



# **FACULTY OF SCIENCE**

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## **COURSE STRUCTURE**

(Choice Based Credit System)

**B. SC. LIFE SCIENCES (INDUSTRIAL  
BIOTECHNOLOGY, MICROBIOLOGY,  
BIOCHEMISTRY)**

**Effective from Academic Year: 2023-2024**



Faculty Name: SCIENCE

Programme Name: B. Sc. LIFE SCIENCES (Industrial Biotechnology/Microbiology/Biochemistry)

Semester: I Academic Batch: 2023-24

Course Group	Board of Studies / Faculty Ownership	Course Code	Course Name	Cr	Teaching Scheme				Assessment/ Evaluation Type		External Exam Duration (Hrs.)		INT(T) Max./ Passing	EXT(T) Max./ Passing	INT(P) Max./ Passing	EXT(P) Max./ Passing	Grand Total Max./ Passing
					T	P	Tu	Cont. Hrs	T	P	T	P					
Discipline Specific Course-1	Biological Sciences		Introduction to Fermentation Technology	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-2	Biological Sciences		General Microbiology	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-3	Biological Sciences		Molecules of life	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Generic Elective	Chemical Sciences		Chemistry-I	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Ability Enhancement Course	Humanities		English	2	2			2	✓		2		50/18	50/17			100/35
Skill Enhancement Course	Biological Sciences		Microbial Techniques	2		2		2		✓		2			50/18	50/17	100/35
Value Addition Course (any one)	Arts		National Service Scheme (NSS)	2		2		2		✓		2			50/18	50/17	100/35
			National Cadet Corps (NCC)	2		2		2		✓		2			50/18	50/17	100/35
			Sports	2		2		2		✓		2			50/18	50/17	100/35
				22													

# T = Theory, P = Practical, Tu = Tutorial

Name & Sign  
[Chairman - Board of Studies]:

DR. SHILPA GUPTA

Name & Sign  
[Dean / Director]:

DR. BASUDEB BAKSHI

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Faculty Name:

SCIENCE

Programme Name:

B. Sc. LIFE SCIENCES(Industrial Biotechnology/Microbiology/Biochemistry)

Semester:

II

Academic Batch:

2023-24

Course Group	Board of Studies / Faculty Ownership	Course Code	Course Name	Cr	Teaching Scheme				Assessment/ Evaluation Type		External Exam Duration (Hrs.)		INT(T) Max./ Passing	EXT(T) Max./ Passing	INT(P) Max./ Passing	EXT(P) Max./ Passing	Grand Total Max./ Passing
					T	P	Tu	Cont. Hrs	T	P	T	P					
Discipline Specific Course-1	Biological Sciences		Introduction to Bioprocess Technology	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-2	Biological Sciences		Microbial Physiology	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-3	Biological Sciences		Enzymology	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Generic Elective	Chemical Sciences		Chemistry-II	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Ability Enhancement Course	Interdisciplinary		Environmental Studies	2	2			2	✓		2		50/18	50/17			100/35
Skill Enhancement Course	Biological Sciences		Organic Farming	2	2			2	✓		2		50/18	50/17			100/35
Value Addition Course	FCML		Liberal Arts	2		2		2		✓		2			50/18	50/17	100/35
				22													

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Faculty Name: SCIENCE

Programme Name: B. Sc. LIFE SCIENCES(Industrial Biotechnology/Microbiology/Biochemistry)

Semester: III

Academic Batch: 2023-24

Course Group	Board of Studies / Faculty Ownership	Course Code	Course Name	Cr	Teaching Scheme				Assessment/ Evaluation Type		External Exam Duration (Hrs.)		INT(T) Max./ Passing	EXT(T) Max./ Passing	INT(P) Max./ Passing	EXT(P) Max./ Passing	Grand Total Max./ Passing
					T	P	Tu	Cont. Hrs	T	P	T	P					
Discipline Specific Course-1	Biological Sciences		Bio separation Technology	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-2	Biological Sciences		Microbial Ecology & Diversity	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-3	Biological Sciences		Techniques in Biochemistry	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Generic Elective	Biological Sciences		DNA Structure Function and Repair	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Ability Enhancement Course	Biological Sciences		Environmental Pollution	2	2			2	✓		2		50/18	50/17			100/35
Skill Enhancement Course	Biological Sciences		Bioinstrumentation-I	2	2			2	✓		2		50/18	50/17			100/35
Value Addition Course	FCML		Indian Constitution	2	2			2	✓		2		50/18	50/17			100/35
				22													

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Faculty Name: SCIENCE

Programme Name: B. Sc. LIFE SCIENCES(Industrial Biotechnology/Microbiology/Biochemistry)

Semester: IV

Academic Batch: 2023-24

Course Group	Board of Studies / Faculty Ownership	Course Code	Course Name	Cr	Teaching Scheme				Assessment/ Evaluation Type		External Exam Duration (Hrs.)		INT(T) Max./ Passing	EXT(T) Max./ Passing	INT(P) Max./ Passing	EXT(P) Max./ Passing	Grand Total Max./ Passing
					T	P	Tu	Cont. Hrs	T	P	T	P					
Discipline Specific Course-1	Biological Sciences		Microbial Biotechnology	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-2	Biological Sciences		Microbial Genetics	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-3	Biological Sciences		Metabolism of carbohydrates and lipids	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Generic Elective	Biological Sciences		Gene Expression and Regulation	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Ability Enhancement Course	Biological Sciences		Fundamentals of Biostatistics	2	2			2	✓		2		50/18	50/17			100/35
Skill Enhancement Course	Biological Sciences		Bioinstrumentation-II	2	2			2	✓		2		50/18	50/17			100/35
Value Addition Course	Interdisciplinary		Wildlife Conservation	2	2			2	✓		2		50/18	50/17			100/35
				22													

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Faculty Name: SCIENCE

Programme Name: B. Sc. LIFE SCIENCES(Industrial Biotechnology/Microbiology/Biochemistry)

Semester: V Academic Batch: 2023-24

Course Group	Board of Studies / Faculty Ownership	Course Code	Course Name	Cr	Teaching Scheme				Assessment/ Evaluation Type		External Exam Duration (Hrs.)		INT(T) Max./ Passing	EXT(T) Max./ Passing	INT(P) Max./ Passing	EXT(P) Max./ Passing	Grand Total Max./ Passing
					T	P	Tu	Cont. Hrs	T	P	T	P					
Discipline Specific Course-1	Biological Sciences		Microbial Secondary Metabolites Production	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-2	Biological Sciences		Environmental Microbiology	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-3	Biological Sciences		Metabolism of amino acids and nucleotides	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Elective	Biological Sciences		Documentation, validation and cGMP	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Generic Elective	Biological Sciences		Genetic Engineering	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Skill Enhancement Course	Biological Sciences		Introduction to Bioinformatics	2	2			2	✓		2		50/18	50/17			100/35
				22													

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Faculty Name: SCIENCE

Programme Name: B. Sc. LIFE SCIENCES(Industrial Biotechnology/Microbiology/Biochemistry)

Semester: VI Academic Batch: 2023-24

Course Group	Board of Studies / Faculty Ownership	Course Code	Course Name	Cr	Teaching Scheme				Assessment/ Evaluation Type		External Exam Duration (Hrs.)		INT(T) Max./ Passing	EXT(T) Max./ Passing	INT(P) Max./ Passing	EXT(P) Max./ Passing	Grand Total Max./ Passing
					T	P	Tu	Cont. Hrs	T	P	T	P					
Discipline Specific Course-1	Biological Sciences		Waste water Treatment Technologies	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-2	Biological Sciences		Biopharmaceuticals and Bio therapeutics	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Course-3	Biological Sciences		Membrane Biology and Bioenergetics	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Discipline Specific Elective	Biological Sciences		Environmental Impact Assessment	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Generic Elective	Biological Sciences		Basic Immunology	4	3	1		5	✓	✓	2	2	50/18	50/17	25/9	25/9	150/53
Skill Enhancement Course	Biological Sciences		Entrepreneurship Development	2	2			2	✓		2		50/18	50/17			100/35
				22													

