses 3.4.2 In vivo sites for induction of Humoral response 3.4.3.Germinal centers and antigen induced B cell Differentiation 3.4.4.Cellular events within germinal centers-Overview 3.4.5.Affinity maturation, somatic hyper-mutation and class switching Generation of plasma cells and memory cells	**4L**	

Unit IV: Immunology – II	**15L**	**15**
4.1 Vaccines EMPLOYABILITY	**7L**	
4.1.1 Active and passive immunization		
4.1.2 Types of Vaccine- Killed, attenuated , whole organism, Purified macromolecules as vaccine, recombinant vaccine, DNA vaccine		
4.1.3 Use of Adjuvants as vaccine		
4.1.4 New Strategies of vaccine		
4.1.5 Ideal vaccine		
4.1.6 Route of vaccine administration, Vaccination schedule	**3L**	
4.2 Immuno-hematology		
4.2.1 Human blood group systems, ABO, secretors and non-secretors, Bombay Blood group. Rhesus system and list of other blood group systems		
4.2.2 Hemolytic disease of new born, Coombs test.		
4.3 Complement System	**3L**	
4.3.1 Functions and components of complement		
4.3.2 Complement Activation—classical, alternative and lectin pathway		
4.3.3 Biological consequences of complement activation		
4.4 Clinical Research	**2L**	
4.4.1 Introduction to Clinical research: Definition, types and scope of clinical research, good clinical practices, careers in clinical research		
4.4.2 Ethics in clinical research: Ethical theories and foundations, Integrity and misconduct in clinical research		

Paper Code	Title of the Paper	Practical/Week	Credits
USc6Mi2	Medical Microbiology & Immunology: Part - II	1	1.5

Sr. No.	Name of the Practical
1	Demonstration of malaria parasite in blood films(Demo)
2	Selection and testing of antibiotics using the Kirby-Bauer method
3	Determination of MBC of an antibiotic.
4	Demonstration of E test
5	Blood grouping – Direct & Reverse typing
6	Coomb's Direct test
7	Determination of Isoagglutinin titre
8	Demonstration experiments –VDRL Test

SKILL DEVELOPMENT

Reference: Course Code: USc6Mi2

Text books:

1. Jawetz, Melnick and Adelberg's Medical Microbiology, 26th Edition, Lange publication
2. Ananthanarayan and Panicker's, Textbook of Microbiology, 10th edition2017
3. Ananthanarayan and Panicker's, Textbook of Microbiology, 9thedition
4. Ananthanarayan and Panicker's, Textbook of Microbiology, 8thedition
5. Introduction to diagnostic microbiology for lab Science Maria DannessaDelost2015
6. Prescott's microbiology 10th edition2017
7. Kuby Immunology,4th and 6th edition, W H Freeman and Company
8. Pathak & Palan, Immunology: Essential & Fundamental, 1st& 3rd edition, Capital Publishing Company
9. Fahim Khan, Elements of Immunology, Pearson Education
10. R. S. Satoskar, S. D. Bhandarkar, 2007. Pharmacology and Pharmaco-therapeutics, Popular Prakashan, 20th edition

Reference books / Internet references:

1. Baron Samuel , Medical Microbiology, 4th editionhttp://www.ncbi.nlm.nih.gov/books/NBK7627/
2. Kuby Immunology, 7th Edition, W H Freeman and Company http://www.macmillanlearning.com/catalog/static/whf/kuby/

USc6Mi3 (Microbial Biochemistry: Part-II)

Course Code	**: USc6Mi3**	**Title of the Paper: Microbial Biochemistry: Part-II**	
No. of Lectures	**: 60**	**Credits**	**: 2.5**

Learning Objectives:

Having studied many aspects of microbial physiology in the earlier semester, contents of this semester is designed to understand how myriad organic compounds such as lipids, carbohydrates, proteins and nucleic acids can be utilized by the living cells. These life mechanisms also reveal how biomolecules are synthesized. Since all biosynthetic pathways are denovo or salvage, the vital regulatory role played by enzymes is understood. Various levels and mechanisms of regulation are dealt to make the learner aware of coordinated mechanisms of metabolism in the living cell. Photosynthesis is studied to understand the diversity in mechanism of its electron transfer, pigments and localization of photosynthetic apparatus, although the energy conservation mechanism is not different. Microorganisms are diverse with respect to their metabolism and the field of lithotrophy explains how some universal inorganic compounds can be used to make constituents of cell biomass yet others use them as electron acceptors or reduced compounds as source of energy.

