Manonmaniam Sundaranar University

(Reaccredited with 'A' Grade (CGPA 3.13 out of 4.0) by NAAC in the Third cycle)

Tirunelveli - 627012, Tamilnadu

Department of Biotechnology

M.Sc Biotechnology (Integrated)

(TANCHE Syllabus based LOCF)

2023-2024 onwards

Manonmaniam Sundaranar University

Department of Biotechnology

M.Sc. BIOTECHNOLOGY (Integrated)

Choice Based Credit System

Revised Regulations and Syllabus (w.e.f. 2023-2024)

Vision of the University: To provide quality education to reach the unreached

Mission of the University :

- To conduct research, teaching, and outreach programs to improve conditions of human living.
- To create an academic environment that honors women and men of all races, castes, creeds, and cultures and an atmosphere that values intellectual curiosity, the pursuit of knowledge, academic freedom, and integrity.
- To offer a wide variety of off-campus educational and training programmes, including the use of information technology, to individuals and groups.
- To develop a partnership with industries and government to improve the quality of the workplace and serve as a catalyst for economic and cultural development.
- To provide quality / inclusive education, especially for the rural and unreached segments of economically downtrodden students, including women, socially oppressed, and differently-abled.

Department of Biotechnology

Vision of the department

Originating process development scientists, entrepreneurs, and professionals in the field of biotechnology.

Mission of the department

- Developing intellectuals with a remarkable capability, creativity, and sincerity for uplifting society through innovative biotechnological products and ideas.
- Nurturing and conserving the environment through sustainable biotechnological concepts.

1. **Name of the programme**: MSc. Biotechnology (Integrated)
2. **Preamble of the programme**:

MSc Biotechnology (Integrated) is a ten-semester program that includes theory and practicals in various areas of biotechnology. Additionally, it comprises two research projects: a short research/mini group project in the 6th semester and an individual dissertation project in the 10th semester. These projects aim to enhance knowledge and research skills in biotechnology throughout the course.

Objectives of the programme

- ❖ To impart theoretical and practical knowledge and skills that underpins the various branches of biotechnology.
- ❖ To enable the students to have a thorough understanding and knowledge of different branches of biotechnology.
- ❖ To make the students develop the ability to think analytically in solving problems concerned with biotechnology.

2. Eligibility for admission

The minimum eligibility conditions for admission to the MSc. Biotechnology (Integrated) programme are as follows:

Candidates applying for admission into the first semester of this course must have successfully completed the Higher Secondary Examination conducted by the board of Higher Secondary Education, Government of Tamil Nadu/CBSE/ICS, with a focus on the following science subject groups:

1. Physics, Chemistry, Botany/Zoology
2. Physics, Chemistry, Biology

or any other examination as equivalent to that in a science subject.

Admission will be determined by the overall marks achieved in the Higher Secondary examination, specifically in Physics, Chemistry, Biology/Botany/Zoology, or other relevant subjects, in accordance with the government's reservation policies.

3. Duration of the programme

The students are required to complete the prescribed course of study for a minimum of five academic years (ten semesters). The course is divided into two parts: six semesters (I – VI) for studying the fundamentals of biotechnology (similar to undergraduate biotechnology), and four semesters (VII – X) for studying advanced biotechnology (post-graduate biotechnology). Each semester consists of 90 working days, or as specified by the university..

The mark statements, provisional certificate, and degree certificate shall be awarded in the program named MSc. Biotechnology (Integrated).

i. The mark statements shall be awarded as per the following norms.
   a). Cumulative mark statements shall be awarded from semester I – VI with the footnote Declaration: "A candidate is declared to have completed the BSc. Biotechnology (VI semester) programme successfully only when the cumulative credits earned is a minimum of 143".
   b). Cumulative mark statements from VII semester to IX semester shall be issued separately. The X semester consolidated mark statement comprising I semesters to X semesters shall be issued

ii. Students who wish to withdraw from the MSc. Biotechnology (Integrated) programme may do so after completing the VI semester. These students must indicate their intention to exit the programme by the end of the V semester. Approval from the Vice-Chancellor, granted through the Controller of Examinations, is required for their request to be accepted.

iii. Students who choose the exit option after completing the VI semester will receive their provisional and degree certificates under the name of BSc. Biotechnology. However, these students will not be eligible for university ranking and will not be permitted to re-enroll in the same program.

iv. Those exiting after the VI semester shall be issued with the consolidated statement of a mark with the class classification s per the integrated programme (UG level) of our university departments.

v. For those exiting after the VI semester, the consolidated mark statement for the VI semester will be issued with the controller of examination office seal 'Eligible for the award of BSc. Biotechnology.'

vi. Those who choose to exit after completing six semesters will receive a course completion certificate from the Controller of Examination in the specified format.

This is to certify that the student bearing the name ---------- Reg. no----------joined the MSc. Biotechnology (Integrated) programme during academic year ---------- who opted exit option and earned 143 credits at the end of VI semesters shall be eligible for the award of BSc. Biotechnology.

vii. All students, except those who have chosen the exit option at the end of the VI semester, will be allowed to proceed with the MSc. Biotechnology (Integrated) program in the VII semester.

viii. As this programme is a 5-year integrated programme, the university ranking will only be awarded at the completion of the entire MSc. Biotechnology (Integrated) programme, which includes I – X semesters. Additionally, the university ranking for languages in the I – IV semesters will not be taken into consideration.

ix. Students who are unable to continue the MSc. Biotechnology (Integrated) program during the VII – X semester will be eligible for the BSc. Biotechnology degree award. However, they must first pay the processing fee as determined by the university.

x. Students who are currently enrolled in the VII semester of the MSc. Biotechnology (Integrated) program and have arrears from previous semesters will be allowed to continue their studies in the MSc. Biotechnology (Integrated) program.

xi. The exited student Transfer certificate in serial no.7. The reason for leaving the university shall be noted as completed BSc. Biotechnology by exit option from MSc. Biotechnology (Integrated). The course in which the students were studying at the time of leaving shall be noted as MSc. Biotechnology (Integrated) in the serial no.10.

3. Programme structure

Semester	Course content	Course	Course nature	Contact hours per week	Credits	Continuous internal assessment (CIA)	End semester exam (ESE)	Total
FIRST	Part – I	Tamil/other language	Language	5	3	25	75	100
	Part – II	English	Language	5	3	25	75	100
	Part – III	Cell and Molecular Developmental Biology	Core – I	5	5	25	75	100
		Cell and Molecular Developmental Biology	Core Practical – I	3	2	50	50	100
		Biological Chemistry (Allied - I)	Elective – I	5	3	25	75	100
		Biological Chemistry (Allied Practical – I)	Elective Practical - I	3	2	50	50	100
	Part - IV	Biotechnology for Society	Skill Enhancement Course (SEC-I)	2	2	25	75	100
		Biodiversity	Skill Enhancement - (Foundation Course)	2	2	25	75	100
Sub Total				30	22			
SECOND	Part – I	Tamil/other language	Language	5	3	25	75	100
	Part – II	English	Language	5	3	25	75	100
	Part – III	Genetics	Core – II	5	5	25	75	100
		Genetics	Core Practical – II	3	2	50	50	100
		Microbiology (Allied - II)	Elective - II	5	3	25	75	100
		Microbiology (Allied Practical – II)	Elective Practical - II	3	2	50	50	100
	Part - IV	Public Health and Hygiene	Skill Enhancement Course SEC-II	2	2	25	75	100
		Vermitechnology	Skill Enhancement Course SEC-III	2	2	25	75	100
Sub Total				30	22			
THIRD	Part – I	Tamil/other language	Language	5	3	25	75	100
	Part – II	English	Language	5	3	25	75	100
	Part – III	Immunology	Core – III	5	5	25	75	100
		Immunology	Core Practical – III	3	2	50	50	100
		Bioinstrumentation (Allied - III)	Elective – III	4	3	25	75	100
		Bioinstrumentation (Allied Practical- III)	Elective Practical – III	3	2	50	50	100
	Part IV	Mushroom Cultivation	Skill Enhancement Course SEC-IV	2	2	25	75	100
		Herbal medicine	Skill Enhancement Course SEC-V	2	2	25	75	100
		Environmental Studies		1	0			
Sub Total				30	22			
FOURTH	Part – I	Tamil/other language	Language	5	3	25	75	100
	Part – II	English	Language	5	3	25	75	100
	Part – III	Genetic Engineering and rDNA	Core – IV	5	5	25	75	100

