Manonmaniam Sundaranar University

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

Tirunelveli - 627012, Tamilnadu

Department of Biotechnology

MSc Biotechnology

2023 - 2024 onwards

Manonmaniam Sundaranar University

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

Mission of the University :

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

Department of Biotechnology

Vision of the department

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

Mission of the department

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

1. Name of the programme : MSc. Biotechnology

2. Preamble of the programme:

MSc. Biotechnology is a four-semester programme that includes theory and practicals in different areas of biotechnology. In addition, it contains one research project during the fourth semester to enhance knowledge and research skills in biotechnology during the course.

Objectives of the programme

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

Eligibility for Admission

A Candidate with a Bachelor's Degree in Science in the disciplines of Biotechnology, Biology, Botany, Zoology, Microbiology, Nano Science, Nano Technology, Nano Biotechnology, Genetics, Chemistry, Biochemistry, Physics, Agriculture from this University or B.E/ B.TECH (Biotech), B.V.Sc, MBBS, BDS or any area of Biological Sciences / Agriculture and allied sciences; Veterinary and allied sciences or an examination of some other University accepted by the Syndicate as equivalent thereto shall be for the M.Sc Degree Examination of this University after a course of two academic years in an Affiliated Colleges of this University.

Admission will be based on (i) the total marks obtained in the entrance test (50%) and the qualifying examination (50%) and (ii) by following the Tamil Nadu government norms of reservation.

Duration of the programme

The students shall undergo this prescribed programme of study for a period not less than two academic years (four semesters). Each semester would contain 90 working days.

3. **Programme Structure**:

Semester	Course Nature	Course	Credits	Contact hours per week	Continuous internal assessment (CIA)	End semester exam
FIRST	Core I	Biochemistry	4	6(4+2)	25	75
	Core II	Cell and Molecular Biology	4	6(4+2)	25	75
	Core III	Microbiology	4	6(4+2)	25	75
	Practical –I	Biochemistry, Cell and Molecular Biology & Microbiology	2	4(3+1)	25	75
	Elective – I (Discipline Centric)	Food and Nutrition Genetics Virology	3	4	25	75
	Elective – II (Generic)	Basic Analytical Methods Vermiculture Technology Validation of Medicinal Plants	3	4	25	75
		Total	20	30		
SECOND	Core IV	Developmental and Stem cell Biology	4	5(4+1)	25	75
	Core V	Genetic Engineering	4	5(4+1)	25	75
	Core VI	Immunology	4	5(4+1)	25	75
	Practical – II	Immunology, Genetic Engineering and Developmental and Stem cell Biology	2	4(3+1)	25	75
	Elective –III (Discipline Centric)	Dairy Technology Medical Laboratory Technology	3	4	25	75
	Elective –IV (Generic)	Enzyme Technology Pharmaceutical Technology	3	4	25	75
	Skill Enhancement	MOOC / NPTEL / Medical Laboratory Technology	2	3	25	75
	Value Added Course **	Mushroom Cultivation and Apiculture Agrofood products value addition and product development	2	-	25	75
		Sub Total	22	30		
THIRD	Core VII	Plant Biotechnology	4	4	25	75
	Core VIII	Animal Biotechnology	4	4	25	75
	Core IX	Microbial Biotechnology	4	4	25	75
	Core X	Environmental Biotechnology	4	4	25	75
	Practical – V	Plant Biotechnology & Animal Biotechnology	2	4(3+1)	25	75
	Practical – VI	Microbial Technology & Environmental Biotechnology	2	4(3+1)	25	75
	Elective – V (Discipline Centric)	Genomics & Proteomics Herbal Biotechnology	3	4	25	75
	Skill	MOOC/ NPTEL / Medical Coding	2	2	25	75

	Enhancement					
	Value Added Course **	Food and pharma compliance Regulatory affairs and Industrial standards	2	-	25	75
		Internship/ Industrial Activity	2	-	25	75
			27	30		
FOURTH	Core XI	Research Methodology	4	4	25	75
	Core XII	Bioinformatics	4	4	25	75
	Elective - VI (Industry / Entrepreneurship)	Nano Biotechnology Bioethics, Biosafety and IPR System Biology	3	4	25	75
	Skill Enhancement course / Professional Competency Skill	Training for Competitive Examinations – UGC/CSIR-NET, SET	2	2	25	75
	Dissertation	Project	8	16	25	75
	Extension Activity		1	-		
			22	30	25	75
			91			