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Faculty Name: SCIENCE

Programme Name: B. Sc. LIFE SCIENCES(HONOURS/ HONOURS with Research)(Industrial Biotechnology)

Semester: VII

Academic Batch: 2023-24

Course Group	Board of Studies / Faculty Ownership	Course Code	Course Name	Cr	Teaching Scheme				Assessment/ Evaluation Type		External Exam Duration (Hrs.)		INT(T) Max./ Passing	EXT(T) Max./ Passing	INT(P) Max./ Passing	EXT(P) Max./ Passing	Grand Total Max./ Passing
					T	P	Tu	Cont. Hrs	T	P	T	P					
Discipline Specific Course-1	Biological Sciences		Industrial Waste Management	4	3		1	4	✓		2		50/18	50/17			100/35
Discipline Specific Elective-1	Biological Sciences		Food and Dairy Technology	4	3		1	4	✓		2		50/18	50/17			100/35
Discipline Specific Elective-2	Biological Sciences		Enzyme Technology	4	3		1	4	✓		2		50/18	50/17			100/35
Discipline Specific Elective-3	Biological Sciences		Biology of Omics	4	3		1	4	✓		2		50/18	50/17			100/35
	Biological Sciences		Dissertation/ Practicals	6		6				✓							300/105
				22													

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Faculty Name: SCIENCE

Programme Name: B. Sc. LIFE SCIENCES (HONOURS/ HONOURS with Research) (Industrial Biotechnology)

Semester: VIII Academic Batch: 2023-24

Course Group	Board of Studies / Faculty Ownership	Course Code	Course Name	Cr	Teaching Scheme				Assessment/ Evaluation Type		External Exam Duration (Hrs.)		INT(T) Max./ Passing	EXT(T) Max./ Passing	INT(P) Max./ Passing	EXT(P) Max./ Passing	Grand Total Max./ Passing
					T	P	Tu	Cont. Hrs	T	P	T	P					
Discipline Specific Course-1	Biological Sciences		Seminar and Project Proposal	4		4		8		✓		2					100/35
Discipline Specific Elective-1	Biological Sciences		Bio fertilizers and Biopesticides	4	3		1	4	✓		2		50/18	50/17			100/35
Discipline Specific Elective-2	Biological Sciences		Biofuels and Biopolymers	4	3		1	4	✓		2		50/18	50/17			100/35
Discipline Specific Elective-3	Biological Sciences		Biosafety, Bioethics and IPR	4	3		1	4	✓		2		50/18	50/17			100/35
	Biological Sciences		Dissertation/ Practicals	6		6				✓							300/105
				22													

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**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)  
**Semester:** I  
**Course Code:** To be Given by University  
**Course Title:** Introduction to Fermentation Technology  
**Course Group:** Discipline Specific Course – 1

**Course Objectives:**

The objectives of this course are:

- To impart knowledge about fermentation processes and its relevant aspects.
- The course will teach isolation, screening and strain improvement strategies, preservation methods, sterilization of media and air.
- It will be useful to understand various bioreactors and their applications.
- This course will enable the students to understand the concept and importance in fermentation process.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
3		2	4	50/18	50/17	25/09	25/09	150/53

**Detailed Syllabus:**

Sr.	Contents	Hours
1	<b>Isolation, Screening and Preservation of Industrially important microorganism</b> <ul style="list-style-type: none"><li>Isolation of industrially important microorganism and their characteristics</li><li>Screening of industrially important microorganisms (Primary and secondary screening and their significance)</li><li>Preservation and maintenance of Industrially important microorganisms</li></ul>	12



2	<b>Media for industrial fermentations and Sterilization</b> <ul style="list-style-type: none"><li>• Ideal characteristics of fermentation medium.</li><li>• Raw materials of fermentation medium (carbon source, nitrogen source, minerals, growth factors, buffers, precursors, antifoam and water).</li><li>• Sterilization of medium: The design of batch and continuous sterilization process.</li><li>• Sterilization of air (Mechanism of filtration, introduction to absolute and depth filters)</li></ul>	11
3	<b>Fermenter Design, and KLa determination</b> <ul style="list-style-type: none"><li>• Basic functions of a fermenter its aseptic operations and containment.</li><li>• Body construction</li><li>• Aeration and Agitation (impellers, baffles and sparger)</li><li>• Sampling and measurement of process variables (Methods of measurement, Types of measurement devices, control) like temperature, pH, dissolved oxygen, pressure and foam.</li><li>• Introduction to mass transfer of oxygen</li><li>• Methods to determine KLa</li></ul>	11
4	<b>Fermentation types and Fermentation processes</b> <ul style="list-style-type: none"><li>• Surface, solid state and submerged fermentation</li><li>• Batch, fed-batch and continuous fermentation.</li><li>• Penicillin fermentation by <i>Penicillium chrysogenum</i>.</li><li>• Amylase production by submerged and solid state fermentation.</li></ul>	11

### List of Practicals / Tutorials:

1	Preparation of media (Nutrient broth, PDA) in plates and slant.	30
2	Isolation and Screening of organic acid and enzyme producing microorganisms from soil.	
3	Preservation of culture in slants, glycerol stock and wax.	
4	Inoculum preparation of spores and spores counting by Haemocytometer.	
5	Estimation of penicillin from fermented broth using UV-VIS spectrophotometer.	
6	Demonstration of lab scale fermenter.	

### Reference Books:

1	Industrial Microbiology by A. H. Patel, MacMillon India Madras, ISBN:978033390842.
2	Industrial Microbiology by Casida, L. E, Reprint 2005, New Age International, ISBN: 0-85226-1012.
3	Industrial Microbiology by Prescott & Dunn, 4th edition, CBS Publishers, ISBN: 81-239-1001-0
4	Principles of Fermentation Technology by Whitekar & Stanbury, 3rd Edition
5	Methods in Industrial Microbiology : Sikyta

### Supplementary learning Material:

1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )



# CVM UNIVERSITY

Aegis: Charutar Vidya Mandal (Estd.1945)

3	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )
4	DIKSHA ( <a href="https://diksha.gov.in/">https://diksha.gov.in/</a> )

### Pedagogy:

1. Direct classroom Teaching
2. Audio-visual
3. Assignment/ Quizzes
4. Continuous assessment
5. Interactive participative method
6. Seminar Presentation

### Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the fundamental concept of isolation of industrial important microorganisms and their improvement.	25
CO-2	Understand the types of nutrient / raw material used for the media formulations used in industry.	25
CO-3	Understand the design of fermenter and construction and operation under aseptic conditions.	25
CO-4	Understand the types of fermentation process. Understands the relevance of a typical fermentation process	25

### Curriculum Revision:

Version:	1.0
Drafted on (Month-Year):	May 2023
Last Reviewed on (Month-Year):	June 2023
Next Review on (Month-Year):	April 2024



**CVM**  
**UNIVERSITY**

Aegis: Charutar Vidya Mandal (Estd.1945)

**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** I

**Course Code:** To be Given by University

**Course Title:** General Microbiology

**Course Group:** Discipline Specific Course - 2

**Course Objectives:**

The objectives of this course are:

- To give students comprehensive knowledge of the historical aspects and development of Microbiology.
- To make the students to understand the different aspects to the classification of Prokaryotes.
- Students will understand the in-depth knowledge on the structure and functions of prokaryotic And eukaryotic cells.
- Student will learn properties of viruses and exhaustive knowledge of fungi. Further it gives insight into hands on training of basic microbial techniques which will give the student a strong base in scope of microbiology.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
3		2	4	50/18	50/17	25/09	25/09	150/53

**Detailed Syllabus:**

Sr.	Contents	Hours
1	<b>Historical foundation of Microbiology</b> <ul style="list-style-type: none"><li>Establishment of microbiology as a discipline: Spontaneous generation vs biogenesis, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology.</li><li>Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A.Waksman. Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner.</li></ul>	12