Learning Outcomes:

1. Learners will understand general reactions of amino acid degradation
2. Learners will understand fermentation of single and pair of amino acids
3. Learners will understand biosynthesis of amino acids
4. Learners will learn biosynthesis of nucleotides
5. Learners will understand degradation of nucleotides
6. Learners will learn factors affecting catalytic efficiency of enzymes
7. Learners will understand regulation f enzymatic activity
8. Learners will learn regulation of metabolism by DNA binding proteins
9. Learners will learn about global regulatory mechanisms
10. Learners will learn about prokaryotic photosynthesis

11. Learners will learn about inorganic metabolism
12. Learners will learn about lithotrophs

Title & Content		Lectures/ Semester	Notional Periods
Unit I: Metabolism of Proteins and Amino acids		15L	15
1.1	**Protein metabolism** 1.1.1 Overview of protein synthesis 1.1.2 Enzymatic degradation of proteins	02L	
1.2	**General reactions of amino acids catalyzed by** 1.2.1 Amino acid decarboxylases 1.2.2 Amino acid deaminases 1.2.3 Amino acid transaminases 1.2.4 Amino acid racemases	03L	
1.3	**Metabolic fate of amino acids** - Glucogenic and ketogenic amino acids	01L	
1.4	**Fermentation of single amino acid** - Glutamic acid by Clostridium tetanomorphum	01L	
1.5	**Fermentation of pair of amino acids** -Stickland reaction (include enzymes)	01L	
1.6	**Anabolism of amino acids** 1.6.1 Schematic representation of amino acid families 1.6.2 Biosynthesis of amino acids of Serine family (Serine, Glycine and Cysteine) 1.6.3 Biosynthesis of amino acids of aspartate family	07L	
1.7	**Urea cycle**	01L	

Unit II: Metabolism of Nucleic acids and Catalytic efficiency of enzymes		15L	15
2.1	**Catabolism of Nucleotides** 2.1.1 Degradation of purine nucleotides up to uric acid formation 2.1.2 Salvage pathway for purine and pyrimidine nucleotides	03L	
2.2	**Biosynthesis of nucleotides** 2.2.1 Nomenclature and structure of nucleotides 2.2.2 Role of nucleotides (high energy triphosphates) 2.2.3 Biosynthesis of pyrimidine nucleotides 2.2.4 Biosynthesis of purine nucleotides 2.2.5 Biosynthesis of deoxyribonucleotides 2.2.6 Mechanism of ribonucleotide reductase	07L	
2.3	**Factors affecting catalytic efficiency of enzymes**- i) Proximity and orientation, ii) Strain and distortion, iii) Acid base catalysis, iv) Covalent catalysis	05	

ENTREPRENEURSHIP

Unit III: Unit III: Metabolic Regulation		15L	15
3.1	**Definition of terms and major modes of regulation**	02L	
3.2	**Regulation of enzyme activity** 3.2.1 Noncovalent enzyme inhibition 3.2.1.1 Allosteric enzymes and feedback inhibition 3.2.1.2 Patterns of FBI, combined activation and inhibition 3.2.2 Covalent modification of enzymes 3.2.2.1 Monocyclic cascades 3.2.2.2 Examples of covalent modification (without structures) 3.2.2.3 Regulation of Glutamine synthetase	05L	
3.3	**DNA binding proteins and regulation of transcription by positive & negative control** 3.3.1 DNA binding proteins 3.3.2 Negative control of transcription: Repression and Induction 3.3.3 Positive control of transcription: Maltose catabolism in E. coli	04L	
3.4	**Global regulatory mechanisms**	02	