Scheme of evaluation:

For evaluation of theory papers (core and elective), the continuous internal assessment (CIA) will be 25 marks, and the external examination for 75 marks. Practicals carry a maximum of 100 marks with 25 marks internal and 75 marks external. The project carries 100 marks, with 25 as internal and 75 as external.

i. Core and elective papers:

Maximum marks	100
Passing minimum marks	50

a. Continuous internal assessment (CIA):

- The CIA component for a theory course may include tests/seminar/assignmentparts.
- There is no passing minimum for the CIA components and the CIA in total.
- There shall be no provision for improvement of CIA components.
- There shall be three compulsory periodical tests in a semester.
- Each test is conducted for about one and a half units of the syllabus in eachcourse.
- The duration of each test is one hour
- The question paper pattern for the internal test is given below:
- Each test carries a maximum of 25 marks and shall be converted as required.

The following procedure is followed for Internal Marks:

S. No	**Theory Papers: Internal Marks:**	**Marks**
1	Best Two tests out of 3	10 marks
2	Attendance	5 marks
3	Seminar	5 marks
4	Assignment	5 marks
	Total	25

S. No	**Practical Papers: Internal Marks:**	**Marks**
1	Practical Best Test 2 out of 3	25 marks
2	Attendance	5 marks
3	Record	5 marks
4	Viva	5 marks
	Total	40 marks

S. No	**Break-up Details for Attendance**	**Marks**
1	91% to 100%	5 marks
2	76% to 90%	4 marks
3	60% to 75%	3 marks
4	Below 60%	No marks

3. **PATTERN OF QUESTION PAPER:**

Internal examinations:

Section	Type of questions	Max. Marks
Part A	Objective type - 5 questions	5 x 1 = 05
Part B	2 out of 3 descriptive or analytical questions	2 x 5 = 10
Part C	1 out of 2 descriptive or analytical questions	1x 10 =10
	Total Marks	25

The CIA 25 marks are divided as 15 marks for the internal written test (average of the

marks from the best two tests out of three tests), 5 marks for theseminar, and 5 marks for the assignment activities.

External examinations:

- The duration of the University examination for each theory course is 3 hours. The question paper pattern for the end-semester examination of each theory paper is given below:

Section	Type of questions	Max. Marks
Part A	Objective type / descriptive - 10 questions (2 from each unit)	10 x2 = 20
Part B	Unit-wise choice - either (a) or (b) type - 5 questions	5 x 5 = 25
Part C	Two Essay type questions of 15 marks to be answered choosing one from each Unit following either/or pattern	2 x 15 = 30
	Total marks	75

- There is a passing minimum of 50% in the University examination in eachtheory course, and there is a passing minimum of 50% in the overall component, i.e., out of the total marks in the CIA component andUniversity examination for each theory course.
- There will be a special supplementary examination for those candidates who have failed only one subject the last semester.

Internship

The internship course will provide the interns to gain knowledge. Internships are off-campus experiential learning activities designed to provide students with opportunities to make connections between the theory and practical of academic study. Internships are completed under the guidance of an internship supervisor anda faculty guide, who in combination with the interns will create a framework for learning. The interns will append, to their internship contract, from the internship supervisor, which lists responsibilities and how their performance will be evaluated.

a. The interns will be evaluated by research internship supervisor based on their sincerity, and research output.

b. At MSU, the intern will be evaluated through a seminar on his work, by a duly constituted faculty/ expert committee, on the following:.

Criteria for evaluation of Internship

S.No.	Criteria	Internal (25 Marks) Dept.faculty	External (75 marks)
1	Organization profile / Internship module	5	15
2	Activity logbook and evaluation report	5	5
3	Skill acquisition	5	5
4	Originality and innovation	5	10
5	Significance of research outcomes	-	10
6	Report writing	-	15
7	Presentation/Demonstration	5	15
Total (100 Marks)		25	50

Practical

Maximum marks	100
Passing minimum marks	50

Phase of examination	**Marks**	**Evaluation**
Phase II: External - Practical examination	Total – 75 Marks awarded by the External examiner – 75 marks (50 for practicals + 20 for viva + 5 for records)	Only one practical examination be conducted at the end of the semester for the students on a lot basis by appointing two examiners from the same department / one from the other institution. Passing minimum: 50% in the external

Dissertation

Maximum marks	100
Passing minimum marks	50

Mode of project : Individual project

Guide : Each student shall be allotted under the guidance of a department faculty member by the Head of the department.

