MANONMANIAM SUNDARANAR UNIVERSITY

TIRUNELVELI– 627 012

TAMILNADU, INDIA

M.Sc. BIOTECHNOLGY

(FOR AFFILIATED COLLEGES)

CURRICULUM

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

(Effective from the academic year 2021-2022 onwards)

MANONMANIAM SUNDARANAR UNIVERSITY

ABHISHEKAPATTY, TIRUNELVELI– 627 012, TAMILNADU, INIDA

M.Sc. BIOTECHNOLOGY (CBCS PATTERN)

PG COURSES – AFFILIATED COLLEGES

M.Sc. Biotechnology

(Choice Based Credit System)

(Effective from the academic year 2021-2022 onwards)

VISION AND MISSION OF THE UNIVERSITY

VISION

" To provide quality education to reach the unreached "

MISSION

- 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 Department of Biotechnology

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 the amalgamation of biology and technology and is a fast-growing and evolving field in science. Biotechnology has emerged as a major thrust in the field of science and technology having potential to boost the economy of several countries including India. The voice of global Biotechnology in 21st century is to transfer the bio-based technology from "Lab to Land and from Bench to Business" to bring the cost of bio-based commodities within the reach of common man. The courses in Biotechnology Programme are mainly related to recent and emerging trends in Biology. In the M.Sc. Degree programme the most advanced and relevant subjects such as nanotechnology, IPR & Bioentrepreneurship, Bioprocess Technology, Bioinformatics, Medical Biotechnology, stem cell Biology 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 PG course shall undertake 26 courses, off which, 15 core theory courses, 1 elective courses, 8 practical courses ,1 Field work course, and 1 project course. There shall be one elective course which will be an Elective theory paper/Open online course/Study tour /Internshipprogramme.

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 M.Sc. Biotechnology is 90.

4. ELIGIBILITY FOR ADMISSION TO THE COURSE AND EXAMINATION

Candidates shall be admitted to the course provided if he / she has obtained a bachelor's degree in science in Biotechnology / Microbiology / Advanced Zoology and Animal Biotechnology / Plant science and Biotechnology / Zoology / Botany / Biochemistry / Biology / Life Science / Nutrition and Dietetics / B.S.M.S. / B.A.M.S. / B.U.M.S. / B.Sc., in MLT / B.E or B.Tech in Biotechnology / Bioengineering / Bio medical sciences / B.Sc., in Nursing / Genetics / Agriculture / Industrial Microbiology /Immunology / Molecular biology / Environmental Science / Virology / Bioinformatics or any other degree with Ancillary (Allied) in any one of the life sciences / that may be considered as equivalent top by the ManonmaniamSundaranar University.

5. MEDIUM OF INSTRUCTION AND EXAMINATION

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

6. THEORY EXAMINATION

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

7. PRACTICAL EXAMINATION

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

8. Evaluation

A. Each paper carries an internal component

B. There is a pass minimum of 50% for P.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	15 Marks
Seminar	05 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	10 Marks
Model Test	20 Marks
Total	**50 Marks**

F: Project work

Internal	External	Total
50 Marks	50 Marks	100 Marks

Distribution of Marks in Project Course

COMPONENTS	MARKS
Internal	50 Marks
Participation / Paper Presentation in National / International Seminar / Symposium / Publication of Research Article	05 Marks
Project Report	20 Marks
Presentation	15 Marks
Viva-voce	10 Marks
Total	100 Marks

Note:

i) Student should carry out INDIVIDUAL PROJECTS only

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

iii) In house projects are encouraged.

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

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

vi) 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.

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

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

ix) Special weightage may be given for the students who publish their research work in recognised journal including online.

G. FIELD WORK

i) Maximum 5 students can be allotted in a group.

ii) Students can submit their report (Minimum of 15 pages focusing field work, excluding front page, declaration, certificate etc.).

iii) The evaluation will be done at the end of the Second semester by both external and internal examiners for a maximum marks.

Evaluation

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

Distribution of Marks in Field Work

COMPONENTS	**MARKS**
Internal	50 Marks
Field work report	25Marks
Presentation	15 Marks
Viva-voce	10 Marks
Total	100 Marks

H. INTERNSHIP

To strengthen and elevate the professional skills of students, Internship (Part Time / Full Time) is incorporated with 3 credits (3 Hours / Cycle) in Fourth semester. An Internship for a minimum of 45 hours should be completed by every student.

Evaluation

Student shall submit their report (Minimum of 15 pages focusing internship, excluding front page, declaration, certificate etc.) individually.

Evaluation

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

Distribution of Marks

COMPONENTS	**MARKS**
Internal	50 Marks
Internship report	25Marks
Presentation	15 Marks
Viva-voce	10 Marks
Total	100 Marks

OPEN ONLINE COURSE

The student shall undertake an optional career-based Open online course in Biotechnology from an UGC approved MOOC platform (e-PG Pathshala/Swayam etc.) during the fourth semester and submit the Certificate at the end of the fourth semester.

Regarding Online courses are concerned, full liberty is given to the students for the selection of the course. Staff can assist the students in selection of course according to the potential of students.

9. A. The performance of the student is indicated by the Seven Points Scale Grading System as per the UGC norms given below

Grade	Grade point	Percentage of marks	Performance
O	9.5 and above	95-100	Outstanding
E	8.5 and above	85-94	Excellent
D	7.5 and above	75-84	Distinction
A	7 and above	70-74	Very Good
B	6and above	60-69	Good
C	5 and above	50-59	Average
RA	0	Up to 49	Re-Appear

B. The overall performance level of the candidates will be assessed by the following formulae:

Cumulative weighted average of marks = $\frac{\sum(\text{marks} + \text{credits})}{\sum \text{credits}}$

Cumulative weighted average grade points = $\frac{\sum(\text{Grade points} \times \text{credits})}{\sum \text{credits}}$

10 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**

Model Question Paper

Time: 3 hours **Cell Biology & Genetics** **Max:75marks**

Part A

Answer all questions
Choose the correct answer

1. In fluorescence microscopy, which of the following performs the function of removing all light except the blue light?
   a) Exciter filter b) Barrier filter c) Dichroic mirror d) Mercury arc lamp

2. Which part of the light microscope controls the intensity of light entering the viewing area?
   a) Coarse adjustment screw b) Fine adjustment screw c) Diaphragm d) Condenser lens

3. Nuclear DNA replicates in the_____phase.
   a) G2 phase b)M phase c)S phase d)None of the above

4. Cyclin is associated with _____
   a) Leptospirosis b) Glycolysis c) Cylosis d)Mitosis

5. What is the origin of the cancerous cells?
   a) Monoclonal b) Polyclonal c) Stem cells d) Mesodermal cells

6. If DNA is damaged, which of the following gene arrest, cell cycle?
   a) Rb b) p53 c) Hedgehog receptor d) p16

7. Variations in genes are called
   a) Alleles b) Phenotypes c) Genotypes d) Recessive traits

8. **Chromosome structure can be observed best during ____**
   a) Anaphase b)Metaphase c)Prophase d) None of the above

9. Human blood types are produced by alleles A, B, O. Having more than 2 alleles control a trait is c
   a) Incomplete dominance b) codominance c)polygenic trait d) multiple alleles

10. Test cross is
    (a) cross between two recessive homozygotes
    (b) cross between dominant homozygote and heterozygote
    (c) cross between two F_1 hybrids
    (d) cross between an F_1 hybrid and recessive homozygote

Part B

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

11. a) Write a short note on light microscope? (or)
    b) With suitable diagram, discuss the structure of eukaryotic cell?
12. a) Describe FACS and its applications? (or)
    b) Analyse the cellular responses to environmental signals in plants and animals?
13. a) Integrate Telomere shortening & Telomerase? (or)
    b) Illustrate tumour suppressor gene & Oncogenes
14. a) Asses the role of Transposable elements? or
    b) Define Linkage, determine the measurement of genetic linkage & mapping?
15. a) Elaborate allelic and non-allelic gene Interaction? (or)
    b. Define multiple alleles. Summarize the role of gene interactions in multiple alleles

Part C

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

16. a) Summarize fluorescent microscopy & its applications? (or)
    b) Evaluate the construction and function of the confocal microscope, add a note on its advantages?

17. a) Evaluate the role of cyclin in molecular event of cell cycle? (or)
    b) Demonstrate Immortalization of T antigen?

18. a) Interpret the uncontrolled cell cycle? (or)
    b) Explain Hall mark of cancer?

19. a) Illustrate Mendelian Inheritance with examples? (or)
    b)Analyze chromosomal aberrations?

20. a) Evaluate the principle and applications of Hardy Weinberg equilibrium law? (or)
    b) Discuss genetic drift?

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

Duration of Practical Exam: 3 hours

1	Major experiment	15
2	Minor Experiment	10
	Spotters(5x3)	15
3	Viva – Voce	05
4	Record	05
	Total	**50 Marks**

PROGRAMME OUTCOMES (PO)

Upon completion of the M. Sc Biotechnology programme, the candidate should be able to:

PO1: Demonstrate comprehensively systematic and critical thinking to identify, develop, and resolve challenges connected to the Biotechnology Industry, Pharma Industry, Medical or hospital related organizations, Regulatory Agencies, and Academia.

PO2: Developing abilities to answer, evaluate, and understand data obtained by experiments performed in project work or practical lessons.

PO3: Effectively direct in the use of contemporary analytical gadgets, as well as the ability to analyze and solve issues in a variety of biotechnology courses.

PO4: Recognize and carry out societal obligations as biotechnology professionals, employers and employees in diverse industries, controllers, scientists, instructors, and administrators.

PO5: Agree to a code of ethics in the workplace and in social settings, and display outstanding professional, moral, and legal deeds while making decisions.

PO6: Communicate successfully in healthcare, industry, education, and research by using written and spoken communication abilities.

PO7: Apply obligations to improve societal safety and health while maintaining the public's faith in the industry.

Programme Educational Outcomes (PEOs)

PEO1: Formulation of a critical intellectual method to identify and comprehend diverse problems that may be solved using fundamental scientific information and its implications in today's environment.

PEO2: Desire to respond to inventive thinking, scientific approaches, and debugging abilities for a variety of situations by using science expertise in compliance with health, environmental safety, ethnic, and social factors.

PEO3: Understands the role of biotechnology in society, health conflicts, environmental impacts, and cultural challenges via scientific solutions.

PEO4: Demonstrates the capacity to complete difficult tasks and assignments successfully, both alone and collaboratively, and across domains.

PEO5: Enhance the learner's varied skills while also providing a quality attributes to their knowledge for correct recordkeeping, excellent report writing, and briefings.

Program Specific Outcome (PSO)

This curriculum is designed to prepare students for a job in the biotechnology sector or research. The programme is meant to reinforce principles in core areas while also providing hands-on experience in all biotechnology disciplines.

PSO1: Students will be able to design, run experiments, analyze, and comprehend data in order to investigate challenges in Biotechnology and related subjects with this foundational interdisciplinary knowledge.

PSO2: Capacity to comprehend the potentials and impacts of biotechnological breakthroughs on the environment, as well as their application, in order to discover long-term solutions to environmental, health, and societal challenges.

PSO3: This program will help students build strong communication, management, and other skills that will enable them to work on sophisticated applications and collaborate beyond fields.

PSO4: Assist in evolving with new breakthroughs and scientific advancements in the technology era in line with the best academic disposition, corporate, and research ethics throughout one's career.

PSO5: Students will acquire self-directed, lifelong learning and professional development skills, attitudes, and values.