	3.4.1 Global control & catabolite repression 3.4.2 Stringent response		
3.5	**Regulation of EMP and TCA cycle** - (Schematic and Regulation of Pyruvate dehydrogenase Complex)	02	
Unit IV: Prokaryotic Photosynthesis & Inorganic Metabolism		15L	15
4.1	**Photosynthesis** 4.1.1 Definition of terms in photosynthesis (light and dark reactions, Hill reaction & reagent, Photophosphorylation) 4.1.2 Photosynthetic pigments 4.1.3 Location of photochemical apparatus 4.1.4 Photochemical generation of reductant	04L	
4.2	**Light reactions in:** 4.2.1 Purple photosynthetic bacteria 4.2.2 Green sulphur bacteria 4.2.3 Cyanobacteria (with details)	03L	
4.3	**Dark reaction** 4.3.1 Calvin Benson cycle 4.3.2 Reductive TCA cycle	02L	
4.4	**Inorganic Metabolism** 4.4.1 Assimilatory pathways: 4.4.1.1 Assimilation of nitrate, 4.4.1.2 Ammonia fixation – Glutamate dehydrogenase, Glutamine synthetase, GS-GOGAT, Carbamoyl phosphate synthetase 4.4.1.3 Biological nitrogen fixation (Mechanism for N2 fixation and protection of nitrogenase) 4.4.1.4 Assimilation of sulphate 4.4.2 Dissimilatory pathways: 4.4.2.1 Nitrate as an electron acceptor (Denitrification in *Paracoccus denitrificans*) 4.4.2.2 Sulphate as an electron acceptor	05L	
4.5	**Lithotrophy**–Enlist organisms and products formed during oxidation of Hydrogen, carbon monoxide, Ammonia, Nitrite, Sulphur, Iron.	01L	

Paper Code	Title of the Paper	Practical/Week	Credits
USc6Mi3	Microbial Biochemistry: Part-II	1	1.5

Sr. No.	Name of the Practical
1	To study catabolite repression by diauxic growth curve.
2	Protein estimation by Lowry's method
3	Estimation of uric acid
4	Qualitative and Quantitative assay of Protease
5	Study of breakdown of amino acids – Lysine decarboxylase and Deaminase activity
6	Study of Lithotrophs – Nitrosification and Nitrification

Reference: Course Code: USc6Mi3

Text books:

1. Stanier, R. Y., M. Doudoroff and E. A. Adelberg. General Microbiology, 5th edition, The Macmillan press Ltd
2. Conn, E.E., P. K. Stumpf, G. Bruening and R. Y. Doi. 1987. Outlines of Biochemistry, 5th edition, 1987. John Wiley &Sons. New York.
3. Gottschalk., (1985), Bacterial Metabolism, 2nd edition, Springer Verlag
4. White, D., (1995), The Physiology and Biochemistry of Prokaryotes, 3rd edition, Oxford University Press
5. Nelson, D. L. and M.M. Cox (2005), Lehninger, Principles of biochemistry. 4th edition, W. H. Freeman and Company
6. G. Moat, J.W. Foster, M,P. Spector.(2002), Microbial Physiology, 4th edition, WILEYLISS
7. Madigan, M.T. and J.M. Martinko2006. [11th edition] Brock Biology of Microorganisms. Pearson Prentice Hall.
8. Zubay, G. L (1996), Biochemistry, 4th edition, Wm. C. Brown publishers
9. Zubay, G. L (1996), Principles of Biochemistry, Wm. C. Brown publishers
10. Principles of Biochemistry, Lehninger, 5th edition, W. H. Freeman and Company

USc6Mi4 (Bioprocess Technology: Part II)

Course Code	**: USc6Mi4**	**Title of the Paper: Bioprocess Technology: Part II**	
No. of Lectures	**: 60**	**Credits**	**: 2.5**

Learning Objectives:

Bioprocess technology II becomes an important application-based paper covering microbial fermentations as well as applying the techniques of molecular biology to enzyme technology, animal tissue culture as well as plant tissue culture. Thus, it becomes a laboratory to market scenario where the entire products reach. The learner is provided with the details of productions of important products like antibiotics, vitamins, organic acid, amino acids, and mushrooms along with the analysis techniques using various instruments and bioassays.

The learner is provided with the details of productions of important traditional fermentation products like wine, beer, vinegar, and enzymes.

Thus, this paper readies the learner to understand and apply the knowledge of fermentation technology and related products.

The learner is expected to learn the need of Quality management and regulatory bodies as the products need to fulfill these requirements. The learners expected to learn biosafety and therapeutic production of different products like vaccine, biosensors etc.

Thus, this paper readies the learner to understand and apply the knowledge of fermentation technology and related products. This course aims to enable graduates to enter industry with an appropriate level of understanding of the need for both the science and business aspects to be achievable to make a viable product and enhance their entrepreneurial skills.