Nature of project : Every student shall undertake a unique project, which shall be implemented using available lab facilities in the University/ other institution as approved by the guide and Head.

Phase of examination	Marks	Assessment
Phase I – Internal	Total – 25 marks	Periodical reviews by the guide / faculty There is no passing minimumfor assessment
Phase II – External	Total – 75 marks Marks awarded by the external examiner – 75 marks (40 for Project + 15 for Viva-voce+ 20 for dissertation)	Examination shall be conducted at the end of the tenth semester by appointing either two examiners from the same department or at least one from the other department/ institution. Passing minimum: 50% (25 marks) in the external

Model question

Manonmaniam Sundaranar University – November 2023

First semester

MSc. Biotechnology

Biochemistry

Subject code:

Time: 3 hours Total marks: 75

Part A 10X2=20 marks

Answer ALL questions

1	Define the term oligomer	CO1	R
2	Establish the relationship between the enzyme's high activity and optimum pH.	CO1	A
3	Identify the factors triggering glycogenolysis.	CO2	U
4	List out the three primary metabolic fates of pyruvate.	CO2	R
5	Classify the lipids.	CO3	U
6	Appraise the importance of cholesterol biosynthesis in our bodies.	CO3	A
7	Give an example of the quaternary proteins with justification.	CO4	U
8	Name any two amino acids that are both glucogenic as well as ketogenic	CO6	R
9	Identify the DNA's most common conformation.	CO5	R
10	Mention the forces that stabilize nucleic acids.	CO5	R

Part B 5X5= 25 marks

Answer ALL questions. Each question carries equal marks

1a	Explain the necessity of water for life. (Or)	CO1	A
11b	Evaluate the biological significance of buffers	CO1	E
12a	Illustrate the various steps of gluconeogenesis and its regulation. (Or)	CO2	A
12b	Deduce the three main steps of the electron transport chain.		
13a	Give the classification of compound lipids with an example.	CO2	U
	(Or)		
13b	Explain the β-oxidation in detail. How will you predict its energetics?	CO3	AC
14a	How will you classify amino acids?	CO3	U
	(Or)		
14b	Compile the various steps of the uric acid cycle. Add a note on its importance.	CO4	A
15a	Compare and contrast the structure of mRNA and tRNA	CO5	UA
(Or)			
15b	Describe the structure of vitamins with a diagram.	CO6	UA

Part C 2X15= 40 marks

Answer ALL questions. Each question carries equal marks

16	Justify the statement “Miller-Urey experiment scientifically explored the ideas about the origin of life”. Add a note on the significance of the Miller experiment.	CO2	UE
17	Discuss in detail the mechanism of acid-base regulation in ourbody with special references to blood and gastric juice.	CO1	C
18	Explain in detail the structure of carbohydrates with anexample. List out the important function of each type.	CO2	AU
19	Describe in detail the mechanism of acid-base regulation in ourbody with special references to blood and gastric juice	CO5	AR
20	Explain the various steps of fatty acid oxidation? Add a note ontheir significance.	CO4	RE

Programme outcomes (POs)

PO 1 – Learn to apply the biotechnology knowledge and meet the skilled manpower needed for the exploration of inclusive and sustainable development of agro-food, medical, pharmaceutical industries, and healthcare service organizations.

PO 2 – Understand the applications of biotechnology and advances in the diverse fields like medical, microbial, food, environmental, agricultural, plant, animal, aquaculture, nano, and forensic sciences.

PO 3 – Idealize the concept and applications of biotechnological tools in response to various infectious and non-infectious diseases. Interpret the usage of mammalian, plant, and microbial cells to produce therapeutically and other commercially important products.

PO 4 – Explain the significance of genetically modified organisms and their products and general principles underlying the generation of transgenic plants, animals, and microbes.

PO 5 – Appraise the interdisciplinary nature of the bioinformatics course with a substantial understanding of biological, physical, and chemical sciences.

PO 6 – Analyze the current applications of biotechnology to environmental quality evaluation, monitoring, and contaminated environment remediation.

PO 7 – Nurture necessary hands-on technical skills to support biotechnology research activity and innovative product development.

PO 8 – Enable to avail employment opportunities in various government and non-government research laboratories, institutes, bio-industries, and start-ups.

Programme specific outcomes (PSOs):

Upon successful completion of the MSc Biotechnology 2 years programme, the candidate should be able to:

PSO 1: Understand the fundamental importance of living cells, biomolecules, derived products and their processes in modern science, medicine, and industries.