MANONMANIAM SUNDARANAR UNIVERSITY

TIRUNELVELI

PG COURSES – AFFILIATED COLLEGES

Course Structure for M.Sc Biotechnology

(Choice Based Credit System)

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

Sem (1)	Sub no. (2)	Subject status (3)	Subject Title (4)	Contact Hrs/ week (5)	Credits (6)
	1	Core - 1	Cell biology and genetics	6	4
	2	Core - 2	Microbial physiology	6	4
	3	Core - 3	Molecular biology	5	4
	4	Core - 4	Nanobiotechnology	5	4
	5	Core - 5 Practical - 1	Lab in cell biology and molecular biology	4	2
	6	Core - 6 Practical – 2	Lab in Microbial physiology	4	2
			Subtotal	**30**	**20**
II	7	Core - 7	Biochemistry	5	4
	8	Core - 8	Biology of immune system	5	4
	9	Core - 9	Bioprocess technology	4	4
	10	Core - 10	Stem cell biology	4	4
	11	Core - 11	Field Work	4	3
	12	Core - 12 Practical - 3	Lab in Biochemistry	4	2
	13	Core - 13 Practical - 4	Lab in Biology of immune system and bioprocess technology	4	2
			Subtotal	**30**	**23**

III	14	Core - 14	Plant &Animal biotechnology	6	4
	15	Core - 15	Medical Biotechnology	6	4
	16	Core - 16	Applied Biotechnology	5	4
	17	Core - 17	Research methodology and biostatistics	5	4
	18	Core - 18 Practical - 5	Lab in Plant biotechnology and Animal biotechnology	4	2
	19	Core - 19 Practical - 6	Lab in Research methodology and biostatistics	4	2
			Subtotal	**30**	**20**
IV	20	Core - 20	Applied bioinformatics	4	4
	21	Core - 21	Genetic Engineering	5	4
	22	Core - 22	Bioethics, IPR & Bioentrepreneurship	4	4
	23	Core - 23 Practical - 7	Lab in Applied bioinformatics	3	2
	24	Core - 24 Practical - 8	Lab in Genetic Engineering	4	2
	25	Electives (Any one)	**Elective** a) Open Online Course (from UGC approved MOOC platform) b) Study Tour / Field Tour / Internship / c) Theory	3	3
	26	Core - 25	Project	7	8
			Subtotal	**30**	**27**
			Total	**120**	**90**

Elective course – Evaluation – IV Semester

a) External: Internal Assessment = 75:25 marks

b) The external evaluation will be done at the end of the 4th semester.

c) Evaluation of Study tour report and verification of Open online course certificate will be done by both the External examiner and the Internal Guide.

Electives (Any one)	**External (75 Marks)**	**Internal (25 Marks)**
a) Open online course (from UGC approved MOOC platform)	Subject relevance - 25 marks Skill development - 25 marks Oral presentation - 25 marks	Attendance – 10 marks Participation and Interaction in discussions – 15 marks
b) Study tour / Field tour / internship	Study Tour / Field tour / internship - 50 marks Study Tour Report- 25marks	Attendance – 10 marks Involvement, Interaction and Exposure – 15 marks
c) Theory	Evaluation of University examination -75 marks	The average of the best two tests from three compulsory tests– 15 marks Seminar – 5 marks Assignment – 5 marks
Total	**100 Marks**	

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –I / Ppr. No.1 / Core-1

CEL BIOLOLGYAND GENETICS

L	T	P	C
6	0	0	4

Objective: To understand the basic concept of cell structure, membrane, cellular functions of different types of cell, modes of transport across cellular membranes and cell cycle.

Course Outcomes

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

CO. No.	Core – 1: CELL BIOLOLGYAND GENETICS	Cognitive Level
CO1	Know about the cell and its biology, which will help the students to understand the origins of cells and the generation of cell diversity, as well as the common features of cellular structure and function, tools used to observe the structure of cells.	K1, K2
CO2	Understand and apply Cellular responses to environmental signals in plants and animals	K2 ,K3
CO3	Analyse the cell cycle dependent diseases like tumour genes and to differentiate normal cells tumour cells.	K4
CO4	Understand genetic foundations of mendalian and non - mendalian genetics	K1,K2
CO5	Learn the concepts of gene and allele frequencies and able to analyze and apply the Hardy-Weinberg equilibrium for population genetics.	K2,K3,K4,K6

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

CEL BIOLOLGYAND GENETICS

Unit I

Diversity of cell size and shape, Cell theory, Structure of prokaryotic and eukaryotic cells – Isolation and growth of cells. Microscopic techniques for the study of cells – Light, Phase contrast, Polarized, Fluorescent microscopes, Cryo-microscopy, SEM, TEM, Scanning Tunneling microscope, Photomicrography, Confocal microscope. Sub cellular fractionation – centrifuge, Ultracentrifuge.

(20L)

Unit II

Cell cycle – role of cyclin in molecular event of cell cycle. Cellular responses to environmental signals in plants and animals – mechanisms of activation of cell cycle arrest. Cell motility.Cell cycle arrest, senescence, quiescence, immortalization of cells – T antigen, Fluorescent Activated Cell sorting (FACS).

(20L)

Unit III

Cell cycle dependent diseases: Telomere, telomerase, telomere shortening, expression of telomerase in different tissues both somatic and germ cells; aging, uncontrolled cell cycle: cancer, hall mark of cancer, tumour suppressors, oncogenes, difference between normal cell and cancerous cells.

(20L)

Unit IV

Genetic Foundations – Mendelian and non Mendelian inheritance, transformation, transduction, conjugation, recombination. Linkage and measurement of genetic linkage mapping.Mutational analysis.Chromosome structure and its aberrations – translocations, inversions, deletions, duplications, aneuploidy and polyploidy.Transposable elements. Transcription and Translation – prokaryotes and eukaryotes.

(15L)

Unit V

Behavioral genetics, population genetics, gene pool, Hardy Weinberg principle, gene interaction - allelic and non-allelic gene interaction, multiple alleles natural selection, genetic drift. **(15L)**

Total: 90L

Reference Books

1. Molecular biology of cell by Alberts*et al.,*
2. Molecular cell biology by Lodish*et al,*
3. Reproduction in eukaryotic cells by D M Prescott, academic press.
4. Developmental biology by S F Gilbert
5. Cell in development and inheritance by E B Wilson
6. The coiled spring by Ethan Bier
7. Fertilization by F T Longo
8. Molecular biology of steroid and nuclear hormone receptors by L P Freedman.

Mapping

Core – 1: CEL BIOLOLGYAND GENETICS												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	3	3	3	2	2	2	3	3	2	3	2
2	3	3	3	3	3	3	3	3	2	2	2	1
3	3	3	3	3	3	2	2	3	3	3	2	2
4	3	3	3	3	3	3	3	3	3	3	3	2
5	3	3	3	2	2	3	3	3	3	3	3	2

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

MSU / 2021-22 / PG –Colleges / M.Sc. (Biotechnology) / Semester –I / Ppr. No.2 / Core-2

MICROBIAL PHYSIOLOGY

L	T	PC
6	0	0 4

Objective: To understand the nutritional requirements of microorganisms coupled with their growth phases, different metabolic pathways in addition to photosynthesis and anaerobic respiration.

Course Outcomes

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

CO. No.	Core – 2: MICROBIAL PHYSIOLOGY	Cognitive Level
CO1	Understand the diversified branches of microbiology, nutritional requirements of microbes and its classification	K1, K2
CO2	Analyse the physiological and growth aspects of microbes	K4
CO3	Rephrase the metabolism of bacterial growth	K1
CO4	Apply microbes in fermentation technology	K3
CO5	Demonstrate Photosynthetic bacteria, biosynthesis of cell wall and amino acids.	K1,K2,K3

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

MICROBIAL PHYSIOLOGY

Unit I

Nutrition: Nutritional requirements of microorganisms - Autotrophs, Heterotrophs, Photoautorophs, Chemoautotrophs, Copiotrophs, Oligotrophs, Endospore formation in Bacteria. **(15 hrs)**

Unit II

Different phases of growth-growth curve-generation time- factors influencing microbial growth-temperature, pH, pressure, salt concentration, nutrients-synchronous growth and continous cultivation.Diauxic growth. **(15 hrs)**

Unit III

Metabolism-EMP-HMP-ED Pathways-TCA cycle - Electron Transport Chain - Oxidative & Substrate level Phosphorylation. **(14 hrs)**

Unit IV

Anaerobic respiration - Sulphur, Nitrogenous compounds and CO_2 as final electron acceptor-Fermentation - Alcoholic, Propionic and Mixed acid fermentation. **(15 hrs)**

Unit V

Photosynthesis-Oxygenic &Anoxygenic, Carbon dioxide fixation, Biosynthesis of bacterial cellwall, biosynthesis of amino acids (Glutamic acid family) – Bioluminescence. **(15 hrs)**

References

1. Albert G. Moat, John W. Foster, Michael P. Spector, Microbial Physiology, Wiley Interscience, 2003.
2. Daniel R. Caldwell, Microbial Physiology and Metabolism, Star, 2000.
3. Robert K. Poole, Advances in Microbial Physiology, Academic Press, 2002.

Total:90L

Mapping

Core – 2: MICROBIAL PHYSIOLOGY												
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	3	3
2	3	3	3	3	2	3	1	3	3	3	3	3
3	3	3	3	3	3	3	1	3	3	3	3	3
4	3	3	3	3	2	2	2	3	3	3	3	3
5	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 / PG –Colleges / M.Sc.(Biotechnology) / Semester –I / Ppr. No.3 / Core-3

MOLECULAR BIOLOGY

L	T	P	C
5	0	0	4

Objective: To understand the basic concept of genome organization, central dogma, regulation of gene expression, principles of genetic interactions and population genetics.

Course Outcomes

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

CO. No.	Core – 3: MOLECULAR BIOLOGY	Cognitive Level
CO1	To justify Central dogma and DNA replication are the fundamental units of Molecular Biology, recall about Genome organization, summarize the various modes and models of DNA replication and their importance in biological system	K1, K2, K5
CO2	Illustrate the steps in the transcription and translation, Analyse the differences in the transcription and translation process.	K2, K4
CO3	Categorize the properties of ribosome's and differences between prokaryotic systems.	K2, K4
CO4	Explain the gene expression regulation and describe the different model of operon concept	K1, K2
CO5	Illustrate the different receptors and motif which controls the transcription and their biological role	K3

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

MOLECULAR BIOLOGY

Unit I

Organisation of genome: genes, split gene concept, exons, introns, transposons- types (IS elements, replicative transposons, retroposons). Models of DNA Replication, Conservative, Semiconservative and discontinuous, Messelson and Stahl experiment, Steps in initiation of replication, Enzymatic factors involved, Ori site , Okazaki fragments, Termination of replication, Types of DNA polymerases in eukaryotes and prokaryotes, Bacterial replication modes-theta, rolling circle, d-loop replication.

(20L)

Unit II

Process of transcription - stages in initiation, elongation, termination, Types of RNA polymerases in prokaryotes and eukaryotes, Transcription factors in prokaryotes and eukaryotes, post transcriptional modifications, Polyadenylation, capping, r-RNA processing, Splicing-Spliceosome. Differences in transcription between prokaryotes and Eukaryotes, Inhibitor of Transcription. **(15L)**

Unit III

Process of translation - Stages in translation, genetic code, wobble hypothesis, eukaryotic and prokaryotic ribosomes, aminoacyl t-RNA synthatases, and protein factors initiation complex, peptidyltransferase, differences between prokaryotic and eukaryotic systems, inhibition of Translation. **(15L)**

Unit IV

Regulation of gene expression – basic elements in the control of gene expression, structural and regulatory genes, mechanism of activation of gene expression, operon model, *viz*., lactose, arabinose and tryptophan,mechanism of attenuation. Transcriptional control in eukaryotes, zinc finger motifs, leucine zippers, steroid receptors, Cis-acting and trans-acting regulatory factors..

