MANONMANIAM SUNDARANAR UNIVERSITY

TIRUNELVELI– 627 012

TAMILNADU, INDIA

B.Sc. BIOTECHNOLGY

(FOR AFFILIATED COLLEGES)

CURRICULUM

REVISED BASED ON REGULATIONS ON CHOICE BASED CREDIT SYSTEM (CBCS, 2015 - 16) FOR UG DEDGREE PROGRAMS

(Effective from the academic year 2021-2022 onwards)

MANONMANIAM SUNDARANAR UNIVERSITY

ABHISHEKAPATTY, TIRUNELVELI– 627 012, TAMILNADU, INIDA

B.Sc. BIOTECHNOLOGY (CBCS PATTERN)

PG COURSES – AFFILIATED COLLEGES

B.Sc. Biotechnology
(Choice Based Credit System)

(Effective from the academic year 2021-2022 onwards)

Vision of the University

To provide quality education to reach the un-reached

Mission of the University

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

Vision of the Department

Generation of 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 biotechnological concepts.
Exploring the biotechnological potentials of local resources and knowledge

1. PREAMBLE

Biotechnology is a field of applied biology that makes use of living organisms or biological systems to make technological advances and use them in various field. It basically seems to improve the quality of human life and the health of the planet. The courses in Biotechnology Programme are mainly related to recent and emerging trends in Biology. In the B.Sc. Degree programme the most advanced and relevant courses such as nanotechnology, Bioprocess Technology, Bioinformatics, stem cell Biology, Nanotechnology have been incorporated. These will make the students ready for both industry as well as research-oriented endeavors.

2. COURSE DETAILS

Every student admitted to UG course shall undertake 34 courses, off which, 12 core theory courses, 4 allied courses, 2 elective courses, 2 skill based courses, 2 Non major elective courses, 14 practical courses and 1 project course.

3. CREDITS

The term credit is used to describe the quantum of syllabus for various programmes in terms of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design. The total number of credits for BSc. Biotechnology is 157.

4. MEDIUM OF INSTRUCTION AND EXAMINATION

The medium of instruction as well as examination will be in English.

5. THEORY EXAMINATION

The external evaluation will be based on the examination to be conducted by the university at the end of each semester.

6. PRACTICAL EXAMINATION

Practical examinations will be conducted at the end of each semester.

7. Evaluation

A. Each paper carries an internal component

B. There is a pass minimum of 40% for U.G. external and overall components

Theory External: Internal Assessment = 75:25
Practical External: Internal Assessment = 50:50

C. Internal Assessment

Internal marks for Theory shall be allocated in the following manner.

The average of the best two tests from three compulsory tests	20 Marks
Assignment/ Model Making /Quiz	05 Marks
Total	**25 Marks**

Note: Each test will be of one hour duration.

D. Practical

Internal marks for practical shall be allotted in the following manner.

Experimental work	20 Marks
Record	10Marks
Model Test	20 Marks
Total	**50 Marks**

E: Project work

Internal	**External**	**Total**
50 Marks	50 Marks	100 Marks

Distribution of Marks in Project Course

COMPONENTS	**MARKS**
Internal	50 Marks
External	
Project Report	25Marks
Presentation	15 Marks
Viva-voce	10 Marks
Total	100 Marks

Note:

i) Group project

ii) Maximum 5 students can be allotted in a group

iii) Project shall be allotted at the beginning of the IV semester.

iv) In house projects are encouraged.

v) Students may be allowed to carry out the project work in other research institutes.

vi) Faculty members of the respective colleges must serve as guides

vii) Project report evaluation will be done and Viva-voce will be conducted by both the external examiner and the internal examiner at the end of the FOURTH SEMESTER itself.

viii) Project report in THREE copies has to be submitted at the time of the exam.

ix) Evaluation of Project report has to be done by the examiner(s) appointed by the University for 50 Marks.

8 A. The question paper pattern for all theory papers shall be as follows.

Duration of Exam: 3Hours

Section	Type of questions	Mark
Part-A	Multiple choice question (Two question from each unit compulsory)	1×10=10 Marks
Part-B	Internal Choice questions (One question from each unit: either/or)	5×5=25 marks
Part-C	Internal Choice questions (One question from each unit: either/or)	8×5=40 marks
	Total	**75 Marks**

"Eligibility for BSc Biotechnology admission:

The Candidates who shall be admitted to the B.Sc Biotechnology course, should have passed plus two examinations of State or Central Board with Chemistry/Biology/Biochemistry as one of the subjects or any other science subject that may be considered as equivalent by Manonmaniam Sundaranar University."

Question Paper Setting – Instructions to Question Paper setters

Outcome Based Education (OBE) is being adopted in the University from 2022 – 2023 onwards for which the different learning levels of students are to be assessed through Terminal Examinations in addition to Continuous Internal Assessment (CIA). Therefore, the question setters are requested to go through this instruction manual and table showing the choice of action verbs attached herewith in framing relevant questions carefully and then set the questions for each paper accordingly.

- Question Paper Setters are requested to give due weightage to the possible educational levels (Viz., remembering, Understanding, applying, analysing, evaluating and creating) relevant to the course concerned.

- Setters are expected to access one of Bloom's level in each question.

- Remembering and understanding level Questions evaluating of cognition should not exceed 50 percent of the total marks of a question paper.

- Section A consists of Ten MCQ questions two from each unit. The Setters are requested to design the questions belonging to any Bloom's level (K1 to K6) possibly.

- Section B consists of five questions by giving alternate choice asked one from each unit of the course without omitting any unit (K1 to K6).

- Section C consists of five questions with alternate choice to be asked in this section, the setters have to set one question from each unit of the syllabus, the alternative (a) and (b) of the same question number must belong to one level of Bloom's.

- A table consisting of choice of Action Verbs is attached which would be helpful to the Setters to decide the learning level of the assessment question designed.

- A column titled Course Outcome (CO) in the model question paper indicates the specific outcomes of each course which is to be assessed in the Terminal Examinations. Each course has a minimum of five Cos relevant to the course.

  The setters are requested to map the Cos and Ks as per the correlation given in the curriculum.

- The Model Question Paper show the different learning levels identified for the questions present in the model question paper.

Model Question Paper

Time: 3 hours **Biophysics**
Max:75marks

Part A

Answer all questions
Choose the correct answer

1. The SI unit of force
(a) Newton (b) joule (c) meter (d) m^3.

2. A positive ion is formed when an atom
(a) loses an electron (b) gains an electron
(c) loses proton (d) gains a proton

3. Who discovered electron?
(a) J.J. Thomson (b) Chadwick
(c) Pauline (d) E. Goldstein.

4. The unit of radioactivity
(a) ppm (b) ppb (c) dps (d) decibel

5. EEG measures
(a) blood pressure (b) electrical impulse of brain
(c) blood volume (d) brain damage.

6. The half life period of Co60 is
(a) 15 hours (b) 5.27 years
(c) 14.3 days (d) 87.1 days

7. Which organ is related to hearing
(a) plasma membrane (b) tympanic membrane
(c) ear membrane (d) none of these

8. Liquid scintillation counters are used to detect
(a) γ rays (b) β rays (c) α rays (d) all the above

9. Geiger Muller counters are
(a) γ ray detector (b) β ray detector
(c) α ray detector (d) all the above

10. Bioacoustics combines
(a) biology and acoustics (b) biology and zoology
(c) biology and physics (d) none

Part B

Answer all questions, Choosing either (a) or(b)

11. a. Describe the atomic structure. (Or)
    b. Define Biophysics, outline the scope of biophysics
12. a. Distinguish enthalpy and entropy (Or)
    b. Explain the laws of thermodynamics.
13. a. Justify, why Ostwald types of viscometers is best? (Or)
    b. Restate the properties of plasma.
14. a. Analyse the mechanism of hearing. (Or)
    b. Differentiate ECG and EEG?
15. a. Explain the half-life period. (Or)
    b. List out the properties of α, β, γ particles.

Part C

Answer all questions, Choosing either (a) or (b)

16. a. Asses the physical quantities and their units. (Or)
    b. Illustrate the methods of biophysics?
17. a. Evaluate the primary biophysical events in photosynthesis. (Or)
    b. Discuss living beings in equilibrium state.
18. a. Analyse the theories of viscosity. (or)
    b. Interpret the Newtonian and non-Newtonian fluids.
19. a. Discuss imaging techniques. (Or)
    b. Summarize the construction and working of Liquid scintillation counter.
20. a. Predict the beneficial and harmful effects of radiation. (Or)
    b. Describe radioactive pollution in detail.

Model Question Paper

Time: 3 hours **Max:75marks**

Answer all questions in Part A; either (a) or (b) in Part B and Part C

B. The question paper pattern for all practical papers shall be as follows.

Duration of Practical Exam: 3 hours

1	Major experiment	20
2	Minor Experiment	15
3	Spotters(4x2.5)	10
4	Record	05
	Total	**50 Marks**

B.Sc., Biotechnology

Programme Outcomes

Upon completion of B.Sc., Biotechnology Programme, Students will be able to

PO1	Exhibit and master all main ideologies in multidisciplinary sciences.
PO2	Use technological ideas in both basic and applied research.
PO3	Discover latest study topics in all divisions, as well as inter-disciplinary courses in science and engineering.
PO4	Beyond the scientific community, raise awareness on the ecosystem, community, and development.
PO5	Utilize current methodologies, cutting-edge technology, and bio-software.
PO6	Conduct research projects and find solutions to research challenges.
PO7	Fulfill the demands of future on bioscience emphasis areas

Programme Specific Outcomes

PSO1	Understand core (stem cell, plant, animal, molecular biology, genetic engineering, genetics, industrial and environmental biotechnology, Nanoscience and technology) as well as associated (health science, medical microbiology, chemistry, developmental biology, and evolutionary biology) topics.
PSO2	Understand the importance of following excellent laboratory procedures and adhering to safety guidelines.
PSO3	By bringing their practical expertise to use, they may skillfully perform bio-protocols.
PSO4	Gain experience in a variety of core and multidisciplinary research domains and thrust areas.
PSO5	Develop scientific and industry-related skills, as well as the ability to work in industrial and research laboratories.

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

UG COURSES – AFFILIATED COLLEGES

B.SC. BIOTECHNOLOGY

(Choice Based Credit System)

(With effect from the academic year 2021-22 onwards)

Sem (1)	Pt. I/II/ III/IV/V (2)	Sub no. (3)	Subject status (4)	Subject Title (5)	Contact Hrs/ week (6)	L Hrs/ week (7)	T Hrs/ week (8)	P Hrs/ week (9)	C credits (10)
I	I	1	Language	Tamil/ other languages	6	6	0	0	4
	II	2	Language	Communicative English-I	6	6	0	0	4
	III	3	Core-1	Basics of biodiversity and conservation	4	4	0	0	4
	III	4	Core-2	Professional English for Life Sciences- I	4	4	0	0	4
	III	5	Major practical -I	Lab in biodiversity and conservation	2	0	0	2	2
	III	6	Allied I	Biochemistry - I	4	4	0	0	3
	III	7	Allied practical -I	Lab in Biochemistry - I	2	0	0	2	2
	IV	8	Common	Environmental studies	2	2	0	0	2
				Subtotal	**30**				**25**
II	I	9	Language	Tamil/ other languages	6	6	0	0	4
	II	10	Language	Communicative English-II	6	6	0	0	4
	III	11	Core-3	Cell & Molecular biology	4	4	0	0	4
	III	12	Core-4	Professional English for Life Sciences - II	4	4	0	0	4
	III	13	Major practical II	Lab in Cell & molecular biology	2	0	0	2	2
	III	14	Allied - II	Biochemistry II	4	4	0	0	3
	III	15	Allied practical II	Lab in Biochemistry II	2	0	0	2	2
	IV	16	Common	Value Based Education / சமூக ஒழுக்கங்களும் பண்பாட்டு விழுமியங்களும் / Social Harmony	2	2	0	0	2
				Subtotal	**34**				**25**

Sem	Sub. No	Sub. Status	Subject Title	Con Tact Hrs/ week	L Hrs/week	T Hrs/week	P Hrs/week	C credits
III	17	Language	Tamil/ other languages	6	6	0	0	4
	18	Language	English	6	6	0	0	4
	19	Core-5	Microbiology	4	4	0	0	4
	20	Major practical-III	Lab in Microbiology	2	0	0	2	2
	21	Allied III	Genetics	4	4	0	0	3
	22	Allied practical III	Lab in Genetics	2	0	0	2	2
	23	Skill based core-I	Clinical Biochemistry (or) Industrial Biotechnology	4	4	0	0	4
	24	Non major elective	Nutritional biotechnology (or) Vector borne diseases	2	2	0	0	2
	25	Common	Yoga^{+}	2^{+}	0	0	0	2^{+}
			Subtotal	**30**				**27**
IV	26	Language	Tamil/ other languages	6	6	0	0	4
	27	Language	English	6	6	0	0	4
	28	Core-6	Immunology	4	4	0	0	4
	29	Major practical IV	Lab in Immunology	2	0	0	2	2
	30	Allied IV	Biophysics and Biostatistics	4	4	0	0	3
	31	Allied practical IV	Lab in Biophysics and Biostatistics	2	0	0	2	2
	32	Skill based core-II	Essential oil Preparation (or) Vermi and mushroom culture	4	4	0	0	4
	33	Non major elective	Genetic diseases (or) Cancer biology	2	2	0	0	2
	33	Common	Computers for Digital Era^{+}	2^{+}	0	0	0	2^{+}
	34	Extension activity	NCC, NSS, YRC, YWF	0	0	0	0	1
			Subtotal	**30**				**28**

V	I	35	Core-7	Recombinant DNA Technology	5	4	0	0	4
	II	36	Core-8	Bioinformatics	4	4	0	0	4
		37	Core-9	Food Technology	4				4
	III	38	Elective	Nanobiotechnology (or) Genomics	4	4	0	0	4
	III	39	Major practical V	Lab in Recombinant DNA Technology	4	0	0	4	2
	III	40	Major practical VI	Lab in Bioinformatics	3	0	0	3	2
	III	41	Major practical VII	Lab in Food Technology	4	0	0	3	2
	IV	42	Skill Based Common	Personality Development /Effective Communication/ Youth Leadership	2	2	0	0	2
				Subtotal	**30**				**24**
VI	III	43	Core-10	Plant & Animal biotechnology	4	4	0	0	4
	III	44	Core-11	Environmental Biotechnology	4	4	0	0	4
	III	45	Core-12	Bioprocess technology	4	4	0	0	4
	III	46	Elective	Clinical Research (or) Biosafety & Bioethics (or) Developmental Biology	4	4	0	0	4
	III	47	Major practical VIII	Lab in Plant & Animal biotechnology	3	0	0	3	2
	III	48	Major practical IX	Lab in Environmental Biotechnology	2	0	0	3	2
	III	49	Major practical X	Lab in Bioprocess technology	3	0	0	3	2
	III	50		Project - Group	6				6
				Subtotal	**30**				**28**
				Total	**180**				**157**

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester – I / Core – I

BASICS OF BIODIVERSITY AND CONSERVATION

L	T	P	C
4	0	0	4

Objective: To understand the basic principles and importance of biodiversity, need and means of conservation of biodiversity, and sustainable use of bio resources.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	BASICS OF BIODIVERSITY AND CONSERVATION	Cognitive Level
CO1	Understand the biodiversity and its value, Global biodiversity patterns and factors affecting variation in terrestrial, marine, and aquatic ecosystems and to learn the energy flow, food chain, food web & ecological succession	K1, K2
CO2	Know the diversity of plants, animals & microorganisms and to understand the important medicinal plants & its uses	K2 ,K3
CO3	Analyse and evaluate the importance of biological processes on conservation of biodiversity, the range of options for biodiversity conservation; Global biodiversity hotspots and important conservation areas, Endangered & endemic species of India	K4,K5
CO4	Develop biotechnological tools to conserve biodiversity	K5,K6
CO5	Formulate environmental practices of biodiversity and biological resources in the light of ecological and evolutionary dynamics.	K5,K6