PSO 2: Recall the traditional knowledge in various aspects of biotechnology with special reference to microbes and their products.

PSO 3: Develop the ability to design, plan and execute biobased experiments and apply necessary tools for their analysis, interpretation, and reproducibility.

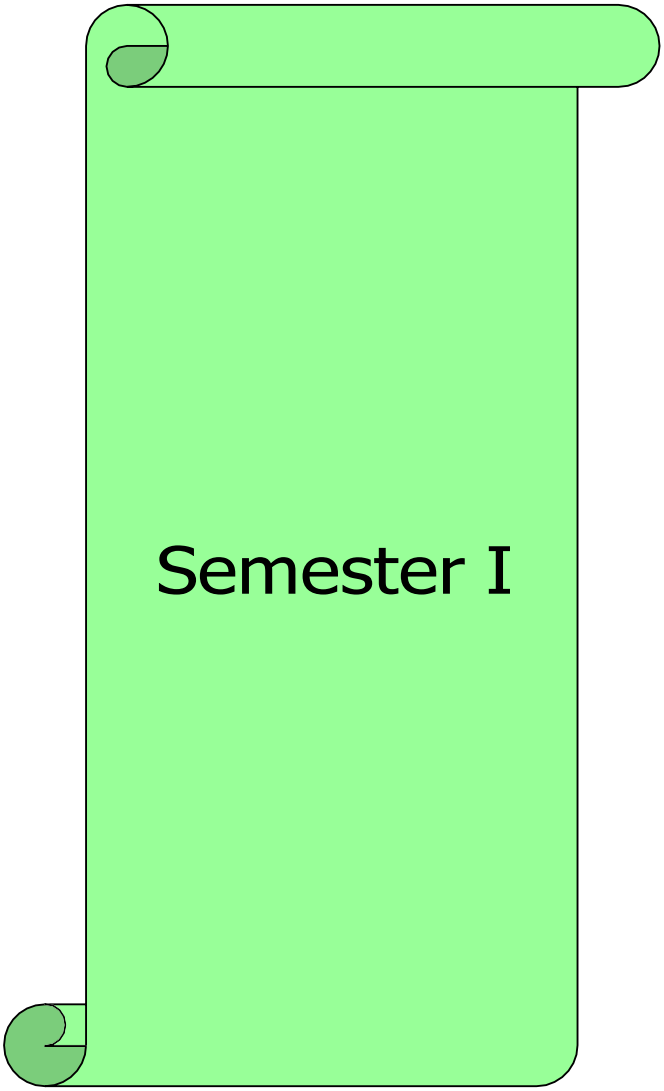
PSO 4: Know to learn, diagnose, and solve biotechnology-associated problems using appropriate modern analytical/biological software/online tools and equipment.

PSO 5: Explore all the career paths available for biotechnologists through suitable skill-based courses, training/internships and implement the same professional or career reward.

PSO 6: Integrate the knowledge acquired and concepts developed with biotechnology's ethical and industrial perspectives.

PSO 7: Recognize the need and produce innovative biological products from available resources for socio-economic development.

PSO 8: Develop empirical knowledge to design and establish new techniques and products in commercial, start-ups, and entrepreneurship


Semester I

Core I - **BIOCHEMISTRY**

L	T	P	C
5	1	0	4

a. Course code:

b. Course objectives:

1. To develop broad and balanced knowledge of understanding biomolecules, keybiochemical concepts, principles, and theories related to biochemistry.
2. To understand various metabolic pathways, their regulation, and significance.
3. To offer students the right analytical tools and acquire theoretical, technical,and analytical skills to address questions and problems in biochemistry.

c. Course prerequisites:

- Intrinsic knowledge of biomolecules and its metabolism.

d. Course outcomes (COs):

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

Course outcome	Expected outcome	Cognitive level
CO1	Identify the biomolecules of significance and their metabolic process	K1, K2
CO2	Understand and explain the carbohydrate metabolism and its significance	K2
CO3	Develop knowledge of various metabolic processes of lipids and their importance.	K3
CO4	Illustrate the structure of proteins, their classification, and the metabolism of amino acids	K4
CO5	Compare the structure of DNA and RNA, their metabolism, regulation, and roles in biological functions.	K5
CO6	Integrate the acquired knowledge and develop the capability to compete in national level examinations for higher studies.	K3, K6

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

e. Course outline

Unit I 12 Hrs

Basic Concepts: Units of measurements of solutes in solution, e.g., Normality, Molality, Molarity. The hyper and hypotonic solution, pH, pK, acids, bases, ionic bonds, covalent bonds, and secondary bonds (hydrogen bonds and Vander Waal‟ bonds)

Unit II 12 Hrs

Biomolecules: Definitions, nomenclature, classification, structure, chemistry, and properties of carbohydrates, Definitions, nomenclature, classification, structure, chemistry, and properties of amino acids and proteins (hemoglobin, myoglobin, and plasma proteins) lipids and Nucleic acids.