(15L)

Unit V

Run on assay, Invitro transcription and translation, promoter, reportor assay, luciferases, types of luciferases. **(10L)**

Total: 75L

Reference Books

1. REA's Problem Solvers in Genetics, Research Education Association,61, Ethel Roadwest, New Jersey
2. Modern Genetic Analysis, Griffiths, Lewontin, Gelbart, and Miller, Freeman's and Co, New York
3. Genes X: Benjamin Lewin
4. Cell and Molecular Biology by Gerald Karp, Academic Press
5. Genomes: T A Brown, John Wiley & Sons
6. Molecular Biology: David P Clark, Elsevier.
7. Principles of gene manipulation – Old, Twyman and Primrose
8. Gene cloning and DNA analysis – T. A. Brown

Mapping

Core – 3: 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	1	3	3	3	3	1
2	3	3	3	3	3	3	3	2	3	3	3	1
3	3	3	3	3	3	3	3	3	3	3	3	1
4	3	3	3	3	3	3	2	3	3	3	3	2
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)

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –I / Ppr. No.4 / Core-4

NANOBIOTECHNOLOGY

L	T	P	C
5	0	0	4

Objective: To understand the basic concepts of nanobiotechnology, principles ofinstrumentation, nanomaterials and their applications in the fields of medicine and scientific research.

Course Outcomes

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

CO. No.	Core – 4: NANOBIOTECHNOLOGY	Cognitive Level
CO1	Understand and learn the foundational of the Nano science and related fields.	K1,K2
CO2	Know the tools and techniques used in nanosciences	K1,K2
CO3	Understand the application and impact of nano materials on environment	K1, K2
CO4	Apply the nanotechnology for advancing medical science thereby improving health care practices	K2, K3
CO5	Apply their learned knowledge to develop Nanomaterial's.	K2,K3

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

NANOBIOTECHNOLOGY

Unit I

Nanobiotechnology – Introduction, Definition, History, Applications, Future, nanotechnology Hazards.

(7L)

Unit II

Tools and Techniques – Bottom-up, molecular self-assembly, Top down Fabrication technique – Electron Beam Lithography (EBL), Dip Pen Nanolithography (DPN), Soft Lithography – PDMS molding, Micro Electro Mechanical System (MEMS), Nano Electro Mechanical System (NEMS), Nanosensor, Transmission Electron Microscope (TEM), Scanning Transmission Electron Microscope (STEM), Scanning Electron Microscope (SEM), Scanning Tunneling Microscope (STM), Atomic Force Microscope (AFM).

(12L)

Unit III

Nanomaterials: Definition, Properties, methods to produce nanomaterials, nanocones, nanotubes, nanowires, nanocomposites, nanogears, Quantum Dots, nanoshells, Self –assembled Monolayers (SAMS).conjugation of protein with ligand. **(8L)**

Unit IV

Nanomedicine: Introduction, Biocompatibility of nanomedical materials, drug delivery, cancer therapy, nanorobotics, nanosurgery, nanosystems in drug targeting, nano-implantable devices, biomedical sensors, diagnostic imaging techniques, Ethical dimensions of nanomedicines.

(9L)

Unit V

Applications of Nanotechnology: Lab on a chip, Synthetic chips based on bacteriorhodopsins and G – protein coupled receptors, DNA microarray, Protein microarray, High throughput DNA sequencing withnanocarbon tubules. **(9L)**

(Total : 75L)

Reference Books

1. Nanobiotechnology-Concepts, Applications and Perspectives. Edited by Christof M. Niemeyer, Chad A. Mirkin Wiley - VCH, 2006.
2. Handbook of Nanostructural Biomaterials and their applications in Nanobiotechnology, Hari Singh Nalwa, American Scientific Publishers. 2005
3. Nanotechnology, Volume: 5-Nanomedicine and Nanotechnology. Edited by Viola Vogel. John Wiley & Sons Limited, 2008.
4. Nature Biotechnology, Volume 21, No. 10, 2003
5. Scientific American Volume 285 No.3, September 2001
6. Ratener D (2003) Nanotechnology – A Gentle Introduction to the Next Big Idea, Prentice Hall, ISBN: 031014005.
7. Nanoscale technology in Biological systems. Ralph S. Greco. CRC Press.2005.

Mapping

Core – 4: NANOBIOTECHNOLOGY												
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	1
2	3	3	3	3	3	3	3	3	3	3	3	2
3	3	3	3	3	3	3	3	3	3	3	3	1
4	3	3	3	3	3	3	3	3	3	3	2	3
5	3	3	3	3	3	3	1	3	3	3	3	3
6	3	3	3	3	3	3	2	3	3	3	2	3

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –I / Ppr. No.5 / Core-5 – Practical - 1

L	T	P	C
0	0	4	2

LAB IN CELL BIOLOGY AND MOLECULAR BIOLOGY

Objective: To Study the basic concept of cell structure, membrane, cellular functions of different types of cell and cell cycle.

Course Outcomes

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

CO. No.	Core – 5 : Practical – 1 LAB IN CELL BIOLOGY AND MOLECULAR BIOLOGY	Cognitive Level
CO1	Demonstration of Histological section for the light microscope	K1,K2
CO2	Isolate mesophyll cells, chloroplasts	K3
CO3	Identify cell division by mitosis (Onion root tip squash) Calculate Mitotic index	K4
CO4	Identify cell division by meiosis – plant , sample (Rheo plant, Tradescantia, onion bud) Identify of Giant chromosome from chironomous larvae Bacterial Transformation Squamous epithelial cell staining	K4
CO5	Isolate chromosomal DNA from bacteria Isolation of chromosomal DNA from Goat Liver Isolate of Total RNA SDS PAGE	K4,K5,K6

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

CELL BIOLOGY

1. Demonstration of Histological section for the light microscope
2. Isolation of Mesophyll cells
3. Isolation of chloroplasts
4. Identification of cell division by mitosis (Onion root tip squash)
5. Calculation of Mitotic index

   Identification of cell division by meiosis – plant sample (Rheo plant, Tradescantia, onion bud)
6. Identification of Giant chromosome from chironomous larvae
7. Bacterial Transformation
8. Squamous epithelial cell staining

MOLECULAR BIOLOGY

1. Isolation of chromosomal DNA from bacteria
2. Isolation of chromosomal DNA from Goat Liver
3. Isolation of Total RNA
4. SDS PAGE

Mapping

Core – 5 : Practical – 1 LAB IN CELL BIOLOGY 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	1
2	3	3	3	3	3	3	3	3	3	3	3	1
3	3	3	3	3	3	3	3	3	3	3	3	1
4	3	3	3	3	3	3	3	3	3	3	2	1
5	3	3	3	3	3	3	1	3	3	3	3	1
6	3	3	3	3	3	3	2	3	3	3	2	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –I / Ppr. No.6 / Core-6 - Practical - 2

L	T	P	C
0	0	4	2

LAB IN MICROBIAL PHYSIOLOGY

Objective: To study the technique involves in the isolation, growth and biochemical characterization of microorganisms.

Course Outcomes

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

CO. No.	Core – 6 : Practical –2 LAB IN MICROBIAL PHYSIOLOGY	Cognitive Level
CO1	Isolate of microorganisms from soil, water, spoiled food	K3
CO2	Determine growth curve of bacteria	K3
CO3	Identify microscopic examination of bacteria and yeast (simple staining), Motility test, Gram staining, Acid-fast staining, Spore staining	K4
CO4	Demonstration of Histological section for the light microscope	K4
CO5	Perform Biochemical characteristics of selected organisms,Assay of antibiotics	K4,K5,K6

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

LAB IN MICROBIAL PHYSIOLOGY

1. Enumeration of microorganisms from soil
2. Enumeration of microorganisms from water
3. Enumeration of microorganisms from spoiled food
4. Determination of growth curve of bacteria
5. Microscopic examination of bacteria and yeast (simple staining)
6. Motility test

7. Gram staining

8. Acid-fast staining

9. Spore staining

10. Biochemical characteristics of selected organisms

    (a) IMViC Test

    (b) Hydrogen sulphide production test

    (c) Catalase test

    (d) Carbohydrate fermentation test

    (e) Starch hydrolysis test

11. Assay of antibiotics and demonstration of antibiotic resistance

12. Demonstration of Molecular characterization of microbes-Bacteria, Fungi

Mapping

Core – 6 : Practical –2 LAB IN MICROBIAL PHYSIOLOGY												
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	2	3
5	3	3	3	3	3	3	1	3	3	3	3	3
6	3	3	3	3	3	3	2	3	3	3	2	3

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –II / Ppr. No.7 / Core-7

BIOCHEMISTRY

L	T	P	C
5	0	0	4

Objective: To understand the concepts of bioenergetics, structural and functional aspects ofbiomolecules, enzyme kinetics, applications and commercial production of enzymes.

Course Outcomes

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

CO. No.	Core – 7: BIOCHEMISTRY	Cognitive Level
CO1	Gain fundamental knowledge in biochemistry; understand carbohydrates and its classifications and functions	K1, K2
CO2	Understand the nucleic acid structure, function and apply the knowledge on biosynthesis of purines and pyrimidine	K1,K2,K3
CO3	Know about proteins and metabolism of proteins and aminoacids	K1,K2
CO4	knowledge of biochemical principles with specific emphasis on different metabolic pathways and regulators of lipids	K1,K2,K3
CO5	Understand the molecular basis Hormones and its mechanisms	K1,K2,K3

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

BIOCHEMISTRY

Unit- I

CARBOHYDRATES : Carbohydrate Classifications, Physic-chemical properties, Biological importance of carbohydrates. Properties of Monosaccharide, Disaccharides and Polysaccharides. Clinical complications of Carbohydrate metabolisms, Diabetes mellitus Type I and Type II. Glycogen storage diseases. **(10L)**

Unit- II

NUCLEIC ACIDS: Nucleic acids-Nucleotide Structure, Biosynthesis and degradation of purines and pyrimidines and their clinical role. Structure of DNA and RNA.Various forms of DNA.

(15L)

Unit- III

PROTEINS: Classification of Proteins, Structure and properties of amino acids and proteins, Metabolism of Proteins and amino acids, Inborn errors of metabolism, Decarboxylation, Transamination, Deamination, and urea cycle.

(15L)

Unit- IV

LIPIDS: Biological importance and Chemical properties of fatty acids. Metabolism of Lipids, Biosynthesis of saturated and unsaturated fatty acids, β-Oxidation of fatty acid, Regulation of lipid metabolism and ketone bodies.Disorders of lipid metabolism, lipoproteins and their significance.

(19L)

Unit V

VITAMINS AND HORMONES: Structure and Biochemical properties of water soluble and fat-soluble vitamins and their coenzyme activity. Hormones: Mechanism of hormone action and its regulation, Hormones of Pancreas, Pituitary, Adrenal, Thyroid and Sex hormones. Bioenergetics: Electron transport chain, Oxidative Phosphorylation and synthesis of ATP.

(16L)

(Total : 75L)

References:

1. Murray, R.K., Granner, D,K., Mayes, P.A. and Rodwell, VW. (2000) : 25th Ed. Harpers Biochemistry, Macmillan Worth Publishers.
2. Nelson D.L. and Cox, M.M. (2000) : 3rd Ed. Lehninger's Principles of Biochemistry, Macmillan Worth Publishers.
3. Devlin, T.M. (1997): 4th Ed. Text book of Biochemistry with Clinical Correlations, Wiley Liss Inc.
4. Stryer, L. (1998): 4th Ed. Biochemistry, W.H. Freeman and Co.
5. Voet, D. VoetJ..G and Prat, C.W,, (1999) : Fundamentals of biochemistry.