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

BASICS OF BIODIVERSITY AND CONSERVATION

Unit I

Biodiversity - Principles, values and importance. Biodiversity acts relating to the protection of the environment. Ecosystem – Structure and function, ecosystem diversity, energy flow, food chain, food web and ecological succession. Types of ecosystem. **(12L)**

Unit II

Introduction to plants, animals and microorganism: Medicinal plants – Definition, scope, classification – Cryptogams and Phanerogams (*Andrographis*, *Ocimum*, *Aegle*, *Catharanthus*), Animals – Vertebrates and Invertebrates, Microorganism – Bacteria, Virus and Fungi. **(11L)**

Unit III

Conservation of biodiversity: *Ex situ* and *In situ* conservation – *In vitro* germplasm conservation – Cryopreservation techniques for short and long term conservation. Biogeographical zones of India – India as a megadiversity nation - Global biodiversity hot spots. Endangered and endemic species of India – Hot spots. **(14L)**

Unit IV

Exploitation of biodiversity – Threats to biodiversity – Conservation of biodiversity using biotechnological tools. Role of individuals in conservation of biodiversity. **(11L)**

Unit V

Environment practices – Climate change – global warming – ozone layer depletion – impacts on human communities. Bioresources – Biofertilizers, Biofuels and Biopesticides. Sustainable use of Bioresources. International agreement – Convention on Biological Diversity. **(12L)**

Total: 60L

References

1. www.gene campaign.org/publications/free releases html
2. Fee publications www.biodiversity.org
3. Ananthakrishnan, T.N. and K.G. Sivaramakrishnan 2006, Animal biodiversity patterns and processes. Scientific publishers, Jodhpur.
4. Biodiversity, E.O. Wilson, Editor, 12th edition, National academy press, USA

Mapping

BASICS OF BIODIVERSITY AND CONSERVATION												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	2	3	3	2	3	3	3	1
2	3	3	3	3	2	3	3	3	3	3	3	1
3	3	3	3	3	2	3	3	3	3	2	3	2
4	3	3	3	3	2	3	3	2	3	3	3	2
5	3	3	3	3	2	3	3	3	2	3	3	2
6	3	3	3	3	2	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester – I / Core – 2

Professional English for Life Sciences

L	T	P	C
4	0	0	4

PROFESSIONAL ENGLISH FOR LIFE SCIENCES

OBJECTIVES:

- To develop the language skills of students by offering adequate practice in professional contexts.
- To enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students
- To focus on developing students' knowledge of domain specific registers and the required language skills.
- To develop strategic competence that will help in efficient communication
- To sharpen students' critical thinking skills and make students culturally aware of the target situation.

LEARNING OUTCOMES:

- Recognise their own ability to improve their own competence in using the language
- Use language for speaking with confidence in an intelligible and acceptable manner
- Understand the importance of reading for life
- Read independently unfamiliar texts with comprehension
- Understand the importance of writing in academic life
- Write simple sentences without committing error of spelling or grammar

(Outcomes based on guidelines in UGC LOCF – Generic Elective)

NB: All four skills are taught based on texts/passages.

UNIT 1: COMMUNICATION

Listening: Listening to audio text and answering questions
- Listening to Instructions

Speaking: Pair work and small group work.
Reading: Comprehension passages –Differentiate between facts and opinion
Writing: Developing a story with pictures**.**
Vocabulary: Register specific - Incorporated into the LSRW tasks (**13)**

UNIT 2: DESCRIPTION

Listening: Listening to process description.-Drawing a flow chart.
Speaking: Role play (formal context)
Reading: Skimming/Scanning-
Reading passages on products, equipment and gadgets.
Writing: Process Description –Compare and Contrast
Paragraph-Sentence Definition and Extended definition-
Free Writing.

Vocabulary: Register specific -Incorporated into the LSRW tasks. (**12)**

UNIT 3: NEGOTIATION STRATEGIES

Listening: Listening to interviews of specialists / Inventors in fields (Subject specific)
Speaking: Brainstorming.(Mind mapping).
Small group discussions (Subject- Specific)
Reading: Longer Reading text.
Writing: Essay Writing (250 words)
Vocabulary: Register specific - Incorporated into the LSRW tasks. (**12)**

UNIT 4: PRESENTATION SKILLS

Listening: Listening to lectures.
Speaking: Short talks.
Reading: Reading Comprehension passages
Writing: Writing Recommendations
Interpreting Visuals inputs
Vocabulary: Register specific -Incorporated into the LSRW tasks. (**13)**

UNIT 5: CRITICAL THINKING SKILLS

Listening: Listening comprehension- Listening for information.
Speaking: Making presentations (with PPT- practice).
Reading :Comprehension passages –Note making.
Comprehension: Motivational article on Professional Competence, Professional Ethics and Life Skills)
Writing: Problem and Solution essay– Creative writing –Summary writing
Vocabulary: Register specific - Incorporated into the LSRW tasks. (**10)**

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester – I / Major Practical –I

LAB IN BIODIVERSITY CONSERVATION

L	T	P	C
0	0	2	2

Objective: To understand the basic Techniques in biodiversity, and microbial enumeration techniques.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	LAB IN BIODIVERSITY CONSERVATION	Cognitive Level
CO1	Identify the medicinal plants & Prepare herbarium in the institution campus and calculation of species diversity index - Shannon wiener index and Simpson dominance index	K1, K2
CO2	Isolate and enumerate microbes from soil, water & leaf litter sources.	K2 ,K3
CO3	Evaluate the structure of Plant cell & animal cell from the given sample.	K5
CO4	Analyse and Evaluate the stages of mitosis & meiosis	K4,K5

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

LAB IN BIODIVERSITY CONSERVATION

1. Identification and preservation of medicinal plants in the institution campus.
2. Calculation of species diversity index -Shannon wiener index and Simpson dominance index
3. Isolation and enumeration of microbes from soil sources.
4. Isolation and enumeration of microbes from water sources.
5. Isolation and enumeration of microbes from leaf litter.
6. Field visit to the nearest ecosystem (terrestrial/fresh water/marine)
7. Plant cell – Onion epidermal peel
8. Animal cell – Buccal cavity smear
9. Study of mitosis – Various stages – onion root tip
10. Study of meiosis – Rhoeo pollen squash

Mapping

LAB IN BIODIVERSITY CONSERVATION												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	3	2	3	2
4	3	3	3	3	3	3	3	3	3	2	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

BIOCHEMISTRY - I

L	T	P	C
4	0	0	3

Objective: To understand the classification, structure and properties of Carbohydrates, polysaccharides, proteins, lipids, and nucleic acids

Course Outcomes

On completion of the course, the students will be able to

CO. No.	BIOCHEMISTRY - I	Cognitive Level
CO1	Understand in detail the structure and physico chemical properties of carbohydrates from monosaccharide to Disaccharides and to know the significance of Biochemistry	K1, K2
CO2	learn the significance of structural and storage polysaccharides in nature and to study the glycolysis & TCA cycle	K1, K2
CO3	Analyse and evaluate the amino acid structures, types of amino acids, classifications, structure of proteins and types of proteins & its functions.	K4
CO4	Evaluate the structure , properties & classification of lipids with reference to lecitin,Cephalin, Sphingomylin	K3,K4
CO5	Analyse and evaluate the Nucleic acid –Nucleosides and Nucleotides. DNA, RNA – types – Structure of tRNA.	K4,K5

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

BIOCHEMISTRY - I

Unit I

Carbohydrates: Definition and classification – configuration of monosaccharides – regular and ring structure. Mutarotation, Chemical properties of glucose and fructose. Structure and properties of disaccharides – Lactose, Maltose and Sucrose – occurrence and structure. **(10L)**

Unit II

Polysaccharides – Homo and Heteropolysaccharies – Starch, Glycogen, Cellulose, Hyaluronic acid and Chondroitin sulfate. Glycolysis and TCA cycle – energy yield. **(9L)**

Unit III

Protein and amino acids: Amino acids - Classifications – Structure - Properties. Proteins - Classification – Properties - Composition - and Structure – Biological functions. **(9L)**

Unit IV

Lipids - Definition – Composition. Fatty acids – classification – properties. Phospholipids – Structure, Properties, Significance (Lecithin, Cephalin and Sphingomyelin). **(8L)**

Unit V

Nucleic acid – Definition – Composition – Functions. Nitrogeneous bases of purines and pyrimidines. Nucleosides and Nucleotides. DNA – Structure - Watson and Crick model. RNA – types – Structure of tRNA. **(9L)**

Total: 45L

References

1. Biochemistry, 1993, Lehinger J, CBS Publishers
2. Biochemistry, 1995, D.Voet and JG.Voet, John Wiley & sons. Inc. 2Ed.
3. Fundamentals of Biochemistry, 2000, Jain J.L. Chand & co, NewDelhi.
4. Biochemistry, 1999, Davidson, V.L. & Sitlmon, D.L., 4th ed, Lippincoth William & Willeing.

Mapping

BIOCHEMISTRY - I												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester – I / Allied Practical –I

LAB IN BIOCHEMISTRY - I

L	T	P	C
0	0	2	2

Objective: To study the qualitative and quantitative analysis of Carbohydrates, polysaccharides, proteins, lipids, and nucleic acids

Course Outcomes

On completion of the course, the students will be able to

CO. No.	LAB IN BIOCHEMISTRY - I	Cognitive Level
CO1	Understand and analyse Qualitative analysis of Carbohydrates, Proteins. Lipids.	K1, K2
CO2	Apply modern instrumentation theory and practice to Nucleic acids & Quantitative analysis of Carbohydrates by Anthrone method.	K2 ,K3
CO3	quantify the analysis of amino acids by ninhydrin method & proteins by Lowry's and Bradford's methods	K4
CO4	analyse the quantitative analysis of DNA by Diphenylamine method	K3,K4
CO5		,K4,

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

LAB IN BIOCHEMISTRY - I

1. Qualitative analysis of Carbohydrates
2. Qualitative analysis of Proteins.
3. Qualitative analysis of Lipids.
4. Qualitative analysis of Nucleic acids.
5. Quantitative analysis of Carbohydrates by Anthrone method.
6. Quantitative analysis of amino acids by ninhydrin method.
7. Quantitative analysis of proteins by Lowry's and Bradford's methods
8. Quantitative analysis of DNA by Diphenylamine method.

Mapping

LAB IN BIOCHEMISTRY - I												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester –II / Core - 3

CELL & MOLECULAR BIOLOGY

L	T	P	C
4	0	0	4

Objective: To understand the basic concept of cell structure, cell organelles, sub cellular organelles, a basic concept of central dogma of molecular biology, regulation of gene expression, and genetic code.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	CELL & MOLECULAR BIOLOGY	Cognitive Level
CO1	Understand and learn about cells, prokaryotic and eukaryotic cells and components , functions of outer covering of the cell	K1, K2
CO2	Interpret the structure, composition and functions of sub cellular organelles including chromosomes	K2 ,K3
CO3	Infer how cell cycle happen inside the cells and also about DNA replication and repair mechanism	K3,K4
CO4	Evaluate and justify the central dogma of molecular biology	K4,K2
CO5	Predict the genes expression and transposable elements	K2,K3,K4,K6

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

CELL & MOLECULAR BIOLOGY

Unit I

Cell as a living entity. Overview of Prokaryotic and eukaryotic cells – Variation in cell size and shapes, organization and function. Cell wall – Composition, organization. Plasma membrane – Properties and functions. **(11L)**

Unit II

Sub cellular organelles - Mitochondria – Chloroplast – Endoplasmic Reticulum – Lysosomes – Golgi complex. Cytosol – Properties of cytoplasmic matrix, Cytoskeleton, Nucleus, Chromosomal types – giant chromosomes – Polytene and Lamp brush chromosomes. **(12L)**

Unit III

Cell cycle – Molecular events – phases – Mitosis and Meiosis. DNA replication – Types – Experiments of Messelson and Stahl – Okazaki fragments – Prokaryotic and Eukaryotic replication. Enzymes of replication. DNA repair mechanism**.(12L)**

Unit IV

Molecular Biology – Introduction – Scope – Applications – Central dogma of Molecular Biology. Transcription and Translation in Prokaryotes and eukaryotes. Post transcriptional and Post translational mechanism. Genetic code – Characteristic features – Genetic Mutation-Mutation in genetic code. **(12L)**

Unit V

Regulation of gene expression – Positive and negative control – Operon concept – Trp operon – Lac operon – Ara operon - Control. Catabolic repression. Transposons. (**13L)**

Total: 60L

References

1. Cell and molecular biology 1998, Roberties and Roberties, K.M. Varghese publication.
2. Cell and molecular biology 1996, Gerald Karp, Blackwell pub, UK.
3. Introduction to cell biology, 1998, Sundarajan, Vikas Pub
4. Genes, 2002, Benjamine Levine- 8 th edition OUP USA 1027p
5. Gardner/Simmons/Shustad. Principles of genetics, 8th EO-1999

Mapping

CELL & MOLECULAR BIOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	2	3	3	3	3	3	3	3
2	3	3	3	3	2	3	3	3	3	3	3	3
3	3	3	3	3	2	3	3	3	3	3	3	3
4	3	3	3	3	2	3	3	3	3	3	3	3
5	3	3	3	3	2	3	3	3	3	3	3	3
6	3	3	3	3	2	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester –II / Core - 4

Professional English for Life Sciences

L	T	P	C
4	0	0	4

Objectives: The Professional Communication Skills Course is intended to help Learners in Arts and Science colleges, • Develop their competence in the use of English with particular reference to the workplace situation. • Enhance the creativity of the students, which will enable them to think of innovative ways to solve issues in the workplace. • Develop their competence and competitiveness and thereby improve their employability skills. • Help students with a research bent of mind develop their skills in writing reports and research proposals.

Outcome of the Course: At the end of the course, learners will be able to, Attend interviews with boldness and confidence.• Adapt easily into the workplace context, having become• communicatively competent. Apply to the Research• & Development organisations/ sections in companies and offices with winning proposals.

Professional English for Life Sciences

Unit 1- Communicative Competence (18 hours) Listening – Listening to two talks/lectures by specialists on selected subject specific topics - (TED Talks) and answering comprehension exercises (inferential questions) Speaking: Small group discussions (the discussions could be based on the listening and reading passages- open ended questions Reading: Two subject-based reading texts followed by comprehension activities/exercises Writing: Summary writing based on the reading passages.

Unit 2 - Persuasive Communication (18 hours) Listening: listening to a product launch-sensitizing learners to the nuances of persuasive communication Speaking: debates – Just-A Minute Activities Reading: reading texts on advertisements (on products relevant to the subject areas) and answering inferential questions 3 Writing: dialogue writing- writing an argumentative /persuasive essay.

Unit 3- Digital Competence (18 hours) Listening to interviews (subject related) Speaking: Interviews with subject specialists (using video conferencing skills) Creating Vlogs (How to become a vlogger and use vlogging to nurture interests – subject related) Reading: Selected sample of Web Page (subject area) Writing: Creating Web Pages Reading Comprehension: Essay on Digital Competence for Academic and Professional Life. The essay will address all aspects of digital competence in relation to MS Office and how they can be utilized in relation to work in the subject area

Unit 4 - Creativity and Imagination (18 hours) Listening to short (2 to 5 minutes) academic videos (prepared by EMRC/ other MOOC videos on Indian academic sites – E.g. https://www.youtube.com/watch?v=tpvicScuDy0) Speaking: Making oral presentations through short films – subject based Reading : Essay on Creativity and Imagination (subject based) Writing – Basic Script Writing for short films (subject based) - Creating blogs, flyers and brochures (subject based) - Poster making – writing slogans/captions (subject based).