2	<b>Classification and Prokaryotic cell structure</b> <ul style="list-style-type: none"><li>Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Classification in brief as per Bergey's Manual of Systematic Bacteriology.</li><li>Overview of prokaryotic cell structure, prokaryotic cell membranes, prokaryotic cytoplasm, cytoplasmic inclusion bodies, cell wall, ribosome, and capsule. Bacterial endospores, exospores, and cyst. Bacterial motility. Bacterial chromosome, nuclear material, plasmid and episomes.</li></ul>	11
3	<b>Eukaryotic cell structure and function</b> <ul style="list-style-type: none"><li>Overview of eukaryotic cell structure, Eukaryotic membranes, Cytoplasmic matrix, Organelles of the biosynthetic-secretory and endocytic pathways, Ribosomes, Mitochondria, Chloroplast, Nucleus, Structures external to the plasma membrane, Comparison of prokaryotic and eukaryotic cells.</li></ul>	11
4	<b>Viruses, Other Acellular Agents and Fungi</b> <ul style="list-style-type: none"><li>Introduction to viruses, General properties of viruses, Viral reproduction, Cultivation of viruses, Virus purification and assays, Principles of virus taxonomy, Viroids and Virusoids, Prions. Lytic and lysogenic cycles.</li><li>Introduction of fungi, Distribution, Structure, Nutrition and metabolism, Reproduction, Characteristics of fungal divisions and Economic significance.</li></ul>	11

#### List of Practicals / Tutorials:

1	Preparation and sterilization of culture media for bacterial cultivation
2	Study of different shapes of bacteria using permanent slides/ pictographs
3	Simple staining: Monochrome staining and Differential: Gram's staining
4	Determination of motility of bacteria by (i) Hanging drop method (ii) Agar stab method
5	Isolation of bacteria [Streak plate, spread plate, pour plate, serial dilution]
6	Determination of CFU count.
7	Study of the following fungi by preparing temporary mounts: <i>Rhizopus</i> and <i>Aspergillus</i> .

#### Reference Books:

1	Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2	Dubey RC and Maheswari DK. A Text book of Microbiology. (2005).S. Chand & Company Ltd., New Delhi.
3	Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
4	Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
5	Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers. 3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition.
6	Wiley JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
7	Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education limited.





8	Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
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Supplementary learning Material:	
1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
3	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )
4	DIKSHA ( <a href="https://diksha.gov.in/">https://diksha.gov.in/</a> )

Pedagogy:
1. Audio -visual aids, power point presentation, videos, animation, models etc.
2. Continuous assessment based on quiz, assignment, seminar.
3. Industrial visit / sample collection/ data collection etc
4. Laboratory experiments
5. Demonstration
6. Student feed back
7. Peer led learning

### Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Acquire knowledge about history and scope of Microbiology.	25
CO-2	Understand various methods of microbial classification.	25
CO-3	Differentiate prokaryotic and eukaryotic cell structure and functions.	25
CO-4	Learn about viruses and nutritional requirements and modes of reproduction in fungi.	25

Curriculum Revision:	
Version:	1.0
Drafted on (Month-Year):	May 2023
Last Reviewed on (Month-Year):	June 2023
Next Review on (Month-Year):	April 2024



**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** I

**Course Code:** To be Given by University

**Course Title:** Molecules of life

**Course Group:** Discipline Specific Course - 3

**Course Objectives:**

The objectives of this course are:

- To provide insight into fundamentals of structures and functions of biomolecules. Student will be able to understand basic structure of enzymes and mechanism of action.
- It also helps to understand the properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins and glycolipids and their importance in biological systems.
- To develop skills to determine amino acid and nucleotide sequences of proteins and DNA respectively.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
3		2	4	50/18	50/17	25/09	25/09	150/53





## Detailed Syllabus:

Sr.	Contents	Hours
1	<b>Introduction to Bio molecules</b> <ul style="list-style-type: none"><li>Nature of biological material and general properties of biomolecules. Carbohydrate: Introduction, occurrence, physiological importance, classification of carbohydrates, monosaccharide, disaccharide, oligosaccharides and polysaccharides.</li><li>Physiological properties of carbohydrates, asymmetric centre in monosaccharides, Optical isomerism, stereoisomerism, epimers, mutarotation, diastereoisomerism configuration in sugar, cyclic structure anomeric carbon atom, fisher's projection formula, Haworths representation.</li><li>Chemical properties of carbohydrates, oxidation and reduction of sugars, action of mineral acids, hydrogen cyanide, and hydrazine on sugars due to hydroxyl groups, reducing action of sugars.</li><li>Polysaccharides: occurrence, structure and physiological importance of starch, glycogen, cellulose, hemicellulose, dextrin, pectin, agar, hyaluronic acid, heparin and chondroitin sulphate.</li></ul>	12
2	<b>Amino acids and proteins</b> <ul style="list-style-type: none"><li>Structure and classification of amino acids, rare amino acids of proteins, non-protein, amino acids, Essential amino acids, amphoteric nature of protein, titration curve of glycine. Physical properties of amino acids- stereospecificity and optical activity.</li><li>Chemical properties of amino acids, chemistry of peptide linkage. Classification of proteins, solubility criteria: salting in and out of protein. Denaturation of proteins. Structure of proteins with examples (Primary, secondary, tertiary, quaternary). Determination of sequence of proteins.</li></ul>	11
3	<b>Lipids</b> <ul style="list-style-type: none"><li>Definition, classification of lipids, fatty acids, essential fatty acids triacylglycerol, properties of triacylglycerol, phospholipids, glycolipids, sphingolipids, sterols, their properties, structures, functions. Lipoproteins.</li></ul>	11
4	<b>Nucleotides and nucleic acid</b> <ul style="list-style-type: none"><li>Structure of nitrogen bases and sugars, structure of nucleosides and nucleotides, Ribose, Deoxyribose and their conformation. - Structure and properties of DNA, forms of DNA.</li></ul> <b>Enzymes</b> <ul style="list-style-type: none"><li>Nomenclature and classification, chemical nature and properties of enzymes, factor affecting enzyme activity, active site, enzyme inhibition, enzyme specificity, Coenzymes.</li></ul>	11



**List of Practicals / Tutorials:**

1	Identification of biomolecules: Carbohydrate (Molisch's test), Protein (Biuret) & lipid (Saponification).	<b>30</b>
2	Qualitative analysis of carbohydrates: Molisch's test, Iodine test, Benedict's test, Fehling's test, Cole's test, Barfoed's test, Saliwanoff's test, Rapid furfural test, Osazone test, Mucic acid test, Inversion test.	
3	Qualitative analysis of proteins: Precipitation test, Mercuric nitrate test, Lead acetate test, Sulphosalicylic test, Potassium ferricyanide test, Tannic acid test, Alcohol test, Heller's test, Ammonium sulphate test.	
4	Qualitative analysis of amino acids: Colour reactions, Biuret test, Ninhydrin test, Millon's test, Arginine test (Sakaguchi test), Xanthoproteic test, Hopkin's Cole test, Ehrlich test, Nitroprusside test.	
5	Qualitative analysis of fat: Test for oil, Solubility test, Dichromate test, Emulsion test, Absorption test, Glycerol test, Acid value of oil, Saponification test, Iodine test, Borax test, and Liebermann-Burchard test.	
6	Estimation of protein by Biuret method.	
7	Estimation of carbohydrate by DNS method.	
8	Estimation of DNA by DPA method.	

**Reference Books:**

1	Biochemistry by Lubert Stryer, W. H. Freeman and Company. 4th /6 <sup>th</sup> edition, 2000/2004 Hardback, ISBN 0716720094
2	Fundamentals of Biochemistry: Life at the Molecular Level, by D. Voet, J. G. Voet, and C. Pratt, 3rd Edition, John Wiley and Co John Wiley & Sons, Inc., New York, , 2008 ISBN : 0471214957; 9780471214953
3	Principles of Biochemistry by Albert Lehninger, W.H. Freeman & Company; 3rd edition (February 2000), ISBN-10: 1572591536
4	Harper's Biochemistry: Harper, 27 <sup>th</sup> Edition, McGraw-Hill Publishing Co; Robert K. Murray, Daryl K. Granner, Victor W. Rodwell, 2006 ISBN-10: 0071461973
5	Outlines of Biochemistry by Conn E E , Stumps P E and and Doi, R.H., John Wiley and sons, Singapore, 5 <sup>th</sup> Edition – 2001
6	Principles of Biochemistry by Horton, Morgan, Secrimgeour, Perry, Rawn , pearson International edition – 4 <sup>th</sup> edition ISBN 978-1-4058-2573-3
7	Harper's Biochemistry: R. K. Murray and others. Appleton and Lange, Stanford. ISBN: 0838536905 25 edition (pb) 2000
8	Plummer, D.T. (1987). 3rd ed. An introduction of Practical Biochemistry. McGraw Hill Book Co.