		Technology						
		Genetic Engineering and rDNA Technology	Core Practical – IV	3	2	50	50	100
		Bioinformatics and Biostatistics (Allied-IV)	Elective – IV	4	3	25	75	100
		Bioinformatics and Biostatistics Allied Practical – IV	Elective Practical – IV	3	2	50	50	100
	Part IV	Environment management in industries	Skill Enhancement Course SEC- VI	2	2	25	75	100
		Organic Farming and Health Management	Skill Enhancement Course SEC-VII	2	2	25	75	100
		Environmental Studies		1	2	25	75	100
Sub Total				30	24			
FIFTH	Part – III	Plant Biotechnology	Core - V	5	5	25	75	100
		Animal Biotechnology	Core - VI	5	5	25	75	100
		Environmental and Industrial Biotechnology	Core - VII	5	5	25	75	100
		Virology Enzymology Aquaculture technology	Select any one Elective – V	4	3	25	75	100
		Cancer Biology Bioethics and Biosafety Clinical nutrition and dietary management	Select any one Elective – VI	4	3	25	75	100
		Plant Biotechnology, Animal Biotechnology Environmental and Industrial Biotechnology	Core Practical - V	3	2	50	50	100
		Internship/ Industrial visit / Filed Visit	Mandatory	-	2	50	50	100
	Part – IV	Value Education	Common	2	2	25	75	100
Sub Total				30	27			
SIXTH	Part – III	Bio entrepreneurship	Core - VIII	5	5	25	75	100
		Pharmaceutical Biotechnology	Core - IX	5	5	25	75	100
		Marine Biotechnology Food Technology	Elective – VII (Any one)	4	3	25	75	100
		Medical Biotechnology Forensic science Good Laboratory Practices	Elective – VIII (Any one)	4	3	25	75	100
		Project	Project	10	5	50	50	100
	Part – IV	Skill based Activities – online course NPTEL/ MOOC		-	1			
	Part – V	Extension Activities		2	1			
Sub Total				30	23			
SEVENTH		Biomolecules and Bioenergy	Core - X	5	5	25	75	100
		Molecular Cell Biology	Core - XI	5	5	25	75	100
		Biomolecules and Bioenergy	Core Practical - VI	3	2	50	50	100
		Molecular Cell biology	Core Practical - VII	3	2	50	50	100
		Bioanalytical Technology	Elective –IX	4	3	25	75	100

		Biosensor	(any one)					
		Biostatistics Enzyme Technology	Elective –X (any one)	3	3	25	75	100
Sub Total				30	20			
EIGHTH		Microbial Biotechnology	Core - XII	5	5	25	75	100
		Applied Biotechnology	Core - XIII	5	5	25	75	100
		Microbial Biotechnology	Core Practical - VIII	3	2	50	50	100
		Applied Biotechnology	Core Practical - IX	3	2	50	50	100
		Gene transfer Technology Biopharmaceuticals	Elective Paper-XI (any one)	4	3	25	75	100
		Regulatory affairs and Industrial standards Eco biotechnology	Elective Paper-XII (any one)	4	3	25	75	100
		NPTEL	Online course / NME	3	2	25	75	100
		Total		30	22			
NINETH		Artificial Intelligence in Biotechnology	Core – XVI	5	5	25	75	100
		Nanobiotechnology	Core – XVII	5	5	25	75	100
		Advanced Immunotechnology	Core – XVIII	5	5	25	75	100
		Artificial Intelligence in Biotechnology and Nanobiotechnology	Practical –X	3	2	50	50	100
		Advanced Immunotechnology	Practical –XI	3	2	50	50	100
		Omics in Biology Molecular Developmental Biology	Elective Paper-XIII (any one)	4	3	25	75	100
		Traineeship in Industries / Institution related to Biotechnology Field (food / clinical trial/ dairy/ aqua sciences, pharmaceutical) CSIR/DBT/DST research laboratories	Internship	2	2	50	50	100
		NPTEL	Online course / NME	3	2	25	75	100
		Project		1	-	-	-	-
Sub Total				30	26			
		Bioprocess Technology	Core – XIX	5	5	25	75	100
TENTH		Research Methodology	Core – XX	5	5	25	75	100
		IPR, Clinical Trails and Social Issues Stem Cell Biology	Elective Paper-XIV(any one)	4	3	25	75	100
		Professional Competency skill	Skill Enhancement course/ NME	4	2	25	75	100
		Extension activity		-	1			
		Dissertation	Project	12	7	50	50	100
Sub Total				30	23			
Total					231			

SCHEME OF EVALUATION

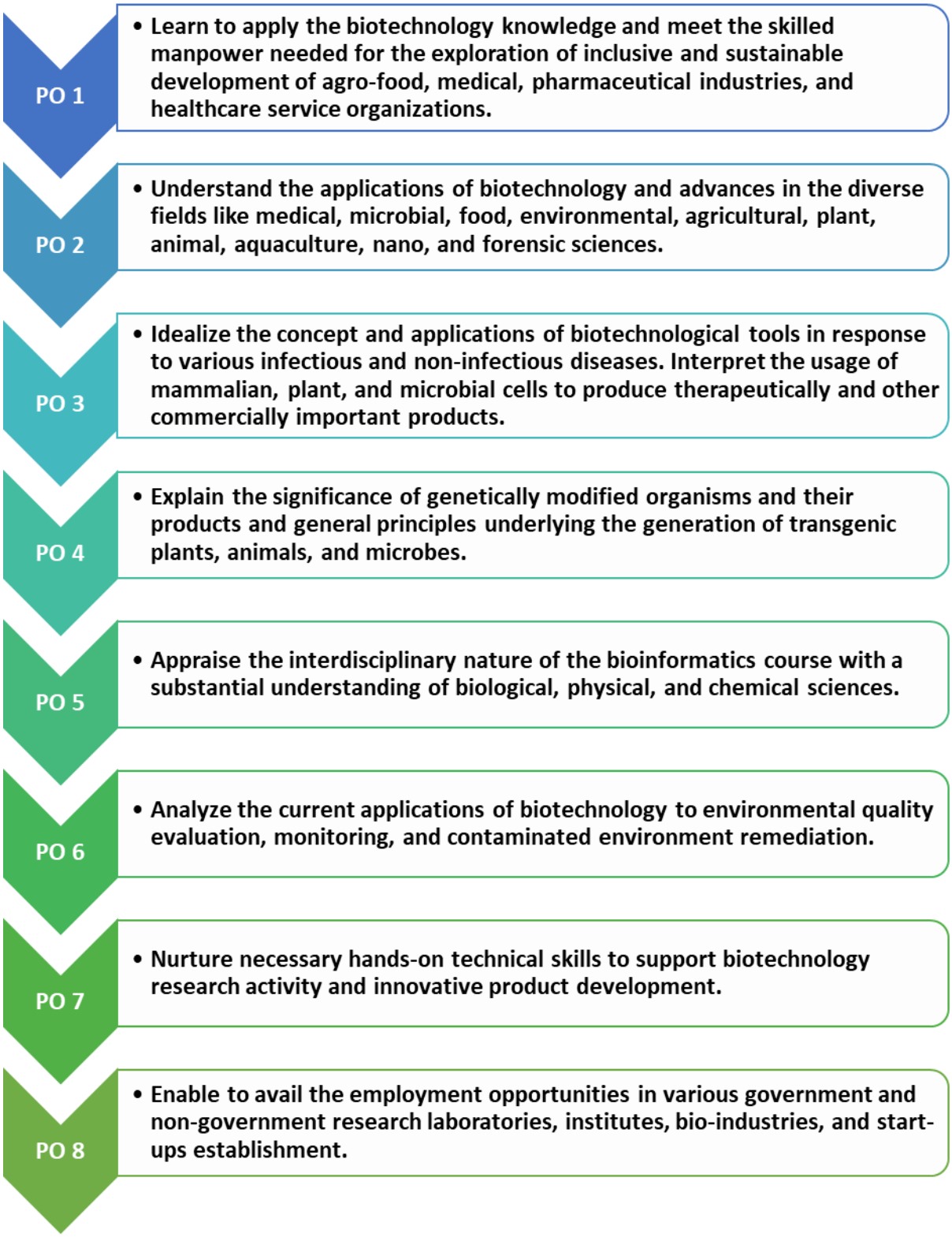
Evaluation Pattern for Internal Assessment (25 Marks)