Unit 5- Workplace Communication & Basics of Academic writing (18 hours) Speaking: Short academic presentation using PowerPoint Reading & Writing: Product Profiles, Circulars, and Minutes of Meeting. Writing an introduction, paraphrasing Punctuation (period, question mark, exclamation point, comma, semicolon, colon, dash, hyphen, parentheses, brackets, braces, apostrophe, quotation marks, and ellipsis) Capitalization (use of upper case) 4

References

1. Cell and molecular biology 1998, Roberties and Roberties, K.M. Varghese publication.
2. Cell and molecular biology 1996, Gerald Karp, Blackwell pub, UK.
3. Introduction to cell biology, 1998, Sundarajan, Vikas Pub
4. Genes, 2002, Benjamine Levine- 8th edition OUP USA 1027p
5. Gardner/Simmons/Shustad. Principles of genetics, 8th EO-1999
6. Website- www.amazon.com

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester – II / Major Practical –II

LAB IN CELL AND MOLECULAR BIOLOGY

L T P C
0 0 2 2

Objective: To study the basic concept of cell structure and cell organelles.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	LAB IN CELL AND MOLECULAR BIOLOGY	Cognitive Level
CO1	Perform Plant cell – Onion epidermal peel, Animal cell – Buccal cavity smear	K1, K2
CO2	Study mitosis – Various stages – onion root tip and Study of meiosis – Rhoeo pollen squash	K2 ,K3
CO3	Isolate DNA from any plant source/animal/Microbial source	K4
CO4	Visit to Biotechnology lab and submission of report.	K5

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

LAB IN CELL AND MOLECULAR BIOLOGY

1. Plant cell – Onion epidermal peel
2. Animal cell – Buccal cavity smear
3. Study of mitosis – Various stages – onion root tip
4. Study of meiosis – Rhoeo pollen squash
5. Isolation of DNA from any plant source
6. Isolation of DNA from animal / microbial sources.
7. Separation of DNA by Agarose gel electrophoresis.
8. Visit to Biotechnology lab and submission of report.

Mapping

LAB IN CELL AND MOLECULAR BIOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester –II / Allied – II

BIOCHEMISTRY - II

L T P C
4 0 0 3

Objective:

To understand the basic concepts of acids and bases, principle and operation of common laboratory instruments and separation techniques.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	BIOCHEMISTRY - II	Cognitive Level
CO1	Understand the basic operating characteristics of instruments-weighing devices. Physical, Chemical and Electronic Balances. pH meter, Salinity Theories of Acids and Bases – Lowry Bronsted theory – Arrhenius theory – Lewis theory.	K1, K2,K3
CO2	Apply and analyse the Principles & types of centrifugation	K2 ,K3,K4
CO3	Evaluate the principle concepts in using analytical and preparatory techniques of chromatography:	K3,K4
CO4	Understand and Evaluate the Principle, Types & Applications of Electrophoresis, UV Trans illuminators. Blotting techniques.	K1,K2,K5
CO5	Understand and Evaluate Principle, Instrumentation and applications of UV-Visible Spectrophotometer. Electromagnetic radiation: Energy – Wavelength, colorimeter, Spectrophotometer, Absorption and emission spectra.	K1,K2,K5

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

BIOCHEMISTRY - II

Unit I

Theories of Acids and Bases – Lowry Bronsted theory – Arrhenius theory – Lewis theory. Derivation of Henderson Hasselbach equation – Applications.Principles and operation methods of weighing devices. Physical, Chemical and Electronic Balances. pH meter, Salinity and conductivity meter. Preparation of buffers .**(14L)**

Unit II

Centrifugation: Principle of centrifugation – Types of centrifuge, Ultracentrifugation , Types of centrifugal separation- differential, density gradient centrifugation, rate zonal sedimentation, isopycnic sedimentation.**(12L)**

Unit III

Chromatography: Principles – types - Applications - Paper chromatography – Thin Layer Chromatography - Column Chromatography (ion exchange,affinity, gel filtration) HPLC. **(12L)**

Unit IV

Electrophorosis: Principle - Factors influence the electrophoresis - Types – Paper – PAGE – SDS PAGE , Two dimensional electrophoresis, Gel documentation system – Principle – Types – Applications, UV Transilluminators**.** Blotting techniques – Principle – Types – Southern Blot – Northern Blot – Western Blot. **(12L)**

Unit V

Instrumentation of colorimeter, spectrophotometer - Applications Principle, Instrumentation and applications of UV-Visible Spectrophotometer.Electromagnetic radiation: Energy – Wavelength - Wave numbers – Frequency. Absorption and emission spectra – Applications. **(12L)**

Total: 60L

References

1. Biologists guide to principles and techniques of practical biochemistry-2000. Wilson K. Walker E. Arnold. Blackwell Pub. UK
2. Biophysical chemistry- Principles and techniques 2001. Upadhyay and Nath, Himalaya publications.
3. Spectroscopic methods in organic chemistry, 4th edition, Dudley H. Williams and Ian Fleming. W.H. Freeman & Co, Sanfransisco.
4. Biophysical chemistry 1980, Vol I, II, III C.R. Cantor & P.R. Schimmel. W.H. Freeman & Co, Sanfransisco
5. A practical guide to clinical biochemistry- 1996, Keith Wilson, Cambridge University press
6.Bioinstrumentation- L. VeeraKumari MJP Publishers , Chennai

Mapping

BIOCHEMISTRY - II												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	2	2	3	3	3	3	2	2
2	3	2	3	3	2	3	2	3	3	3	2	3
3	2	3	3	3	2	3	3	2	3	3	3	2
4	3	3	3	3	2	2	3	3	2	3	3	3
5	3	3	3	3	2	3	3	2	3	3	3	3
6	3	3	3	3	2	3	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester –II / Allied Practical- II

LAB IN BIOCHEMISTRY – II

L	T	P	C
0	0	2	2

Objective:
To study the basic concepts of acids and bases, principle and operation of common laboratory instruments and separation techniques.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	LAB IN BIOCHEMISTRY - II	Cognitive Level
CO1	Estimate the Acid, Iodine & Saponification value of fat.	K1, K2
CO2	Verify of Beer's law using colorimeter.	K2 ,K3
CO3	Find observation maxima of solution using UV-Vis. Spectrophotometer.	K4
CO4	Separate and identify of amino acids & fatty acids by chromatography techniques	K4,K6

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

LAB IN BIOCHEMISTRY - II

1. Estimation of Acid value of fat.
2. Estimation of Iodine value of fat.
3. Estimation of Saponification value of fat.
4. Verification of Beer's law using colorimeter.
5. Finding observation maxima of solution using UV-Vis. Spectrophotometer.
6. Separation and identification of amino acids by paper chromatography.
7. Separation and identification of amino acids by Thin Layer Chromatography.
8. Separation and identification of fatty acids by Thin Layer Chromatography.

Mapping

LAB IN BIOCHEMISTRY - II												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	2	2	3	3	3	3	3	3
2	3	2	2	3	2	3	2	3	3	3	3	3
3	3	3	3	3	2	3	3	3	3	3	3	3
4	3	3	3	3	2	2	3	2	2	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-IV/Core-5

III SEMESTER

Major Paper 5: MICROBIOLOGY

L	T	P	C
4	0	0	4

Objective: To understand applications of microorganisms in different areas.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	MICROBIOLOGY	Cognitive Level
CO1	Understand and learn the Scope of microbiology, major contributors in microbiology.	K1, K2
CO2	Classify microorganism and its Ultrastructure, Staining techniques	K2 ,K3
CO3	Isolate the pure cultures, Culture of microorganisms, Measure the growth and Calculate generation time	K3, K4
CO4	Diagnose microbial diseases in humans, Pathogenicity and treatments.	K4,K5
CO5	Justify Microbial interaction on Plants and formulate antibacterial and antifungal agents.	K2,K3,K4,K6

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

MICROBIOLOGY

Unit I

General Microbiology- History and Scope of Microbiology- Major contributors in microbiology. Principle, operation and maintenance of microbiology - Future of microbiology – Role of microbes in biotechnology. **(14 L)**

Unit II

Microorganism – Classifications and Ultrastructure – Bacteria, Algae, Protozoa, Fungi, Viruses – Ultra structure and characteristics of microorganisms. Staining techniques. **(10 L)**

Unit III

Culture media – Types – Ingredients – Preparation and Sterilization – Isolation of pure cultures – Culture of microorganisms – Measurement of growth – Calculation of generation time – Preservation of microorganisms. **(12 L)**

Unit IV

Gram positive and gram negative organisms - Morphology, cultural characteristics, pathogenicity - Laboratory diagnosis – Treatments. Gram positive – *Staphylococcus, Streptococcus, Bacillus, Clostridium*, Gram - Negative – *Neisseria, E.coli, Klebsiella***. (12 L)**

Unit V

Microbial interaction – Plants – Rhizophere – Mycorrhiza – Plant pathogens – Nodules – Bacterial and viral diseases. Antibiotics and antifungal agents – Mode of action. Probiotics and applications. **(12 L)**

(Total: 60 L)

Outcome: This paper is devoted to study of diversity of microbial habitats, also involves exploiting these principles for economic purpose. Students were expected to master the major theoretical and practical expertise from this course.

References

1. General Microbiology, Stanier, R.Y., Inram, J.L.K., Wheelis, M.L. and Painter, P.R., The Macmillan Press Ltd.
2. Biology of Microorganisms, Brock, Madigan, M.T., Martinko, J.M. and Parker J. Prentice- Hall.
3. Microbiology, Pelczar, M.J.Jr., Chan, E.C.S. and Kreig N.R., Tata McGraw Hill.
4. Microbial Genetics, Maloy, S.R., Cronan, J.E.Jr. and Freifelder, D. Jones, Bartlett Publishers.
5. Chemical Microbiology, An introduction to Microbial Physiology – A.H. Rose, Butterworth, London.
6. Microbiology – A laboratory Manual, Cappucino, J.G and Sherman, N, Addison Wesley.

Mapping

MICROBIOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	2	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	2	2
3	3	3	3	3	3	2	3	3	3	3	2	2
4	3	3	2	2	3	2	3	3	3	3	3	3
5	3	3	2	2	3	2	3	3	3	3	3	3
6	3	3	2	2	3	2	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges/UG/B.Sc Biotechnology/sem-IV/Core Practical -3

L	T	P	C
0	0	3	2

Major Practical III: LAB IN MICROBIOLOGY

Objective: To understand study the basic microbial isolation and enumeration techniques.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	LAB IN MICROBIOLOGY	Cognitive Level
CO1	Prepare liquid and solid media for growth of microorganism	K1, K2
CO2	Perform Plating techniques - Spread, Streak and Pour plate Storage of microorganism: slant and stab culture	K3
CO3	Perform Microscopic examination of bacteria and yeast Counting of microorganisms using Hemocytometer	K4
CO4	Assay antibiotics and demonstrate of antibiotic resistance.	K4
CO5	Characterize biochemically of selected microbes : IMViC, Oxidase, Catalase and Starch hydrolysis	K5

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

LAB IN MICROBIOLOGY

1. Preparation of liquid and solid media for growth of microorganism
2. Plating techniques - Spread, Streak and Pour plate
3. Storage of microorganism: slant and stab culture
4. Isolation of microorganism from soil
5. Growth : Growth curve – Measurement of growth by turbidometry method
6. Microscopic examination of bacteria and yeast
7. Counting of microorganisms using Hemocytometer
8. Assay of antibiotics and demonstration of antibiotic resistance
9. Biochemical characterization of selected microbes : IMViC, Oxidase, Catalase and Starch hydrolysis
10. One step growth curve of *Coliphage*

Mapping

LAB IN MICROBIOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	2	3	3	3	2	3	3	3
3	3	3	2	3	2	3	2	3	3	2	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	2
6	3	3	3	3	3	3	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester –III / Allied- III

GENETICS

L	T	P	C
4	0	0	4

Objectives

To understand the basic principles of genetic materials & its inheritance. To understand Mendelian principle in plant cross. To study human chromosomes and syndromes.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	GENETICS	Cognitive Level
CO1	Understand and learn Mendel's Work, Terminology, Monohybrid and Dihybrid Cross, Mendelian Laws- Back/Test Cross. Complete and Incomplete Dominance	K1, K2
CO2	Demonstrate allelic and Non Allelic interaction, Multiple allelic interaction.	K2 ,K3
CO3	Understand Genic balance theory of Bridges, Environment and Sex determination, Hormonal control of sex determination (free martin	K2,K3
CO4	Conclude Chromosomal aberrations, Extra Chromosomal Inheritance	K3,K4,K5
CO5	Summaraise Genetic analysis. Mutagenesis, and mutational analysis.	K2,K3,K4,K6

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

GENETICS

Unit I

Introduction to Genetics - Mendel's Work, Terminology, Monohybrid and Dihybrid Cross ,Mendelian Laws- Back/Test Cross. Complete and Incomplete Dominance. Gene interactions: Complementary genes: Flower colour in sweet peas, Epistasis: Plumage colour in poultry. Supplementary genes: Coat colour in mice. (12)

Unit II

Allelic and Non Allelic – Multiple alleles: ABO Blood groups and Rh factor in Human beings. Multiple factors: Skin colour in Human beings. Coupling and repulsion hypothesis, Linkage and Crossing over in Drosophila - Mechanism of crossing over-Types of crossing over, Sex Linkage: in Man (Hemophilia and Colour blindness),Measurement of linkage and gene mapping. (12)

Unit III

Sex determination: Chromosomal theory of sex determination- XX-XY, XX-XO, ZW-ZZ, ZO-ZZ types, Genic balance theory of Bridges, Environment and Sex determination, Hormonal control of sex determination (free martin). (12)

Unit IV

Chromosomal aberrations: Structural: Deletions, Duplications, Translocations and Inversions, Numerical: Euploidy (Monoploidy, Polyploidy), Aneuploidy (Monosomes, Nullisomes and Trisomes). Extra Chromosomal Inheritance: Kappa particles in Paramecium, Plastid inheritance in Mirabilis jalapa. (12)

Unit V

Human Chromosomes: Normal human karyotype, inherited disorders: Allosomal (Klinefelter's syndrome and Turner's syndrome), Autosomal (Down syndrome). Mendelian Traits: Strait hair, Curly hair, Widow's peak, Dimpled Cheeks, Mid digital hair, Hitchhiker's thumb, Clasping of hands and Hypertrichosis. Genetic analysis. Mutagenesis: Types: Site directed mutagenesis, base analogue mutants. (12) Total:60

REFERENCE:

1. Gardner, E.J., Michael J. Simmons, Peter Sunstad, D., (1991). Principles of Genetics.8th edition John Wiley and Sons, INC.
2. Benjamin Lewin., (2004). Genes VIII. Pearson Prentice Hall, Pearson Education, Inc. Strickberger M.W., (1985).Genetics.3rd Edition, Macmillan Publishing Co., New Delhi.
3. William D. Stansfield., (1991). Schaum's outline of theory and problems of genetics.3rd edition, Schaum's Outline Series.Mcgraw-Hill. 9
4. Daniel L. Haartl., Elizabeth W. Jones., (2001). Genetics.5th edition, Jones and Bartlett Publishers., Sudbury.
5. Charlotte J. Avers., (1980). Genetics.D.VanNostrand and Company, New York.