Unit III 12 Hrs

Metabolism: Metabolism of Carbohydrates, EMP, TCA, HMP. Glycogen metabolism, Gluconeogenesis. Amino Acids-Transamination, Deamination, Urea cycle. Lipids and Nucleic Acids -Their Biosynthesis Mechanism of Oxidative Phosphorylation and Its Inhibitors, Uncouplers, Photophosphorylation.

Unit IV 12 Hrs

Enzymology: Enzymes general aspects (classifications and structure). The allosteric mechanism, regulatory and active sites, and active energy. Iso-enzymes. Enzyme kinetics (MM, LB plot, Km)
And hormones.

Unit V 12 Hrs

Clinical biochemistry: Blood sugar level, Factors controlling blood sugar level – hypoglycemia, hyperglycemia, Diabetes mellitus, types – GTT. Metabolism of bilirubin- jaundice-types. Differential diagnosis and liver function tests. Renal functional test and gastric function test.

f. Mapping of Course Outcomes to POs and PSOsMapping of COs to POs

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

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

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

(L – Low, M – Medium, H – High)

g. Text books/References:

1) David L Nelson and Michael M. Cox, 2017. Lehninger Principles ofBiochemistry, 7th edition, NJ, W.H. Freeman
2) Donald Voet, Judith G. Voet, 2011. Biochemistry, 4th Edition (International Student Version), John Wiley & Sons (Asia) Pte Ltd
3) Donald Voet, Judith G. Voet, Charlotte W. Pratt, 2012. Fundamentals of Biochemistry: Life at the Molecular Level 4th Edition, Wiley.
4) Jeoffrey Zubay, 1995. Principles of Biochemistry Wm C. Brown Publications.
5) Lubert Stryer, Jeremy Berg, John Tymoczko, Gregory Gatto, 2019.Biochemistry, 9th Edition, New York, Freeman.

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

1) https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQlU+6LM40K jY1Q==
2) https://microbenotes.com/category/biochemistry/
3) https://nptel.ac.in/courses/102106087
4) https://onlinecourses.nptel.ac.in/noc22_bt22/preview
5) https://study.com/academy/topic/biochemistry-study-guide.html
6) https://www.brainkart.com/subject/Biochemistry_302/
7) https://www.easybiologyclass.com/topic-biochemistry/

Core II - **CELL AND MOLECULAR BIOLOGY**

a. Course code:

L	T	P	C
5	1	0	4

b. Course objectives:

1. To strengthen the student's basic and depth knowledge of the central dogmaof life, cell division, and cell cycle.
2. To explain the Techniques in cell biology.
3. To explain the synchronization of cells and the aging of cells.

c. Course prerequisites:

- Necessary information of central dogma, cell division and cell cycle.

d. Course outcomes (Cos)

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

Course outcomes	Expected outcome	Cognitive level
CO1	Understand the basic principles of DNA replication.	K2
CO2	Enhance the basic knowledge of transcription and translation of DNA.	K2 & K4
CO3	Know about cell division and cell biology techniques.	K2
CO4	Understand the density arrest of DNA replication.	K5
CO5	Understand the concepts of cell synchronization and aging of the cell.	K2 & K5
CO6	Develop the basic knowledge of molecular biology.	K6

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

e. Course outline:

Unit I 12 Hrs

Cell Biology: Structure and function of cells in prokaryotes and eukaryotes; Structure and organization of Membrane – Membrane Model, active and passive, transport channels and pumps. Structure & Biogenesis of Mitochondria and Chloroplast. Structure of Endoplasmic reticulum, Golgi complex, lysosomes.

Unit II 12 Hrs

Cell division: Mitosis, Meiosis, regulation of cell cycle; factors regulating cell cycle. Nucleic acid structure, Genome Organization. DNA replication: Enzymes and mechanisms of DNA replication in prokaryotes and eukaryotes, Telomeres, telomerase and end replication. Role of telomerase in aging and cancer. DNA replication models DNA damage, Mutations, DNA repair and recombination.