- Internal Assessment - Best 2 Exam marks taken out of 3 (10 Marks)
- Assignment / Power point presentation / Case study (10 Marks)
- Attendance (5 Marks)

Evaluation Pattern for External Assessment (75 Marks)

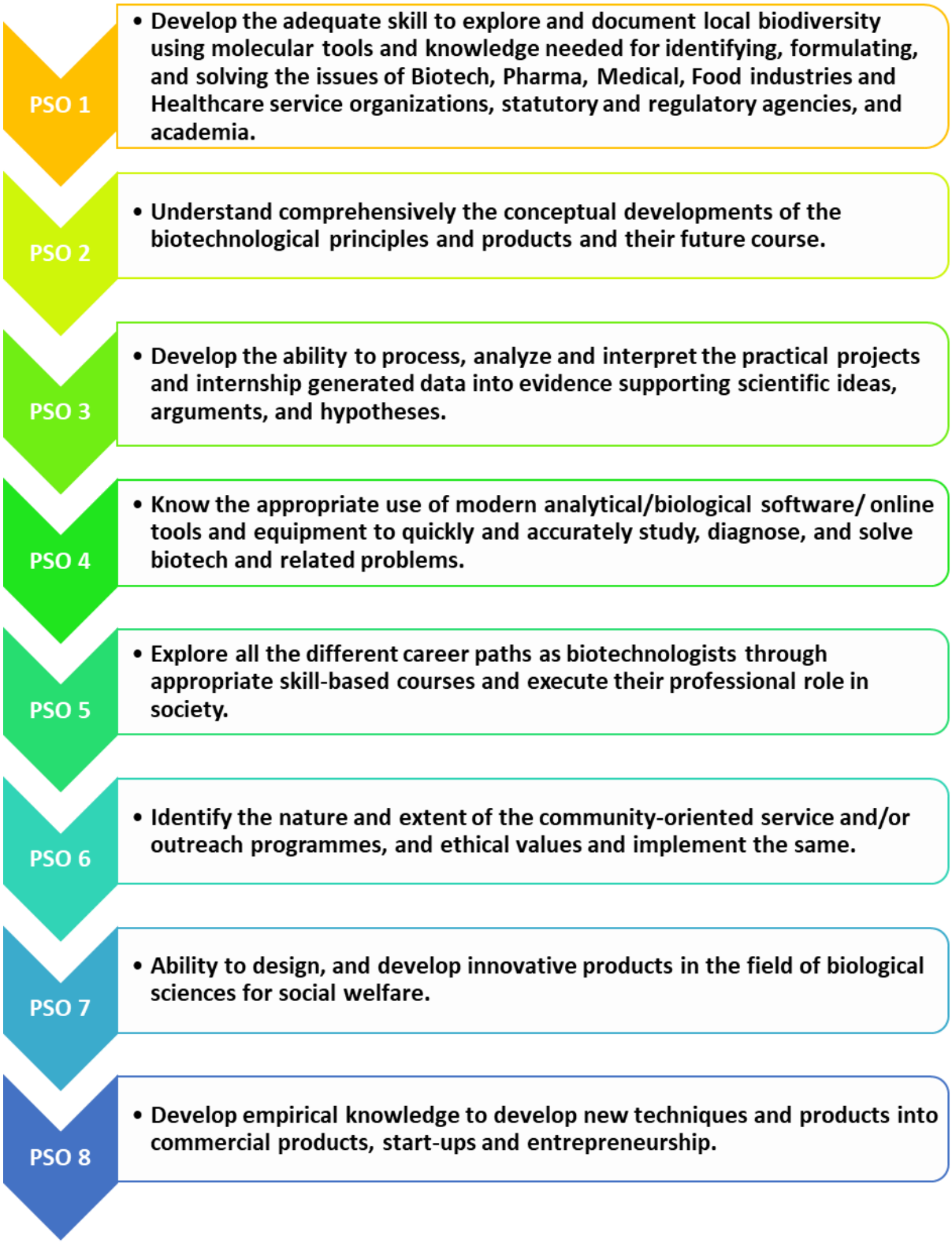
- Section - A (Multiple Choice Questions) (1 x 10 = 10 Marks)
- Section - B (Five Mark Questions with choice) (7 x 5 = 35 Marks)
    - Section - C (Ten Mark Questions with choice) (3 x 10 = 30 Marks)

Programme outcome (POs)



Programme specific outcome (PSOs)

Upon successful completion of the MSc. Biotechnology (Integrated) 5 years programme, the candidate should be able to:



SEMESTER - I

CORE – I- CELL & MOLECULAR DEVELOPMENTAL BIOLOGY

a. Course code:

L	T	P	C
4	1	0	4

b. Course objectives:

The main objectives of this course include:

1) Understanding the scientific evidence regarding the origin of life on Earth.
2) Studying the different types of cell organelles and their structural arrangements.
3) Enhancing students' foundational understanding of DNA as genetic material and the molecular process of DNA repair.
4) Gaining a comprehensive understanding of protein synthesis and its regulation.

c. Course prerequisites:

- - Fundamental understanding of cells
- - Fundamental understanding of DNA.

d. Course outcome (COs):

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

Course outcome	Expected outcome	Cognitive level
CO1	Gain a comprehensive understanding of the fundamental principles and concepts surrounding theories explaining the origin of life on our planet.	K1 & K2
CO2	Enhance the basic knowledge of cell theory, types of cells, and cellular organization	K2 & K4
CO3	Understanding and remembering the functions, biogenesis, and structural properties of cellular organelles.	K3 & K5
CO4	Understanding the Fundamentals of DNA and familiarize oneself with its basic structure and functions.	K2
CO5	Examine the characteristics of the genetic code and the associated mutations.	K4 & K5
CO6	Describe the mechanism of protein synthesis & regulation and create an idea about the basic principles in molecular biology	K2 & K6

(K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, K6 – Create)

e. Course outline:

UNIT	Contents	No. of Hours
I	Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).	10
II	Biomacromolecules and Biomicromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes -Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton.	20
III	Structure and functions of DNA and RNA -Central Dogma of the cell. DNA - Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes -	15

	RNA Processing - Genetic code- Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation.	
IV	Cell cycle - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - ExtraCellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.	15
V	Gametogenesis - Spermatogenesis and Oogenesis in mammals. Fertilization- Types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals- Organogenesis.	15

f. Mapping of course outcome to POs and PSOs

Mapping of COs to POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	H	M	M	M	M	M
CO2	H	M	H	M	L	M	H	M
CO3	H	M	M	M	L	L	M	M
CO4	M	M	M	M	M	L	M	M
CO5	H	M	H	M	L	L	M	M
CO6	M	M	H	M	M	M	M	M

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	M	M	H	H	M	M	M	M
CO2	M	M	M	M	H	M	M	M
CO3	M	H	M	M	M	M	M	M
CO4	M	H	M	M	M	L	M	M
CO5	M	M	M	M	H	M	H	H
CO6	M	H	M	M	H	M	H	H

(L – Low, M – Medium, H – High)

g. Text Books/ References

1) Bruce Alberts et al., 2014. Essential Cell Biology, Taylor and Francis Group.
2) Devasena, T.2012. Cell Biology, Oxford University Press.
3) Geoffrey M Cooper, Robert E Hausman, 2016. The cell: A molecular approach. ASM press
4) George Plopper, 2016. Principles Cell Biology, Jones & Bartlett Publishers.
5) Gilbert, S.F. 2016. Developmental Biology, 11th edition. Sinauer Associates Inc. Publishers, MA. USA.
6) Gupta, Renu &Makhija, Seema &Toteja, Ravi. (2018). Cell Biology: Practical Manual.