Course Specific Objectives:

1. Learners will be able to study production of bacterial biotechnological products such as biofertilizer, bioinsecticide and biopolymers.
2. Learners will be able to study to study algal biotechnological products such as biofuels, biodiesel, and other products.
3. Learners will be able to study production of yeasts for important products.
4. Learners will be able to study the applications of animal and plant tissue culture

techniques.

5. Learners will understand the principles of quality assurance, quality control, GMP and sterility assurance in pharmaceutical industry.
6. Learners will understand the methods for immobilization of enzymes and their applications.
7. Learners will understand different types of bioassay.
8. Learners will understand the actual process involved in fermentations of important products.

Learning Outcomes:

- Understand the actual process involved in fermentations of important products.
- To apply the knowledge of applications of animal and plant tissue culture techniques.
- Learn the applications of immobilized enzymes in various fields.
- Learn the salient features of quality management and regulatory procedures.
- Explain the basic principles of quality assurance, quality control, GMP and sterility assurance in pharmaceutical industry.

At the end of the course the learner will also acquire the following practical skills

- Techniques involved in running a bioassay, immobilization of cells & sterility testing.
- Preliminary techniques in animal & plant tissue culture.

Title & Content		Lectures/ Semester	Notional Periods
Unit I: Biotechnological Products		15L	15
1.1	**Bacterial Biotechnology** 1.1.1 Bioinsecticides 1.1.2 Bacterial Biofertilizer- Production of bacterial biofertilizer, Rhizobium, Phosphate solubilizing bacteria. 1.1.3 Biopolymers- Microbial production of Xanthan gum, Melanin, Alginate, PHAs and PHBs	05L	
1.2	**Algal Biotechnology** 1.2.1 Important products produced by Algae 1.2.1.1 Biofuels, Bio-Oil, Biohydrogen, Biomethane, Bioethanol, Biobutanol, Biodiesel 1.2.1.2 Pigments and other important compound	06L	
1.3	**Yeast Biotechnology** 1.3.1 Production of carotenoid from yeast	04L	

	1.3.2 Lipid production by Oleaginous yeast		

Unit II: Advances in Bioprocess Technology		15L	15
2.1	**Animal biotechnology** 2.2.1 Primary cell culture and established cell lines: Basic principles 2.2.3 Growth media: Cell viability Scale up of cultured cells and tissue. Applications of cell culture: Vaccines, somatic cell fusion, valuable products	05L	
2.2	**Plant tissue culture** SKILL DEVELOPMENT 2.2.1 Introduction 2.2.2 Requirements for in vitro culture, Methods of plant cell and issue culture 2.2.3 Types of cultures of plant materials: explants, callus, organogenesis, root culture, shoot culture, micropropagation, suspension culture, protoplast culture, protoplast fusion and somatic hybridization. 2.2.4 Applications: production of disease resistant plants, production of virus free plant, In vitro selection of cell lines for disease resistance, micropropagation, secondary metabolites from cell culture, transgenic plants for crop improvement	05L	
2.3	**Immobilized enzyme and cells** SKILL DEVELOPMENT 2.3.1 Introduction and Definitions 2.3.2 Methods 2.3.3 Immobilized Enzyme Reactors 2.3.4 Applications	05L	

Unit III: Quality Assurance, Quality Control, Bioassay, and Intellectual property rights		15L	15
3.1	**Quality assurance and quality control** Definitions, Chemical and pharmaceutical products Variables of batch process Q.A and Q.C w. r. t. - Raw materials, method of manufacturing, in process items, finished products, label and labeling, packaging materials Control of microbial contamination during manufacturing	04L	
3.2	**Sterilization control and assurance**	02L	
3.3	**Bioassay** Introduction Types: Diffusion, End Point, Turbidimetric, Metabolic Response, Enzymatic	03L	
3.4	**Intellectual property rights** Genesis, Role of WTO and TRIPS Overview of patent system Requirements for patentability Patent Categories Preliminary steps for patent applications Patent Procedures For biotech and microbiological products	05L	
3.5	**Overview of Effluent environmental aspect** Effluent treatment- Introduction The strength of fermentation effluents	01L	