**Supplementary learning Material:**

1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
3	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )



**CVM**  
**UNIVERSITY**

Aegis: Charutar Vidya Mandal (Estd.1945)

4 DIKSHA (<https://diksha.gov.in/>)

**Pedagogy:**

1. Audio -visual aids, power point presentation, videos, animation, models etc.
2. Continuous assessment based on quiz, assignment, seminar.
3. Sample collection/ data collection etc
4. Laboratory experiments
5. Demonstration
6. Student feed back
7. Peer led learning

**Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):**

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes (CO):**

Sr.	Course Outcome Statements	%weightage
CO-1	Understand chemical and physical characters of biomolecules to be known to the students.	25
CO-2	Learn the structure, classification and functions of Carbohydrates, Lipid and Protein.	25
CO-3	Different protein structure, their physical chemical properties	25
CO-4	Learn the structure, classification and functions of Nucleic acid and enzyme.	25

**Curriculum Revision:**

Version:	1.0
Drafted on (Month-Year):	May 2023
Last Reviewed on (Month-Year):	June 2023
Next Review on (Month-Year):	April 2024



**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** I

**Course Code:** To be Given by University

**Course Title:** Chemistry-I

**Course Group:** Generic Elective

**Course Objectives:**

The objectives of this course are:

- To educate the students to develop the knowledge of the fundamental principles of chemistry and to enable understanding of the nomenclature, structural, isomerism, stereochemistry of organic compounds.
- Student will understand acid-base concept and solution behaviour. It provides the fundamental knowledge of the properties of transition metals and basics of coordination chemistry.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
3		2	4	50/18	50/17	25/09	25/09	150/53

**Detailed Syllabus:**

Sr.	Contents	Hours
1	<b>IUPAC nomenclature</b> Introduction of organic compound and their classification. Physical Properties and systemic IUPAC nomenclature of different class of organic compounds including alkanes, alkenes, alkynes, cycloalkanes, bicyclic, spiro, aromatic and heterocyclic compounds.	12
2	<b>Stereochemistry</b> Elements of symmetrycentre, plane and axis of symmetry. Isomers and classification of isomers. Configuration, conformational isomers. Separation of enantiomers. Absolute configuration (R and S). Conversion of projection formulas. Stereochemistry of compounds containing two asymmetric carbon atoms. Conformations around a C-C bond in acyclic compounds. Structure of cycloalkanes, Cyclohexane conformations. Stereochemistry of disubstituted cyclohexanes.	11



3	<b>Ionic equilibrium in aqueous solutions</b> Acids & Bases, Arrhenius theory of Acids and Bases, The Lowry – Bronsted Concept, Strength of Acids and Bases, The Lewis concept, pH Scale, pH and Buffers Structure and physical properties of water, Self-Ionization of water, Hydrolysis, Buffer Solutions, Indicator, Sparingly Soluble Salts, Common ion effect, Selective Precipitation, acid-base titration and use of indicators, mathematical treatment of acid-base titrations.	11
4	<b>Fundamental concept of coordination chemistry</b> Position of d-block elements in the periodic table, Electronic configuration and Classification of d-block elements in 3d, 4d, 5d and 6d series. Definition of coordination compounds Werner's theory, Co-ordination number, Classification of ligands, Nomenclature of co-ordination compounds, Chelate, chelating ligand and Chelation, Uses of Chelates.	11

### List of Practicals / Tutorials:

1	Volumetric analysis: Determination of concentration of Strong acid [HCl] and weak acids [oxalic acid/Acetic acid] by titrating against strong base [NaOH].	30
2	Volumetric analysis: Determination of concentration of transition metal salts (Cu, Ni, Zn) by titrating against EDTA.	
3	Qualitative Analysis : Identification of Organic substance: Salicylic acid, Cinnamic acid, Benzoic acid, $\alpha$ -Naphthol, $\beta$ -Naphthol, o-nitroaniline, m-nitroaniline, p-nitroaniline, Naphthalene, m-dinitrobenzene, Anthracene.	

### Reference Books:

1	Morrison R. T. & Boyd R. N., <i>Organic chemistry</i> (6 <sup>th</sup> edition).
2	IUPAC nomenclature by Robert M. Silverstein.
3	Stereochemistry by P. S. Kalsi.
4	A text book of organic chemistry by Arun Bahl & B. S. Bahl, 16 <sup>th</sup> Edition
5	Principles of Physical chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, 41 <sup>th</sup> Ed.
6	Biophysical chemistry, Principles and Techniques by Upadhyay, Upadhyay and Nath.
7	Cotton, F.A. & Wilkinson, G. <i>Basic Inorganic Chemistry</i> , Wiley
8	Elements of Physical Chemistry by S. Glasstone and D. Lewis

### Supplementary learning Material:

1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
3	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )
4	DIKSHA ( <a href="https://diksha.gov.in/">https://diksha.gov.in/</a> )

### Pedagogy:

1. Audio -visual aids, power point presentation, videos, animation, models etc.
2. Continuous assessment based on quiz, assignment, seminar.
3. Industrial visit
4. Laboratory experiments
5. Demonstration



- 6. Student feed back
- 7. Peer led learning

**Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):**

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes (CO):**

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the fundamental principles of organic chemistry that include chemical bonding	25
CO-2	Learn nomenclature, structural of various classes of compounds	25
CO-3	Develop concept of isomerism, stereochemistry, Chirality	25
CO-4	Acquire concept of Acidity, Alkalinity, applications of indicator	25

**Curriculum Revision:**

Version:	1.0
Drafted on (Month-Year):	May 2023
Last Reviewed on (Month-Year):	June 2023
Next Review on (Month-Year):	April 2024





**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** I

**Course Code:** To be Given by University

**Course Title:** English

**Course Group:** Ability Enhancement Course

**Course Objectives:**

The objectives of this course are:

- English is now used almost exclusively as the language of science. By learning a single language, scientists around the world gain access to the vast scientific literature and can communicate with other scientists anywhere in the world.
- Students will learn about various scientific terms and will be able to enhance skills. Verbal and Non-verbal communication, writing skills, reviewing will be remedy for the students to get better and better subjectively.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
2			2	50/18	50/17			100/35

**Detailed Syllabus:**

Sr.	Contents	Hours
1	<b>Vocabulary and Presentation Skill Development</b> <ul style="list-style-type: none"><li>Listening Skills, Speaking Skills, Reading Skills and Writing Skills (LSRW)</li><li>Defining the Purpose &amp; how to make an effective presentation (MS PowerPoint)</li><li>Outline preparation</li><li>Review / Content / Précis writing.</li></ul>	15
2	<b>Introduction and Language of Communication</b> <ul style="list-style-type: none"><li>Theory of Communication, Types and Modes of Communication</li><li>Verbal and Non-verbal (Spoken and Written)</li><li>Personal, Social and Business Barriers and Strategies; Intra-personal, Inter-personal and Group communication, Expressing opinions</li></ul>	15



**Reference Books:**

1	Fluency in English - Part II, Oxford University Press, 2006.
2	Business English, Pearson, 2008.
3	Language, Literature and Creativity, Orient Blackswan, 2013.
4	Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

**Supplementary learning Material:**

1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
3	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )
4	DIKSHA ( <a href="https://diksha.gov.in/">https://diksha.gov.in/</a> )

**Pedagogy:**

- 1.Audio -visual aids, power point presentation, videos, animation, models etc.
2. Continuous assessment based on quiz, assignment, seminar.
- 3.Group Discussion
4. Student feed back
5. Peer led learning

**Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):**

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes (CO):**

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the preparation of Well-organized presentation slides	50
CO-2	Improve presenting skill	50

**Curriculum Revision:**

Version:	1.0
Drafted on (Month-Year):	May 2023
Last Reviewed on (Month-Year):	June 2023
Next Review on (Month-Year):	April 2024





**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** I

**Course Code:** To be Given by University

**Course Title:** Microbial Techniques

**Course Group:** Skill Enhancement Course

**Course Objectives:**

The objectives of this course are:

- Ability to apply the tools and techniques of Microbiology in conducting research.
- Acquire basic skills in aseptic techniques, microscopy.
- Learn different staining techniques, microbial cultivation, and enumeration techniques.
- Prepare the student for advance studies in the subject of Microbiology.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
		2	2			50/18	50/17	100/35

**Detailed Syllabus:**

Sr.	Contents	Hours
1	<b>Introduction to laboratory equipment:</b> (Principle and Applications) Microscope, Autoclave, Hot air oven, Incubator, pH meter, biological safety cabinet. Cleaning and sterilization of glassware. Sterilization techniques – Chemical, UV, autoclaving, and membrane filtration. Basic microbe handling techniques. Cryo-stock and glycerol stock preparation, maintenance, and Preservation of Bacteria. <b>Special Staining Techniques:</b> Endospore staining, Acid fast staining, Capsule staining, Metachromatic granules staining, cell wall staining.	15



<b>2</b>	<b>Media preparation and cultivation of microbes</b> Liquid media- Peptone water, Nutrient broth; Solid media- Nutrient agar (Agar slant, Agar plate); Enriched Medium- Blood agar; Differential medium - Mac Conkey agar; Enrichment Medium - Selenite F broth; Selective medium- EMB, MSA. Isolation and cultivation of bacteria. Preparation of culture media for cultivation of yeast and fungi (spoiled bread/fruits/vegetable). Isolation of bacterial flora of skin by swab method. Determination of microbiological quality of milk sample by MBRT..	<b>15</b>
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## Reference Books:

<b>1</b>	Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
<b>2</b>	Murphy, D.B. Fundamental of Light Microscopy & Electron Imaging, 1st Edition. Wiley-Liss. (2001).
<b>3</b>	Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

## Supplementary learning Material:

<b>1</b>	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
<b>2</b>	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
<b>3</b>	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )
<b>4</b>	DIKSHA ( <a href="https://diksha.gov.in/">https://diksha.gov.in/</a> )

## Pedagogy:

1. Audio -visual aids, power point presentation, videos, animation, models etc.
2. Continuous assessment based on quiz, assignment, seminar.
3. Group Discussion
4. Student feed back
- 5.. Peer led learning

## Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.



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**Course Outcomes (CO):**

Sr.	Course Outcome Statements	%weightage
CO-1	Students will familiarize with various lab equipments relevant to microbiological work. They will learn different types of staining to observe microbes and their cell components.	50
CO-2	Students will learn to prepare different media, cultivation method and their applications.	50

**Curriculum Revision:**

Version:	1.0
Drafted on (Month-Year):	May 2023
Last Reviewed on (Month-Year):	June 2023
Next Review on (Month-Year):	April 2024



**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** II

**Course Code:** To be Given by University

**Course Title:** Introduction to Bioprocess Technology

**Course Group:** Discipline Specific Course - 1

**Course Objectives:**

The objectives of this course are:

- To impart knowledge about fermentation processes and its relevant aspects.
- The course will teach strain improvement strategies, sterilization of media and air and maintenance of media quality.
- It will be useful to understand various bioreactors and their applications. It is also useful to understand microbial growth, its kinetics and its relevance with product formation.
- This course will enable the students to understand the concept and importance of fermentation processes.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
3		2	4	50/18	50/17	25/09	25/09	150/53

**Detailed Syllabus:**

Sr.	Contents	Hours
1	<b>Strain improvement of Industrially important microorganism</b> Isolation of mutant producing primary and secondary metabolites isolation and use of auxotrophic mutants, isolation and use of revertant mutants Use of protoplast fusion Use of parasexual cycle Use of recombination systems	12
2	<b>Sterilization methods and principles:</b> Media sterilization, mathematical modelling of sterilization processes, Arrhenius equation, Del factor, effect of sterilization on media quality and yield coefficients, batch and continuous sterilization, filter and steam sterilization at industrial scale	11



3	<b>Design of fermenter and reactors:</b> Basic components of a fermenter, laboratory and industrial scale fermenters, mechanical, Types of fermenter like stirred tank, bubble column, airlift, packed beds, fluidized beds, photo-bioreactors and animal cell culture bioreactor, Plug flow reactors <b>Bioprocess Control parameters:</b> Instrumentation for monitoring bioreactor and fermentation processes, Sensors, Controllers, fermentation control systems and architecture, Incubation and sequence control, and containment.	11
4	<b>Microbial Growth kinetics:</b> Kinetics of growth and substrate utilization in batch, fed batch and continuous systems. Inoculum development, aseptic inoculation and sampling. <b>Agitation and aeration:</b> Mass transfer of oxygen, Determination of KLa, factors affecting KLa, fluid rheology, Newtonian and non-Newtonian fluids, Bingham plastic, pseudo plastic, power number, Reynolds number.	11

### List of Practicals / Tutorials:

1	Replica plate technique for isolation of Auxotroph and antibiotic resistant mutants.	30
2	Grid Plate technique for isolation of antibiotic resistant mutants.	
3	Sterility testing of pharmaceutical products like (antibiotics /distilled water for injection).	
4	Estimation of ethanol by dichromate method	
5	Immobilization of microbial cells by entrapment method	
6	Determination of KLa using sulphite oxidation method	

### Reference Books:

1	Principles of Fermentation Technology by Whitekar & Stanbury, 3rd Edition
2	Methods in Industrial Microbiology : Sikyta
3	Fermentation Microbiology and Biotechnology, El Mansi and Bryc
4	Comprehensive Biotechnology : Murray Moo Young

### Supplementary learning Material:

1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
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4	DIKSHA ( <a href="https://diksha.gov.in/">https://diksha.gov.in/</a> )

### Pedagogy:

1. Direct classroom Teaching
2. Audio-visual
3. Assignment/ Quizzes
4. Continuous assessment
5. Interactive participative method
6. Seminar Presentation



**Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):**

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes (CO):**

Sr.	Course Outcome Statements	%weightage
CO-1	The students can able to understand the role of microbes in fermentation processes. They can understand the different strategies of strain improvement which can enhance the industrial production of desire compound.	25
CO-2	Understands aseptic environment, sterilization and its various methods.	25
CO-3	Will know fermenter design, its components and its variable control parameters.	25
CO-4	Understands microbial growth, it's kinetics and association of product formation with growth. The students will understand the concept of mass transfer and various methods to determine KLa.	25

**Curriculum Revision:**

Version:	1.0
Drafted on (Month-Year):	May 2023
Last Reviewed on (Month-Year):	June 2023
Next Review on (Month-Year):	April 2024



**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** II

**Course Code:** To be Given by University

**Course Title:** Microbial Physiology

**Course Group:** Discipline Specific Course – 2

**Course Objectives:**

The objectives of this course are:

- To educate the students to develop a clear understanding of the fundamental concepts of microbial physiology and metabolism occurring inside microbes.
- The students will understand nutritional classification of microbes.
- Students will understand pure culture techniques and methods of culturing, preservation and maintenance of microorganisms.
- This course will aid students to acquire skills and competence in microbiological laboratory practices.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
3		2	4	50/18	50/17	25/09	25/09	150/53

**Detailed Syllabus:**

Sr.	Contents	Hours
1	Microbial Nutrition Nutritional types: Requirement of nutrients for microbes and classification of microorganisms based on carbon, energy and electron sources viz. Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph. Primary and secondary active transport; Passive and facilitated diffusion. Effect of oxygen on growth, classification on the basis of oxygen requirement and tolerance (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe).	12