Unit III 12 Hrs

Transcription: Basic mechanism in prokaryotes and eukaryotes. RNA polymerase, Reverse transcriptase and regulation. Post-transcriptional processing: 5'-Cap formation; 3'-end processing and polyadenylation; splicing: RNA editing; Nuclear export of mRNA; mRNA stability. Translation- Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co-and post-translational Modifications of proteins and localization.

Unit IV 12 Hrs

Gene regulation: Prokaryotic gene regulation- Operon concept; Lac operon and tryptophan operon. Eukaryotic gene regulation: Chromatin Structure, Regulation at transcriptional Level: DNA binding domains of the regulatory proteins. Biochemistry and Applications of ribozyme technologies. Transposable genetic elements

Unit V 12 Hrs

Epigenetics: Epigenetic regulation of gene expression, Modifications, Cancer Epigenetics. Cancer Biology: Viral and cellular oncogenes; Tumor suppressor genes-Structure, function and mechanism of action of pRB and p53, p21, BRACA1. Oncogenes as transcriptional activators.

f. Mapping of course outcomes to POs and PSOsMapping of COs to POs

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

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

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

(L – Low, M – Medium, H – High)

g. Text books/References:

1) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter, 2002. Molecular Biology of the Cell, 4th edition, Garland Science, New York.
2) Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Kelsey C. Martin, Michael Yaffe, Angelika Amon, 2016 Molecular Cell Biology, 9th edition.
3) Leonard P. Freedman, 1998, Molecular Biology of Steroid and Nuclear Hormone Receptors, Springer
4) Watson James D, Baker Tania A, Bell Stephen P, Gann Alexander, Levine Michael, Losick Richard, 2017. Molecular Biology of the Gene, 7th Edition, Pearson Education.
5) Wilson EB, Macmillan, 2004. Cell in Development and Inheritance, MacMillan,New York.

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

1) https://nptel.ac.in/courses/102106025

2) https://www.britannica.com/science/cell-biology

3) https://www.bu.edu/gk12/nishant/cellbioarticle.htm

4) https://www.slideshare.net/MichaelHo6/lecture-notes-cell-biology

5) https://www.uou.ac.in/sites/default/files/slm/BSCBO-301.pdf

Core III - MICROBIOLOGY

a. Course code:

L	T	P	C
5	1	0	4

b. Course objectives:

1. To understand the basics of the microbial world, diversity, and metabolism.
2. To explain the techniques in microbiology.
3. To explain the disease associated with them and their control.

c. Course prerequisites:

- Fundamental familiarity with microbes and the impact of their diseases on the human community.

d. Course outcomes

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

Course Outcomes	Expected outcome	Cognitive Level
CO1	Understand the history and metabolism of microbes	K2
CO2	Thorough knowledge of microbial growth	K4
CO3	Know the structural organisation of bacterial cells and their functions.	K2 & K4
CO4	Insight onto the microbial genetics	K3 & K5
CO5	Expertise on infectious diseases	K2, K4 & K5
CO6	Develop advanced techniques to diagnose microbe associated diseases	K3 & K6

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

e. Course outline:

Unit I 12 Hrs

History of Microbiology - Classification of microorganism – Kingdom-Protista, Prokaryotic and eukaryotic microorganisms, Five kingdom concept of classification, Archae bacteria, Eubacteria, and eukaryotes. Microscope-Light field, Dark field, Fluorescent and Electron microscope, Prokaryotic and Eukaryotic cell structure. Staining techniques-Simple and differential staining.

Unit II 12 Hrs

Nutritional classification of bacteria, Isolation, cultivation, enumeration, and preservation of microbes; Culture media and its types- Pure culture technique -Growth curve; Axenic culture, Synchronous culture, Continuous culture; Effect of physical and chemical factors on microbial growth.

Unit III 12 Hrs

Sterilization and Disinfection: Moist heat, Dry heat, Radiation, Filtration, Phenols, Halogens, Phenol coefficient method. Antibiotics - Inhibitors of Nucleic acid, protein, and cell wall synthesis. Chemotherapeutic agents – Antimicrobial susceptibility test.

Unit IV 12 Hrs

Microbial diversity-methods to assess microbial diversity, Culture dependent, and Culture-independent methods. Molecular analysis of bacterial community; Denaturating Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length (TRFL) Polymorphism (T-RFLP), Amplified Ribosomal DNA and Restriction Analysis (ARDRA).