Mapping

GENETICS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	2	1	3	3	3	2	3
2	3	3	3	3	3	2	1	3	3	2	3	3
3	3	3	3	3	3	2	2	3	3	2	2	2
4	3	3	3	3	3	2	2	3	2	3	2	2
5	3	3	3	3	3	2	2	3	3	3	3	2
6	3	3	3	3	3	2	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /Part-III (B.Sc.Biotechnology) / Semester –III / Allied- III

Practical III

LAB IN GENETICS

L	T	P	C
2	0	0	2

Objectives

To understand the basic principles protocols of genetic materials & its inheritance.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	LAB IN GENETICS	Cognitive Level
CO1	Perform Numerical problems solving Mendel' Laws of inheritance – Monohybrid, Dihybrid, Test cross, Back cross	K5
CO2	Problems solving gene Interaction Complementary, Supplementary, Epistasis, Incomplete Dominance	K5
CO3	Perform Chromosome mapping using 3 point test cross data Drosophila – male and female identification, Mutant forms (from pictures)	K4
CO4	Analysis Linkage and crossing over (Drosopila/ Human) Observation and recording of simple Mendelian traits in man	K6

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

LAB IN GENETICS

1.Numerical problems solving Mendel' Laws of inheritance – Monohybrid, Dihybrid, Test cross, Back cross

2. Problems solving gene Interaction- Complementary, Supplementary, Epistasis, Incomplete Dominance

3. Chromosome mapping using 3 point test cross data

4.Drosophila – male and female identification, Mutant forms (from pictures)

5. Linkage and crossing over (Drosophila/ Human)

6.Observation and recording of simple Mendelian traits in man

Mapping

LAB IN GENETICS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	2	3	3	3	3	2
3	3	3	3	3	3	2	3	3	3	2	3	2
4	3	3	3	3	3	3	2	3	3	3	3	2
5	3	3	3	3	3	3	3	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-IV/skill based Core-1

SKILL BASED CORE (ANY ONE)

A. CLINICAL BIOCHEMISTRY

L	T	P	C
4	0	0	4

Objective: To give basic awareness about the concepts and physical aspects in Clinical biochemistry and to develop analytical skills in students in order to prepare them to use diagnosing instruments.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	CLINICAL BIOCHEMISTRY	Cognitive Level
CO1	Understand basic concepts of clinical biochemistry and can learn the biochemical principles and preliminary concept of cardiovascular, liver and kidney disorders	K1, K2
CO2	Predict diseases related to carbohydrate metabolism especially in blood sugar	K2 ,K3
CO3	Investigate inborn error of metabolism and its clinical importance	K4
CO4	Assess organ function test, liver function test, renal function test, gastric function test.	K4,K5
CO5	Assess functional and non-functional plasma enzymes, Isoenzymes with examples, Enzyme patterns in acute pancreatitis	K2,K3,K4,K6

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

CLINICAL BIOCHEMISTRY

Unit I

Basic concepts of Clinical Biochemistry: Definition and scope of clinical Biochemistry in diagnostics, collection and preservation of biological fluids (blood, serum, plasma, urine and CSF), normal values of important constituents of blood, CSF, urine, etc. Biochemical principles of water and electrolyte imbalance, acid base homeostasis, preliminary concept of cardiovascular, liver and kidney disorders including laboratory test for respective markers. **(15 L)**

Unit II

Diseases related to carbohydrate metabolism: Regulation of blood sugar, Glycosuria –types of glycosuria. Oral glucose tolerance test in normal and diabetic condition, Diabetes mellitus and diabetes incipidus – hypoglycemia, hyperglycemia, ketonuria, ketosis. **(10 L)**

Unit III

Inborn errors of metabolism: Introduction – clinical importance, phenyl ketonuria, cystinuria, alkaptonuria, Fanconi's syndrome, galactosemia, albinism, tyrosinemia and haemophilia. **(10 L)**

Unit IV

Organ function test: Lipid and lipoproteins: Classifications, composition, mode of action – Cholesterol. Factors affecting blood cholesterol level. Dyslipoproteinemia, IHD, atherosclerosis, risk factor and fatty liver. Liver function test: Metabolism of Bilirubin, jaundice – types, differential diagnosis. Liver function test – Icteric test, Vandenberg test, plasma protein changes, PT. Renal function test: Clearance test – Urea, Creatinine, Inulin, PAH test, concentration and dilution test. Gastric function test: Collection of gastric contents, examination of gastric residuum, FTM, stimulation test, tubeless gastric analysis. **(15 L)**

Unit V

Clinical enzymology: Functional and non-functional plasma enzymes, Isoenzymes with examples, Enzyme patterns in acute pancreatitis, liver damage, bone disorder, myocardial infarction and muscle wasting. **(10 L)**

Total (60 L)

Outcome: Create awareness about the various syndrome and their diagnosing test in Clinical biochemistry.

References

1. Text book of Clinical Biochemistry – Carl A. Bordis and Edward R. Ashwood
2. Text book of Medical Biochemistry – Dr. M.N. Chatterjee and Rane Shinde
3. Clinical Chemistry in diagnosis and treatment – Philip D. Mayne
4. Clinical chemistry – William Hoffman
5. Clinical Biochemistry with clinical correlation – Devin, Wiley
6. Practical Clinical Biochemistry – Harold Varley, CBS, New Delhi

Mapping

CLINICAL BIOCHEMISTRY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	1	1	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	2	2	3	2
3	3	3	3	3	2	2	3	3	3	3	3	2
4	3	3	3	3	2	1	2	3	2	2	3	3
5	3	3	3	3	1	1	2	3	3	3	3	3
6	3	3	3	3	2	2	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

B. INDUSTRIAL BIOTECHNOLOGY

L	T	P	C
4	0	0	4

Objective: To give basic awareness techniques Blue green Algae, feed formulation, and economic importance.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	INDUSTRIAL BIOTECHNOLOGY	Cognitive Level
CO1	Learn different species of Blue green algae and its characterization and benefits	K1, K2
CO2	Formulate sea weed culture and its uses	K2 ,K3
CO3	Prepare different types of fish feed and chicken feed, Manufacturing of fish feed and chicken feed, Nutritional value of fish feed and chicken feed and Processing	K4,K5,K6
CO4	Know about the growth of *Andographis paniculata*, *Catharanthus roseus*, *Ocimum tenuiflorum* and its Economic importance, harvesting, packaging and manufacturing of medicinal plants	K1,K2,K3
CO5	Develop strategy for stability, packaging, product improvement and marketing	K5, K6

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

INDUSTRIAL BIOTECHNOLOGY

Unit I

Blue Green Algae – Different species of Blue Green Alae ultra of BGA, characterization, processing and packaging, benefits of BGA **(15L)**

Unit II

Sea weed culture and uses of sea weed as fertilizer, Sea weed farming in India, Environmental contaminants, pathogens and toxins from the harvest area **(11L)**

Unit III

Fish feed, Chicken feed, Types, Equipments used in feed manufacture, Nutritional value of feed in relation to storage, Effect of processing on the nutritional value of feeds **(9L)**

Unit IV

Economic importance of *Andographis paniculata*, *Catharanthus roseus*, *Ocimum tenuiflorum* farming, harvesting, packaging and marketing **(14L)**

Unit V

Stability Packaging, product improvement and marketing

(11L) **Total (60L)**

References

1. Basic Industrial biotechnology by Munawar T Mohammed Swam A. V. N. LAP Lambert Academic Publishing
2. Industrial Biotechnology Vol 8, Mary Ann Liebert, Inc.
3. Industrial Biotechnology, Dr. Kavita A.I.T.B.S. Publishers, India
4. Basic Industrial Biotechnology, S.M.Reddy, S. Ram Reddy, G. Narendra Babu, Ist Edition, New Age International Publishers.

Mapping

INDUSTRIAL BIOTECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	2	3	3	3	2	3	2
2	3	3	3	3	3	2	3	3	3	3	3	2
3	3	3	3	3	3	2	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	3	3	3	2
5	3	3	3	3	3	3	3	3	3	3	2	3
6	3	3	3	3	3	1	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges/B.Sc Biotechnology/Sem-IV/Non-Major Elective-1

NON MAJOR ELECTIVE (ANY ONE)

A. NUTRITIONAL BIOTECHNOLOGY

L	T	P	C
2	0	0	2

Objective: The course is intended to introduce the student to the basics of physiological aspects and to familiarize the students with the basics of human nutrition.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	NUTRITIONAL BIOTECHNOLOGY	Cognitive Level
CO1	Learn about nutrition Recommended Dietary Allowances (RDA) and balanced diet- factors affecting RDA, principles of deriving RDA	K1, K2
CO2	Summarise Dietary fibre, role of fibres, recommended dietary allowances and sources	K2 ,K3
CO3	Classify proteins and know the functions, chemical composition, digestion and absorption, sources, recommended dietary allowances,	K3,K4
CO4	Predict the vitamins structure and biochemical roles, deficiency disorders of vitamin	K4,K5
CO5	Conclude disorders related to hyper activity and deficiencies of these elements. Diseases related to nutritional deficiencies	K4,K5,K6

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

NUTRITIONAL BIOTECHNOLOGY

Unit I

Nutrition –definition, Recommended Dietary Allowances (RDA) and balanced diet- factors affecting RDA, principles of deriving RDA. Carbohydrates – classification, functions, digestion and absorption maintenance of blood sugar level, sources. **(10L)**

Unit II

Dietary fibre, role of fibres, recommended dietary allowances and sources, Lipids – classification, chemical composition, functions, sources, digestion and absorption recommended dietary allowances, deficiency diseases **(5L)**

Unit III

Proteins**,** classification, functions, chemical composition, digestion and absorption, sources, recommended dietary allowances, deficiency diseases, factors affecting protein utilization. **(5L)**

Unit 1V

Vitamins- structure and biochemical roles, deficiency disorders of vitamin A, D, E,K, B_1, B_2, B_6, Folic acid, Panthothenic acid, Niacin and Vitamin C. **(5L)**

Unit V

Minerals- biochemical functions of Na, K, Ca, P, I, Fe and Se - Disorders related to hyper activity and deficiencies of these elements. Diseases related to nutritional deficiencies- Carbohydrates, Lipid, Proteins, Vitamins and Minerals. **(5L)**

Total (30L)

Outcome: This course is introduced the basics of physiological aspects and basics of human nutrition to the students.

References

1. Nutrition science – B.SriLakshmi,New age international (P) limited
2. Nutritional Biochemistry – M.S. Swaminathan
3. Nutritional Biochemistry, 2nd edition, Tom Brody, Academic Press
4. Nutrition – An integrated approach, 3rd edition, Ruth L. Pike and Myrtle L.Brown

Mapping

NUTRITIONAL BIOTECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	3	3	3	3	2	2
2	3	3	3	3	3	2	2	3	3	3	3	3
3	3	3	2	3	3	3	2	3	3	3	3	3
4	3	3	2	3	3	3	1	3	3	3	2	2
5	3	3	3	3	2	3	1	3	3	3	3	3
6	3	3	3	3	3	3	1	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

A. VECTOR BORNE DISEASES

L	T	P	C
2	0	0	2

Objective: This course is designed to get an in-depth knowledge in Vector borne microbial diseases. This knowledge is very important as far as Biotechnology is concerned.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	VECTOR BORNE DISEASES	Cognitive Level
CO1	Understand and learn about general entomology, insect morphology and classification insects and other arthropods of medical importance and their structures and functions.	K1, K2
CO2	Relate biology and ecology of mosquitoes, biology and life history of Aedes, Culex and Anopheles, their behaviour and ecology	K2 ,K3
CO3	Interpret communicable & infective disease control – definitions related to communicable diseases,	K3,K4
CO4	Compare vector borne diseases and vectors affecting the health of man and domestic animals.	K1,K2
CO5	Integrate various control strategies and environmental management and control in urban settings, control at aquatic stages,	K2,K3,K4,K6

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

VECTOR BORNE DISEASES

Unit I

Introduction to general entomology, insect morphology and classification insects and other arthropods of medical importance and their structures and functions. Methods for collecting these insects and arthropods, their preservation maintenance and transportation. **(5L)**

Unit II

Biology and ecology of mosquitoes, biology and life history of Aedes, Culex and Anopheles, their behaviour and ecology with special reference to dengue, chicken gunya, Biology and ecology of other blood sucking insects, ticks and mites, Biology and morphology of fleas, lice, culicodes. **(10L)**

Unit III

Communicable & infective disease control – definitions related to communicable diseases, infection, contamination, decontamination, disinfection, transmission (direct and indirect) **(5L)**

Unit IV

Vector borne diseases- a brief account of insect vectors affecting the health of man and domestic animals. Epidemiology and control of vectors and vector borne diseases like dengue, plaque, malaria, filariasis, tuberculosis, MMR, chicken pox, pertussis, chickengunya and mite borne diseases. **(6L)**

Unit V

Various control strategies and environmental management. Control in urban settings, control at aquatic stages, adult population, personal protection, insecticide resistance mechanism and control dynamics. **(4L)**

Total (30L)

Outcome: The students are expected to master all microbial related techniques to pursue studies in biotechnology.

References

1. Gordon R.M., Lavoipierre M.M.J., (1962). Entomology for Students of Medicine. Blackwell Scientific Publishers.
2. Service M.W., (1966) Medical entomology for students. Chapman and Hall.
3. Kettle D.S., (1984) Medical and Veterinary Entomolgy. CAB International.
4. Bates M (1949) Natural History of Mosquitoes. The Macmillan Co.
5. Baker R.H and Wharton R. (1952) Introduction to Acarology. The Macmillan Co.

Mapping

VECTOR BORNE DISEASES												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	1	1	3	2	3	3	3	3	2
2	3	3	3	3	3	3	2	3	3	3	3	2
3	3	3	3	3	3	3	3	3	3	3	3	2
4	3	3	3	3	3	3	3	3	3	3	3	2
5	3	3	3	1	1	3	2	3	3	3	3	3
6	3	3	3	1	1	3	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

SEMESTER IV
MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-IV/ Core-6

MAJOR PAPER 6 – IMMUNOLOGY

L	T	P	C
4	0	0	4

Objective: To give a basic training to the students of Biotechnology on immune system, immunology and immunology related techniques.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	IMMUNOLOGY	Cognitive Level
CO1	Define and recite Immune system, Primary and Secondary lymphoid organs - Structure and functions	K1, K2
CO2	Illustrate about the Immunity - Types – Innate and Acquired - Immune response - Humoral and Cell Mediated. Vaccines – types, production and uses,	K2 ,K3
CO3	Interpret the Immunoglobulins - Structure – Types - Properties and functions - Antigen antibody interactions	K4
CO4	Summarise antigen processing and presentation – Exogenous and endogenous pathways – Cytokines – Hypersensitivity reactions	K3,K4
CO5	Evaluate Immunological techniques – WIDAL, VDRL, Pregnancy and Rheumatoid factor tests, Principle and applications of RIA – ELISA	K4, K5

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

IMMUNOLOGY

Unit 1

Introduction – History & Scope - Developments – Immunity - Cells of immune system – B and T lymphocytes, cell surface markers – TCR – BCR. Lymphocyte traffic – Primary and Secondary lymphoid organs - Structure and functions.**(12L)**

Unit II

Immunity - Types – Innate and Acquired - Immune response - Humoral and Cell Mediated. Vaccines – types, production and uses, Antigens – Properties - Types – Immunogenicity, antigenicity - Epitopes - Haptens - Adjuvants. **(11L)**

Unit III

Immunoglobulins - Structure – Types - Properties and functions - Antigen antibody interactions - Precipitation – Agglutination - Cross reactivity – Cytolysis. Complement systems - Classical and alternative pathways. Major Histocompatibility Complex - structure and functions. **(11L)**

Unit IV

Antigen processing and presentation – Exogenous and endogenous pathways – Cytokines – Hypersensitivity reactions - Immediate and Delayed, Autoimmune diseases, Immuno deficiency diseases, Transplantation Immunology – specificity of graft, mechanism of graft rejection, Tumour Immunology, Immunoregulation. **(14L)**

Unit V

Immunological techniques – WIDAL, VDRL, Pregnancy and Rheumatoid factor tests, Principle and applications of RIA – ELISA. Immunodiffusion – Immunoelectrophorosis – Immunofluorescence - Monoclonal antibody – Production and applications. **(12L)**

Total (60L)

Outcome:

This course will create an interest in immunology and is essential for further studies in Biotechnology. It also throws light on its use in the field of therapeutics.

References

1. Ivan, M. Roit, Jonathan and Brostof and David Male (1998): Immunology – 5th Edition. (Churchil Livingstone Publishers).
2. Janis Kuby (1998): Imunology – 3rd and 4th Edition (W.H.Freeman).
3. Weir, D.N (1997): Immunology (8th Edition, Churchil Livingstone Publishers).
4. Nandini Shetti: Immunology Introductory Text Books.
5. Essential Immunology by Roit, I, Blackwell Science, Oxford.