2	<b>Media type, control and Preservation</b> <ul style="list-style-type: none"><li>• Role of macro and micro-nutrients. Components of media: Natural, Synthetic, Complex, Selective media, Differential Media, Enriched and enrichment media. Methods for culturing aerobic and anaerobic bacteria; Colony and broth culture characteristics.</li><li>• Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation. Chemical methods of microbial control: disinfectants, types and mode of action. Maintenance and preservation techniques for microorganisms (Sub culturing, Oil overlay, Sand cultures, Storage at low temperature, Lyophilisation, Liquid Nitrogen).</li></ul>	11
3	<b>Microbial Growth</b> <ul style="list-style-type: none"><li>• Growth in Microbes (growth phases, generation time, growth curve and specific growth rate). Measurement of cell mass and cell number; Factors affecting microbial growth; Continuous and batch cultures; details of synchronous and Diauxic growth curve. Physical factors influencing growth: Temperature; pH; Atmospheric Pressure; Salt Concentration. Chemical factors: heavy metal (copper), surfactants. Control of Microorganisms: patterns of microbial death, control of microorganism growth by antiseptics.</li></ul>	11
4	<b>Microbial Photosynthesis</b> <ul style="list-style-type: none"><li>• Concept of photosynthesis and associated pigments in microbes; photosynthetic apparatus in pro and eukaryotes; anoxygenic and oxygenic photosynthesis; light and dark reaction; photorespiration and its significance; Effect of light, temperature; pH and CO<sub>2</sub> concentration on photosynthesis; measurement of net photosynthetic yield. Electron transport chain in photosynthetic bacteria.</li></ul>	11

### List of Practicals / Tutorials:

1	Introduction of media and its constituents for microbial growth.	30
2	Different methods for isolation and maintenance of microorganisms.	
3	Isolation of microbes using differential media.	
4	To study and plot the growth curve of <i>E. coli</i> using spectrophotometric method and to calculate specific growth rate and generation time.	
5	To study and plot the growth curve of <i>Aspergillus niger</i> by radial growth measurements.	
6	To study the effect of temperature of <i>Aspergillus niger</i> by dry weight method.	
7	Demonstration of the thermal death time and decimal reduction time of <i>E. coli</i> .	
8	Isolation of Photosynthetic bacteria.	
9	Preservation of bacterial cultures.	

### Reference Books:

1	Moat A.G. and Foster S.W. Microbial Physiology (4th Ed.) (2004). John Wiley and Sons, New York.
2	Gerald Karp. Cell Biology (3rd Ed.) (2003). McGraw Hill Book Company, New York.





3	Stanier R. Y, Ingrahm J. I, Wheelis M. L and Painter P. R. General Microbiology. (5th Ed.) (1987). McMillan Press. UK.
4	Dubey R. C and Maheswari D. K. A Text book of Microbiology. (2005). S. Chand & Company Ltd., New Delhi.
5	Nelson D. L. & Cox M. M. Lehninger's Principles of Biochemistry, 4th edition. (2005). W. H. Freeman & Co. NY.
6	Pelczar Jr, M. J, Chan E. C. S., Krieg N R, Microbiology, (5th Ed.), (2001). McGraw Hill Book Company, NY.
7	Madigan M. T, Martinko J. M and Parker J. (2003). Brock Biology of Microorganisms. 10th edition. Pearson/Benjamin Cummings.
8	Reddy S. R. and Reddy S. M. (2005). Microbial Physiology. Scientific Publishers India.

### Supplementary learning Material:

1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
3	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )
4	DIKSHA ( <a href="https://diksha.gov.in/">https://diksha.gov.in/</a> )

### Pedagogy:

1. Audio -visual aids, power point presentation, videos, animation, models etc.
2. Continuous assessment based on quiz, assignment, seminar.
3. Industrial visit / sample collection/ data collection etc
4. Laboratory experiments
5. Demonstration
6. Student feed back
7. Peer led learning

### Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Design synthetic media for screening of specific culture.	25
CO-2	Describe and differentiate type of growth requirement for specific microbial culture.	25
CO-3	Describe and evaluate the growth of microorganisms and factors affecting it.	25
CO-4	Describe the microbial photosynthesis and depict the role of pigments associated with microbes.	25



**CVM**  
**UNIVERSITY**

Aegis: Charutar Vidya Mandal (Estd.1945)

Curriculum Revision:	
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**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** II

**Course Code:** To be Given by University

**Course Title:** Enzymology

**Course Group:** Discipline Specific Course – 3

**Course Objectives:**

The objectives of this course are to enable students....

- To understand the Enzyme and their classification, structure of enzyme and their action & purification.
- The course will teach the enzyme kinetics, mechanisms of enzyme catalysis and Methods to study enzymes and its mechanisms of regulations using suitable examples of enzymes in the cell.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
3		2	4	50/18	50/17	25/09	25/09	150/53

**Detailed Syllabus:**

Sr.	Contents	Hours
1	<b>An Introduction to enzymes:</b> What are enzymes, brief history of enzymes, concepts of coenzymes, cofactors, holoenzymes, apoenzyme, activators, inhibitors, regulatory enzymes. Specificity of enzyme (active site) and models for enzyme specificity (Lock and key, induced-fit and transition-state stabilization hypothesis). Enzyme classification: IUB enzyme classification.	12
2	<b>Methods for isolation and purification of enzymes:-</b> Methods for homogenization of tissue, Method for protein purification depend on size (centrifugation, gel filtration, dialysis and ultrafiltration), Method for protein purification depend on polarity (ion-exchange chromatography, electrophoresis, isoelectric focusing, hydrophobic interaction chromatography), Method for protein purification depend on changes in solubility (change in pH, change in ionic strength, decrease in dielectric constant), Method for protein purification depend on possession of specific binding sites or structural features (affinity chromatography, affinity elution, dye-ligand chromatography, immunoabsorption chromatography and covalent chromatography).	11



3	<b>Enzyme kinetics:-</b> Concept of activation energy for uncatalyzed and catalyzed (chemical and enzyme) reaction. Type of reaction (zero-order, first-order and second order). Unisubstrate enzyme kinetics; factors affecting the rate of enzyme catalyzed reactions forms and derivation of Michaelis-Menten equation; significance of $V_{max}$ , $K_m$ and different plots (Lineweaver-Burk, Eadie-Hofstee and Hanes plots). Enzyme inhibition – type of inhibition (reversible and irreversible), competitive, non-competitive, uncompetitive, mixed, partial, substrate, and allosteric.	11
4	<b>Mechanism of Enzyme Action and immobilization of enzymes:</b> Enzyme mechanisms: Factors affecting catalytic efficiency, Mechanism of Lysozyme, Chymotrypsin, Carboxypeptidase, Aspartate Transcarbamylase. Allosteric enzymes and sigmoidal kinetics: Protein ligand binding, Co-operativity, MWC & KNF models, Immobilized enzymes:- Methods of immobilization, use of immobilized enzymes, advantage and disadvantage of immobilized enzymes. Industrial applications of enzymes.	11

### List of Practicals / Tutorials:

1	Estimation of reducing sugar by DNS method	30
2	Determination of invertase activity	
3	Effect of enzyme concentration on enzyme catalyzed reaction	
4	Effect of pH on enzyme catalyzed reaction	
5	Effect of temperature on enzyme catalyzed reaction	
6	Effect of time on enzyme catalyzed reaction	
7	Effect of substrate concentration on enzyme catalyzed reaction and determination of $K_m$ and $V_{max}$ of enzyme	
8	Demonstration of immobilization of enzyme/whole cell using appropriate method	