7) James D. Watson (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers.
8) John K. Young, 2010. Introduction to Cell Biology, World Scientific.
9) Karp's Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). Wiley Publications.
10) Lodish, H., Baltimore, D; fesk, A., Zipursky S.L., Matsudaride, P., Darnel. 2018. Molecular Cell Biology, American Scientific Books. W.H. Freeman, New York
11) Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press.

h. MOOC, SWAYAM, NPTEL, online and e-resources

1) http://www.cellbiol.com/education.php
2) https://dnalc.cshl.edu/websites/
3) https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/
4) https://nptel.ac.in/courses/102106025
5) https://www.britannica.com/science/cell-biology
6) https://www.bu.edu/gk12/nishant/cellbioarticle.htm
7) https://www.cellsignal.com/contents/science/cst-pathways/science-pathways
8) https://www.slideshare.net/MichaelHo6/lecture-notes-cell-biology
9) https://www.uou.ac.in/sites/default/files/slm/BSCBO-301.pdf
10)

Core Practical I - CELL & MOLECULAR DEVELOPMENTAL BIOLOGY

a. Course code:

b. Course objectives:

L	T	P	C
0	0	4	2

The primary goals of this course include:

1. Acquiring the necessary laboratory skills to proficiently execute, interpret, and evaluate commonly employed molecular biology techniques.
2. Elucidating the fundamental molecular mechanisms underlying mitosis and meiosis.
3. Offering hands-on experience to individuals aspiring to pursue careers in biological research.

c. Course prerequisites:

- Basic understanding of cells.
- Familiarity with chemicals and buffer preparation.

d. Course outcome (COs):

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

Course outcome	Expected outcome	Cognitive level
CO1	Identify and explain the different stages in cell divisions	K1, K2
CO2	Develop knowledge to perform and apply histochemical techniques.	K3
CO3	Demonstrate the handing techniques of microscopes and use them to observe histochemical specimens.	K4
CO4	Perform karyotyping to distinguish chromosome complement within the cells.	K4, K5

CO5	Describe the experimental procedures for polythene chromosome and chloroplast isolation	K3, K6
CO6	Facilitate the ways of applying novel molecular biology techniques for the welfare of society.	K6

(K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, K6 – Create)

e. Course outline:

UNIT	Contents	No. of Hours
I	Components of a Compound / Light Microscope.	9
II	Blood smear preparation and Identification of Blood cells Buccal smear preparation and Identification of squamous epithelial cells.	9
III	Isolation and Identification of plant cells.	9
IV	Observation of sperm & Egg Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs. Types of placenta in mammals.	9
V	Cell fractionation and Identification of cell organelles (Demo)	9
Total		**45**

f. Mapping of course outcome to POs and PSOs

Mapping of COs to POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	H	L	H	M	M	M	H
CO2	M	M	M	H	M	M	H	H
CO3	H	H	M	H	L	M	M	M
CO4	H	H	M	H	M	L	M	M
CO5	H	M	M	M	M	H	M	H
CO6	H	H	H	M	M	M	H	H

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	M	H	H	M	M	M	H	H
CO2	L	H	H	M	M	L	M	M
CO3	M	M	H	M	H	M	H	H
CO4	H	M	L	H	M	M	H	L
CO5	M	H	H	M	M	M	M	M
CO6	H	H	H	H	H	H	H	H

(L – Low, M – Medium, H – High)

g. Laboratory manuals / Reference:

1) Carson S, Miller HB, Srougi MC, Witherow DS, 2019. Molecular biology techniques: a classroom laboratory manual. Academic Press.

2) Chaitanya KV, 2013. Cell and Molecular biology: A lab manual, Prentice Hall India Learning Private Limited
3) Rajan. S, Selvi Christy R, 2018. Experimental procedures in life sciences, CBS Publishers & Distributors Pvt Ltd, India.
4) Sharma RK, 2013. Basic techniques in biochemistry and molecular biology. IK International Pvt Ltd.
5) Surzycki S, 2012. Basic techniques in molecular biology. Springer Science & Business Media.

Elective I- BIOLOGICAL CHEMISTRY (Allied - I)

L	T	P	C
4	0	0	3

a. Course code:

b. Course objectives:

1. Foster a learning experience that cultivates a profound interest in the field of Biochemistry among leaners.
2. Cultivate a comprehensive understanding of biomolecules, essential biochemical concepts, principles, and theories.
3. Equip leaners with the necessary analytical tools, theoretical knowledge, technical expertise, and analytical skills to effectively tackle biochemistry-related questions and problems.

c. Course prerequisites:

- Higher Secondary level chemistry basic knowledge

d. Course outcome (COs):

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

Course outcome	Expected outcome	Cognitive level
CO1	Describe the basic structure of atoms, molecules, and chemical bonds	K1
CO2	Understand and explain the process of Metabolism and its significance	K2, K3
CO3	Develop knowledge on various metabolic processes of carbohydrates, electron transport chain, and its importance.	K3
CO4	Illustrate the lipid metabolic processes, the structure of amino acids, and their significance.	K4
CO5	Compare the difference between DNA & RNA and distinguish their roles in biological functions	K2, K5
CO6	Integrate the acquired knowledge and enhance the capability to compete in competitive examinations	K3, K6

(K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, K6 – Create)

e. Course outline:

UNIT	Contents	No. of Hours
I	Atomic theory, formation of molecules, electronic configuration of atoms- s & p shapes of atomic orbitals. Periodic table, periodic classification, valency. Types of chemical bonds. Classification of organic compounds -. Hybridization in methane, ethane, acetylene, and benzene. Definition with examples- electrophiles, nucleophiles and free	15

	radicals. Types of reactions with an example: addition, substitution, elimination, condensation and polymerization. Electrophilic substitution reaction in benzene, nitration and sulphonation.	
II	Acids & Bases properties and differences, Concepts of acids and bases-Arrhenius, Lowry-Bronsted and Lewis. Concentration of solution, ways of expressing concentrations of solutions – per cent by weight, normality, molarity, molality, mole fraction. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of buffers, Henderson-Hasselbalch equation, mechanism of buffer action of acidic buffer and basic buffer.	15
III	Importance to Biochemistry-the chemical foundation of life. Water: its unique properties, ionization of water, buffering action in biological system, properties and characteristics of water. Classification of carbohydrates. Properties of carbohydrates. Ring structure of sugars and conformations of sugars. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Cori's cycle, Glycolysis, TCA cycle, bioenergetics of carbohydrate metabolism.	15
IV	Classification of Lipids. Characteristics, Properties and Biological importance of lipids. Metabolism of Fatty acids, triglycerides, phospholipids, cholesterol. B-oxidation of fatty acids. Classification of nucleic acids. Purine and Pyrimidine bases. Classification of DNA & RNA. Metabolism of Nucleic acids, Salvage pathway.	15
V	Classification and structure of amino acids. Structural conformation of proteins. Classification of proteins. Properties and biological importance of amino acids and proteins. Degradation of Amino acids and Urea Cycle. Vitamins and Hormones. Role of hormones in metabolism. ATP production. Oxidative phosphorylation, Electron transport chain and Photophosphorylation.	15

f. Mapping of course outcome to POs and PSOs

Mapping of COs to POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	L	H	L	H	M	L	H
CO2	H	H	M	H	L	H	H	M
CO3	M	H	H	M	H	M	H	H
CO4	H	M	H	H	M	H	M	H
CO5	M	H	H	M	H	H	H	M
CO6	H	H	H	H	H	H	H	H