Mapping

IMMUNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	1	3	2	3	3	3	1	3
2	3	3	3	3	3	3	2	3	3	3	3	3
3	3	3	3	3	3	3	2	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	2	2
5	3	3	3	3	3	2	3	3	3	3	2	2
6	3	3	3	3	3	3	3	2	2	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-IV/Core Practical-4

Major Practicals IV – LAB IN IMMUNOLOGY

L	T	P	C
0	0	3	2

Objective: To give a basic training to the students of Biotechnology on immunological technique.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	LAB IN IMMUNOLOGY	Cognitive Level
CO1	Identify human blood groups – A, B, AB, O and Rh factor.	K3
CO2	Perform total leukocyte count on the given blood sample and total RBC count on the given blood sample.	K3, K4
CO3	Identify different cells of the blood sample and differential count of the given blood sample	K3, K4
CO4	Perform Immunodiffusion by Ouchterlony method and Immunoelectrophoresis with a given antigen – antibody system	K4,K5
CO5	Perform Rocket Immunoelectrophoresis.	K6

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

LAB IN IMMUNOLOGY

1. Identification of human blood groups – A, B, AB, O and Rh factor.
2. Total leukocyte count on the given blood sample.
3. Total RBC count on the given blood sample.
4. Identify different cells of the blood sample.
5. Differential count of the given blood sample
6. Immunodiffusion by Ouchterlony method - Demonstration.
7. Immunoelectrophoresis with a given antigen – antibody system - Demonstration.
8. Rocket Immunoelectrophoresis – Demonstration.
9. Perform DOT ELISA.

Mapping

LAB IN IMMUNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	2	3	3	3	1	3	1
2	3	3	3	3	3	2	3	3	3	3	3	3
3	3	3	3	3	3	2	3	3	3	2	2	2
4	3	3	3	3	3	2	3	3	3	2	2	2
5	3	3	3	3	3	2	3	3	3	3	3	3
6	3	3	3	3	3	2	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-IV/Allied-4

Allied Paper III – BIOPHYSICS & BIOSTATISTICS

L	T	P	C
3	0	0	3

Objectives: To introduce the physical aspects and bioenergetics of the living system and to familiarize the principle and working of various instruments used in biotechnology experiments.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	BIOPHYSICS & BIOSTATISTICS	Cognitive Level
CO1	Recall the basic concepts of atomic structure and the fundamental principles,differentiate the formation of molecules from atoms: bond different types – properties and strength – molecular orbita	K1, K2
CO2	Learn the Laws of thermodynamics – Entropy – enthalpy – free energy of a system.	K2 ,K3
CO3	Relate and differentiate various biopotential measuring instruments (EEG, ECG, , GM Counter), Diffusion, Viscosity, capillary action, Newtonian and non-Newtonian fluids. Osmosis and its biological significance.	K4, K5,K6
CO4	Understand the scope of biostatistics and their limitations. Collection, classification, tabulation, Frequency table & Graphical representation of data.	K1,K2
CO5	Measure the central tendency .dispersion , standard error, Karl Pearson's Correlation Coefficient, ANOVA	,K4,K5,K6

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

BIOPHYSICS & BIOSTATISTICS

Unit I

Definition, scope and methods of biophysics, Physical quantities and their units, physics of atoms and molecules – atomic structure–relationship between atomic structure and chemical properties. Formation of molecules from atoms: bond different types – properties and strength – molecular orbital. **(10 L)**

Unit II

Bioenergetics, Laws of thermodynamics – Entropy – enthalpy – free energy of a system, living body as a thermodynamic system. Photosynthesis – Primary biophysical events. **(8 L)**

Unit III

Diffusion – Fick's law of diffusion, Viscosity: Theory of viscosity, capillary action, Newtonian and non-Newtonian fluids. Osmosis and its biological significance. Bioacoustics – sound and its characteristics, Radioactive substances and its Biological applications (EEG, ECG, , GM Counter. **(9 L)**

Unit IV

Definition and scope of biostatistics and their limitations. Collection, classification, tabulation of statistical data, Frequency table – univariate and bivariate frequency table, diagrammatic and graphical representation of data.**(9L)**

Unit V

Measure of central tendency – mean, median, mode (individual, discrete and continuous series) and their merits and demerits. Measure of dispersion – range, quartile deviation, mean deviation, standard deviation Coefficient of variation, standard error, Karl Pearson's Correlation Coefficient, Test of significance – ANOVA (one way and two way). **(9 L)**

Total (45 L)

Outcome: The students will be able to understand the fundamentals of biophysics and the general instrumental techniques used in biotechnology.

References:

1. Physical Biochemistry, applications to Biochemistry and Molecular biology – D. Freifelder
2. General Biophysics, Vol I and II – H.V. Volkones
3. Molecular Biophysics – B. Pullman and M. Voino
4. Aspects of Biophysics, Hughe S.W, John Willy and Sons
5. Introduction of Biophysics by Pranab Kumar Banargy, S. Chand and Co.

6. Statistical Methods by S.P. Gupta – Sultan Chand & Sons
7. An introduction to Biostatistics by Sundar Rao and Richard J, PHI publications
8. Fundamentals of Biostatistics by Veer Bala Rastogi
9. Statistics by R.S. N. Pillai and Bhagavathi, S. Chand & Sons
10. Biostatistics by P.N. Arora and P.K. Malhan, HPH Publications
11. Biostatistics by Gurumani

Mapping

BIOPHYSICS & BIOSTATISTICS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	1	2	3	3	3	2	2	3	3	3	3	3
2	2	2	2	3	3	2	3	3	3	3	3	2
3	2	3	3	3	3	3	3	3	3	3	3	3
4	2	3	3	3	2	2	3	3	3	3	3	3
5	2	3	3	3	3	2	2	3	3	3	3	3
6	2	3	3	3	2	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-IV/Allied practical-4

Allied Practical IV: LAB IN BIOPHYSICS & BIOSTATISTICS

L	T	P	C
0	0	2	2

Objectives: To study the physical aspects and bioenergetics of the living system and to familiarize the principle and working of various instruments used in Biophysics experiments.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	LAB IN BIOPHYSICS & BIOSTATISTICS	Cognitive Level
CO1	Demonstrate ECG, EEG, CT scan, X-ray, estimate the amount of protein by Barfoed's method	K4,K5
CO2	Determine the pH &viscosity of different solutions	K2 ,K3
CO3	Perform diagrammatic representation of data – bar (simple, multiple), pie diagram using MS EXCEL Calculate the measures of central tendency, dispersion, correlation ,ANOVA	K2,K3,K4

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

BIOPHYSICS

1. ECG, EEG, CT scan, X-ray – demonstration
2. Estimation of protein by Barfoed's method
3. Determination of pH of a solution
4. Determination of the viscosity of different solutions using Ostwald Viscometer

BIOSTATISTICS

1. Diagrammatic representation of data – bar (simple, multiple), pie diagram using MS EXCEL
2. Measures of central tendency
3. Measures of dispersion
4. correlation
5. Calculation ANOVA – one way and two way

Mapping

LAB IN BIOPHYSICS & BIOSTATISTICS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	2	3	3	3	3	3	3	3	3	2	3	3
2	3	2	2	2	2	3	3	3	3	2	3	3
3	3	2	2	2	2	3	2	2	3	3	3	3
4	3	2	2	2	2	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	2	2
6	3	3	3	3	3	3	2	2	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-IV/Skill Based Core-2

SKILL BASED COURSES (ANY ONE PAPER)

A. ESSENTIAL OIL PREPARATIONS

L	T	P	C
4	0	0	4

Objective: This course will give an idea about the application of Essential oil preparation, particularly it produce self employment. This focuses on the Source of raw material, Extraction methods, Registration, packing and marketing.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	ESSENTIAL OIL PREPARATIONS	Cognitive Level
CO1	Understand the Prepare essential oils - Source, distribution and applications. Factors affecting the yield and quality. Aromatherapy uses.	K1, K3,K3
CO2	Characterize- boiling point, volatility and solubility, physicochemical properties and Constituents of essential oils.	K2 ,K3
CO3	Extract the oils using methods –Distillation-Steam distillation, Hydrodistillation, Maceration, Solvent extraction, distillation apparatus, Advantages	K3, K4
CO4	Identify plants yielding essential oil - Morphology, Method of extraction, Useful part, Medicinal uses of Clove, Sandal, Lemongrass, Eucalyptus and Peppermint	K2,K3,K4
CO5	Develop the registration. Packing, Storage and utilisation of essential oils. Quality & purity, Grade, Pricing and marketing, Economic benefits.	K4, K5, K6

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

ESSENTIAL OIL PREPARATIONS

Unit I

Essential oils - Source, distribution and applications. Factors affecting the yield and quality. Aromatherapy uses. **(9L)**

Unit II

Characterization- boiling point, volatility and solubility, physicochemical properties and Constituents of essential oils. **(11L)**

Unit III

Extraction methods –Distillation-Steam distillation, Hydrodistillation**,** Maceration, Solvent extraction, distillation apparatus**,** Advantages, LC-MS. **(15L)**

Unit IV

Plants yielding essential oil - Morphology, Method of extraction, Useful part, Medicinal uses of Clove, Sandal, Lemongrass, Eucalyptus and Peppermint. **(14L)**

Unit V

Registration. Packing, Storage and utilisation of essential oils. Quality & purity, Grade, Pricing and marketing, Economic benefits. **(11L)**

Total (60L)

References

1. Aromatic and Medicinal plants, yielding essential oilfor pharmaceutical perfumery and cosmetic industry and Trade by Shiva M.P (2002).
2. Aromatic and vital oil plants by Rajkumar Joshi. Agrotech press New Delhi.(2013).

Mapping

ESSENTIAL OIL PREPARATIONS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	2	3	3	3	3	3	3	3	3	3	2	3
2	2	3	3	3	3	3	3	3	3	3	2	3
3	3	3	3	3	3	3	2	3	3	3	2	3
4	3	3	3	3	3	3	2	3	3	2	3	3
5	3	3	3	2	3	3	2	3	3	2	3	3
6	3	3	3	2	3	3	2	3	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

A. VERMI AND MUSHROOM CULTURE

L	T	P	C
4	0	0	4

Objective: This course will give an idea about the application of biological science, particularly plant science in business generations and self employment. This focuses on the Vermicompost and Mushroom cultivation, its marketing and also in Agriculture depended economy and its impact on society.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	VERMI AND MUSHROOM CULTURE	Cognitive Level
CO1	Understand and learn Ecological classification of soil, Humus feeders, Humus formers leaf, mold, top soil and sub soil types.	K1, K2
CO2	Predict the conditions for vermi culture like temperature, moisture, pH, soil type, organic matter, protection from sunlight, rain, predators-food preference	K2 ,K3
CO3	Perform vermi composting-using required conditions-Requirements-Methods-Hep-Pot-Tray-changes during Vermi compost	K4,K5
CO4	Learn Importance of mushrooms; History of mushrooms cultivation; resent status of mushroom industry in India, cultivable edible mushrooms; Biology of mushrooms	K1,K2, K3
CO5	Plan and construct Mushrooms farm, design and layout; Spawn principles and techniques of spawn production;	K4,K5,K6

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

VERMI AND MUSHROOM CULTURE

Unit I

Vermi composting - Definition, introduction and scope: Ecological classification: Humus feeders, Humus formers leaf, mold, top soil and sub soil types. Physical, chemical and biological changes brought by earthworm in soil-burrows- drilosphere - earthworm casts. **(11L)**

Unit II

Optimal conditions for vermi culture-temperature, moisture, pH, soil type, organic matter, protection from sunlight, rain, predators-food preference. Basic components for vermi culture-culture practices- Home- School-Industries-Vermi wash. **(12L)**

Unit III

Composting- vermi composting-Required conditions-Requirements-Methods-Hep-Pot-Tray-changes during Vermi compost-Advantages-Cost-Benefit analysis of vermi composting-Role of Earthworms in soil fertility–Use of Vermicompost for crop production –Use of earthworms in land improvement and land reclamation, Economics of Vermicompost and vermiwash production. **(13L)**

Unit IV

Introduction and Importance of mushrooms; History of mushrooms cultivation; resent status of mushroom industry in India, cultivable edible mushrooms; Biology of mushrooms: food value of edible mushrooms; Poisonous mushrooms and Medicinal mushrooms. **(10L)**

Unit V

Mushrooms farm structure; design and layout; Spawn principles and techniques of spawn production; Cultivation techniques of white button mushroom, oyster mushroom; Management of fungal bacterial and viral diseases in mushroom; pests and nematodes in mushrooms; Post harvesting techniques and Economics of mushroom cultivation. **(14L)** **Total (60L)**

Outcome: After this course, it gave an idea about the self employment. This focuses on the Vermicompost and Mushroom cultivation, its marketing and also in Agriculture depended economy definitely helps to students.

References

1. Sultan Ahmed Ismail, 2005, The Earthworm Book, second revised Edition, Mother India Press, Goa.
2. Edwards C.A. and Bohlen, P.J 1996, Ecology of earthworms – 3rd Edition, Chapman and Hall.
3. Jsmail, S.A., 1970, Vermicology, The Biology of earth worms, Orient Longman, London.
4. Lee, K.E., 1985. Earthworms – Their ecology and relationship with soil and land use, Academic Press, Sydney

Mapping

VERMI AND MUSHROOM CULTURE												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	3	3	3	3	3	2
2	3	3	3	3	3	3	3	3	3	3	3	2
3	3	2	3	3	2	3	3	3	3	3	2	3
4	3	2	3	3	2	3	3	3	3	3	2	3
5	3	2	3	3	3	3	3	3	3	3	3	2
6	3	3	3	3	3	3	3	3	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-IV/Nonmajor elective-2

NON MAJOR ELECTIVE (ANYONE PAPER)

A. GENETIC DISEASES

L	T	P	C
2	0	0	2

Objective: This course for non biology or non biotechnology students, who are interested to know about the methods and application of microbial genetics, and microbial diseases.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	GENETIC DISEASES	Cognitive Level
CO1	Learn the origin of medical genetics, classification of genetic diseases- definition and impact of genetic diseases, human chromosomes – structure and organization of DNA	K1, K2
CO2	Recite the metabolic disorders and inherited disease- Diabetes, Hypertension, Alzheimer disease, Duchene's muscular dystrophy	K2 ,K3
CO3	Illustrate and interpret carcinogenesis and mutation, phenotype of cancerous cells, Tumor suppressor oncogene, cancer stem cell theory	K2 ,K3,K4
CO4	Evaluate diagnostic and therapeutic protocol: antiviral drugs, antifertility drugs, anticancerous agents, anti-inflammatory drugs, diagnostic kit and probes, Vaccines	K3,K4,K5
CO5	Facilitate the genetic counselling, prenatal diagnosis technique, treatment, methods of tracking diseased genes, diagnosis of genetic disorders.	K4,k5,K6

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

Unit I

The origin of medical genetics, classification of genetic diseases- definition and impact of genetic diseases, human chromosomes – structure and organization of DNA – Normal human karyotype, chromosomes abnormalities, disorder of autosomes and sex chromosome. **(7L)**

Unit II

Metabolic disorders and inherited disease- Diabetes, Hypertension, Alzheimer disease, Duchene's muscular dystrophy, Urolithiasis, Parkinson's disease, Schizophrenia, Hemophilia, Sickle cell anaemia. **(6L)**

Unit III

Carcinogenesis and mutation, phenotype of cancerous cells, Tumor suppressor oncogene, cancer stem cell theory, Radiotherapy, chemotherapy and immune therapy. **(6L)**

Unit IV

Diagnostic and therapeutic protocol: antiviral drugs, antifertility drugs, anticancerous agents, anti inflammatory drugs, diagnostic kit and probes, Vaccines. **(6L)**

Unit V

Genetic counselling, prenatal diagnosis technique, treatment, methods of tracking diseased genes, diagnosis of genetic disorders. **(5L)**

Total (30L)

Outcome: The students are expected to master all microbial related techniques.