Mapping

Core – 7: BIOCHEMISTRY												
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	2	3
5	3	3	3	3	3	3	1	3	3	3	3	3
6	3	3	3	3	3	3	2	3	3	3	2	3

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –II / Ppr. No.8 / Core-8

BIOLOGY OF IMMUNE SYSTEM

L	T	P	C
5	0	0	4

Objective: To impart Knowledge on the science of immunology, immune mechanisms of body, and the classification structure and mechanism of immune activation.

Course Outcomes

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

CO. No.	Core – 8: BIOLOGY OF IMMUNE SYSTEM	Cognitive Level
CO1	Compare and contrast innate and adaptive immunity. Describe the cell types and organs present in the immune response. Recognize the difference between antigenicity and immunogenicity	K1, K2
CO2	Illustrate the structure of Immunoglobulin, outline the different theories of proposed for antibody development.	K2, K3
CO3	Criticise the antigen and antibody reaction.	K5
CO4	Explain the different complement pathways and Illustrate the antigen processing pathways.	K2, K3
CO5	Elucidate the reasons for immunization and aware of different vaccination and Explain the stages of transplantation responses	K2

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

BIOLOGY OF IMMUNE SYSTEM

Unit I

Immune system: Organization, structure and functions of lymphoid organs – Bone marrow, thymus, spleen and lymph nodes; Cells of the immune system – Haematopoeisis, B lymphocytes, T Lymphocytes, TCR, BCR,NK cells, Granulocytes, Types of immunity : Innate and acquired. humoral and cell mediated immune response. Antigen: definition, types, properties, T dependent and T independent antigens, super antigens – antigenicity and immunogenicity, epitopes, haptens and adjuvants.

(16L)

Unit II

Immunoglobulins – structure and functions, Theories of antibody formation, Generation of antibody diversity. Antigen-antibody interactions- precipitation and agglutination, Cytokines- Properties and functions- Interleukins and Interferons.

(15L)

Unit III

The complement systems: mode of activation, classical and alternate pathway, Membrane Attack Complex (MAC), Major histocompatibility complex (MHC): Structure and functions of MHC, MHC molecules and genes, Mechanisms of antigen processing and presentation-cytosolic and endocytic pathways. Inflammation – mechanism and significance.

(14L)

Unit IV

Regulation of immune response**,** Immune response to infectious diseases – bacterial- TB, viral - HIV, protozoan- malaria. Autoimmune disorders, Hypersensitivity reactions – types and pathogenesis, Immuno deficiency diseases, Transplantation immunology, Immunosuppression, Tumour immunology, vaccination- new generation vaccines.

(14L)

Unit V

Immunological techniques – WIDAL,VDRL, pregnancy and Rheumatoid factor tests, Coomb's test, Well Felix test, Brucella agglutination test, Principle and applications of Radioimmuno assay (RIA), Enzyme Linked ImmunoSorbant Assay (ELISA), Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, Monoclonal antibody – production and applications.

(16L)

(Total : 75L)

Reference Books

1. Kuby Immunology (2007) by Thomas J. Kindt, Richard A. Goldsby and Barbara A. Osborne. W.H.Freeman and Company
2. Immunology (2006) by David Male, Jonathan Brostoff, David B Roth and Ivan Roit. Elsevier Publishers.
3. Essentials of Clinical Immunology (2006) by Helen Chapel, ManselHaeney, SirajMisbah and Neil Snowden. Blackwell Publishing.
4. Immunology (2006) by C. VamanRao. Narosa Publishing House Pvt, Ltd
5. Immunobiology (The immune system in health and disease) (2005) by Charles A. Janeway, Paul Travers, Mark Walport and Mark Sholmchik. Garland Publishing.
6. Immunology of Infectious Diseases (2002) Edited by Kaufmann, Sher and Ahmed. ASM Press.
7. Understanding Immunology (2001) by Peter Wood. Pearson Education Limited
8. Roitt's Essential Immunology (2001) by Ivan M. Roit and Pete J. Delves. Blackwell Science Ltd.
9. Antibody Engineering (2006) by Ed Harlow and David Lane. Panima Publishing Corporation.

Mapping

Core – 8: BIOLOGY OF IMMUNE SYSTEM												
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	1
2	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
4	3	3	3	3	3	3	3	3	3	3	2	2
5	3	3	3	3	3	3	1	3	3	3	3	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –II / Ppr. No.9 / Core-9

BIOPROCESS TECHNOLOGY

L	T	P	C
4	0	0	4

Objective: To impart Knowledge on basic principles of bioprocess, design of fermentor, asepticoperations, and separation techniques to recover value added products from living organisms and application of biotechnological process in industries.

Course Outcomes

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

CO. No.	Core – 9 : BIOPROCESS TECHNOLOGY	Cognitive Level
CO1	Understand biological and Basic concepts underlying bioprocesses engineering	K1, K2
CO2	Rephrase procedures for the design and control of bioreactors	K1,K2,
CO3	Know and illustrate the basic downstream processing principles	K1,K2
CO4	Apply the knowledge on industrial production of amino acids, alcohols, chemicals etc.	K1,K2,K3
CO5	Apply the knowledge on food preservation and packing	K1,K2,K3

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

BIOPROCESS TECHNOLOGY

Unit I

Introduction to Bioprocess Engineering, Isolation, Screening Preservation and Maintenance of Industrial Microorganisms, secondary metabolites.Media for Industrial Fermentation, Air and Media Sterilization.

(11L)

Unit II

Bioreactors, Design &construction, Types of fermentation processes: Batch, Fed-batch and continuous bio reactions, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc., Measurement and control of bioprocess parameters.

(12L)

Unit III:

Downstream Processing: Introduction, Removal of microbial cells and solid Matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, Membrane process, Drying and Crystallization.

(13L)

Unit IV:

Whole cell Immobilization, protein immobilization and their Industrial Applications, Industrial Production of Chemicals: Alcohol (ethanol), Acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycin, tetracycline), Amino acids (lysine, glutamic acid), Single cell Protein, Use of microbes in mineral beneficiation and oil recovery. **(14L)**

Unit V:

Introduction to Food Technology, Elementary idea of canning and packing, sterilization and Pasteurization of food Products, Technology of Typical Food/Food products (bread, cheese, idly) - Food Preservation. Microbial contamination in preserved food.**(10L)**

(Total : 60L)

Reference Books

1. Biochemical Engineering, Aiba, S., Humphrey, A.E. and Millis, N.F. Univ. of Tokyo Press, Tokyo
2. Biochemical Reactors, Atkinson, B., Pion Ltd., London
3. Biochemical Engineering Fundamentals, Baily, J.E. and Ollis, D.F., McGraw- Hill Book Co. New York
4. Bioprocess Technology: Fundamentals and Applications, KTH, Stockholm.
5. Process Engineering in Biotechnology, Jackson, A. T., Prentice Iiall, Engelwood Cliffs
6. Bioprocess Engineering: Basic Concepts, Shuler, M.L. and Kargi, F., Prentice Hall, Engelwood Cliffs
7. Principles of Fermentation Technology, Stanbury, P.F and Whitaker, A., Pergamon Press, Oxford
8. Bio reaction Engineering Principles, Nielson,J. and Villadsen, J., Plenum Press
9. Chemical Engineering Problems in Biotechnology, Shuler, M.L. (Ed.), AICHE
10. Biochemical Engineering, Lee, J .M., Prentice Hall Inc.
11. Bioprocess Engineering - Kinetics, Mass Transport, Reactors and Gene Expression, Vieth, W.F., John Wiley & Sons, Inc.

Mapping

Core – 9 : 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	3	3	3	3	3	3	1
2	3	3	3	3	3	3	3	3	3	3	2	1
3	3	3	3	3	3	3	3	3	3	3	2	1
4	3	3	3	3	3	3	3	3	3	3	2	1
5	3	3	3	3	3	3	3	3	3	3	2	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –II / Ppr. No.10 / Core-10

Stem Cell Biology

L	T	P	C
4	0	0	4

Objective: To impart Knowledge on basic principles of Stem cells, mechanism of self renewal, Cancer stem cell and ethical issues in stem cell biology.

Course Outcomes

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

CO. No.	Core – 10 : STEM CELL BIOLOGY	Cognitive Level
CO1	Understand basic concepts underlying stem cell biology.	K1, K2
CO2	Know the types of stem cells and its molecular mechanisms.	K1,K2,
CO3	Apply stem cell biology in cord blood banking transplantation.	K2,K3
CO4	Apply the knowledge regeneration and manipulation of human embryonic stem cells.	K1,K2,K3
CO5	Apply the knowledge of stem cells on cancer therapy.	K3,K4,K5

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

STEM CELL BIOLOGY

Unit I:

Stem Cell Basics: Stem cells, embryonic stem cells, embryonic germ cells, bone marrow stem cells, adult stem cells, differentiation. Introduction to concepts in stem cell biology – renewal, potency etc. Stem cell characterizations: Isolation and characterization, markers and their identification, growth factor requirements and their maintenance in culture. Pluripotency and reprogramming. **(9L)**

Unit II:

Hematopoietic Stem Cell, Induced Pluripotent Stem (iPS) cell technology, epigenetic memory in iPS cells, epigenetic controls of stem cells. Early embryonic development, Lymphoid cell differentiation and maturation, cell cycle regulators in stem cells. Molecular mechanisms of self-renewal, pluri/multipotency and lineage differentiation.Molecular basis of pleuripotency and stem cell niche. **(9L)**

Unit III:

The human umbilical cord: A source of stem cells. Isolation of mesenchymal stem cells (MSCs) from the umbilical cord, *in vitro* differentiation potential of umbilical cord mesenchymal stem cell. In vivo applications umbilical cord stem cells, cord blood stem cells transplantation – advantages and disadvantages, cord blood banking. **(8L)**

Unit IV:

Generation and manipulation of mouse embryonic stem cells. Generation and manipulation of human embryonic stem cells, animal models of regeneration – Hydra, Planaria, earth worm, zebra fish etc. **(9L)**

Unit V:

Cancer stem cell – origin of cancer stem cells, impact of cancer stem cell, concept on cancer therapy. Epigenetics and reprogramming in stem cell biology. Stem cell gene therapy, stem cell therapy for neurodegenerative diseases. Stem cell therapy for cardiac regeneration, clinical cell transplantation for leukemia. Ethical issues associated with stem cell biology. **(10L)**

(Total : 45L)

References

1. Robert Lonza, John Gearhart, Brigid Hogan, Douglas Melton, Roger Pederson, E.Donnal Thomas, James Thomson and Sir LanWIlmut. (2009): 2nd Ed. Essentials of Stem Cell Biology, Elsevier.
2. DeepaBhartiya, NibeditaLenka. (2013): Pluripotent Stem Cells, IntechOpen.
3. Jonathan M. W. Slack. (2018): The Science of Stem Cells, Wiley.
4. Mary Clarke, Jonathan Frampton. (2020): Stem Cells Biology and Application, CRC Press.

Mapping

Core – 10 : STEM CELL 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	1
2	3	3	3	3	3	3	3	3	3	3	2	1
3	3	3	3	3	3	3	3	3	3	3	2	1
4	3	3	3	3	3	3	3	3	3	3	2	1
5	3	3	3	3	3	3	3	3	3	3	2	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –II / Ppr. No.11 / Core-11-Field Work

FIELD WORK

L	T	P	C
0	0	4	3

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –II / Ppr. No.12 / Core-12 - Practical 3

L	T	P	C
0	0	4	2

LAB IN BIOCHEMISTRY

Objective: To study various techniques of quantification, estimation, separation and purification of biomolecules and enzymes.