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	H	M	L	M	H	L	H	H

CO2	M	H	M	H	M	M	M	M
CO3	H	M	H	L	H	H	L	H
CO4	H	H	M	H	M	M	M	L
CO5	M	L	H	M	M	M	H	M
CO6	H	H	H	H	H	H	H	H

(L – Low, M – Medium, H – High)

g. Text Books/ References

1) Abhilasha Shourie, Shilpa S, Chapadgoankar &Anamika Singh (2020) Textbook of Biochemistry 1st Edition.I.K International Publishing
2) BahlArun, Bahl B. S. (2016), A Textbook of Organic Chemistry, 22nd Edition, S. Chand & Sons publications
3) Berg JM, Tymoczko JL, Stryer L, 2006. Biochemistry. VI Edition. W.H Freeman and Co.
4) Deb, A.C. 2016, Fundamentals of Biochemistry, New central book agencies, 7th edition.
5) Donald Voet, Judith G. Voet, 2011. Biochemistry, 4th Edition (International Student Version), John Wiley & Sons (Asia) Pvt Ltd
6) Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W.C. Brown Publishers, 1995, 3rd edition.
7) Jain, J.L. 2016, Fundamentals of Biochemistry, S. Chand publication, 7th edition.
8) Lehninger (2013) Principles of Biochemistrty 4 th edition WH Freeman and Company NY
9) LubertStryer, Jeremy Berg, John Tymoczko, Gregory Gatto, 2019. Biochemistry, 9th Edition, New York, Freeman
10) Murray et al., (2003) Harper's biochemistry 26 th edition Appleton and Lange Publishers Florida USA

h. MOOC, SWAYAM, NPTEL, online and e-resources

1) https://onlinecourses.nptel.ac.in/noc22_bt22/preview
2) https://study.com/academy/topic/biochemistry-study-guide.html
3) https://www.brainkart.com/subject/Biochemistry_302/
4) https://www.easybiologyclass.com/topic-biochemistry/
5) http/dwb4.unl.edu/chem869p/chem869plinks/s
6) ww.longwood.edu/staff/buckalewdw/C3%20Biomolecules.pp

Elective Practical- I -BIOLOGICAL CHEMISTRY (Allied Practical 1)

a. Course code:

L	T	P	C
1	0	3	2

b. Course objectives:

The primary goals of this course include:

1. The objective is to enhance laboratory skills in chemical preparation and instrument handling, specifically in the field of biochemistry.

2. The goal is to gain a comprehensive understanding of different biochemical assays and their importance.

3. The aim is to equip students with analytical skills that can be applied to address inquiries and challenges in the field of biochemistry

.c. Course prerequisites:

Basic knowledge about chemicals and buffer preparation

d. Course outcomes (COs):

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

Course outcomes	Expected outcome	Cognitive level
CO1	Observe the functioning of instruments and relate their use in biochemical analysis.	K1, K2
CO2	Know the ways to estimate important parameters including the blood glucose level	K2
CO3	Determine the concentration of carbohydrates, lipids, and proteins present in any biological sample.	K3
CO4	Illustrate the importance of SGOT/ SGPT assay	K4
CO5	Estimate the concentration of serum cholesterol	K5
CO6	Integrate the acquired skills and develop the capability to perform independent research	K3, K6

(K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, K6 – Create)

e. Course outline:

UNIT	Contents	No. of Hours
1	**Systematic analysis of Organic compounds** Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid), Phenol, Urea, Benzaldehyde, Aniline (Aniline not to be given for exam), Detection of elements (N, Halogens), Distinguish between aliphatic and aromatic compounds. Distinguish between Saturated and unsaturated compounds	9
II	**Qualitative Analysis** Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch & glycogen. Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine.	9
III	**Volumetric Analysis**: 1. Estimation of Glycine- Formal Titration. 2. Determination of Ascorbic acid – DCPIP method.	9

	3. Estimation of Ferrous sulphate using standard Mohr's salt	
IV	Colorimetric Analysis 1. Estimation of glucose 2. Estimation of Cholesterol- Zak's method 3.Estimation of proteins – Bradford's method	9
Total		**45**

f. Mapping of course outcomes to POs and PSOs

Mapping of COs to POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	L	H	M	M	H	H	H	L
CO2	H	H	H	H	M	H	M	H
CO3	H	M	M	H	H	H	H	H
CO4	M	H	H	M	M	H	H	M
CO5	H	H	M	H	H	M	M	H
CO6	M	H	H	L	H	L	H	H

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	M	H	H	M	H	M	H	L
CO2	H	H	H	H	L	H	M	H
CO3	H	M	H	L	H	M	H	H
CO4	L	H	M	H	H	H	M	H
CO5	H	H	M	H	M	H	H	H
CO6	H	M	H	H	H	H	M	H

(L – Low, M – Medium, H – High)

g. Laboratory manuals/ Reference

1) David L Nelson, Michael M. Cox, 2017. Lehninger Principles of Biochemistry, 7th edition, W.H. Freeman
2) Donald Voet, Judith G. Voet, 2011. Biochemistry, 4th Edition (International Student Version), John Wiley & Sons (Asia) Pte Ltd.
3) Hands Thacher Clarke 2007. A hand book of Oraganic: Qualitative and quantitative Analysis.

4) Jayaraman, J. 2011. Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers.
5) Lubert Stryer, Jeremy Berg, John Tymoczko, Gregory Gatto, 2019. Biochemistry, 9th Edition, New York, Freeman.
6) Panday, O P Bajpai, D N. Giri S, 2016. Practical Chemistry, S Chand, Revised edition.
7) Rodney Boyer, 2000. Modern experimental biochemistry. 3rd edition, Prentice Hall Publisher, USA.
8) Sawhney Randhir, Singh S. K., 2005. Introductory Practical Biochemistry, Alpha Science International Ltd, 2nd edition.
9) Wilson KM, Walker JM, 2010. Principles and Techniques of Biochemistry and Molecular Biology,7th edition, Cambridge University Press, UK

BIOTECHNOLOGY FOR SOCIETY (SEC 1)

Subject Code	**L**	**T**	**P**	**S**	**Credits**	**Instructional Hours**	**Marks**		
							CIA	**External**	**Total**
	4	**1**			**5**	**5**	**25**	**75**	**100**
Learning Objective									
LO1	Will understand the role of Biotechnology in Sericulture, Apiculture and Mushroom Cultivation								
LO2	Will gain knowledge about the production of Bio fertilizer and advantages of Biopestisides								
LO3	Will understand the significance of microorganisms in Biodegradation								
LO4	Will get know about History of Antibiotics								
LO5	Will able to comprehend about Transgenic Plants								
UNIT	**Contents**								**No. of Hours**
1	Introduction to Biotechnology- Role of Biotechnology in sericulture- Rearing of silkworms- Importance and applications- Role of Biotechnology in apiculture- Bee hive hierarchy- Bee keeping process- Products obtained-								15

	Mushroom farming stages- Cultivation of paddy straw mushroom- Importance of mushroom cultivation.	
II	Biofertilizer- Definition- Mass production of Rhizobium-Advantages and disadvantages- Biopesticides- Definition- Microbial biopesticides- Bacillus thuringiensis- Single cell protein- Introduction- history- production of Spirulina SCP- Applications- Advantages & disadvantages.	15
III	Biodegradation- Definition- Process-role of microorganisms in biodegradation - biodegradable plastics-advantages- Bio weapons- Introduction- history- potential agents- delivery methods- harmful effects.	15
IV	Antibiotics- Definition- Introduction and history of antibiotics- sources- classification- spectrum- production of penicillin- definition of antibiotic resistance.	15
V	Transgenic plants – Definition of transgene and transgenesis - BT Cotton, Flavr-Savr tomato and Golden rice- history – importance, applications, advantages and disadvantages.	15
Total		**75**

Text Books	
1	Sathyanarayana, U., Chakrapani, U., (2008). Biotechnology, First edition, Books and allied (P) Ltd, Kolkata.
2	A.K. Chatterji, (2011).Introduction to Environmental Biotechnology, Third edition, PHI Learning Pvt Ltd. New Delhi. ISBN-978-81-203-4298-9
3	R.C. Dubey, (2014). A text book of Biotechnology, S.Chand& Company, New Delhi. ISBN 9788121926089
4	H. Patel, (2011).Industrial Microbiology,(2nd edition), MacMillan Publishers
5	Thakur, I.S., (2019).Environmental Biotechnology- Basic principles and applications- (2nd edition)- Dreamtech Press, ISBN 978-93-89307-55-9
3	
1	Basics of Biotechnology Paperback – 1 January 2004 by A.J. Nair (Author) Publisher Laxmi Publications
2	Basic Biotechnology Paperback – 2 February 2008 by Ratledge Colin (Author) Publisher Cambridge University Press