References

1. Genetics – Strickberger, M.W, Printice Hall Edition 4, 1997.
2. Genes VII by Benjamin Lewin.
3. Cell and Molecular Biology – Robertis et al. Waverly publication, edition 8, 1995.
4. Molecular Biology of the Cell – Alberts, Garland Publication, edition 4 , 2002.
5. Principles of Genetics - E. J.Gardener, M.J. Simmons and D.P. Snustad, John Wiley and Sons publications.
6. The science of Genetics by Alen G. Atherly, Jack. R, Girton, Jhon. F, Mc Donald, Sounders college publishers.
7. Human Genetics, A. Gardener, R.T. Howell and T. Davies, published by Vinod Vasishtha for Viva Books private Ltd.

Mapping

GENETIC DISEASES												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	2	3	3	3	3	1	1	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	2	2	1	3
4	3	3	3	2	3	3	3	3	3	3	1	3
5	3	3	3	2	3	3	3	3	3	2	1	3
6	3	3	3	2	3	3	3	3	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

A. CANCER BIOLOGY

L	T	P	C
2	0	0	2

Objective: This course for non biology or non biotechnology students, who are interested to know about the Biology of Cancer.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	CANCER BIOLOGY	Cognitive Level
CO1	Illustrate the fundamentals of Cancer biology- regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor,	K1, K2
CO2	Understand the principles of carcinogenesis – Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis	K2 ,K3
CO3	Understand and learn the principles of Molecular Cell Biology of Cancer – Signal targets and cancer, activation of kinases, Oncogenes, Identification of oncogenes,	K2,K3
CO4	Recite the principles of cancer metastasis - Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade,	K3,K4
CO5	Predict new Molecules for Cancer Therapy – Different forms of therapy, chemotherapy, radiation therapy, detection of cancers	K4,K5,K6

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

Unit I

Fundamentals of Cancer biology- regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumour markers, molecular tools for early diagnosis of cancer. **(7L)**

Unit II

Principles of carcinogenesis – Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, X –ray radiation - mechanisms of radiation carcinogenesis. **(5L)**

Unit III

Principles of Molecular Cell Biology of Cancer – Signal targets and cancer, activation of kinases, Oncogenes, Identification of oncogenes, retroviruses and oncogenes, Oncogenes/proto oncogene activity. Growth factors related to transformation, telomerase. **(7L)**

Unit IV

Principles of cancer metastasis - Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion. **(6L)**

Unit V

New Molecules for Cancer Therapy – Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, advances in cancer detection. Use of signal targets towards therapy of cancer, Gene therapy. **(5L)**

Total (30L)

Outcome: This course creates knowledge in tumour, oncogenes, signals and diagnosis and treatment of Cancer.

References

1. Maly B.W.J, "Virology a Practical Approach", IRLI Press, Oxford, 1987.
2. Dunmock N.J and Primrose S.B., "Introduction to Molecular Virology", Blacwell Scientific Publications, oxford, 1988.
3. "An Introduction To Cellular and Molecular Biology of Cancer", Oxford Medocal Publications, 1991.

Mapping

CANCER BIOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	1	3	1	2	3	2
2	3	3	3	3	3	3	1	3	3	3	3	2
3	3	3	3	3	3	3	2	3	3	3	3	2
4	3	3	3	3	3	3	2	3	3	3	3	2
5	3	3	3	3	3	3	2	3	3	3	3	3
6	3	3	3	3	3	3	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

SEMESTER V
MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-V/Core-7

Major Paper 7- Recombinant DNA TECHNOLOGY

L	T	P	C
5	0	0	4

Objective: To give a basic Knowledge to the students of Biotechnology on recombinant DNA and related techniques.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	RECOMBINANT DNA TECHNOLOGY	Cognitive Level
CO1	Illustrate the scope of genetic engineering, restriction enzymes, ligases, alkaline phosphatase , polynucleotidekinase,	K1, K2
CO2	Construct the gene cloning vectors-Plasmids, construction of PBR ^{322}, Bacteriophage vectors, phagemids, cosmids, yeast vectors and expression vectors	K2 ,K3
CO3	Analysing DNA and protein sequences, polymerase chain reaction, inverse PCR, RT-PCR, Site directed mutagenesis.	K2,K3
CO4	Predict gene expression strategies: expression in bacteria, yeast, insect, and insect celllines, and mammalian cell lines.	K3,K4
CO5	Summarise transposon tagging, Role of gene tagging in gene analysis, transgenic animals (mice, cattle, fish), transgenic plants	K4,K5,K6

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

Unit I

History and scope of genetic engineering, restriction enzymes, ligases, alkaline phosphatase , polynucleotidekinase, terminal nucleotidyl transferase, DNA polymerases, Taq DNA polymerase, RNAse, reverse transcriptase, linkers, adapters, oligonucleotide primers and homopolymer tailing. **(11L)**

Unit II

Gene cloning vectors-Plasmids, construction of PBR ^{322}, Bacteriophage vectors, phagemids, cosmids, yeast vectors and expression vectors in prokaryotic and eukaryotics, cloning strategies-gene library construction, screening of gene library. **(13L)**

Unit III

Analyzing DNA and protein sequences, polymerase chain reaction, inverse PCR, RT-PCR, Site directed mutagenesis, phage display, nucleic acid microarrays, northern blot, uses of online tools-web cutters and SAGE (serial analysis of gene expression). **(12L)**

Unit IV

Expression strategies: expression in bacteria, yeast, insect, and insect celllines, and mammalian cell lines. Recombinant proteins, production, purification, re-folding and stabilization of proteins. **(12L)**

Unit V

Transposon tagging, Role of gene tagging in gene analysis, transgenic animals (mice, cattle, fish), transgenic plants (herbicide tolerance, delayed ripening) antisense RNA technology, human gene therapy. **(12L)**

Total (60L)

Outcome: This course will create an interest in genetic engineering and is essential for further studies in Biotechnology.

References

1. Primrose, S B, 1994, Molecular Biotechnology (2nd ED) Blackwell Scientific Publishers, Oxford.
2. James D. Watson. Recombinant DNA (2001). Scientific American Books. USA
3. Benjamin Lewin, Genes-V111, Oxford University press.
4. Glover, D.M and B.D Hames, DNA cloning1-4 (2006) Oxford University press.

Mapping

RECOMBINANT DNA TECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	1	1	2	3	3	3	3	2
2	3	3	3	3	2	3	2	3	3	2	2	2
3	3	2	2	3	3	3	2	3	3	3	3	3
4	3	3	3	3	3	3	2	3	3	2	2	3
5	3	3	3	3	3	3	2	3	3	3	3	3
6	3	3	3	3	3	3	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-V/Core-8

Major Paper 8 - ENVIRONMENTAL BIOTECHNOLOGY

L	T	P	C
4	0	0	4

Objective: This course is for biotechnology students, to create interest in Environment, and create knowledge in various environment protection techniques such as bioremediation, bioconversion etc.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	ENVIRONMENTAL BIOTECHNOLOGY	Cognitive Level
CO1	Learn recite habitat Ecology: Lithosphere, Hydrosphere, Atmosphere, Ecosystems – types, food chain, food web, Energy flow, Ecological niche type	K1, K2
CO2	Review and summarise environmental Pollution: Types, Air pollution - natural and anthropogenic sources of pollution, Primary and secondary pollutants,	K2 ,K3
CO3	Understand and learn water pollution – types and sources, consequences of water pollution, concepts of BOD, COD and DO, Analysis of water quality, Sewage and industrial waste water treatment and recycling of wastes	K2,K3
CO4	Analysis the soil quality, industrial waste effluents and heavy metals and their interaction with soil components	K3,K4
CO5	Illustrate bioransformation, bioconversion, bioremediation, phytoremediation, Environmental problems, Environmental monitoring	K2,K4,K5,K6

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

ENVIRONMENTAL BIOTECHNOLOGY

Unit 1

Habitat Ecology: Lithosphere, Hydrosphere, Atmosphere, Ecosystems – types, food chain, food web, Energy flow, Ecological niche type**.**

(12L)

Unit 2

Environmental Pollution: Types, Air pollution - natural and anthropogenic sources of pollution, Primary and secondary pollutants, Transport and diffusion of air pollutants, gas laws governing the behaviour of pollutants in atmosphere, methods of monitoring and control of air pollutants, Biogas production **(14L)**

Unit: 3

Water pollution – types and sources, consequences of water pollution, concepts of BOD, COD and DO, Analysis of water quality, Sewage and industrial waste water treatment and recycling of wastes. **(10L)**

Unit: 4

Soil pollution – soil quality analysis, industrial waste effluents and heavy metals and their interaction with soil components. Noise pollution – sources, measurement and control. Marine pollution – sources and its control.

(12L)

Unit: 5

Bioransformation – bioconversion, bioremediation, phytoremediation, Environmental problems, Environmental monitoring – Biosensors and biological indicators, Effect of pollutants in human beings, plants, animals and climate. **(12L)** **Total (60L)**

References

1. Environmental Biotechnology – Sayler and Fox
2. Microbial Biotechnology – A N Glazer
3. Ecology – Eugine P. Odum, Saunders College Pub New York, 1983.
4. Ecology and Environment – P.D. Sharma, Narosa Pub, 1999.
5. Waste water Engineering – treatment, disposal and Reuse – Metcalf and Eddy, Inc. Tata. Mc. Graw Hill, New Delhi.
6. Introduction to Biodeterioration. D Allsopp and K. J. Seal, ELBS/Edward Arnold.

Mapping

ENVIRONMENTAL BIOTECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	2	3	3	2	3	2	2	3	2
2	3	3	3	3	3	3	2	3	3	3	3	1
3	3	3	3	3	3	3	2	3	3	3	3	1
4	3	3	3	3	3	3	2	3	3	3	3	3
5	3	3	3	3	3	3	2	3	3	3	3	1
6	3	3	3	3	3	3	2	3	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-V/Core-9

Major Paper 10- FOOD TECHNOLOGY

L	T	P	C
4	0	0	4

Objectives: This course is designed to give adequate knowledge on food technology so as to train the students' entrepreneurs

Course Outcomes

On completion of the course, the students will be able to

CO. No.	FOOD TECHNOLOGY	Cognitive Level
CO1	Learn the constituent of food - contribution to texture, flavour and organoleptic properties of food	K1, K2
CO2	Understand the Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food borne diseases - infections and intoxications, food spoilage - causes.	K1,K2 ,K3
CO3	Food Processing Raw material characteristics; cleaning, sorting and grading of foods.	K2,K3
CO4	Food Preservation Use of high temperatures - sterilization, pasteurization, blanching	K3,K4
CO5	Manufacture of food products Bread and baked goods, dairy products - milk processing,	K4,K5,K6

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

Unit I : Food chemistry Constituent of food - contribution to texture, flavour and organoleptic properties of food; food additives - intentional and non-intentional and their functions; enzymes in food processing. **(12L)**

Unit II: Food Microbiology Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food borne diseases - infections and intoxications, food spoilage - causes. **(12L)**

Unit III : Food Processing Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations - mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing. **(12L)**

Unit IV : Food Preservation Use of high temperatures - sterilization, pasteurization, blanching, canning - concept, procedure & application; Low temperature storage - freezing curve characteristics. Factors affecting quality of frozen foods; irradiation preservation of foods. **(12L)**

Unit V: Manufacture of food products Bread and baked goods, dairy products - milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; meat, poultry and fish products; confectionery, beverages. **(12L)** **Total (60L)**

Text Books

1. Crosby, N.T. 1981. Food packaging. Materials Applied Science Publishers, London.

2. David, S. Robinson. 1997. Food Chemistry and nutritive value. Longman group, UK.

3. Frazier, W.C. and Westhoff, D.C. 1988. Food Microbiology. 4th Edition. McGram-Hill, New York.

4. Pyke, M. 1981. Food Science and Technology. 4th Edition. John Murray, London.

5. Sivasankar, B. 2002. Food processing and preservation. Prentice Hall, New Delhi. Reference Books

Mapping

FOOD TECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	2	1	2	3	3	3	2	2
2	3	3	3	3	3	3	2	3	3	3	2	2
3	3	3	3	3	3	3	2	3	3	3	1	1
4	3	3	3	3	3	3	2	3	3	3	3	3
5	3	3	3	3	3	3	2	3	3	3	2	3
6	3	3	3	3	3	3	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/semV/MajorElective-1

MAJOR ELECTIVE (Select any one)

A. NANOBIOTECHNOLOGY

L	T	P	C
4	0	0	4

Objective:
This course is for biotechnology students, who are interested to know about the methods and application of modern Nanobiomolecules and their contribution in the various fields of biotechnology and healthcare.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	NANOBIOTECHNOLOGY	Cognitive Level
CO1	Learn and restate the fabrication and characterization of nanostructures	K1, K2
CO2	Understand, interpret and relate the Nano materials, Classify based on dimensionality-Quantum Dots, Wells and Wires-Carbon- based nano materials	K2 ,K3
CO3	Prepare and evaluate protein based nanostructures building blocks and templates, DNA based nanostructures	K3,K4
CO4	Apply and evaluate nanotechnology in agriculture – Fertilizer and pesticides, food, electronics, fabric, solar cells,	K3,K4,K5
CO5	Create biomaterials, integrate biological responses (extra and intra vascular system) – Metallic, Ceramic and Polymeric implant materials.	K4,K5,K6

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

Unit I
Fabrication and characterization of nanostructures **-** Introduction – Scientific revolutions –Time and length scale in structures – Definition of a nanosystem, Chemical methods, Physical methods, Microbial production of inorganic nanoparticles, Characterization: UV Spectroscopy, FTIR, SEM, TEM, AFM.**(13L)**

Unit II
Nano materials - Classification based on dimensionality-Quantum Dots, Wells and Wires-Carbon- based nano materials (buckyballs, nanotubes, graphene)– Metal based nano materials (nanogold, nanosilver and metal oxides) - Nanocomposites- Nanopolymers – Nanoglasses –Nano ceramics. **(12L)**

Unit III
Biology inspired concepts **-** Protein based nanostructures building blocks and templates, DNA based nanostructures – Topographic and Electrostatic properties of DNA and proteins, Use of DNA molecules in nanomechanics and nanocomputing. **(11L)**

Unit 1V
Application of Nanoparticles **-** Introduction to bio sensors and tissue engineering , Targetted nanoparticles for drug delivery, Nanotechnology in agriculture – Fertilizer and pesticides, food, electronics, fabric, solar cells, fabric Future of Bionanotechnology. **(12L)**

Unit V
Biomaterials - Classification of biomaterials – Comparison of properties of some common biomaterials - Effects of physiological fluid on the properties of biomaterials – Biological

responses (extra and intra vascular system) – Metallic, Ceramic and Polymeric implant materials. **(12L)**

Total (60L)

Outcome:

This course create knowledge to biotechnology students, about the methods and application of modern Nanobiomolecules and their contribution in the various fields of biotechnology and healthcare.