Course Outcomes

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

CO. No.	Core – 12 : Practical –3 LAB IN BIOCHEMISTRY	Cognitive Level
CO1	Quantify total carbohydrate,amino acids, Proteins, RNA,DNA	K3
CO2	Verification of Beer Lambert's law.	K4
CO3	Quantifyreducing sugars, Methionine	K3
CO4	Separate amino acids and pigments by chromatography	K4
CO5	Purify enzymes by precipitation and dialysis	K4,K5,K6

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

LAB IN BIOCHEMISTRY

1. Quantification of total carbohydrate by anthrone method
2. Quantification of aminoacids by ninhydrin method
3. Quantification of protein by Biuret method
4. Quantification of RNA by orcinol method
5. Quantification of DNA by diphenyl amine method
6. Verification of Beer Lambert's law.
7. Quantitative estimation of reducing sugars by Dinitrosalicylic acid method.
8. Quantitative estimation of Methionine by Nitroprusside method.

9. Estimation of protein- Bradford Method.

10. Estimation of Cholesterol from serum by Zak's method

11. Separation of amino acids by Paper chromatography (Descending /Ascending)

12. Separation of Plant pigments by Thin layer chromatography

13. Purification of enzymes – precipitation and dialysis

Mapping

Core – 12 : Practical –3 LAB IN BIOCHEMISTRY												
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	1
2	3	3	3	3	3	3	3	3	3	3	2	1
3	3	3	3	3	3	3	3	3	3	3	2	1
4	3	3	3	3	3	3	3	3	3	3	2	1
5	3	3	3	3	3	3	3	3	3	3	2	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –II / Ppr. No.13 / Core-13 - Practical 4

L	T	P	C
0	0	4	2

LAB IN BIOLOGY OF IMMUNE SYSTEM AND BIOPROCESS TECHNOLOGY

Objective: To study on the science of immunology, blood cells, and the mechanism of antigen and antibody reaction.To impart Knowledge on basic principles of bioprocess, design of fermentor, enzyme kinetics and application of biotechnological process in industries.

Course Outcomes

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

CO. No.	Core – 13 : Practical –4 LAB IN BIOLOGY OF IMMUNE SYSTEM AND BIOPROCESS TECHNOLOGYBIOLOGY OF IMMUNE SYSTEM	Cognitive Level
CO1	Quantify total carbohydrate,aminoacids, Proteins, RNA,DNA	K3
CO2	Verification of Beer Lambert's law.	K4
CO3	Quantifyreducing sugars, Methionine	K3
CO4	Separate amino acids and pigments by chromatography	K4
CO5	Purify enzymes by precipitation and dialysis	K4,K5,K6

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

BIOLOGY OF IMMUNE SYSTEM

1. Blood film preparation and identification of cells
2. Preparation of serum
3. Blood grouping
4. Total leukocyte count
5. Total RBC count
6. Single and double immune diffusion

7. Immuno-elctrophoresis
8. ELISA

BIOPROCESS TECHNOLOGY

1. Surface culture fermentation to study the production of lactic acid using sucrose and lactose.
2. Growth kinetics for some industrially useful organism
3. Isolation of alpha Amylase from Sweet Potato or Potato
4. Determination of Alpha Amylase Enzyme activity
5. Immobilization of whole cell
6. Immobilization of enzyme

Mapping

Core – 13 : Practical –4 LAB IN BIOLOGY OF IMMUNE SYSTEM AND BIOPROCESS TECHNOLOGYBIOLOGY OF IMMUNE SYSTEM												
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	1
2	3	3	3	3	3	3	3	3	3	3	2	1
3	3	3	3	3	3	3	3	3	3	3	2	1
4	3	3	3	3	3	3	3	3	3	3	2	1
5	3	3	3	3	3	3	3	3	3	3	2	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –III / Ppr. No.14 / Core-14

PLANT & ANIMAL BIOTECHNOLOGY

L	T	P	C
6	0	0	4

Objectives: To provide knowledge on the techniques to manipulate genome of plants & animals, tissue culture facilities and Animal Stem Cells and Tissue Engineering facilities.

Course Outcomes

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

CO. No.	Core – 14 : PLANT & ANIMAL BIOTECHNOLOGY	Cognitive Level
CO1	learn the principles and technical advances behind the in vitro culture of plant cells	K1, K2
CO2	Learn the applications of plant transformation for improving the productivity and performance.	K1,K2,
CO3	understand the basic principles and techniques of animal cell culture and media formulation	K2,K3
CO4	Apply gene transfer technologies for animals and animal cell lines.	K3,K4
CO5	understand the techniques and problems both technical and ethical in animal cloning, Apply the knowledge in the production of plant and animal vaccines	K3,K4,K5

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

PLANT & ANIMAL BIOTECHNOLOGY

Unit 1: Introduction to Plant Tissue Culture

Historical account, Totipotency.Preparation of nutrient media for callus culture. Processing ofVarious explants (mature seed, leaf base, node) for culture initiation. Callus cultures through organogenesis and somatic embryogenesis. Protoplast isolation and fusion.Transfer and establishment of whole plants in soil. **(18)**

Unit 2: Gremplasm conservation & transformation

GermplasmConservation :cryopreservation-methodology and steps, Plant conversion from synthetic seeds. Micropropagation of medicinal plants. Secondary metabolites from plant cells. Isolation and purification ofTi-plasmid DNA. Agrobacterium mediated transformation of plants. Transient ß- glucuronidase (GUS) gene expression assays in transformed intact explants and callus tissues by histochemical method. **(20)**

Unit 3: Animal Cell Culture

types of culture media, composition, preparation and metabolic functions. Role of CO2, Serum, supplements, growth factors (EGF, PDGF, NGF, Gap-43). Biology of cultured cells culture environment, cell adhesion, cell proliferation and differentiation. Characterization of cultured cells, viability, Gene Transfer, cytotoxicity, growth parameters, celldeath and Apoptosis **(20)**

Unit 4 : Animal Stem Cells and Tissue Engineering

Embryonic and adult stem cells, properties, with reference to stem cells culture.Tissue engineering of skin, bone and neuronal tissues, biomaterials used in tissue engineering, three dimensional culture and transplantation of engineered cells. Tissue engineering -. Gene knock out and mice models. Methods of animal cloning. **(16)**

Unit 5: Transgenic

Transgenic plant with modified quality (Improved starch, oil, seed protein quality). Plant derived vaccines; Plants with improved nutrient value (Golden Rice). Pharmaceutical products produced by mammalian cells – plasminogen activator, erythropoietin, blood clotting factors, glycoprotein hormones, interleukins, interferons, Cell culture based vaccines.

(16)

Total (90)

Outcome: The students will have the ability to understand and apply different techniques of plant genome editing and tissue culture, Animal Stem Cells and Tissue Engineering facilities.

References

1. Robert N. Trigiano. Dennis J. Gray, 1996, Plant Tissue Culture Concept and Laboratory Excersises. CRC Press, London.
2. P.S.Srivasta, 1998. Plant Tissue Culture and Molecular Biology, Narosa Publishing House, New Delhi.
3. John H. Dods and LorrinW.Roberts, 1995, Experiments in Plant Tissue Culture, Cambridge
University Press, USA.
4. J. Hammond, P. McGarvey and V. Yusibov (Eds): Plant Biotechnology. Springer Verlag, 2000
5. T-J. Fu, G. Singh, and W.R. Curtis (Eds.): Plant Cell and Tissue Culturefor the Production of
Food Ingredients. Kluwer Acadernic/Plenum Press. 1999.
6. H.S. Chawla: Biotechnology in Crop Improvement. International Book distributing Company.
1998.
7 .Ballinic C.A., Philips J.P and Moo Young M. Animal Biotechnology.Pergamon Press, New York. 1989.
8. Watson J.D.et al. Molecular Biology of Gene (6th Ed.) Publisher Benjamin Cummings.2007.
9. Berger S. L. and A.R. Kimmel.Methods in enzymology guide to molecular cloning techniques
(Vol 152). Academic Press Inc. San Diego.1996.
10. Glick, B.R. and Pasternak J.J. Molecular Biotechnology.ASM Press, Washington DC.2003.

Mapping

Core – 14 : PLANT & ANIMAL 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	3	3	3	3	3	2	2
3	3	3	3	3	3	3	3	3	3	3	2	2
4	3	3	3	3	3	3	3	3	3	3	2	2
5	3	3	3	3	3	3	3	3	3	3	2	2

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology)/ Semester –III / Ppr.no.15 / Core-15

Medical Biotechnology

L	T	P	C
6	0	0	4

Objectives: To provide knowledge on the Disease, diagnosis, drug and future medicine.

Course Outcomes

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

CO. No.	Core – 15 : MEDICAL BIOTECHNOLOGY	Cognitive Level
CO1	learn the molecular aspect of diseases like genetic and microbial	K1, K2
CO2	interpret the prognostic and diagnostic methods and techniques to identify markers	K3,K4
CO3	conclude a clear picture on various biomolecules and molecular therapeutic approaches	K2,K3
CO4	compile the prophylaxis method, medical information database	K3,K4
CO5	model the treatment strategies and how to screen compounds for a particular bioactivity	K3,K4,K5

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

Unit I:

Molecular aspect of Diseases: Genetic: Huntington's disease, Sickle cell disease,Klinefelter syndrome, Duchenne Muscular Dystrophy, Parkinson's disease, Coronary artery diseases; **Microbial:** Hepatitis, Lyme disease, AIDS, Tuberculosis; **Metabolic:** Diabetes mellitus, Faber's disease, Muscle diseases. **(20)**

Unit II:

Diagnosis of diseases: Prenatal diagnosis- invasive and non-invasive techniques;Monoclonal antibodies. Protein and enzyme markers, DNA probes, Enzyme probes, Proteomics for diagnosis, Nanodiagnosticts. **(20)**

Unit III:

Vaccinology: Health care products: rDNA drugs and vaccines- insulin, growth hormone,factor VIII, Tissue Plasminogen Activator, Interferons, Lymphokines and Hepatitis-B vaccines. DNA based vaccines. Current strategies for development of vaccines against HIV, Malaria, Tuberculosis, SARS-Covid. **(15)**

Unit IV:

Drugs and their Mechanism: Aspirin, Paracetamol, Avil, Antibiotics, Antiviral drugs, drugsfor metabolic diseases, Anticancer drugs,Anti-hypertensive drugs, Bronchodilator drugs and their mode of actions. **(20)**

Unit V:

Future of Medical Biotechnology: Individualized medicine; Gene therapy, Nanomedicine-Nanoparticles, Nanodevices- Medical microrobotics, Nanomedicine and Nanosurgery- for cancers, neurological disorders, Stem cell therapy. **(15)**

Total: 90

References Books

1. Medical Biotechnology; Albert Sasson (2006), United Nations Publications.
2. Medical Biotechnology; S.N. Jogland (2000), Himalaya Publication.
3. Medical Devices and Systems in Biomedical Engineering Handbook, Vol 2; Joseph Bronzino and Bronzino and Bronzino.
4. The Proteus effect, Ann B Parson (2006); National Academic Press
5. Biotechnology and Biopharmaceuticals (2003), Rodney J.Y. Hoan milo Gilbaldi, Wiley John and Sons.
6. Stem Cell Now: Christopher Thomas Scott (2005) Penguin group (USA).
7. Biotechnology Demystified Sharon Walker (2006) McGrow Hill Publication.