### Reference Books:

1	Fundamentals of enzymology: Nicholason Price & Stevens <b>ISBN – 0-19850-229-X.</b>
2	Enzymes: Biochemistry, Biotechnology and Clinical Chemistry: Trevor Palmer, Philip L. Bonner, 2 <sup>nd</sup> edition Horwood Publishing Limited, <b>ISBN – 978-1-904275-27-5.</b>
3	Biochemistry: Donald Voet, Judith G. Voet, 4 <sup>th</sup> Edition, John Wiley & Sons, Inc., New York, 2008 <b>ISBN – 13 978-0470-57095-1..</b>
4	Fundamentals of Biochemistry: Life at the Molecular Level, D Voet, J.G Voet and C. W. Pratt. 5 <sup>th</sup> Edition John Wiley and Sons, Inc, New York, <b>ISBN – 978-1-118-91840-1.</b>
5	Biochemistry: Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto, Jr., Lubert Stryer 8 <sup>th</sup> Edition. W. H. Freeman and Company; ISBN–13: 978-1-4641-2610-9.
6	Textbook of Medical Biochemistry: Chatterjee M.N and Rana Shinde. 8 <sup>th</sup> Edition, Jaypee Brothers Medical Publisher PVT Ltd. <b>ISBN – 978-93-5025-484-4.</b>
7	Lehninger Principles of Biochemistry: David L. Nelson, Michael M. Cox, 7 <sup>th</sup> Edition. W. H. Freeman and Company. <b>ISBN – 13: 978-1-4641-2611-6.</b>
8	Harpers's Biochemistry: Robert Murray, Victor Rodwell, David Bender, Kathleen M. Botham, P. Anthony Weil, Peter J. Kennelly, 28 <sup>th</sup> Edition. Mc Graw Hill Publishing Company. <b>ISBN – 978-0-07-170197-6.</b>
9	Practical Enzymology: Prof. Dr. Hans Bisswanger 2 <sup>nd</sup> Edition (2011, Wiley-Blackwell) <b>ISBN– 978-3-527-32076-9.</b>



**Supplementary learning Material:**

1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	COURSERA ( <a href="https://www.coursera.org/">https://www.coursera.org/</a> )
3	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
4	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )
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**Pedagogy:**

1. Audio -visual aids, power point presentation, videos, animation, models etc.
2. Continuous assessment based on quiz, assignment, seminar.
3. Industrial visit / sample collection etc
4. Laboratory experiments
5. Problem solving
6. Demonstration
7. Student feed back

**Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):**

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes (CO):**

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the fundamental concept of enzymes and their specificity of action and classification.	25
CO-2	Understand Enzyme purification strategies from variety of sources and to study the purity of enzymes..	25
CO-3	Understand the enzyme kinetics with respect to presence of Substrate, inhibitors and activators and significance of Km, Vmax & Kcat, and enzyme efficiency.	25
CO-4	Understand the mechanisms of different enzyme actions. Understands the relevance of Isoenzymes and its physiological significance, enzyme immobilization techniques and industrial application of enzymes.	25

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**CVM**  
**UNIVERSITY**

Aegis: Charutar Vidya Mandal (Estd.1945)

**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** II

**Course Code:** To be Given by University

**Course Title:** Chemistry-II

**Course Group:** Generic Elective

**Course Objectives:**

The objectives of this course are to enable students.....

- To educate the students to develop the knowledge of the basics of quantitative analysis.
- Understanding of the standardization and student can apply theoretical knowledge to prepare solutions and basic chemical analysis methods.
- Student will understand clearly reaction kinetics and thermodynamic parameters of reaction and their application in biological system.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
3		2	4	50/18	50/17	25/09	25/09	150/53

**Detailed Syllabus:**

Sr.	Contents	Hours
1	<b>General Introduction of analytical chemistry</b> Introduction, Qualitative and Quantitative analysis, Types of titrations. Requirements for titrimetric analysis. Concentration systems: molarity, formality, normality, wt%, ppm, milliequivalence and millimoles-problems. Primary and Secondary standards, criteria for primary standards. Preparation of standard solutions, standardization of solutions. Limitation of volumetric analysis, endpoint and equivalence point. Introduction to Instrumental and Chemical Methods of analysis, Applications of Chemical Analytical Chemistry, Sampling of Solid, Liquid and Gas, Stages of Analysis, Interferences, Selection of Methods, limitations of Analytical Methods.	12





2	<b>Thermodynamics</b> Terminology of thermodynamics, First law of thermodynamics, internal energy, enthalpy of a system, heat capacity, spontaneous process, Second law of thermodynamics, concept of entropy, entropy of mixing, standard entropies, criteria for reversible and irreversible process, Gibbs-Helmholtz equation, Third law of thermodynamics, determination of absolute entropies of elements and compounds. Applications of first and second law of thermodynamics in living cells.	11
3	<b>Chemical Kinetics</b> Introduction, Rate of reaction, Rate constant, Half life time, Determination of Half life time of reaction, Order of reaction Derivation of First law, second order rate reaction constant for ( $a=b$ ) and ( $a \neq b$ ). Derivation of third order. Mathematical problems. Catalysis characteristics of catalysis, Types of catalysis, homogeneous and heterogeneous catalysis, enzyme catalyzed reaction and derivation mechanism.	11
4	<b>Physical properties of liquids</b> <b>Surface tension:</b> surface energy, factors affecting surface tension, interfacial tension, surface active agents, measurements of surface tensions. <b>Viscosity:</b> units of viscosity, factors affecting viscosity, measurement of viscosity, application of viscometer, significance of viscosity in biological system.	11

### List of Practicals / Tutorials:

1	Preparation of normal/molar solutions of acids and bases.	30
2	Preparation and standardization of primary and secondary standard solution.	
3	Volumetric analysis of Weak Acid/ Strong Base.	
4	To determine the amount of carbonate and bicarbonate in a given mixture by titrating it against sulphuric acid/ hydrochloric acid.	
5	To determine the concentration of a solution for the given liquid by determination of surface-tension of a liquid by drop-volume method at various concentration.	
6	To determine the viscosity of the given liquid with the help of Ostwald's viscometer.	
7	To determine the percentage composition of the given solution by Ostwald's viscometer.	
8	To determine the molecular weight of given polymer using Ostwald's viscometer.	
9	Determination of Pka value of amino acid (glycine).	
10	Potentiometric titration of Acid / Base.	

### Reference Books:

1	Quantitative analysis by R. A Day, Jr. & A. L. Underwood 6 <sup>th</sup> Edition, Printice Hall of India Private Limited New Delhi. 2005. ISBN: 61-203-0793-3, 9788120307933.
2	Basic concept of Analytical Chemistry by S. M. Khopkar, New age International Publishers, 2004. ISBN 81-224-2092-3.
3	Vogel's Text book of Quantitative Chemical Analysis by J. Mendhan, R. C. Denney, M. Thomas, B. Sivasankar. 6 <sup>th</sup> Ed. Pearson 2009. ISBN: 978-81-317-2325-8.
4	Biophysical chemistry, Principles and Techniques by Upadhyay, Upadhyay and Nath, Himalaya Publishing House, 2019. ISBN978-98-5142-227-3



5	Principles of Physical chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, 41 <sup>th</sup> Ed. Vishal Publishing Co. 2012. ISBN: 81-88646-00-8
6	Lehninger's principles of biochemistry by David Nelson and Michel Cox. 5 <sup>th</sup> Ed. W. H. Freeman Company, New York. 2005. ISBN: 978-0-23022699-9.
7	An advance course in practical Chemistry by Ghoshal, Mahapatra, Nad. New central book agency, Kolkata, 2004. ISBN: 81-7381-302-7.

### Supplementary learning Material:

1	<a href="https://camtools.cam.ac.uk/access/content/group/6041b37a-7fa4-4a47-808b-b20db3a36122/Module%202/Practice%20Questions/mod2/index.htm">https://camtools.cam.ac.uk/access/content/group/6041b37a-7fa4-4a47-808b-b20db3a36122/Module%202/Practice%20Questions/mod2/index.htm</a>
2	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
3	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
4	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )
5	DIKSHA ( <a href="https://diksha.gov.in/">https://diksha.gov.in/</a> )

### Pedagogy:

1. Audio -visual aids, power point presentation, videos, animation, models etc.
2. Continuous assessment based on quiz, assignment, seminar.
3. Industrial visit
4. Laboratory experiments
5. Demonstration
6. Student feed back
7. Peer led learning

### Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Preparations of solution and to learn concentration units.	25
CO-2	To understand some of the basics of analytical chemistry.	25
CO-3	To learn fundamentals of thermodynamic chemistry and chemical kinetics.	25
CO-4	Develop concept of physical properties of solutions.	25

### Curriculum Revision:

Version:	1.0
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Last Reviewed on (Month-Year):	June 2023
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**FACULTY OF SCIENCE**

**Effective from Academic Batch: 2023-24**

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** II

**Course Code:** To be Given by University

**Course Title:** Environmental Studies

**Course Group:** Ability Enhancement Course

**Course Objectives:**

The objectives of this course are to enable students to...