References

1. Nabok A., "Organic and Inorganic Nanostructures", Artech House, 2005.
2. Dupas C., Houdy P., Lahmani M., "Nanoscience: Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.
3. Rolf E. Hummel, "Electronic Properties of Materials", 4th Ed., Springer, New York, 2011.
4. Silver F. and Dillion C., "Biocompatibility: Interactions of Biological and Implantable Materials", VCH Publishers, New York, 1989

Mapping

NANOBIOTECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	2	2	3	3	3	2	2
2	3	3	3	3	3	2	2	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	2	2
4	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

A. GENOMICS

L	T	P	C
4	0	0	4

Objective: This course is for biotechnology students, who are interested to know about the methods and application of genomics and proteomics, tools and software of bioinformatics at the elementary levels.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	GENOMICS	Cognitive Level
CO1	Recall and recite overview of genome, sequence of genome acquisition and analysis, homologies, SNPs	K1, K2
CO2	Restate DNA sequencing methods, Maxam and Gilbert method, ladder, Fluorescent, Shot gun, Mass Spectrometry,	K2 ,K3
CO3	Apply and analyse Genome Data Bank, metabolic pathway data – construction and screening of cDNA, libraries and microarrays	K3.K4
CO4	Predict Protein sequence Analysis,sequence data banks WBRF – PIR – SWISSPROT – databases	K3,K4,K5
CO5	Create Tools for data bank – pairwise alignment – Needleman and Wusch algorithm - Smithj waterman	K4,K5,K6

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

Unit I

Genome – overview of genome, sequence of genome acquisition and analysis – homologies – SNPs – Genetic analysis, Linkage mapping, High Resolution Chromosome mapping and analysis – Physical mapping, YAC, Hybrid mapping, strategies, Sequence Specific Tags (SST), Sequence Tagged Sites (STS), ISH, FISH, RFLP, RAPD. **(13L)**

Unit II

DNA sequencing – methods, Maxam and Gilbert method, ladder, Fluorescent, Shot gun, Mass Spectrometry, automation sequencing – Find gene mutations, implications of DNA – Sequencing and sequencing genomes. **(12L)**

Unit III

Genome Data Bank, metabolic pathway data – construction and screening of cDNA, libraries and microarrays – Applications of DNA arrays – PCR – Variations in PCR – Gene Disruptions – Sage and Sade, Pharmacogenomics. **(12L)**

Unit IV

Protein sequence Analysis – introduction – sequence data banks – WBRF – PIR – SWISSPROT – databases, data mining – algorithms of Proteomics and its applications - Protein Expression profiling – Protein protein interactions – Protein modifications. Automation - nucleic acid data bank – EMBL Nucleotide sequence data bank – AIDS virus sequence data bank – RNA data bank. **(12L)**

Unit V

Tools for data bank – pairwise alignment – Needleman and Wusch algorithm - Smithj waterman – Multiple alignment – CLUSTRAL – PRAS –BLAST – FAST, Algorithms to analyse sequence data – PDB, Cambridge structure data base (ISD), 2d electrophoresis, IEF, HPLC, Protein digestion technique, Mass spectrometry, MALDI, TOF, peptides, mass fingerprinting. **(11L)**

Total (60L)

Outcome: This paper create knowledge about rapidly growing branches of highthroughput, large scale biology & maturing discipline like Genomics and Proteomics. This paper includes genome analysis, proteome analysis, and structural & functional proteomics.

REFERENCE

1. Principles of Proteomics, R.M. Twyman
2. Handbook of Proteomic Method, P. Michael Conn
3. Proteomics – Introduction to methods and applications, A. Kraj and J. Silberring
4. Genomics, Cantor and Smith
5. Biochemistry, L. Stryer
6. Bioinformatics computing, Bergeron
7. Computational Molecular Biology, P. Clote and R. Backofen
8. Bioinformatics, Biocomputing and Perl: An introduction to Bioinformatics computing skills, Michad Moorhiase and Paul Barry John

Mapping

GENOMICS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	2	3	3	2	3	3	3	1	3	3	3	2
2	3	3	3	2	3	3	3	1	3	2	2	2
3	2	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	1	3	3	3
5	2	3	3	2	3	3	3	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-V/Core Practical-5

Major Practical V: Lab in RECOMBINANT DNA TECHNOLOGY

L	T	P	C
0	0	4	2

Objective: To give a basic Knowledge to the students of Biotechnology on recombinant DNA and related techniques.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Lab in RECOMBINANT DNA TECHNOLOGY	Cognitive Level
CO1	Isolate DNA - from Plant cell, Animal cell (goat liver), & Microbes, Isolate Plasmid DNA from bacteria.	K1, K2
CO2	Perform gel electrophoresis and digestion of plasmid DNA with restriction digestion	K2 ,K3
CO3	Perform ligation of DNA fragment and elution of DNA from agarose gel electrophoresis	K2,K3
CO4	Experiment Polymerase Chain Reaction and Gel documentation & photography, RFLP and RAPD	K3,K4

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

Lab in RECOMBINANT DNA TECHNOLOGY

1. DNA isolation - from Plant cell, Animal cell (goat liver), & Microbes
2. Plasmid DNA isolation
3. Gel electrophoresis
4. Digestion of plasmid DNA with restriction digestion
5. Ligation of DNA fragment
6. Elution of DNA from agarose gel electrophoresis
7. Polymerase Chain Reaction
8. Gel documentation & photography
9. RFLP and RAPD mapping - Demonstration
10. Southern blotting technique

Mapping

RECOMBINANT DNA TECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	2	2	3	3	3	3	3	3	2	3	3	2
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	2	3	2	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-VI/Core Practical-6

PRACTICAL – Lab in ENVIRONMENTAL BIOTECHNOLOGY

L	T	P	C
0	0	3	2

Objective: This course is for biotechnology students, to create interest in Environment, and create knowledge in various environment protection techniques such as bioremediation, bioconversion etc.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	ENVIRONMENTAL BIOTECHNOLOGY	Cognitive Level
CO1	Assess of total Coliforms from potable water systems, Water quality analysis, pH and stability	K5
CO2	Determine Total Dissolved Solids in water, Determine Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in sewage water.	K2 ,K3
CO3	Estimate of nitrate in drinking water, Quantify dissolved oxygen concentration in a water sample	K2,K3
CO4	Culture sewage water for the determination of microbial occurrence,Growth response of bacteria on petroleum fuel	K3,K4

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

Lab in ENVIRONMENTAL BIOTECHNOLOGY

1. Assessment of total Coliforms from potable water systems.
2. Water quality analysis, pH and stability.
3. Determination of Total Dissolved Solids in water
4. Quantification of dissolved oxygen concentration in a water sample
5. Determination of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in sewage water.
6. Estimation of nitrate in drinking water.
7. Biogas production – demonstration.
8. Culture of sewage water for the determination of microbial occurrence.
9. Growth response of bacteria on petroleum fuel.
10. Visit to Spirulina/ Mushroom production units/ Industrial waste water treatment plants.

Mapping

ENVIRONMENTAL BIOTECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	2	2	3	3	3	2	3	3	2	2	3
2	3	3	3	3	3	3	2	3	3	3	3	3
3	3	3	3	3	3	3	2	3	3	3	3	3
4	3	3	3	3	3	3	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-V/Core Elective Practical-7

Major Practical IX: Lab in FOOD TECHNOLOGY

L	T	P	C
0	0	4	2

Objectives: This course is designed to give adequate knowledge on food processing technique to train the students' entrepreneurs

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Lab in FOOD TECHNOLOGY	Cognitive Level
CO1	Isolate microorganism from fruits from internal and external, Isolate microorganism from fish surface	K2
CO2	Qualitative examination of milk by methylene blue test and Qualitative examination of milk by Resazurin test	K2 ,K3
CO3	Produce pickles from various food products- Fish, vegetables, meat etc.,	K2,K3
CO4	Test various Soft drinks, Produce squash, Jam	K3,K4

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

Lab in FOOD TECHNOLOGY

1. Isolation of microorganism from fruits from internal and external
2. Isolation of microorganism from fish surface
3. Qualitative examination of milk by methylene blue test
4. Qualitative examination of milk by Resazurin test
5. Production of pickles from various food products- Fish, vegetables, meat etc.,
6. Production of squash, Jam
7. Demonstration of Bread Making.
8. Testing of Soft drinks.

Mapping

FOOD TECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	3	2	3	3	3	3	3
2	3	3	3	3	3	3	2	3	3	3	3	3
3	3	3	3	3	3	2	2	3	3	3	3	3
4	3	3	3	3	3	2	1	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

SEMESTER-VI
MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-VI/Core-10
Major Paper 10 - PLANT AND ANIMALBIOTECHNOLOGY

L	T	P	C
4	0	0	4

Objective: To introduce the basics of the subject of Plant and animal biotechnology and its applications to the students in an attractive and simple manner.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	PLANT AND ANIMALBIOTECHNOLOGY	Cognitive Level
CO1	Understand about Plant tissue culture and restate various Micro propagation techniques	K1,K2
CO2	Recite the techniques of Embryo culture, Protoplast culture, Somatic embryogenesis, and cryopreservation. Relate the Gene transfer methods in Transgenic plants such as insect, fungus, cold, drought and saline resistant plants	K3,K3,K4
CO3	Learn Animal Biotechnology and Culture of animal cells. Understand Transgenic animals and their applications.	K2, K4
CO4	Create knowledge in Animal cloning. Analyses the economic importance of farm animals. Learn Cryobiology and gene mapping.	K1, K2, K6
CO5	Understand the Role of plant tissue culture in agriculture, forestry and horticulture. Learn about animal cell-based vaccines. Rephrase Social ethical and legal issues in Biotechnology	K1, K2, K3

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

Unit: 1

Plant tissue culture – History, totipotency, explant, Procedures in plant tissue culture – Fumigation, Sterilization, media preparation, plant growth regulators, Callus induction and culture, Suspension culture, Organogenesis, Micropropogation, Single Cell culture, , virus elimination and shoot tip cultures, synthetic seeds, somaclonal variation (14 L)

Unit : 2

Embryo culture, Protoplast culture, Somatic embryogenesis, cryopreservation, Gene transfer methods, Transposons, Gene silencing, Molecular markers – types and uses, Plant genome projects, Germplasm conservation, Transgenic plants – insect, fungus, cold, drought and saline resistant plants, transgenic cotton and transgenic brinjal (12L)

Unit : 3

Animal Biotechnology – Culture of animal cells, cell lines, media preparation, Suspension culture, embryo culture, teratogenesis and teratomas, Transformation of animal cells – vectors, Transgenic animals, production of recombinant proteins, Mammalian cell line culture, Edible vaccine (10 L)

Unit: 4

Animal cloning – Cryobiology, Embryo fusion, Baculovirus in biocontrol and foreign gene expression, silk worm and fish as bioreactors, Reproductive cloning, Mammalian embryo fusion, Gene mapping and identification of genes of economic importance in farm animals(10 L)

Unit: 5

Role of plant tissue culture in agriculture, forestry and horticulture, Procedures involved in commercialization of transgenic crops, Application of animal Biotechnology, Gene therapy – types, and applications, animal cell based manufacturing - vaccines, toxicity testing and tissue engineering, Social ethical and legal issues in Biotechnology (14 L)

Total (60L)

References

1. J. Hammod, P Mcarvey and V. Yasibov (Eds). Plant Biotechnology Springer Verlag 2000.
2. T. J. Fu, G. Singh and W. R. Curtis (Eds), Plant cell and tissue culture for the production of food ingredients, Kluwer Academic/ Plenum Press. 1999.
3. Paul Christou and Hary Klee (2004), Handbook of Plant Biotechnology, Vol. I and II John Wiley and Sons.
4. P. K. Guptha. Elements of Biotechnology. Rastogi and Co, Meerut, 1996.
5. Animal Biotechnology – R Sasidhara, MJP Publishers, 2006.
6. Animal Biotechnology – M Ranga, Studam Publishers, 2006.
7. A text book of Biotechnology, R C Dubey, S Chand Co. Ltd.

Mapping

PLANT AND ANIMALBIOTECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	2	3	2	3	1	3	1	2
2	3	3	3	3	2	3	2	3	3	3	3	2
3	3	3	3	3	2	3	2	3	3	3	3	2
4	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	2	3
6	3	3	3	3	3	3	3	3	3	3	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

Major Paper 11- BIOINFORMATICS

L	T	P	C
4	0	0	4

Objective: This course is for biotechnology students, who are interested to know about the methods and application of bioinformatics, databases, tools and software of bioinformatics at the elementary levels.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	BIOINFORMATICS	Cognitive Level
CO1	Learn the application of Bioinformatics to create algorithm.	K2, K6
CO2	Know about Data banks, Analyses Ramachandran map	K2, K4
CO3	Understand about data mining and data ware house. Demonstrate the pairwise, multiple sequence alignment.	K2, K4
CO4	Create knowledge in cytochrome c and 16s RNA sequencing. Know about Primer design.	K1, K2, K6
CO5	Predict structure for RNA and DNA, create structure modelling.	K4,K5,K6

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

BIOINFORMATICS

Unit I

Bioinformatics - an overview, Scope and applications. Introduction to computers, file management, Algorithm- definition and examples- Types of Algorithm-iterative, recursive, fast and slow algorithms. **(11L)**

Unit II

DNA databank--the EMBL nucleotide sequence data bank, The protein sequence database-the NBRI-PIR database, macro molecular structures, Ramachandran map – peptide data bank, enzyme databases-cloning vector data bases. **(12L)**

Unit III

In Data mining, Data ware housing, BLAST, FASTA algorithm to analysis sequence data. Pair-wise alignment and Multiple alignment of nucleic acids and protein sequences, CLUSTALW. **(11L)**

Unit IV

Primer Designing, degenerative primers, calculation of annealing temperature, Cytochrome C oxidase gene sequencing, 16S RNA sequencing, complementary & reverse complementary strands. **(12L)**

Unit V

Structure prediction of RNA and Protein, RASMOL, Molmol, Concepts of structure modelling, modelling and threading, Drug design, Access of web based bioinformatics tools. Principle and types of Molecular docking. **(14L)**

Total (60L)

Outcome: This course create knowledge to the students of biology about the importance of the bioinformatics, databases, tools and software of bioinformatics at the elementary levels.

References

1. Introduction to computers – Balaguruswamy
2. Vittal R. Srinivas, " BIOINFORMATICS : A MODERN APPROACH" , 2005, ISBN : 978-81-203-2858-7, published by PHI Learning Private Limited, New Delhi.
3. Andreas D.Baxevanis, B.F. Francis Ouellette, "Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins", Third Edition, 2005-2006, ISBN: 978-81-265-2192-0, published by John Wiley & Sons INC., U.K.

Mapping

BIOINFORMATICS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	1	1	2	3	3	3	3	2
2	3	3	3	3	3	3	2	3	3	3	3	2
3	3	3	3	3	3	3	2	3	3	3	3	23
4	3	3	3	3	3	3	2	3	3	3	3	3
5	3	3	3	3	3	3	2	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.Sc Biotechnology/sem-VI/Core-12

Major Paper 11-BIOPROCESS TECHNOLOGY

L	T	P	C
4	0	0	4

Objective: To introduced the industrial application of Bioprocess technology through this course. Students should be trained to understand commercial importance of biotechnology through its industrial aspects.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	BIOPROCESS TECHNOLOGY	Cognitive Level
CO1	Recall and recite the fundamentals of bioprocess engineering. Analyses the development of inoculums for yeast, bacteria, mycelia and fungal processes.	K2, K6
CO2	Demonstrate the Sterilization methods continuous, pasteurization, batch sterilization, continuous sterilization, filter sterilization. Rephrase Microbial growth kinetics.	K2, K4
CO3	Understand Bioreactor and their applications.	K2, K4
CO4	Learn Downstream process. Understand Purification techniques such as ultrafiltration, reverse osmosis, dialysis, Chromatography.	K1, K2, K6
CO5	Understand Microbial products in pharma, food and Agriculture production and their harvesting methods	K1, K2, K3

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

BIOPROCESS TECHNOLOGY

Unit I

Fundamentals of Bioprocess engineering: Introduction of bioprocess, Media design and usage in fermentation, Types of media, composition of media – carbon sources, nitrogen sources, vitamins, mineral, inducer, precursors and inhibitors. Microbial growth, isolation and preservation and maintenance of industrial microorganism, Inoculums development: Development of inoculums for yeast, bacteria, mycelia and fungal processes, Aseptic inoculation of the fermentor. **(12L)**

Unit II

Sterilization methods: Moist, heat, dry heat, flame, filter, gas, HTST, Treatment: continuous, pasteurization, batch sterilization, continuous sterilization, filter sterilization. Microbial growth kinetics: Factors affecting microbial growth, fermentation kinetics. **(11L)**

Unit III

Bioreactor : Introduction to bioreactor, Batch and fed batch reactor, continuous reactor, solid state and submerged, aerobic and anaerobic fermentation, mixed microbial population, immobilization of cells and co immobilization, immobilized reactor, Design of bioreactor: construction of material, Basic components – Agitator, aerator, valves, seals, stirrer, glands, measurement and control of parameters, pH ,Do, gas, analysis, control pathway, computer in controlling, Air lift, stirred tank, tower, fluidized bed, packed bed, pulsed filed, Photoreactor. **(13L)**

Unit IV

Downstream processing: Biomass removal, separation of microbial cells and solid matters, centrifugation, sedimentation, flocculation, microfiltration, Disintegration of microorganism : Sonification, bead mills, homogenizers, chemical lysis, enzymatic lysis, membrane based purification, ultrafiltration, reverse osmosis, dialysis, Chromatography: size , charge, shape, hydrophobic interaction, Drying :spray driers, drum driers, freeze dries. **(12L)**

Unit V

Microbial products in pharma, food and agri, production and harvest , recovery and use, enzymes, antibiotics : (Pencillin, tetracycline, streptomycin) Vitamin (B2 & B12) Aminoacid (Lysine, glutamic acid, arginine, threonine) Organic solvents (acetone, butanol, ethanol, glycerol) Organic acid (acetic acid, citric acid, latic acid) use of microbes in mineral beneficiation recovery. **(12L)**

Total (60L)

Outcome: This course is improving the principles of fermentation, rheological behavior of fluids and mass transfer. Further the students are enriched to apply these principles to bioprocessing units.