Mapping

Core – 15 : MEDICAL 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	3	1
2	3	3	3	3	3	3	3	3	3	3	2	1
3	3	3	3	3	3	3	3	3	3	3	2	1
4	3	3	3	3	3	3	3	3	3	3	2	1
5	3	3	3	3	3	3	3	3	3	3	2	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –III / Ppr.no.16 / Core-16

APPLIED BIOTECHNOLOGY

L	T	P	C
5	0	0	4

Objectives: To provide knowledge on the extent of application of biotechnology in different avenues of sciences.

Course Outcomes

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

CO. No.	Core – 16: APPLIED BIOTECHNOLOGY	Cognitive Level
CO1	Distinguish among diverse methods and technologies and their applications in marine biotechnology	K2,K3
CO2	Demonstrate Cancer cells and its biology, gene therapy and its mechanism	K3,K4
CO3	conclude a clear picture on Pharmacogenetics and Pharmacokinetics	K2,K3,K4
CO4	Compile the Concept of Nano-biotechnology & Historical background	K3,K4
CO5	Evaluate the environmental management and its impact, can create waste management sysyem	K3,K4,K5

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

APPLIED BIOTECHNOLOGY

Unit 1: Marine Biotechnology

History of marine biology, biogeochemical cycles, food chain and food web.Marine Pollution biology indicators (marine micro algae) biodegradation & bioremediation, marine fouling and corrosion Importance of coastal aquaculture, marine fishery resources, Medicinal compound from marine flora and fauna, marine toxin, antiviral and antimicrobial agents.**(15)**

Unit 2:Cancer biology and gene therapy

Cancer Biology - treatment of cancer-chemo therapy, radio therapy, immunotherapy and gene therapy. Gene therapy, barriers to gene delivery, overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome mediated gene delivery. Cellular therapy; use of stem cells. **(15)**

Unit 3:PHARMACEUTICAL TECHNOLOGY

Pharmacogenetics and pharmacokinetics: absorption, distribution, metabolism and excretion of drugs.New therapeutic strategies and delivery systems: Transdermal delivery system, liposomes, peptide and protein delivery, glycoprotein administration, gene therapy and RNA interference. **(15)**

Unit 4 :Nanobiotechnology

Concept of Nano-biotechnology & Historical background.Overview application and method of microbial nano-particle production with reference to Bacteriorhodopsin. DNA-Protein Nanostructures : Oligonucleotide-Enzyme conjugates. DNA conjugates of binding proteins. Non-covalent DNA-Streptavidin conjugates. DNA-Protein conjugates in microarray technology **(15)**

Unit 5: Environmental Biotechnology

Environmental management and Impact Assessment. Overview on Environmental Pollution, Microbiology of degradation of Xenobiotics: Degradation of hydrocarbons, substituted hydrocarbons, oil pollution and surfactants. Bioremediation of contaminated soils, Biotechnology intervention in waste water treatment.solid wastes management: composting, vermiculture, mushroom cultivation and biogas production. **(15)**

Total:75

Outcome: The students will have the ability to understand the uses and application of the biotechnology on various sectors of the economy. It also helps them to broaden the scope of ideas related to biotechnology and other walks of science.

References

1. Recent advances in marine biotechnology volume 3 - M. Fingerman, R .Nagabhushanam Mary - Frances Thomson.
2. Bradach, J.E., H.H. Ryther and W.D. MC Larney, Aquaculture, farming and husbandry and fresh and marine organisms, Wiley lnterscience, New York. 1972.
3. Stickney, R.R., 2000. Encyclopedia of Aquaculture. John Wiley Sons Inc. pp. 1063.
4. JuditPongracz and Mary Keen, Medical Biotechnology 1st Edition, Elsevier Publications,2008.
5. S. N. Jogdand Medical Biotechnology 2nd Edition Himalaya Publishers 2008.
6. Jawetz, Melnuk and Adelgerg, Medical Microbiology, Appleton & Lange Pub 1971.
7. Medical pharmacology, K.D.Tripathi.
8. Katzung, B.G.Basis and clinical pharmacology, Prentice Hall of International
9. Pharmacology and Therapeutics-Satoskar
10. Novel drug delivery system - Y. W. Chein.
11. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor), Chad A. 12.Mirkin (Editor) , Wiley Publishers, April 2004.
12. Nanotechnology, William Illsey Atkinson, JAICO Publishing House, Second Impression-2008.
13. Wastewater Engineering - Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., Tata McGraw Hill, New Delhi.
14. Environmental Biotechnology, M. H. Fulekar, CRC Press, 2010

Mapping

Core – 16: APPLIED 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	3	1
2	3	3	3	3	3	3	3	3	3	3	2	1
3	3	3	3	3	3	3	3	3	3	3	2	1
4	3	3	3	3	3	3	3	3	3	3	2	1
5	3	3	3	3	3	3	3	3	3	3	2	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology)/ Semester –III / Ppr.no. 17 / Core-17

Research methodology and Biostatistics

L	T	P	C
5	0	0	4

Objectives: To provide knowledge on Research methodology includes data collection, Preparation of scientific documents, and the use of statistical softwares.

Course outcome

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

CO. No.	Core – 17: RESEARCH METHODOLOGY& BIOSTATISTICS	Cognitive Level
CO1	Compare the research process and types of research	K2,K3
CO2	Understand and Demonstratethe concepts and methods of literature surveyand data collection	K2,K3
CO3	Design and developed a research plan, to find theuse of computational techniques and able to write a research articles	K2,K3,K4
CO4	Compile and correlate the observations and results for publication	K3,K4,K
CO5	Make use of computer based tools and techniques in research and analysis	K3,K4,K5

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

RESEARCH METHODOLOGY& BIOSTATISTICS

UnitI: Research methodology: An introduction – meaning, objective and types of research. Defining research problem – selection of problems.Sampling design – random sample.Measurement and scaling techniques, error in measurement. **(15)**

Unit II:

Methods of data collection – primary data – interview method, questionnaire, secondary data, case study method. Online data base library. The computer and its role in research.**(15)**

Unit III:

Preparation of scientific documents: Data management, Research papers, review articles, format of journals – proof reading. Journals: Standard of research journals, impact factor, citation index, methods of citation. Oral presentation, poster presentation, bibliography, thesis writing. **(15)**

Unit IV:

Measures of central tendency – mean, median, mode, dispersion – range, quartile deviation, mean deviation, standard deviation, coefficient of variation. Standard error, correlation, correlation coefficient, regression. **(15)**

Unit V:

Hypothesis – definition, basic concepts concerning testing of hypotheses, test of hypotheses and its limitations, significance test and fixing level of significance, Chi square test, student's t test. ANOVA – one way and two way. Use of statistical softwares. **(15)**

Total:75

Reference Books

1. Research Methodology, Kothari
2. Statistics for Life Science, M.L. Samuels and J.A. Witmer
3. Statistics, R.S.N. Pillai
4. Design and analysis of Experiments, Montgomery and C. Douglas

Mapping

Core – 17: RESEARCH METHODOLOGY& BIOSTATISTICS												
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	2	2
3	3	3	3	3	3	3	3	3	3	3	2	2
4	3	3	3	3	3	3	3	3	3	3	2	2
5	3	3	3	3	3	3	3	3	3	3	2	2

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –III / Ppr.no.18 / core -18/ Practical- 5

L T P C
0 0 4 2

LAB IN PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY

OBJECTIVES

To introduce the basic steps of micro propagation of plants, basic steps in animal cell culture and handling of lab animals

OUTCOME

The practical course provides knowledge about the basic techniques of micro propagation of plants and basic techniques in animal cell culture

Course Outcomes

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

CO. No.	Core – 18: Practical -5 LAB IN PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY	Cognitive Level
CO1	Prepare plant tissue culture media	K3
CO2	Perform Meristem culture, Callus induction, regenerate callus	K3,K4,K6
CO3	Isolate protoplasts – mechanical method, enzymatic method Prepare synthetic seeds Isolate of plant genomic DNA	K3,K4,K6
CO4	Perform Cell counting and cell viability, Measurement of doubling time andPreparation of metaphase chromosomes from cultured cells	K3,K4,K6
CO5	Handle of lab animals	K3,K5

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

LAB IN PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY

1. Preparation of plant tissue culture media
2. Meristem culture
3. Callus induction
4. Regeneration of adventitious root/shoot from callus
5. Acclimatization
6. Direct organogenesis – shoot tip culture
7. Embry culture
8. Isolation of protoplasts – mechanical method, enzymatic method
9. Preparation of synthetic seeds
10. Isolation of plant genomic DNA
11. Cell counting and cell viability
12. Measurement of doubling time
13. Preparation of metaphase chromosomes from cultured cells

14. Isolation of DNA from animal cells
15. Demonstration of apoptosis by DNA laddering
16. Handling of lab animals

Mapping

Core – 18: Practical-5 LAB IN PLANT BIOTECHNOLOGY AND ANIMAL 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	3	2
2	3	3	3	3	3	3	3	3	3	3	2	2
3	3	3	3	3	3	3	3	3	3	3	2	2
4	3	3	3	3	3	3	3	3	3	3	2	1
5	3	3	3	3	3	3	3	3	3	3	1	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –III / Ppr. No.19 /Practical -6

L T P C
0 0 4 2

LAB IN RESEARCH METHODOLOGY AND BIOSTATISTICS

OBJECTIVES

To have a working knowledge to carry out the basic statistical and research analysis

OUTCOME

The practical course helps to develop competency in presenting and discussing study results in a scientifically sound manner

Course Outcomes

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

CO. No.	Core – 19: Practical -6 LAB IN RESEARCH METHODOLOGY AND BIOSTATISTICS	Cognitive Level
CO1	Prepare bar diagram	K3
CO2	Calculate central tendency – mean, geometric mean, harmonic mean, median Calculate dispersion – Mean deviation, quartile deviation and standard deviation Calculate correlation	K3,K4,K6
CO3	Choose research methods Conduct background research	K3,K4,K6
CO4	Prepare a research proposal Prepare a manuscript for publication in journal	K5, K6
CO5	Reporting the findings	K3,K5

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

LAB IN RESEARCH METHODOLOGY AND BIOSTATISTICS

1. Preparation of bar diagram (Single, multiple, subdivided, percentage), line diagram and pie diagram using MS EXCEL
2. Calculation of central tendency – mean, geometric mean, harmonic mean, median
3. Calculation of dispersion – Mean deviation, quartile deviation and standard deviation
4. Calculation of correlation
5. Finding the regression equation
6. Calculation of ANOVA (One-way)
7. Calculation of t-test
8. Calculation of Chi square value
9. Defining project
10. Choosing research methods
11. Conducting background research
12. Choosing your participants

13. Preparing a research proposal
14. Preparing a manuscript for publication in journal
15. Analysing the data
16. Reporting the findings

Mapping

Core – 19: Practical -6 LAB IN RESEARCH METHODOLOGY AND BIOSTATISTICS												
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	2	3
3	3	3	3	3	3	3	3	3	3	3	2	3
4	3	3	3	3	3	3	3	3	3	3	2	3
5	3	3	3	3	3	3	3	3	3	3	1	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester - IV/ Ppr.no.20 / Core-20

Applied Bioinformatics

L	T	P	C
4	0	0	4

Objective: To understand the concept of Bioinformaticssoftwares- Sequence analysis, visualization and prediction.