Unit V 12 Hrs

Microbial community in natural habitats –air, water, soil, food, and milk. Food and milk-borne diseases, Extremophiles- habitant& Classification, Halophiles, Thermophiles, Alkaliphiles, Acidophiles, Biotechnological applications of Extremophiles.

f. Mapping of Course Outcomes to POs and PSOs

Mapping of COs to POs

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

CO6	H	H	H	M	M	M	H	H

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

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

(L – Low, M – Medium, H – High)

g. Textbooks/References:

1) Arora, Brij Bala Arora DR, 2019. Textbook of Microbiology-4th edition. CBS Publisher
2) Brock, Madigan, MT, Martinko JM, Parker J, 2018. Biology of Microorganisms, Prentice Hall.
3) Pelczar MJ Jr, Chan ECS, Kraig NR, 2013. Microbiology, Tata McGraw-Hill.
4) Rose AH, Butterworth, 2021. Chemical Microbiology-An introduction to Microbial Physiology 2nd edition, Butterworth, London.
5) Stanier RY, Ingram JLK, Wheelis ML, Painter PR, 2003. General Microbiology, Macmillan Press Ltd.

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

1) http://ecoursesonline.iasri.res.in/course/view.php?id=108
2) https://alison.com/course/foundational-microbiology
3) https://nptel.ac.in/courses/102103015
4) https://nptel.ac.in/courses/105107173
5) https://www.mooc-list.com/tags/microbiology
6) https://www.pdfdrive.com/microbiology-books.html

ELECTIVE I - **GENETICS**

a. Course code:

L	T	P	C
5	0	0	3

b. Course objectives:

1. To enable us to explore many different components of living systems and the advent of proteomics will made it possible to identify a broad spectrum of proteins in living systems.

c. Course prerequisites:

- This elective subject will help to understand basic principles and applications in genomics and proteomics.

d. **Course out Comes**

Course Outcomes	Expected outcome	Cognitive Level
CO1	To provide the basic knowledge of genetics in higher eukaryotic domains and over all concepts of Mendelian genetics.	K2
CO2	To understand about genetic in heritance and linkages	K4
CO3	To provide the basic concept sex determination	K2 & K4
CO4	To understand about genetic code, mutation and regulations	K3 & K5
CO5	To Enrich the students' knowledge with respect to genetic engineering ,transgenesis and ethics	K2, K4 & K5

e. Course outline:

Unit I 12 Hrs

History of Genetics: Definition and scope of Genetics- Pre-mendelian genetic concepts. Basis of Mendelian Inheritance and Mendelian genetics. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes

Unit II 12 Hrs

Blood Groups and their Inheritance in Human–Linkage and Crossing Over:- Drosophila – Morgans" Experiments – Complete and Incomplete Linkage, Linkage Groups, Crossing Over types, Mechanisms – Cytological Evidence for Crossing Over, Mapping of Chromosomes–Interference and Coincidence.

Unit III 12 Hrs

Sex Linkage in Drosophila and Man, Sex influenced and Sex Limited Genes–Non-Disjunction and Gynandromorphs –Cytoplasmic Inheritance–Meternal Effect on Limnaea (Shell Coiling), Male Sterlity (Rode's Experiment)

Unit IV 12 Hrs

Nature and Function of Genetic Material – Genetic code – Why the genetic code is comma less, non-ambiguous, degenerate triplet code. Fine Structure of the Gene. Gene Regulation – Operon Concept–Lac Operon –Positive and Negative Regulation. Mutation – Molecular Basis of Mutation, Types of Mutation, Mutagens, Mutable and Mutator Genes. Chromosomal Aberrations – Numerical and Structural Examples from Human.

Unit V 12 Hrs

Genetic engineering–Objectives, tools, gene cloning, and gene isolation. Transgenic plants and animals, Animal Breeding – Heterosis, Inbreeding, Out Breeding, Out Crossing, Hybrid Vigour. Population Genetics-Hardy Weinberg Law–Gene Frequency, Factors Affecting Gene Frequency, Eugenics, Euphenics and Ethenics, Bioethics.

Text Books

1. Gardner et al (1991).Principles of Genetics. John Wiley.
2. Hartl.D.L.Aprimerofpopulationgenetics.IIIedition,Sinauerassociatesinc.Sunderland,2000
3. Human genetics, A. Gardner, R. T. Howell and T. Davies, Published by Vinod Vasishtha for Viva Books private limited, 2008.
4. The science of Genetics by AlanG. Atherly, Jack. R, Girton, Jhon.F, McDonald. Sounders college publishers.