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**
CLO3	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**
CLO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO5	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**
TOTAL	**15**	**14**	**15**	**15**	**14**	**15**	**13**	**14**	**15**
Average	**3**	**2.8**	**3**	**3**	**2.8**	**3**	**2.6**	**2.8**	**5**

BIODIVERSITY (Foundation Course)

L	T	P	C
2	0	0	2

a. Course code:

b. Course objectives:

1) Understanding the importance and underlying concepts of biodiversity.
2) Identifying the interdisciplinary aspects of managing biodiversity.

c.Course prerequisites:

c. • Basic knowledge of taxonomic principles used for identifying flora and fauna is required.

d. Course outcome (COs):

At the conclusion of the course, the student will have the ability to #

Course outcome	Expected outcome	Cognitive Level
CO1	Gain knowledge about the various types, hot spots, bio resources, and economic values of biodiversity in India.	K1, K2 & K4
CO2	Comprehend the connection between organisms and their habitats, with a specific focus on human beings.	K2 &K3
CO3	Critically analyze and tackle the ecological challenges of the 21st century, with a special emphasis on the Indian context	K4
CO4	Utilize scientifically generated information and analysis to address conservation and biodiversity concerns.	K3, K5 & K6
CO5	Assess the significance of ethics, values, and norms in interventions for biodiversity conservation.	K5
CO6	Formulate conservation strategies to safeguard the local natural environment and habitats	K6

(K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, K6 – Create)

e. Course outline:

UNIT	Contents	No. of Hours
I	Ecosystem concept Introduction and overview of ecosystem ecology –History of ecosystem ecology, Ecosystem structure and functioning, Ecosystem diversity and landscapes, Ecosystem resilience and change, Trophic dynamics and temporal dynamics, Ecological efficiencies	6 hours
II	Biodiversity and its origin, Global and local trends, Mega biodiversity countries, hot spots and heritage sites, types of diversity, levels of biodiversity (genetic, species, ecological diversities), value of biodiversity.	6 hours
III	History, guiding principles, conservation challenges and models of conservation biology. IUCN Red list categories and criteria, habitat management and establishment of wildlife corridors and protected areas, bio-indicators. Biosphere reserves, insitu and exsitu conservations (sanctuaries, nationalparks, zoologicalparks, botanical gardens, oceanorium).	6 hours
IV	Environmental Pollution- Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management. Environment Protection Act: Air, water, forest and wildlife acts, issues involved in enforcement of environmental legislation.	6 hours
V	Water conservation, Rain water harvesting & water shed management, and environmental ethics. Climate change, global warming, acid rain, ozone Layer depletion. Environmental protection act, population explosion. Disaster management.	6 hours

	Total Lecture hours	30 hours

f. Mapping of course outcome to POs and PSOs

Mapping of COs to POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	H	H	M	M	L	M	M
CO2	H	M	H	H	L	M	M	M
CO3	M	M	M	M	L	M	M	M
CO4	H	M	M	L	L	M	M	H
CO5	M	M	M	H	M	H	H	M
CO6	M	H	M	L	L	M	M	M

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	H	M	M	M	M	L	M	M
CO2	M	H	M	M	M	M	M	M
CO3	H	M	M	H	M	M	M	M
CO4	H	M	H	H	M	H	M	M
CO5	M	M	H	M	M	H	H	M
CO6	M	M	H	M	M	M	M	M

(L – Low, M – Medium, H – High)

g. Text Books/ References

1) Benson E, 1999. Plant Conservation Biotechnology. Taylor & Francis, NY, USA.
2) Stuart C, Spalding M, Jenkins, M, 2008. The world's Protected Areas: Status, Values and prospects in 21st century, University of California Press, Berkeley.
3) Trivedy RK, Goel PK, Trisal CL, 1998. Practical methods in ecology and environmental science. Enviro Media publishers, Karad Maharashtra.
4) Van Dyke F, 2008.Conservation Biology Foundations, Concepts, Applications 2nd Edition, Springer
5) Wickens GE, 2004 Economic Botany: Principles and Practices, Springer. Kluwer Publishers, Dordrecht, The Netherlands

h. MOOC, SWAYAM, NPTEL, online and e-resources

1) https://onlinecourses.swayam2.ac.in/cec21_ge31/preview
2) https://soe.environment.gov.au/theme/biodiversity/topic/2016/importance-biodiversity
3) https://www.askiitians.com/biology/biodiversity-and-conservation/
4) https://www.nationalgeographic.org/encyclopedia/biodiversity/
5) https://www.researchgate.net/publication/304523269_Sample_Course_Material_for_Biodiversity_and_Sustainable_Education

SEMESTER II

CORE – II-GENETICS

L	T	P	C
4	1	0	4

a. Course code:

b. Course objective:

The objectives of this course are as follows:

1. To enhance students' understanding of gene-related concepts.
2. To delve deeper into concepts of microbial and human genetics.
3. To showcase knowledge and practical skills in genetic analysis for the diagnosis of genetic diseases.

c. Course prerequisites:

- Basic knowledge of gene, chromosome, and allele concept
- Comprehend the definitions of the Mendelian principle, pedigree analysis
- Understand the significance of mutation perception

d. Course outcome (COs):

At the end of this course, the student will be able to

Course Outcome	Expected outcome	Cognitive Level
CO1	Understand the key principles behind the genome of both prokaryotes and eukaryotes.	K2
CO2	Explain the gene interaction between characters and analyse linkages and crossing over	K2 & K4
CO3	Examine the genetic issues with tests	K3
CO4	Gain the knowledge about microbes involved in genetics and their gene transfer between microbes	K1
CO5	Solve the mutational errors and alter the chromosomes	K3
CO6	Invent genetically modified innovative products for human welfare	K6

(K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create)

e. Course outline:

UNIT	Contents	No. of Hours
I	Mendel’s experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel’s laws. Incomplete dominance. Interaction of Genes- Epistasis -lethal genes. Multiple alleles – In Drosophila, Rabbit and Blood group inheritance in man.	15
II	Linkage - linkage in Drosophila- Morgan’s experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over.	15

	Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance -Carbon dioxide sensitivity in Drosophila and milk factor in mice. Sex –Linked Inheritance and Sex- Determination in Man.	
III	Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sex duction	15
IV	Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy)	15
V	Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics.	15

f. Mapping of course outcome to POs and PSOs

Mapping of COs to POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	H	H	M	L	M	M
CO2	M	H	H	M	L	M	H	M
CO3	L	M	M	L	M	H	L	H
CO4	M	H	L	M	H	M	M	L
CO5	H	M	M	H	L	M	H	L
CO6	H	H	H	H	M	M	H	H

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	H	M	L	M	H	M	L	M
CO2	M	H	M	H	L	H	M	H
CO3	L	M	H	M	H	L	L	M
CO4	M	H	M	L	M	H	M	L
CO5	H	M	L	M	H	M	L	M
CO6	H	H	M	H	H	H	H	H

(L – Low, M – Medium, H – High)

g. Text books/ References

1) Carroll SB, Grenier JK, Weatherbee SD, 2001. From DNA to Diversity: Molecular Genetics and the Evolution of Animal Design. Blackwell Science.
2) Gardner, Simmons, Snustad. 2006. Principles of Genetics, 8th edition, Wiley.