References

1. Principles of Fermentation Technology by P.F. Stanbury and A. Whitaker, Pergamon Press, 2nd Edition, 2005.
2. Industrial Microbiology by Prescott and Dunns 4th edition edited by Gerald reed, Chapman and Hall Publications, 2007.
3. Introduction to Biochemical engineering by D.G. Rao, McGraw- Hill Publications, 1st Edition, 2007.

Mapping

BIOPROCESS TECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	2	3	3	2	2	3	3	2	3	2
2	3	2	3	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	2	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3
6	3	3	3	3	3	3	3	3	3	3	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/ 2021-22 / UG-Colleges /B.ScBiotechnology/semVI/Core Elective-2

MAJOR ELECTIVE (Select any one)

A. CLINICAL RESEACH

L	T	P	C
4	0	0	4

Objective: To understand the basic steps in the drug research, toxicological, pre-clinical and clinical studies.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	CLINICAL RESEACH	Cognitive Level
CO1	Know basics of drug discovery, drug discovery and drug development.Understand pharmaco dynamic and pharmacokinetic (ADME).	K1, K2, K6
CO2	Evaluate drug discovery process and ethics in clinical research, unethical trials, thalidomide tragedy	K2, K4
CO3	Experiment Clinical trials - phase I, II, III, IV trials. Rephrase monitoring treatment outcome – termination of trial and safety monitoring in clinical trials	K2,K3, K4
CO4	Understand the General principles of toxicology studies such as carcinogenicity, mutagenicity, teratogenicity, reproductive toxicity, local toxicity, genotoxicity.	K1, K2, K6
CO5	Recall Basic terminology used in clinical research. Know the Types of clinical trials – single blinding, double blinding, randomized trials.	K1, K2, K3

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

CLINICAL RESEACH

Unit I

Introduction to drug discovery and drug development, basics of pharmacology and clinical research. Basic knowledge about receptors, drugs, pharmacodynamic, pharmacokinetic (ADME), Introduction to pharmacoeconomics. **(12L)**

Unit II

New drug discovery process – purpose, main steps involved in new drug discovery process, timelines for each steps, advantages and purpose of each steps, ethics in clinical research, unethical trials, thalidomide tragedy. **(11L)**

Unit III

Clinical trials - phase I, II, III, IV trials, Post marketing surveillance-methods – principles of sampling – inclusion and exclusion criteria – methods of allocation and randomization – informed consent process (in brief) – monitoring treatment outcome – termination of trial – safety monitoring in clinical trials. **(13L)**

Unit IV

Preclinical toxicology: General principles, systemic toxicology (single dose and repeated dose toxicity studies), carcinogenicity, mutagenicity, teratogenicity, reproductive toxicity, local toxicity, genotoxicity. **(12L)**

Unit V

Basic terminology used in clinical research, Types of clinical trials – single blinding, double blinding, randomized trials, cross over design and their examples, interventional study, ethical committee and its members, Institutional ethical committee, Data management in clinical trials. **(12L)**

Total (60L)

Outcome: Students acquire a basic understanding about the drug research.

References:

1. Basic and Clinical Pharmacology, Prentice Hall, International, katzung, B.G.
2. Clinical Pharmacology. Scientific book agency, Laurence, D.R and Bennet P.N.
3. Clinical Pharmacy and Therapeutics. Herfindal E.T., Hirschman J.L., Williams and Wilkins.
4. Drug Interaction, Kven Stockley, Hamsten.

Mapping

CLINICAL RESEACH												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	1	2	3	3	3	2	3	2
2	3	2	2	3	3	3	3	3	3	2	3	3
3	3	2	3	3	2	3	3	3	3	3	3	3
4	3	3	3	3	3	2	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	2	3	2	3
6	3	3	3	3	3	1	2	1	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

A. BIOSAFETY AND BIOETHICS

L	T	P	C
4	0	0	4

Objective: To introduce Biosafety regulations and ethical practices in biotechnology.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	BIOSAFETY AND BIOETHICS	Cognitive Level
CO1	Learn the Benefits of biotechnologies and Biotechnology, Recombinant therapeutic products for human and health care. Know the Social issues – Public opinions against the molecular technologies.	K2, K6
CO2	Know the Basic of Patentability and Pharmaceutical Industry-issues. Learn IPR: Copyright- Trade Mark and designs.	K2, K4
CO3	Learn biosafety, framework of biosafety regulation I in India. Understand the Regulation of Genetically modified Organism in India.	K2, K4
CO4	Rephrase Bioethics, IPR, ethical issues and Ethical clearance norms.	K1, K2, K6
CO5	Recall ethical issues against the molecular technologies, and National & International. Legal issues- Legal actions taken by countries for use of the molecular technologies.	K1, K2, K3

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

BIOSAFETY AND BIOETHICS

Unit I

Biotechnology – Society, Risks, Ethics and Patenting. Benefits of biotechnology, ELSI of Biotechnology, Recombinant therapeutic products for human and health care. Genetic modifications, recombinant foods, safety of GM foods. Release of genetically engineered organisms- Human embryonic stem cell research – cloning. Social issues – Public opinions against the molecular technologies. **(13L)**

Unit II

Patents – Basic of Patentability-Non Patentable Inventions- Patent Application – Producer in India – Treaties and conventions of patents – Patent Cooperation Treaty – TRIPS and Pharmaceutical Industry- issuses and prospects. Other Forms of IPR : Copyright- Trade Mark – designs – Know how – Patenting of biotechnology products and processes. **(14L)**

Unit III

Biosafety – definitions- biosaftey level, framework of biosafety regulation I India, structure and functions of committees, DBT guidelines on biosafety in conducting research in biology/biotechnology- Regulation of Genetically modified Organism in India- Biosafety regulation fortransgenicplants and animals – labeling of GM foods. **(12L)**

Unit IV

Bioethics – definition – Bioethics of IPR- ethical in biotechnology-animal ethics Guidelines for use of lab animals in medical colleges- Licensing of animal house- Human cloning- ethical issuses- Ethical clearance norms. **(10L)**

Unit V

Ethical issues – ethical issues against the molecular technologies, Bioethics- Necessity of Bioethics, different paradigms of bioethics – National & International. Legal issues- Legal actions taken by countries for use of the molecular technologies. **(11L)**

Total (60L)

Outcome: Create Indepth Knowledge on biosafety regulatory frame work for GMO's. Exposure to legal and socio economic impacts of biotechnology, Exposure to ethical concerns of biotechnology research.

References

1. Biosafety, Traylor,Fredric&Koch , 2002 . Michigsn state University Pub., USA
2. Contemporary issuses in Bioethics, Beauchamp& Leory, 1999.Wardsworth Pub. Co.Belmont, California
3. Manual of patent practice and procedure. IRP India, 2005. Ministry of commerce and industry, NewDelhi . PP 163.
4. Biotechnolgy and safety assessment, John A. Thomas, 2004.pp 333.

Mapping

BIOSAFETY AND BIOETHICS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	2	2	3	3	3	3	3	2	2
2	3	3	3	2	2	3	3	3	3	3	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	2	2	3	3	3
5	3	3	3	2	2	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

A. DEVELOPMENTAL BIOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES: To understand the sequential changes from single cell organization to organ level of organization in the development of multicellular organisms.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	DEVELOPMENTAL BIOLOGY	Cognitive Level
CO1	Recall and recite Gametogenesis & Fertilization: Spermatogenesis – definition **-** Development and structure of mammalian sperm.	K1,K2,K3
CO2	Demonstrate types of cleavage, factors affecting cleavage, molecular changes, Cleavage in Frog, and Chick, Amphibians, Mammals, Morula and Blastulation.	K2, K4
CO3	Understand Fate maps & Gastrulation**:** Natural and Artificial Marking in eggs. Gastrulation Definition and process in Frog, Amphibians, Mammals, Chick and chick embryo gastrulation.	K2, K4
CO4	Learn the Organogenesis & Regeneration process, Development of brain and heart in Chick. Foetal membranes in chick, Organizer, Placenta in mammals.	K1, K2, K6
CO5	Know the metamorphosis, Hormonal control of metamorphosis in amphibians. Insect metamorphosis**.** Environmental Influences on Development	K1, K2, K3

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

DEVELOPMENTAL BIOLOGY

Unit I

Gametogenesis & Fertilization: Spermatogenesis – definition **-** Development and structure of mammalian sperm. Mechanism and significance of Oogenesis, Vitellogenesis Types of eggs and egg membranes. Reproduction: Structure of human testis and ovary, Graafian follicle, Menstrual cycle and its hormonal control. **(11L)**

Unit II

Cleavage: Definition-Cleavage, types of cleavage, factors affecting cleavage, molecular changes, Cleavage in Frog, and Chick, Amphibians, Mammals, Morula and Blastulation. Fertilization: Pre and Post fertilization events -significance; Parthenogenesis **(12L)**

Unit III

Fate maps & Gastrulation**:** Natural and Artificial Marking in eggs. Gastrulation Definition and process in Frog, Amphibians, Mammals, Chick and chick embryo gastrulation. Test tube babies –Twins Amniocentosis, Nuclear Transplantation in Acetabularia **(12L)**

Unit IV

Organogenesis & Regeneration: Development of brain and heart in Chick. Foetal membranes in chick, Organizer, Placenta in mammals. Regeneration – Definition, Types –Regeneration in Amphibians –Regeneration in Planaria. Birth control : Contraceptive devices: urgical method – Hormonal methods **(13L)**

Unit V

Metamorphosis: Definition and Significance. Hormonal control of metamorphosis in amphibians. Insect metamorphosis**.** Environmental Influences on Development **(12L)**

Total (60L)

Outcome: understands the students about sequential changes from single cell organization to organ level in the development of multicellular organisms.

References:

1. Modern Embryology, Saunders International student edition,
2. Philadelphia.3rd Edition 1981. Eli Benjamini et al., (1991)
3. Developmental biology Gilbert, Scott's. (1985). Sinauer Association, Inc., Publishers.
4. Chordate embryology, Verma , P.S., V.K. Agarwal and Tyagi, 1995. S. Chand & Co., New Delhi.
5. Chordate Embryology, S.Chand and Co. Ltd., New Delhi (1998). Bodmer,

Mapping

DEVELOPMENTAL BIOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	1	1	3	2	3	3	3	3	3	3
2	3	3	3	2	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	2	3	3	3	3	3	3
5	3	3	3	3	3	2	2	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

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Major Practical VIII: Lab in PLANT & ANIMAL BIOTECHNOLOGY

L	T	P	C
0	0	3	2

Objective: To study the basics technique of Plant and animal biotechnology and its application.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Lab in PLANT & ANIMAL BIOTECHNOLOGY	Cognitive Level
CO1	Design own plant tissue culture laboratory, Sterilize plant materials, Prepare plant tissue culture media	K2, K6
CO2	Establish Callus, Synthetic seeds, Isolate protoplast from plant cells	K2, K3,K4
CO3	Perform Cell suspension culture and Acclimatisation	K2, K4
CO4	Prepare animal tissue culture medium and membrane filtration Perform Demonstration on Measurement of doubling time, DNA Isolation from animal cells, handling lab animals.	K1, K2, K3

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

Lab in PLANT & ANIMAL BIOTECHNOLOGY

1. Organization of plant tissue culture laboratory
2. Sterilization of plant materials
3. Preparation of plant tissue culture media
4. Callus establishment
5. Synthetic seeds
6. Isolation of protoplast from plant cells
7. Cell suspension culture
8. Acclimatisation
9. Preparation of animal tissue culture medium and membrane filtration
10. Demonstration on Measurement of doubling time
11. Demonstration of DNA Isolation from animal cells
12. Demonstration of handling lab animals.

Mapping

PLANT & ANIMAL BIOTECHNOLOGY												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	2	3	2	3	3	3	3	3	3	2	2
2	3	3	3	3	3	3	3	3	3	2	2	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

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Major Practical IX: Lab in BIOINFORMATICS

L	T	P	C
0	0	2	2

Objective: This course is to study the methods and application of bioinformatics, Biological database, tools and software of bioinformatics at the elementary levels.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Lab in BIOINFORMATICS	Cognitive Level
CO1	Retrieve nucleotide sequence, protein sequence	K2, K6
CO2	Perform BLAST – pairwise sequence alignment, FASTA – pairwise sequence alignment	K2, K4
CO3	Perform Clustal omega/W, Multiple sequence alignment of nucleotide	K2, K4
CO4	Perform Primer designing and multiple sequence alignment of protein	K1, K2, K6

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

Lab in BIOINFORMATICS

1. Retrieval of nucleotide sequence
2. Retrieval of protein sequence
3. BLAST – pairwise sequence alignment
4. FASTA – pairwise sequence alignment
5. Clustal omega/W
6. Multiple sequence alignment of nucleotide
7. Primer designing
8. Multiple sequence alignment of protein
9. Visualization of structure database- RASMOL, PDB VIEWER

Mapping

BIOINFORMATICS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	3	2	2	3	3	3	2	2
2	3	3	3	3	3	3	3	3	3	3	2	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

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Major Practical X: Lab in BIOPROCESS TECHNOLOGY

L	T	P	C
0	0	3	2

Objective: To study the industrial application of Bioprocess technology through this course. Students should be trained to understand commercial importance of biotechnology through its industrial aspects.

Course Outcomes

On completion of the course, the students will be able to

CO. No.	Lab in BIOPROCESS TECHNOLOGY	Cognitive Level
CO1	Isolate useful microorganism from natural source, Pure nd mixed culture	K2, K6
CO2	Produce Enzymes and antibiotics	K2, K6
CO3	Optimize media for enzyme production, Immobilize microbial enzymes	K2, K4
CO4	Wine and Alcohol production, Down streaming processing: product recovery, centrifugation, chromatography – Thin layer chromatography, crystallization	K1, K2, K6

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

Lab in BIOPROCESS TECHNOLOGY

1. Isolation of useful microorganism from natural source
2. Pure culture and mixed culture
3. Production of Enzymes
4. Production of antibiotics
5. Optimization of media for enzyme production
6. Immobilization of microbial enzymes
7. Wine and Alcohol production
8. Down streaming processing: product recovery, centrifugation, chromatography – Thin layer chromatography, crystallization

Mapping

BIOPROCESS TECHNOLOGY												
CO/PO/PSO	PO							PSO				
	1	2	3	4	5	6	7	1	2	3	4	5
1	3	3	3	3	3	2	2	3	3	3	2	2
2	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

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Major Practical X: Lab in BIOPROCESS TECHNOLOGY

L	T	P	C
0	0	6	6

Project - Group

Total Course Outcome: The overall course aims at training students in the areas of modern Biotechnology. The graduates are expected to carry out both basic and applied research in the areas of Biotechnology having academic and/or industrial relevance. The students would also be trained to assist industry in developing and/or solving problems of Biotechnology. In addition, the program so aims at generating manpower capable of teaching Biotechnology at postgraduate and undergraduate level.