Course Outcomes

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

CO. No.	Core – 20: APPLIED BIOINFORMATICS	Cognitive Level
CO1	Explain the importance and recent development of bioinformatics, classify the types of various algorithm, create a programming knowledge	K1, K4,K6
CO2	Describe the different Database, Explain different methods used in protein and nucleic acid sequence analysis using bioinformatics software, Describe the basic concept of next generation sequence	K1, K2
CO3	Predict the RNA structure, Summarise the various modelling techniques, discoveries of bioinformatics based drug.	K2, K3, K6
CO4	Rephrase the basic principles of Biophysics,atomic structure and chemical properties.	K2
CO5	Predict the Protein structure and create the Ramachandran plot	K6

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

APPLIED BIOINFORMATICS

Unit I:

Introduction of digital computers: File management,Algorithm – definition and examples – types of Algorithm – iterative, recursivealgorithms. low-level and high-level languages. Flow charts and programming techniques. Bioinformatics – an overview, scope and applications.Data mining, data ware housing. **(12)**

Unit II:

DNA data bank – the EMBL nucleotide sequence data bank – genbank – DDBJ. Enzyme databases – cloning vector data bases, BLAST, FASTA, Pairwise alignment and multiple alignments of nucleic acids and protein sequences, CLUSTAL W. NGS data analysis.**(12)**

Unit III:

Computational modeling: Secondary structure prediction of RNA, homology modelling, threading. RASMOL, MOLMOL, protein docking, drug designing, and web based bioinformatics tools. **(12)**

Unit IV:

Biophysics – Definition, scope and methods. Atomic structure, atomic orbital, wave functions, electronic structure of atoms, relationship between atomic structure and chemical properties.Molecule – different types of bonds – molecular orbital. **(12)**

Unit V:

Proteins: Protein structure - primary, secondary, tertiary and quaternary, globular, fibrous proteins, Ramachandran plot. Three dimensional structure and confirmation using physical methods – ORD, CD, ESR, PAGE, SDS-PAGE, diagonal electrophoresis.DNA-protein interactions; DNA-drug interactions, Protein-drug interaction, Molecular docking.**(12)**

Total:60

Reference Books

1. Introduction to Computers, Balaguruswamy
2. Nucleic acid and protein sequence analysis and structural studies, M.A. Bishop and C.I. Rawlings
3. An introduction to Bioinformatics algorithms, N.C. Jones and P.A. Pevzner
4. General Biophysics, Volkones
5. Molecular Biophysics, B. Pullman and M. Voino

Mapping

Core – 20: APPLIED BIOINFORMATICS												
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	2	3
3	3	3	3	3	3	3	3	3	3	3	2	3
4	3	3	3	3	3	3	3	3	3	3	2	3
5	3	3	3	3	3	3	3	3	3	3	1	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr.no.21 / Core-21

Genetic Engineering

L	T	P	C
5	0	0	4

Objective 1. To understand the concept of recombinant DNA technology for gene manipulation 2.To understand the gene manipulation methods and their applications 3. To explain the general principles of generating transgenic organisms

Course Outcomes

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

CO. No.	Core – 21: GENETIC ENGINEERING	Cognitive Level
CO1	Understand the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering.	K1, K4,K6
CO2	Get detailed knowledge of gene transfer methods and identifying suitable hosts for cloning.	K1, K2
CO3	Know the various techniques like blotting,Markers and PCR technology	K2, K3, K5
CO4	Rephrase the transposable elements and Introduction of Recombinant DNA molecules into appropriate hosts	K2
CO5	theoretical knowledge of genetic engineering for development of new recombinant DNA molecules	K2, K3

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

Unit-I: Restriction endonucleases and their importance in gene cloning. Enzymes used in recombinant-DNA technology: DNA polymerases, ligasesand DNA modifying enzymes (methylases, alkalinephosphatases,topoisomerases). Cloning vectors: Plasmids, Phagemids, Cosmids. **(12)**

Unit-II: Gene cloning strategies, analysis and expression of cloned genes. Construction of Genomic libraries: genome mapping and chromosomewalking and DNA foot printing, BAC and YAC. C-DNA synthesis: Isolation of eukaryotic mRNA and mechanism of C-DNAsynthesis, c-DNA libraries and in vitro packaging. Genome sequencing: Different strategies. DNA sequencing methods- Maxam-Gilbert and Sanger's method, automatedsequencing, multiplex sequencing. DNA arrays- principle, spotted DNA array; oligonucleotide chips **(12)**

Unit-III: Blotting techniques: Southern, Western and Northern blotting techniques. Molecular markers: RFLP, RAPD, AFLP, SSR and their applications.DNA finger printing technology and its application in forensic medicine. PCR Technology-Designing and synthesis of oligonucleotide primers, PCRamplification of specific DNA sequences, current innovations, cloning PCRproducts, mutagenesis by PCR. **(12)**

Unit-IV: Introduction of Recombinant DNA molecules into appropriate hosts-competentcells preparation. Genetic selection – alpha complementation, insertionalinactivation.Screening of libraries using labeled probes.Transposable elements, types and mechanism of transposition. **(12)**

Unit-V: Site directed mutagenesis and RNA interference. Knock-in and knock- out technology. Genome engineering technology- CRISPR-Cas system, TALENs & zinc finger,Nucleases.Next generation sequencing- principle, types and applications. Applications of genetic engineering in agriculture & animal husbandry.Applications of genetic engineering in industry and medicine. **(12)**

Total: 60

REFERENCE

1. Principles of Gene Manipulation and Genomics- Sandy B. Primrose, Richard Twyman 7th Edition; Blackwell Publishing

2. Gene Cloning and DNA Analysis: An Introduction- T. A. Brown - John Wiley & Sons

3. An Introduction to Genetic Engineering- Desmond S.T. Nicholl – Cambridge University Press

4. Molecular Biotechnology: Principles and Applications of Recombinant DNABernard R. Glick, Jack J. Pasternak, Cheryl L. Patten- ASM Press

5. Molecular Cloning: A Laboratory Manual (Cold Spring Harbor) - M. R. Green, J. Sambrook

Mapping

Core – 21: GENETIC ENGINEERING												
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	2	3
3	3	3	3	3	3	3	3	3	3	3	2	3
4	3	3	3	3	3	3	3	3	3	3	2	3
5	3	3	3	3	3	3	3	3	3	3	1	1

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

MSU / 2021-22 / PG –Colleges / M.Sc. (Biotechnology) / Semester –IV / pr.no.22/ Core-22

BIOETHICS, IPR & BIOENTREPRENERSHIP

L	T	P	C
4	0	0	4

Objectives: To provide knowledge about bioethics and details of IPR policies for successful Entrepreneurship.

Course Outcomes

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

CO. No.	Core – 22: BIOETHICS, IPR & BIOENTREPRENERSHIP	Cognitive Level
CO1	Distinguish knowledge of biosafety and risk assessment of products derived from recombinant DNA researchand environment release of genetically modified organisms, national and international regulations.	K1, K2,K3
CO2	Analyze different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents	K3,K4
CO3	Understand and apply framework of biosafety regulation in India	K2,K3
CO4	Analyze ethical aspects related to biological, biomedical, health care and biotechnology research	K4,K5
CO5	Organize policy of companies and other technology-intensive organizations to build, manage and govern technologybased business Differentiate systemic and cross-functional identification, control and governance of IP assets in sourcing, collaboration and exploitation	K4,K5,K6

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

BIOETHICS, IPR & BIOENTREPRENERSHIP

Unit 1: Applications of Biotechnology

Society, Risks, Ethics and Patenting.Benefits of biotechnology, ELSI of biotechnology, Recombinant therapeutic products for human health care.Genetic modificationsrecombinant foods, safety of GM foods.Release of genetically engineered organisms-Human embryonic stem cell research-cloning. **(12)**

Unit 2: Patents Introduction

Basis of Patentability, Non Patentable Inventions, Patent Application Procedure in India, Treaties and Conventions of Patents, Patent Cooperation Treaty, TRIPS and Pharmaceutical Industry, issues and prospects. Other Forms of IPR, Definition, Different forms 35 of IPR, Benefits of IPR system. WTO, GATT, Objectives, Structural format of WTO - Economic Impact of WTO, WTO Agreements, Benefits of WTO in relation to biotechnology. **(12)**

Unit 3: Biosafety

Biosafety, Definitions, biosafety levels, framework of biosafety regulation in India; Structure and functions of Committees; DBT guidelines on biosafety in conducting research in biotechnology.Regulations of Genetically modified Organisms in India, Biosafety regulation for transgenic plants and animals, labeling of GM foods. **(12)**

Unit 4 : Bioethics

Definition, Bioethics of IPR, ethical criteria in biotechnology, animal ethics; Guidelines for use of lab animals in medical Colleges, Licensing of animal house, Human cloning, Ethical issues, Ethical clearance norms for conducting studies on human subjects. Ethical and Other Legal Issues in Biotechnology. **(12)**

Unit 5: Company Start-up: An Overview

Structure of a Company, Start-up of a Company, New Product Development.Market Research.Sales & Marketing Principles. Start-up India policy, start-up policy of state, Angel ventures, Mentors and mentoring, Incubators, Funding agencies, Startup pitching. Scaling the startup. **(12)**

Outcome: The students will have the ability to understand and apply the regulation of bioethics and policies of IPR.

References

1. Biosafety, Traylor, Fredric & Koch, 2002. Michigan sate University Pub., USA.
2. Contemporary issues in Bioethics, Beauchamp & Leroy, 1999. Wards worth Pub. Co. Belmont, California.
3. www.ipr-helpdesk.org/
4. www.patentoffice.nic.in/ipr/patent/patents.html
5. www.bangalorebio.com/GovtInfo/ipr.htm
6. Manual of patent practice and procedure. IPR India, 2005. Ministry of commerce and industry, New Delhi, pp.163.
7. Biotechnology and safety assessment, John.A.Thomas, 2004. pp.333.
8. The Manual for Indian Start-ups: Tools to Start and Scale-up Your New Venture, Vijaya Kumar Ivaturi, Meena Ganesh Penguin Random House India, 2017

Mapping

Core – 22: BIOETHICS, IPR & BIOENTREPRENERSHIP												
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

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr.23 / Practical – 7

Lab in Applied Bioinformatics

L	T	P	C
0	0	3	2

OBJECTIVES: To have a working knowledge to carry out the Bioinformatics tools

Course Outcomes

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

CO. No.	Core – 23: Practical – 7 Lab in Applied Bioinformatics	Cognitive Level
CO1	Perform Pairwise alignment,local alignment of DNA	K6
CO2	PerformMultiple alignment of nucleotide	K6
CO3	Perform BLAST, FASTA	K6
CO4	Perform PCR designing	K6
CO5	Perform NGS data Analysis	K6

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

Lab in Applied Bioinformatics

1. Pairwise alignment – global alignment of DNA and protein using Needleman – Wunch algorithm
2. Perform local alignment of DNA and protein using Smith-Watermann algorithm
3. Multiple alignment of nucleotide
4. Multiple alignment of protein
5. BLAST
6. FASTA
7. CLUSTAL Omega
8. Protein structure viewing – RASMOL, SWISS PDB VIEWER
9. PCR primer designing
10. NGS data analysis

Mapping

Core – 23: Practical – 7 Lab in Applied Bioinformatics												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	2	3	3	3	3	2	3	3	3	2	1
2	3	3	3	3	3	3	2	3	3	3	2	1
3	3	3	3	3	3	3	2	3	3	3	2	1
4	3	3	3	3	3	3	2	3	3	3	2	1
5	3	3	3	3	3	3	2	3	3	3	2	3

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

MSU / 2021-22 / PG –Colleges / M.Sc. (Biotechnology) / Semester –III / Ppr.no.24 / Practical- 8

LAB IN GENETIC ENGINEERING

L	T	P	C
0	0	4	2

OBJECTIVES: To have a working knowledge to carry out the Molecular manipulations

Course Outcomes

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

CO. No.	Core – 24: Practical – 8 LAB IN GENETIC ENGINEERING	Cognitive Level
CO1	Perform Agarose gel electrophoresis	K3
CO2	Perform Elution of DNA,Restriction digestion of DNA,Ligation	K3
CO3	PerformPolymerase chain reaction	K3
CO4	Perform Bacterial Transformation,Transduction	K3
CO5	Perform Southern blotting technique	K3

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

LAB IN GENETIC ENGINEERING

1. Agarose gel electrophoresis
2. Elution of DNA
3. Restriction digestion of DNA
4. Ligation
5. Polymerase chain reaction
6. Bacterial Transformation
7. Transduction
8. Phage isolation
9. Conjugation
10. Southern blotting technique

Mapping

Core – 24: Practical – 8 LAB IN GENETIC ENGINEERING												
CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
1	3	2	3	3	3	3	2	3	3	3	2	1
2	3	3	3	3	3	3	2	3	3	3	2	1
3	3	3	3	3	3	3	2	3	3	3	2	1
4	3	3	3	3	3	3	2	3	3	3	2	1
5	3	3	3	3	3	3	2	3	3	3	2	3

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr.no.25 / Elective 1 (I) -

L	T	P	C
3	0	0	3

OPEN ONLINE COURSE

The student shall undertake an optional career-based Open online course in Biotechnology from an UGC approved MOOC platform (e-PG Pathshala/Swayam etc.) during the fourth semester and submit the Certificate at the end of the fourth semester.