3) Klug, Cummings, Spencer, 2016. Concepts of Genetics, Tenth edition, Pearson Education India.
4) Lewis, R.2001. Human Genetics- Concepts and application. 4th edition. McGraw Hill.
5) Veer BalaRastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, KedarNath Ram
6) Verma PS, Agarwal VK, 2010. Genetics, Ninth edition, S Chand Publishing.
7) Watson JD, Hopkins NH, Roberts JW et al. 1987. Molecular Biology of the Gene, 4th edn. Menlo Park, CA: Benjamin-Cummings.
8) Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000. Instant notes in Genetics. Viva books, Ltd

h. MOOC, SWAYAM, NPTEL, online and e-resources

1) https://www.careers360.com/courses/genetics-course
2) https://ocw.mit.edu/courses/7-03-genetics-fall-2004/pages/lecture-notes/
3) http://www.ocw.mit.edu
4) https://nptel.ac.in/courses/102103013
5) https://archive.nptel.ac.in/courses/102/104/102104052/
6) https://www.acpsd.net
7) http://enjoy.m.wikipedia.org

Core Practical II - GENETICS

a. Course code:

L	T	P	C
0	0	3	2

b. Course details

The aim objectives of this course are:

1. To enrich the student's minds with concepts concerned with genes.
2. To explore more into microbial and human genetics concepts.
3. To demonstrate the genetic analysis knowledge and practical skills for genetic disease diagnosis.

c. Course prerequisites:

- Basic knowledge of gene, chromosome, and allele concept
- Comprehend the definitions of the Mendelian principle, pedigree analysis
- Understand the significance of mutation perception

d. Course outcome (COs):

At the end of this course, the student will be able to

Course Outcome	Expected outcome	Cognitive Level
CO1	Explain the concept of laws of inheritance and the various ways in which traits are inherited	K1
CO2	Recognize the importance of pedigree analysis and probability in understanding genetic patterns	K2

CO3	Explore the genetic basis of different issues and the molecular techniques used to address them.	K3
CO4	Evaluate the significance of karyotyping in identifying genetic disorders	K3 & K4
CO5	Analyze and resolve mutations and chromosomal abnormalities	K3 & K5
CO6	Create genetically-modified products for the betterment of human well-being	K6

(K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create)

e. Course outline:

Unit	Contents	No. of Hours
1	Mitotic stages of onion (*Allium cepa*) root tip Meiotic stages of cockroach testes/ Flower bud	9
II	Giant chromosomes from Chironomus larvae/ Drosophila salivary glands	9
III	Identification of Barr bodies from Buccal smear	9
IV	Preparations of culture medium and culture of Drosophila – methods of maintenance Identifications of mutants of Drosophila	9
V	Human karyotyping (Demo)	9
Total		**45**

f. Mapping of course outcome to POs and PSOs

Mapping of COs to POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	L	M	M	H	L	L	M	M
CO2	L	M	M	H	L	H	H	H
CO3	H	H	M	M	L	L	M	M
CO4	H	H	H	M	L	L	H	H
CO5	H	H	M	M	L	M	H	M
CO6	H	H	H	H	M	H	H	H

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	M	M	H	H	M	L	L	M
CO2	H	M	H	H	M	L	M	M
CO3	H	H	H	H	H	M	M	H
CO4	H	H	H	H	H	M	M	H
CO5	H	M	H	H	H	L	M	H
CO6	H	H	H	H	H	H	H	H

(L – Low, M – Medium, H – High)

g. Text books/ References

1) Chiyedza Small, 2019. Genetics Laboratory Manual 1st Edition Kendall Hunt Publishing.
2) Chowdhury Madhumita Roy, 2019. Laboratory Manual for Molecular Genetic Tests, Jaypee Brothers Medical Publishers.
3) Christopher Blair, Genetics Laboratory Manual, New York City College of Technology, ttps://academicworks.cuny.edu/ny_oers/7
4) Gregore Koliantz, Daniel B. Szymanski, 2015. Genetics: A Laboratory Manual, Wiley.
5) Kaushik Kumar Panigrahi, 2019. Practical Manual on "Fundamentals of Genetics" (PBG-121). Odisha University of Agriculture & Technology.
6) Worku Mhiret, 2019. Laboratory Manual for Principles of Genetics, LAP Lambert Academic Publishing

Elective II- FUNDAMENTALS OF MICROBIOLOGY – Allied -2

L	T	P	C
4	1	0	4

a. Course code:

b. Course objectives:

The main objectives of this course are as follows:

1. To develop a comprehensive understanding of microorganisms.
2. To comprehend their morphology, mode of multiplication, metabolism, diagnosis, and treatment.

c. Course prerequisites:

- Basic knowledge about microbes

d. Course Outcome

At the end of the course, a student will be able to:

Course	Expected outcome	Cognitive

Outcome		Level
CO1	Ability to acquire, articulate, retain and apply specialized skills and knowledge relevant to Microbiology	K3
CO2	Comprehend the diversity of microorganisms and microbial communities inhabiting a multitude of habitats	K1 & K4
CO3	Understand the pathogenesis as well as the significance of microbes to humankind.	K2 & K5
CO4	Define and appraise the concepts of invisible organisms	K1, K4 & K5
CO5	Understand the mycological concepts and their application	K2, K4 & K5
CO6	Justify the significance of microorganisms in human life	K6

(K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, K6 – Create)

e. Course outline:

UNIT	Contents	No. of Hours
I	History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Scope of microbiology – Role of microbes in biotechnology.	15
II	Structure of bacteria - Bacterial growth and measurement of growth, Media – types and preparation- plating methods - staining methods (Gram's, capsule, spore, LCB mount) methods of preservation and storage of microbes. Culture of fungi, virus and algae.	15
III	Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL.	15
IV	Bioinsecticides - *Bacillus thuringiensis*, Baculoviruses- Biofertilizers - *Azospirillum* and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt).	15
V	Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria).	15

f. Mapping of course outcome to POs and PSOs

Mapping of COs to POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	H	M	L	M	M	H	M
CO2	M	M	H	M	L	L	H	M
CO3	H	M	H	M	L	M	M	M
CO4	M	M	M	L	M	M	H	H
CO5	H	H	M	H	L	M	H	H

CO6	H	H	H	M	M	M	H	H

(L – Low, M – Medium, H – High)

Mapping of Cos to PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	M	H	M	M	M	M	H	M
CO2	M	H	M	M	M	M	L	M
CO3	H	H	M	H	H	M	H	H
CO4	M	M	M	M	H	L	M	M
CO5	H	H	M	M	M	L	H	H
CO6	H	H	H	H	H	M	H	H

(L – Low, M – Medium, H – High)

g. Text Books/ References:

1) Ananthanarayanan, Paniker, Kapil, 2013Textbook book of Microbiology, 9th edition, Orient Black Swan.
2) Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby CollegePublishing, St Louis.
3) Brock, Madigan, MT, Martinko JM, Parker J, 2018. Biology of Microorganisms, Prentice-Hall.
4) Dubey R.C. and Maheswari, S. 2003. A textbook of Microbiology, New Delhi: S. Chand & Co.
5) Gerhardt, P., Murray, R.G., Wood, W.A., Kreig, N.R. 1994. Methods for General and Molecular Bacteriology. ASM Press, Washington, DC
6) Gillespie, Bamford, 2012. Medical Microbiology and Infection at a Glance, 4th edition, 2012.
7) Madigan, Martinko, Bender, Buckley, Stahl, 2017. Brock Biology of Microorganisms, 14th edition, 2017.
8) Pelczar MJ Jr, Chan ECS, Kreig NR, 2013. Microbiology, Tata McGraw-Hill.
9) Prescott, Harley, Klein, Microbiology, 10th Edition, McGraw – Hill, 2016.
10) Rose AH, Butterworth, 2021. Chemical Microbiology-An introduction to Microbial Physiology 2nd edition, Butterworth, London.
11) Stanier RY, Ingram JLK, Wheelis ML, Painter PR, 2003. General Microbiology, Macmillan Press Ltd.
12) Tortora, G.J., Funke, B.R., Case,C.L. 2013. Microbiology. An Introduction 11thEdition., A La Carte Pearson.

h. MOOC, SWAYAM, NPTEL, online and e-resources

1) http://ecoursesonline.iasri.res.in/course/view.php?id=108
2) http://www ejb.org/content.
3) https://alison.com/course/foundational-microbiology
4) https://bio.libretexts.org/@go/page/9188
5) https://nptel.ac.in/courses/102103015
6) https://nptel.ac.in/courses/105107173

7) https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology
8) https://www.mooc-list.com/tags/microbiology
9) https://www.pdfdrive.com/microbiology-books.html
10) www. Biotech.kth.se Electronic Journal of biotechnology

Elective Practical- II- FUNDAMENTALS OF MICROBIOLOGY (Allied Practical II)

a. Course code:

L	T	P	C
0	0	3	2

b. Course objectives:

The main goals of this course include:

1. Identifying microbes using staining and microscopic techniques.
2. Characterizing microorganisms using biochemical methods.
3. Examining the antibacterial activity of different discs using the agar disc diffusion method