EMPLOYABILITY

Unit IV: Industrial Fermentations		15L	15
4.1	**Penicillin and semisynthetic Penicillin:** Introduction, biosynthesis and regulation, strain development, production methods. Semisynthetic penicillin: Examples, production, advantages	03L	
4.2	**Aminoglycoside: Streptomycin:** Aminoglycoside antibiotics, biosynthesis, regulation of biosynthesis, strain development, production method, recovery.	04L	
4.3	**Vitamin B 12:** Occurrence and economic significance, structure, biosynthesis, production based on media containing carbohydrates by- *Propionibacterium* and *Pseudomonas*, recovery.	02L	
4.4	**Citric acid:** Introduction, strains used for production, biosynthesis, nutrient media, production processes- surface and submerged, product recovery.	04L	
4.5	**Glutamic acid:** Production strains, biosynthesis, effect of permeability on production, conditions of manufacturing, production process and recovery.	02L	
4.6	**Mushroom cultivation (*Agaricus*):** Edible mushroom species, preparation of substrate- composting- phase I and phase II, Factors affecting composting, preparation of spawn, casing, induction of fruiting body formation, harvesting	02L	

Paper Code	Title of the Paper	Practical/Week	Credits
USc6Mi4	Bioprocess Technology: Part II	1	1.5

Sr. No.	Name of the Practical
1	Cultivation of algae, lipid detection by staining
2	Isolation of carotenoid producing marine red yeast.
3	Bioburden estimation of pharmaceutical finished products
4	Sterility testing of injectable
5	Chemical estimation of Penicillin
6	Bioassay of an antibiotic (Penicillin).

7	Bioassay of Cyanocobalamin
8	Citric acid Efficiency and estimation by titration.

Reference: Course Code: USc6Mi4

Text books:

1. Casida L. E., "Industrial Microbiology" (2009) Reprint, New Age International (P) Ltd, Publishers, New Delhi.
2. Stanbury P. F., Whitaker A. & Hall S. J., (1997), "Principles of Fermentation Technology", 2nd Edition, Aditya Books Pvt. Ltd, New Delhi.
3. Stanbury P. F., Whitaker A. & Hall S. J 3rd Edition (2017) "Principles of Fermentation Technology"
4. H. K. Das., "Text book of Biotechnology", 2nd and 3rd edition.
5. A textbook of biotechnology R.C.Dubey 4 th edition. S.Chand.
6. H. A. Modi, (2009). ''Fermentation Technology'' Vol. 1 & 2, Pointer Publications, India
7. Okafor Nduka (2007) ''Modern Industrial Microbiology and Biotechnology'', Science Publications Enfield, NH, USA.
8. Crueger W. and Crueger A. (2000) "Biotechnology -"A Textbook of Industrial
9. Microbiology", 2nd Edition, Panima Publishing Corporation, New Delhi.
10. PrescottandDunn's''IndustrialMicrobiology''(1982)4thEdition,McMillan Publishers.
11. Veerakumari L. "Bioinstrumentation", MJP Publisher
12. Pharmaceutical Microbiology, Hugo and Russell, 7th edition, Blackwell Science.

Reference books:

1. Peppler, H. J. and Perlman, D. (1979), "Microbial Technology''. Vol 1 & 2, Academic Press.
2. Williams, Bryan L; Wilson, 2nd edition." A Biologist's guide to principles and techniques of practical biochemistry" Baltimore: University Park Press, 1981.
3. Wilson, Keith, 1936-; Goulding, Kenneth H, 3rd edition., A Biologist's guide to principles and techniques of practical biochemistry" London ; Baltimore : E. Arnold, 1986.
4. Wilson and Walker, "Principles and techniques of practical biochemistry" 5th edition.
5. Awasthi, Mamta and Singh, Rajiv Kumar .2011. Development of algae for the production of bioethanol, biomethane, biohydrogen and biodiesel. Indian Journal of Current Science.1:14-23.
6. Sharma, Nivedita and Sharma, Poonam. 2017. Industrial and biotechnological Applications of algae: A review. Journal of Advances in Plant Biology, Vol 1, issue 1.
7. Dhaliwal. M.K. 2016. Isolation of carotenoids producing marine red yeasts. Indian journal of Geo-marine Science. Vol 45(8). 1029-1034

Modality of Assessment

Assessment pattern for theory

Scheme of Examination

The learner's Performance shall be assessed by conducting the Semester End Examinations with 100% marks. Semester End Theory Assessment - 100% (75/25 marks)