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr.no.25 / Elective 1 (II)

FIELD WORK / INTERNSHIP / STUDY TOUR

L	T	P	C
0	0	4	3

An Internship for a minimum of 45 hours should be completed by every student.

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr.no.25 / Elective 1 (III) -a

A-BIOSENSORS

L	T	P	C
3	0	0	3

Objectives of the Course: This course helps to understand the use of Biomolecules as recognition elements for detection of a particular analyze and the use of biological elements such as proteins in place of silicon chips.

Outcome: The students will have the ability to understand the concepts of biosensor and how it can be used for the benefits of the biosphere

Course Outcomes

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

CO. No.	Elective 1 A- BIOSENSORS	Cognitive Level
CO1	State and recite about biosensors and its operating conditions positive and negative controls, safety requirements of a biosensor	K1, K2
CO2	Summarise and examine biologically active material and analyte, types of membranes used in biosensor constructions.	K3,K4
CO3	Compare and asses Various types of transducers, principles and applications	K3, K4,K5
CO4	Design and create biosensors in clinical chemistry, medicine and health care	K4,K5
CO5	Construct Low cost- biosensor for industrial processes for online monitoring; biosensors for environmental monitoring.	K5,K6

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

A-BIOSENSORS

Unit 1: Introduction

What are Biosensors? Advantages and limitations, various components of biosensors.Desired characteristics of biosensors: reliability, simplicity, cost, and related parameters. Operating conditions, calibration, positive and negative controls, safety requirements of a biosensor.**(9)**

Unit 2: Types of Biosensors

Biocatalysis based biosensors, bioaffinity based biosensors & microorganisms based biosensors, biologically active material and analyte. Types of membranes used in biosensor constructions. **(9)**

Unit 3: Transducers in Biosensors

Various types of transducers; principles and applications - Calorimetric, optical, potentiometric / ampere metricconductormetric/resistor metric, Piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers. Chemiluminiscene – based biosensors. **(9)**

Unit 4: Application and Uses Of Biosensors I

Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food **(9)**

Unit 5: Application and Uses Of Biosensors II

Low cost- biosensor for industrial processes for online monitoring; biosensors for environmental monitoring. **(9)**

Total:45

REFERENCE:

1. Brian R Eggins - Biosensors an Introduction , First edition (1996), John Wiley & Sons Publishers.

2. Loic J. Blum, Pierre R Coulet - Biosensors Principles and Applications, First edition (1991), Marcel Dekker,Inc,.

3. Donald G. Buerk - Biosensors Theory and Applications, First Edition (1993),Technomic Publishing. Co, Inc,.

4. Aboul - Enein, H. V., Stefan, R. and Van Staden, (1999) Chemiluminiscence - based biosensors - An overview crit Rev. Anal. Chem. 29, 323-331.

5. Pearson, J.E. Gill, A., and Vadgama, P. (2000) Analytical aspects of biosensorsAnnClinBiochem 37, 119-145.

Mapping

Elective 1 A- BIOSENSORS												
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	3	3	3	3	3	2	2
3	3	3	3	3	3	3	3	3	3	3	2	2
4	3	3	3	3	3	3	3	3	3	3	2	2
5	3	3	3	3	3	3	3	3	3	3	2	2

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr. No.25 / Elective-1(III)-B

B-ENVIRONMENTAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

Objective: To get familiarize with biotechnological interventions related to environment.

Course Outcomes

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

CO. No.	Elective 1 B-ENVIRONMENTAL BIOTECHNOLOGY	Cognitive Level
CO1	Recall and recite fundamentals of Microbial Diversity and Environmental Pollutants General characters, important uses and harmful effects	K1, K2
CO2	Clarify, restate and relate environmental Microbiology and Reactions Bioremediation, advantages and disadvantages	K2,K3,K4
CO3	Evaluate biotransformation and Biodegradation Common prejudices against the use of enzymes	K4,K5
CO4	Compose bioremediation of Soil, Water and Air.	K5,K6
CO5	Organise factors Affecting the Bioremediation Processes, Effects of co-substrates on microorganisms,	K4,K5,K6

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

B - ENVIRONMENTAL BIOTECHNOLOGY

Unit 1: Fundamentals of Microbial Diversity and Environmental Pollutants General characters, important uses and harmful effects of a) Protozoa b) algae, c) fungi, d) bacteria and e) viruses. Water, Soil and Air: their sources and effects. Sources of Heavy Metal Pollution, Microbial Systems for Heavy Metal Accumulation. Environmental problems-ozone depletion, greenhouse effect, water, air and soil pollution, land degradation **(9)**

Unit 2: Environmental Microbiology and Reactions Bioremediation, advantages and disadvantages; In-situ and ex-situ bioremediation. Slurry bioremediation; Bioremediation of contaminated ground water and phytoremediation of metals in soil; microbiology of degradation of xenobiotics, Role of environmental biotechnology in the management of environmental problems **(9)**

Unit 3: Biotransformation and Biodegradation Common prejudices against the use of enzymes- Advantages & Disadvantages of Biocatalysts - Isolated Enzymes versus whole cell systems- Mechanistic Aspects and Enzyme Sources, Xenobiotic compounds: Aliphatic, Aromatics, Polyaromatic hydrocarbons, Polycyclic aromatic compounds, Pesticides, Surfactants and microbial treatment of oil pollution **(9)**

Unit 4: Bioremediation of Soil, Water and Air Environment of Soil Microorganisms, Soil Organic Matter and Characteristics, Soil Microorganisms Association with Plants, pesticides and Microorganisms; Biotechnologies for Ex-Situ Remediation of Soil, Waste water characteristics - Sewage and waste water treatments systems; Primary, secondary and tertiary treatments- Biological waste water treatment - Atmospheric Environment for Microorganisms, Microbial Degradation of Contaminants in Gas Phase, Biological Filtration Processes for Decontamination of Air Stream **(9)**

Unit 5: Advances and Case Studies Biopesticides, Biofertilizers, Biofuels, Biosensors, Bioindicators, Biodegradable plastics, Factors Affecting the Bioremediation Processes, Effects of co-substrates on microorganisms, Phytoremediation, Sequestering Carbon Dioxide, Biomonitoring, Biomembrane Reactors, Important Case Studies in Environmental Biotechnology: Oil spill, Textile wastewater treatment. **(9)**

Total: 45L

Textbook(s): 1. McCarty PL - Environmental biotechnology: principles and applications - Tata McGraw- Hill Education – 2012

2. Mitchell R, Gu J D - Environmental microbiology - John Wiley & Sons – 2010 (2nd Edition)

3. Díaz E - Microbial biodegradation: genomics and molecular biology - Horizon Scientific Press - 2008.

4. Scragg AH - Environmental biotechnology - Essex: Longman - 1999.

Mapping

Elective 1 B - ENVIRONMENTAL 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	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

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr. No.25 / Elective-1(III)-C

C - TISSUE ENGINEERING

L T P C
3 0 0 3

OBJECTIVES: To apply knowledge of science, and engineering; to design and conduct experiments, as well as to analyze and interpret data; to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Course Outcomes

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

CO. No.	Elective 1 C-TISSUE ENGINEERING	Cognitive Level
CO1	Outline ,recall and review quantitative cell and tissue biology	K1, K2,K3
CO2	Arrange and develop engineering methods and design	K2,K3
CO3	Relate and categorise clinical implementation, host integration and producing tissue engineering therapies	K3, K4
CO4	Construct fabrication technologies and immune isolation techniques.	K4,K5
CO5	Design and construct tissue engineering of nerves, the tendons, ligaments, cornea, cartilage and myocardium, meniscal tissues	K4,K5,K6

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

C - TISSUE ENGINEERING

Unit I: Quantitative cell and tissue biology – including tissue organization, tissue dynamics, morphogenesis, stem cells, cellular fate processes and their co-ordination. Cell and tissue characterization – including high throughput technologies, cell and tissue properties, cell and tissue culture and gene transfer.**(10)**

Unit II: Engineering methods and design – including time constant analysis, scale-up procedures, cell separations, biomaterial scaffolds, three dimensional scaffold design, laboratory scale manufacture of a cell carrier, phase separation, self -assembly, gas foaming, solid free form fabrication, injectable systems, structural and functional scaffold modification, composite scaffolds. **(10)**

Unit III: Clinical implementation – including conventional approaches to tissue repair, host integration and producing tissue engineering therapies **(5)**

Unit IV: Tailoring of biomaterials: Exploration of traditional and novel materials including alginates, polysaccharides and fibrillar fibrin gels. Fabrication technologies and immune isolation techniques.Bioactive hydrogels, gene delivery, growth factors and degradation of biodegradable polymers.**(10)**

Unit V: Tissue engineering applications – blood cell substitutes and tissue engineering of nerves, the tendons, ligaments, cornea, cartilage and myocardium, meniscal tissues. Synthetic biology, Prospects and ethical issues.**(10)Total: 45L**

OUTCOME:

1. To specify the different types of biodegradable biomaterials that can be used in tissue engineering applications
2. To discuss the complex interactions between biomaterials, cells and signals in biological systems

Reference Books

1. Scaffolding in tissue engineering, Peter X. Ma, Jennifer H. Elisseeff
2. Introduction to Bioengineering, Yuan-Cheng Fung, ShuChien
3. Functional Tissue Engineering, FarshidGuilak, David L. Butler, Steven A. Goldstein
4. Frontiers in Tissue Engineering, Charles W. Patrick, Antonios G. Mikos, Larry V. Mcintire
Principles of tissue Engineering, Robert Paul Lanza, Robert S. Langer, Joseph Vacanti

Mapping

Elective 1 C - TISSUE ENGINEERING												
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	2	2	2
2	3	3	3	3	3	3	3	3	3	2	2	1
3	3	3	3	3	3	3	3	3	3	3	3	1
4	3	3	3	3	3	3	2	3	3	3	3	1
5	3	3	3	3	3	3	2	3	3	2	3	1

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

MSU / 2021-22 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr.no.19 / Core-25

Project

L	T	P	C
0	0	7	8