- To develop clear understanding of various aspects of environment this includes ecosystem, biodiversity, and conservation of biodiversity, Indian hotspots, endangered flora and fauna of India.
- It also develops an attitude of concern for the environment and acquiring skills to help the concerned individuals in identifying and solving environmental problems.

**Teaching & Examination Scheme:**

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		Practical		Total
				Internal	External	Internal	External	
2			2	50/18	50/17			100/35

**Detailed Syllabus:**

Sr.	Contents	Hours
1	<b>Introduction to environmental studies:</b> Multidisciplinary nature of environmental studies; components of environment: atmosphere, hydrosphere, lithosphere, and biosphere. <ul style="list-style-type: none"><li>Scope and importance; Concept of sustainability and sustainable development; Brief history of environmentalism.</li></ul>	02



2	<b>Natural Resources:</b> Land resources: Minerals, soil, agricultural crops, natural forest products, medicinal plants, and forest-based industries and livelihoods; Land cover, land use change, land degradation, soil erosion, and desertification; Causes of deforestation; Impacts of mining and dam building on environment, forests, biodiversity, and tribal communities. Water resources: Natural and man-made sources; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts, and international & interstate conflicts over water. Energy resources: Renewable and non-renewable energy sources; Use of alternate energy sources; Growing energy needs; Energy contents of coal, petroleum, natural gas and biogas; Agro residues as a biomass energy source. <ul style="list-style-type: none"><li>Case studies: Contemporary Indian issues related to mining, dams, forests, energy, etc (e.g., National Solar Mission, Cauvery River water conflict, Sardar Sarovar dam, Chipko movement, Appiko movement, Tarun Bharat Sangh, etc)</li></ul>	10
3	<b>Global Environmental Issues and Policies</b> Causes of Climate change, Global warming, Ozone layer depletion, and Acid rain, Impacts on human communities, biodiversity, global economy, and agriculture. International agreements and programmes: Earth Summit, UNFCCC, Montreal and Kyoto protocols, Convention on Biological Diversity (CBD), Ramsar convention, The Chemical Weapons Convention (CWC), UNEP, CITES, etc. Sustainable Development Goals: India's National Action Plan on Climate Change and its major missions. Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980; Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.	10
4	<b>Human Communities and the Environment:</b> Human population growth: Impacts on environment, human health, and welfare; Carbon footprint. Resettlement and rehabilitation of developmental projects affected persons and communities, relevant case studies. Environmental movements: Chipko movement, Appiko movement, Silent valley movement, Bishnois of Rajasthan, Narmada Bachao Andolan, etc. Environmental justice: National Green Tribunal and its importance. Environmental philosophy: Environmental ethics; Role of various religions and cultural practices in environmental conservation. Environmental communication and public awareness: case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan, National Environment Awareness Campaign (NEAC), National Green Corps (NGC) "Eco-club" programme, etc.)	08

### Reference Books:

1	Ecology - Principles and Applications by J.L. Chapman & M.J. Reiss. (2008) (2nd Ed.) Cambridge University Press, U.K. (ISBN: 978-0-521-68920-5)
2	Ecology and Environment by P.D. Sharma. (2010). (10th Ed.) Rastogi Publications, Meerut (India). (ISBN: 978-81-7133-905-1)
3	Elements of Ecology by Thomas Smith & Robert Smith. (2007) (6th Ed.) Dorling Kindersley Press. (South Asia). (ISBN: 81-317-1557-4)



4	Fundamentals of Ecology by Eugene Odum & Gray Barrett. (2009) (5th Ed.) Cengage Learning & Nelson Education Press. (ISBN: 978-81-315-0020-0)
5	Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6	Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8 <sup>th</sup> edition. John Wiley & Sons.
7	Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
8	Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.

### Supplementary learning Material:

1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	NPTTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
3	e-PATHSHALA ( <a href="https://epathshala.nic.in/">https://epathshala.nic.in/</a> )
4	DIKSHA ( <a href="https://diksha.gov.in/">https://diksha.gov.in/</a> )

### Pedagogy:

1. Audio -visual aids, power point presentation, videos, animation, models etc.
2. Continuous assessment based on quiz, assignment, seminar.
3. Field trip / Industrial visit / sample collection/ data collection etc
4. Case study
5. Group Discussion
6. Student feed back
7. Peer led learning

### Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
50	20	10	10	5	5	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Students will gain of in-depth knowledge on natural processes and resources that sustain life and govern economy.	10
CO-2	Students will acquire critical thinking for environmental protection, and sustainable development.	30
CO-3	Students will develop attitude for active participation in solving current environmental problems and preventing the future ones.	30
CO-4	Students will adopt sustainability as a practice in life, society, and industry.	30



**CVM**  
**UNIVERSITY**

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**CVM**  
**UNIVERSITY**

Aegis: Charutar Vidya Mandal (Estd.1945)

## FACULTY OF SCIENCE

Effective from Academic Batch: 2023-24

**Programme:** B.Sc. LIFE SCIENCES (HONOURS)

**Semester:** I

**Course Code:** To be given by university

**Course Title:** Organic Farming

**Course Group:** Skill Enhancement Course (SEC)

Course Objectives:

The objectives of this course are to enable students to...

- Learn significance of the holistic concept organic farming
- Acquaint students with cultural production practices typically employed in organic farming.
- Examine challenges and trends in the production, processing, and marketing of organic farm products.
- Introduce students to the large body of literature relating to organic agriculture practices.

### Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		J/V/P*		Total
				Internal	External	Internal	External	
2			2	50/18	50/17			100/35

\* J: Jury; V: Viva; P: Practical

### Detailed Syllabus:

Sr.	Contents	Hours
1	History of alternative agricultural Development, Effects of Green revolution organic farming. Need, concepts, definition, characteristics, and components of organic farming. Relevance to modern agriculture, different eco-friendly farming system, biological farming Natural farming, biodynamic farming, permaculture, regenerative agriculture, and Zero Budget farming. Organic nutrient sources and their fortification, organic manures, methods of composting. Green manures: bio fertiliser types, methods of application, benefits and limitations.	15



2	Nutrient use in organic farming-scope and limitations. Nutrient management in organic farming. Organic ecosystem and their concepts. Choice of crops and varieties in organic farming, crop rotations, need and benefits, multiple cropping. Fundamentals of insect, disease and weed management under organic mode of production-cultural-biological methods-nonchemical pest & disease management. Initiatives taken by the central and state governments, NGOs, and other organizations for promotion of organic agriculture in India	15
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### Reference Books:

- 1 Tiwari, V.N., Gupta, D.K., Maloo, S.R and Somani, L.L. 2010. Natural, organic, biological, ecological, and biodynamic farming. Agrotech Publishing Academy, Udaipur. 420p.
- 2 Mukund Joshi and Prabhakarasetty, T.K. 2006. Sustainability through organic farming. Kalyani publishers, New Delhi. 349p.
- 3 Balasubramanian, R., Balakishnan, K and Siva Subramanian, K. 2013. Principles and practices of organic farming. Satish Serial Publishing House. 453p.
- 4 Arun K. Sharma. 2002. A Handbook of organic farming. Agrobios, India. 627p.

### Supplementary learning Material:

1	SWAYAM ( <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> )
2	NPTEL ( <a href="https://nptel.ac.in/">https://nptel.ac.in/</a> )
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### Pedagogy:

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3. Industrial visit
4. Laboratory experiments
5. Demonstration
6. Student feed back
7. Peer led learning

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Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analysing; E: Evaluating; C: Creating
R	U	A	N	E	C	
20	20	20	10	10	20	

### Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Students will get knowledge of the historical, biological, and ecological basis for organic farming including crop and livestock management.	50



**CVM**  
**UNIVERSITY**

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<b>CO-2</b>	Students will develop critical thinking with a systems approach to agriculture using case studies as working examples of farming systems.	<b>50</b>
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