Scheme of Examination for Each Semester:

Internal Evaluation: 25 Marks (20 marks internal test and 05 marks for overall conduct)

Semester End Examination: 75 Marks

I. Theory

Each theory paper shall be of two and half hour duration **All questions are compulsory and will have 100% internal options**		
Q-1	From Unit – I	**15 Marks**
Q-2	From Unit – II	**15 Marks**
Q-3	From Unit – III	**15 Marks**
Q-4	From Unit – IV	**15 Marks**
Q-5	From Unit I– IV Objective questions from all the **FOUR** Units with equal weightage of marks allotted to each Unit. Question can be split into: a. Define b. Significance c. Example	**15 Marks**

II. Practical

The External examination per practical course will be conducted as per the Following scheme			
Sr. No.	**Particulars**	**Marks**	**Total**
1.	**Laboratory work (Each Paper- Major & Minor)**	**30**	**120**
2.	**Journal (Each Paper)**	**05**	**20**
3.	**Viva (Each Paper)**	**05**	**20**

4.	**Quiz (Each Paper)**	**10**	**40**
TOTAL		**50 Marks/Paper**	**200 Marks**

Semester V:

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 the Head of the Department / Co-ordinator of the department; failing which the student will not be allowed to appear for the practical examination.

Semester VI:

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 the Head of the Department/ Co-ordinator of the department; failing which the student will not be allowed to appear for the practical examination. Overall Examination and Marks Distribution Pattern

Semester V

Course	USc5Mi1	USc5Mi2	USc5Mi3	USc5Mi4	Grand Total
Theory	100	100	100	100	400
Practical	50	50	50	50	200

Semester VI

Course	USc6Mi1	USc6Mi2	USc6Mi3	USc6Mi4	Grand Total
Theory	100	100	100	100	400
Practical	50	50	50	50	200

COURSE WISE CREDIT ASSIGNMENT UNDER THE FACULTY OF SCIENCE

Course wise credit assignments under the faculty of science Type of Courses / Credits Assigned	First Year (Credit x No. of Courses)		Second Year (Credit x No. of Courses)		Third Year (Credit x No. of Courses)		Total Credit Value
	First Semester	Second Semester	Third Semester	Fourth Semester	Fifth Semester	Sixth Semester	
Core Courses (Theory)	04x03	04x03	06x02	06x02	2.5x04	2.5x04	68
Core Courses (Practicals)	02x03	02x03	03x02	03x02	1.5x04	1.5x04	36
Foundation course	02x01	02x01	02x01	02x01			08
Applied Component Courses (Theory)					02x01	02x01	04
Applied Component Courses (Practical)					02x01	02x01	04
Total	**20**	**20**	**20**	**20**	**20**	**20**	**120**

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

Title of the Programme

B. Sc. in Microbiology

(Faculty of Science)

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

Two Credit Course

Semester V and VI

(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. in Microbiology**
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**	Theory 50 Marks; Internal: External 20:30
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 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)

Preamble

1) Introduction

This course is designed to equip learner with a knowledge related to advanced instrumentation with respect to construction, working principle and applications. Through lectures, discussions, and engaging activities, demonstration (if possible) learner will gain a comprehensive understanding of essential biochemical concepts.

2) Aims and Objectives

- **Improve the accuracy and precision of measurements.** This is important in a wide range of fields, from scientific research to industrial process control.
- **Increase the sensitivity of measurements.** This allows scientists to detect and quantify smaller amounts of analytes, which is important for fields such as drug discovery and environmental monitoring.
- **Improve the speed of measurements.** This is important for applications where real-time data is needed, such as in medical diagnostics and manufacturing.
- **Develop new measurement techniques that can be used to analyse complex systems.** This is important for fields such as materials science and biotechnology.
- **To make instrumentation more user-friendly and accessible.** This will allow a wider range of people to use advanced instrumentation, which will ultimately lead to a greater understanding of the world around us.

3) Learning Outcomes

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

- **Apply** their knowledge to study the analytes under investigation.
- **Communicate** their understanding of functioning of advanced instruments for biological purpose.
- **Critically evaluate** the importance of instrumentation in various biological studies.