.c. Course prerequisites:

1) It is important for students to possess a fundamental understanding of microorganism classification.
2) Familiarity with sterilization techniques is crucial.

d. Course outcomes (COs):

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

Course outcomes	Expected outcome	Cognitive level
CO1	Describe the importance of sterilization techniques	K1
CO2	Understand the significance of media preparation for microbes	K2
CO3	Illustrate the concept of staining techniques to identify the microbes	K3
CO4	Differentiate the bacterial culture by Gram staining	K4
CO5	Analyze and evaluate the antibiotic susceptibility	K4 & K5
CO6	Invent and develop the drugs against the diverse antibiotic-resistant microorganism	K5 & K6

(K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyse, K5 – Evaluate, K6 – Create)

e. Course outline:

UNIT	Contents	No. of Hours
I	Sterilization techniques – Preparation of Media	9
II	Inoculation techniques- Pour plate, spread plate Isolation of bacteria from various sources and dilution techniques.	9
III	Staining techniques: Simple, Gram's, Capsule (Negative), Spores, Preparation of temporary mounts- Lacto phenol cotton blue staining.	9
IV	Motility tests: Hanging drop technique.	9

V	Biochemical characterization - catalase, oxidase, IMVIC test and TSI. Antibiotic sensitivity test (demonstration).	9
Total		**45**

f. Mapping of course outcomes to POs and PSOs

Mapping of COs to POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	H	H	M	M	H	M	M
CO2	M	H	H	M	L	L	M	M
CO3	M	H	H	M	L	L	M	M
CO4	M	M	M	M	L	L	M	M
CO5	M	H	H	H	L	H	H	H
CO6	M	H	H	M	H	M	H	H

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	M	H	M	M	M	M	M	M
CO2	M	H	H	M	H	M	H	H
CO3	M	H	M	M	H	M	M	H
CO4	M	H	M	M	H	M	M	M
CO5	H	H	H	H	H	M	H	H
CO6	H	H	H	H	H	H	H	H

(L – Low, M – Medium, H – High)

g. Laboratory manuals/Reference

1) Amita J, Jyotsna A., Vimala V., 2018. Microbiology Practical Manual. (1st Edition). Elsevier India.
2) Aneja KR, 2002. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production technology, Third edition. New age International Publishers.
3) Atlas RM, Brown AE, Parks LC, 1995. Laboratory Manual of Experimental Microbiology, Mosby, St. Louis.
4) Cappuccino JG, Sherman N, 2002. Microbiology: A Laboratory Manual, Addison–Wesley.
5) Holt JG, Krieg NR, 2000. Bergey's Manual of Determinative Bacteriology, Ninth edition Lippincott Williams & Wilkin Publishers.
6) Kannan K, 2002. Laboratory Manual in General Microbiology, Panima Publishers.1
7) R C Dubey RC., Maheswari DK. 2002. Practical Microbiology. S. Chand Publishing.
8) Sundararaj T., 2005. Microbiology Lab Manual (1st edition) publications.
9) Talib VH., 2019. Handbook Medical Laboratory Technology. (2nd Edition). CBS.
10) Wheelis M, 2010. Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.

Web Resources

1 http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403.
2 https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
3 https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
4 https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology

PUBLIC HEALTH AND HYGIENE (SEC-2)

Subject Code	L	T	P	S	Credits	Instructional Hours	Marks		
							CIA	External	Total
	4	1			5	5	25	75	100

Learning Objective	
LO1	can explain the importance of health and hygiene
LO2	can analyze the importance of food and malnutrition
LO3	can understand the cause of diseases
LO4	Will get know about lifestyle diseases
LO5	Will get awareness about various Health Services Organizations

UNIT	Contents	No. of Hours
1	Scope health and hygiene – Concept of health and disease - Pollution and health hazards; water and airborne diseases. Radiation hazards: Mobile Cell tower and electronic. Role of health education in environment improvement and prevention of diseases. Personal hygiene, oral hygiene and sex hygiene.	15
II	Classification of food into micro and macro nutrients. Balanced diet, Importance of dietary fibres.Significance of breast feeding. Malnutrition anomalies – Anaemia, Kwashiorkar, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure).	15

III	Communicable viral diseases- measles, chicken pox, poliomyelitis, swine flu, dengue, chickungunya, rabies, leprosy and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus,plague, whooping cough, diphtheria, leprosy. sexually transmitted diseases- AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases.	15
IV	Non-communicable diseases such as hypertension, stroke, coronary heart disease, myocardial infarction.Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions. Diabetes- types and their effect on human health. Gastrointestinal disorders- acidity, peptic ulcer, constipation, piles. (cause, symptoms, precaution and remedy) Obesity (Definition and consequences). Mental illness(depression and anxiety). Oral and lung cancer and their preventive measures.	15
V	Health Services Organizations: World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF) and Indian Red Cross (IRC).	
Total		**75**
Text Books		
1	Mary Jane Schneider (2011) Introduction to Public Health.	
2	Muthu, V.K. (2014) A Short Book of Public Health.	
3	Detels, R. (2017) Oxford Textbook of Public Health (6th edition).	
4	Gibney, M.J. (2013) Public Health Nutrition.	
5	Wong, K.V. (2017) Nutrition, Health and Disease.	
Reference Books		
1	S. Lal, (2018), Vikas. Public Health Management Principles And Practice, 2nd Edition, CBS Publishers and Distributors Pvt Ltd, ISBN: 978-93-87742-93-2.	
2	Mary-Jane Schneider (2016), Introduction to Public Health,(5th Edition), Jones & Bartlett Learning,. ISBN-13: 978-1284197594	
3	Carolyn D. Berdanier, Johanna T. Dwyer, David Heber (2013), Handbook of Nutrition and Food, (3rd Edition), CRC Press,. ISBN 9781466505711	
4	Sue Reed, Dino Pisaniello, GezaBenke, Kerrie Burton. (2013), Principles of Occupational Health and Hygiene: An Introduction, (2nd Revised ed. Edition), Allen &Unwin,	
5	V. Kumaresan, R. Sorna Raj, (2012) Public Health and Hygiene,(1st Edition),	

	Saras Publication.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	**3**	**3**	**-**	**2**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**-**	**2**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**	**3**
CLO5	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**3**
TOTAL	**14**	**15**	**4**	**11**	**15**	**15**	**14**	**14**	**15**
Average	**2.8**	**3**	**0.8**	**2.2**	**3**	**3**	**2.8**	**2.8**	**3**

VERMITECHNOLOGY (SEC-3)

L	T	P	C
2	0	0	2

Course outcome:

Students will gain knowledge on types of the earthworm culture methods, vermicomposting and its economical benefits.

Unit – I

Types, Collection and Preservation of earthworms - Types and basic characteristics of species suitable for vermicomposting; Role of earth worms in soil fertility, Biology of Lampito maruitti; Collection and Preservation of Earthworms; Flow sheet for vermi technology.

Unit – II

Culturing techniques of earthworms and composting materials General method; Pot method; Wooden box method; Propagation; Factor affecting culturing of earthworm; Vermicomposting materials; Preliminary treatment of composting materials.

Unit – III

Small scale techniques of Vermicomposting - Indoor dual bin method; Bed method; Pit method; Heap method; Expandable worm tower assembly method; Hanging basket method; Physical, chemical and biological properties of vermicompost.

Unit – IV

Large scale techniques of Vermicomposting Outdoor dual bin; Raised cage; Dual pit; Commercial model; Trickling filter vermicomposting; Keep it simple and save plan.

Unit – V

Vermiwash and Economics - Chemical composition of vermiwash; Techniques of vermiwash production: Advantages of Vermicomposting; Prospects of vermi-culture as self-employment venture.

References:

1. The Earthworm book, Ismail, S.A., other India Press, Goa
2. Somani, L.L. 2008. Vermicomposting and vermiwash. Agrotech Publishing Academy, Udaipur.
3. Talashilkar and Dosani, 2005. Earthworm in Agriculture. Agrobios (India), Jodhpur.
4. Ranganathan, L.S. 2006. Vermi biotechnology from soil health to human health – Agrobios, India.