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 2024-2025)

Course Structure

Course Code: USc5MiCC
Course Title: Advanced instrumentation-I
Course Type: Two Credit 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	**Apply** knowledge to visualize cell structures or tracing biomolecules using advanced microscopic techniques
CO-2	**Design** techniques for separation of molecules using advanced chromatographic techniques
CO-3	**Apply** knowledge to identify the macromolecules using advanced chromatographic techniques
CO-4	**Distinguish** the role of analytical instruments in biological analysis
CO-5	**Explain** the working principles of sophisticated analytical instruments

Course Code: USc5MiCC **Course Title: Advanced Instrumentation-I**

Unit I: Advanced Microscopy

Unit II: Advanced Chromatography

Unit. Subunit	Topic	Lectures
1	**Advanced Microscopy (15)** **Principle, Instrumentation, Working and Applications**	
	A. Fluorescence microscope	3
	B. Scanning Electron Microscope	3
	C. Transmission Electron Microscope	3
	D. Confocal Microscope	3
	E. Phase Contrast Microscope	3
Unit 2	**Advanced Chromatography (15)** **Principle, Instrumentation, Working and Applications**	
	A. Gas Chromatography	3
	B. Gel Permeation Chromatography	3
	C. Ion Exchange Chromatography	2
	D. Affinity Chromatography	2
	E. High Performance Liquid Chromatography	3
	F. HPTLC	2

Reference

1. Banwell, C.N. and McCash, E.M., 2012, Fundamentals of Molecular Spectroscopy, 4th Ed., New Delhi, Tata McGraw Hill Education Pvt. Ltd.
2. Upadhyay, Upadhyay and Nath, 2012, Biophysical Chemistry: Principles and Techniques, Mumbai, Himalaya Publishing House
3. Analytical Chemistry by Open Learning Series, 2008, New York, John Wiley and Sons.
4. Braun R. , Introduction to Instrumental Analysis, New York, McGarw Hill Book Company
5. Skoog, Holler and Nieman, Principles of Instrumental Analysis, 5th Ed. Australia, Thomson Brock/Cole
6. Elements of Biotechnology: 2009 PK Gupta, Rastogi Publications Edition 2nd

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 2024-2025)

Course Structure

Course Code: USc6MiCC
Course Title: Advanced instrumentation-II
Course Type: Two Credit 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	**Apply** knowledge to carry out analysis of biomolecules using advanced spectroscopic techniques
CO-2	**Create** techniques for separation of biomolecules using electrophoretic techniques
CO-3	**Apply** knowledge to separate molecules based on density using centrifugation techniques
CO-4	**Distinguish** the role of analytical instruments in biological analysis
CO-5	**Explain** the working principles of sophisticated analytical instruments

Course Code: USc6MiCC **Course Title: Advanced Instrumentation-II**

Unit I: Spectroscopy

Unit II: Electrophoresis and Centrifugation

Unit. Subunit	Topic	Lectures
1	**Spectroscopy (15)** **Principle, Instrumentation, Working and Applications**	
	A. Properties and types of light	1
	B. Fluorimetry	2
	C. Flame Spectrophotometry	3
	D. Mass Spectrometry	3
	E. Fourier Transform Infrared Spectroscopy	3
	F. Atomic Absorption Spectrometry	3
Unit 2	**Electrophoresis and Centrifugation (15)** **Principle, Working and Applications**	
	A. Gel Electrophoresis: Brief overview on AGE, PAGE	2
	B. Two-Dimensional Gel Electrophoresis	2
	C. Immuno-electrophoresis	2
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Reference

1. Banwell, C.N. and McCash, E.M., 2012, Fundamentals of Molecular Spectroscopy, 4th Ed., New Delhi, Tata McGraw Hill Education Pvt. Ltd.
2. Upadhyay, Upadhyay and Nath, 2012, Biophysical Chemistry: Principles and Techniques, Mumbai, Himalaya Publishing House.
3. Analytical Chemistry by Open Learning Series, 2008, New York, John Wiley and Sons.
4. Braun R. , Introduction to Instrumental Analysis, New York, McGarw Hill Book Company.
5. Skoog, Holler and Nieman, Principles of Instrumental Analysis, 5th Ed. Australia, Thomson Brock/Cole.
6. Wilson and Walker. Principles and Techniques of Biochemistry and Molecular Biology. 8th Ed.
7. Elements of Biotechnology: 2009 PK Gupta, Rastogi Publications Edition 2nd.