Reference Books

1. Strachan and Read (2003).Human Molecular Genetics. Wiley.
2. Pasternak (2005).An Introduction to Molecular Human Genetics. Fritzgarald.
3. Prichard & Korf (2004).Medical Geneticsata Glance. Blackwell.
4. Manu L Lothari,Lopa A Mehta,sadhana S Roy Choudhury(2009).Essential of Human Genetics (Universities Press India ltd) Publishing.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websitesetc.]

1. https://www.classcentral.com/course/swayam-genetics-and-genomics-17623
2. https://nptel.ac.in/courses/102/104/102104052/
3. https://www.coursera.org/learn/genetics-evolution

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO–Programme Outcome,CO–CourseoutcomeS–Strong,M–Medium,L– Low(maybeavoided)

ELECTIVE I - **VIROLOGY**

a. Course code:

L	T	P	C
5	0	0	3

b. Course objectives:

1. Contrast differences in virus architecture and classification.
2. To understand the viral diagnostic and detection methods.
3. Distinguish characteristics of normal cells and virus- infected cells.
4. Explain and apply methods used in research and diagnosis of viral diseases.
5. Describe cellular and therapeutic antiviral strategies and social stigmas against infected individuals.

c. Course prerequisites:

- To understand the biology of viruses, pathogenesis, clinical features, epidemiology, and prophylaxis of dreadful viral infections in susceptible hosts.

d. Course Outcomes

Course Outcomes	Expected outcome	Cognitive Level
CO1	To describe and review the General Virology and cultivation	K1

	of viruses	
CO2	To know the Viral diagnostic and detection methods	K4
CO3	To explain viral replication strategies; and compare and contrast replication mechanisms used by viruses relevant to human disease	K2 & K4
CO4	To discuss principles of virus pathogenesis	K3 & K5
CO5	To explain host antiviral immune mechanisms at a cellular and molecular level and vaccine strategies and mechanisms of antiviral drugs	K2, K4 & K5

e. Course outline:

Unit I 12 Hrs

General Virology: Structure of viruses: Enveloped and non-enveloped viruses, Capsid symmetries-icosahedral, polyhedral and helical, structural proteins-matrix proteins and lipoproteins, viral genomic organization and replication-types of nucleic acids, protein-nucleic-acid interactions and genome packaging, Virus related structures-viroids and prions. Cultivation of viruses: Inovo, Invivo, Ex vivo/Invitro. Cytopathic effect-pock forming unit.

Unit II 12 Hrs

Viral diagnostic and detection methods: Sample processing-enrichment and concentration, Direct methods of detection-light microscopy (inclusion bodies), electron microscopy, Immuno diagnosis, hemagglutination, Complement fixation, neutralization, Western blot, Radioactive Immuno precipitation Assay (RIPA), Flow Cytometry and Immuno histochemistry. Nucleic acid-based diagnosis: Nucleic acid hybridization, PCR, microarray and nucleotide sequencing, LINE probe assay.

Unit III 12 Hrs

Bacteriophages and plant viruses: Bacteriophage: Morphology, genome organization, classification-Lifecycle-Lytic and Lysogenic Cycle, Head and tailphages-T4 phage- phage-Filamentous Bacteriophages-174-M13, phage therapy for control of bacterial poultry diseases. Viral Disease in Plants: Histological, physiological and cytological changes in infected plants, Behavior of viruses in plants, Methods for detection of plant viruses, Transmission of plant viruses through vectors-insects, nematodes and fungi.

Unit IV 12 Hrs

Clinical virology: Pathogenesis, clinical symptoms, epidemiology and prophylaxis of DNA Viruses-pox virus, Herpes Virus, Adenovirus, Hepatitis Virus. RNA Viruses- Picorna Virus, Orthomyxo Virus, Rabies Virus, HIV. Oncogenic viruses; Virus-induced cell transformation and oncogenesis, Mechanism of cell transformation by tumor viruses, Retrovirus mediated oncogenesis.

Unit V 12 Hrs

Viral vaccines and anti-viral drugs: Viral vaccines, conventional vaccines-killed and attenuated, Modern vaccines-DNA vaccines, recombinant DNA/protein vaccines, subunits vaccines, peptide vaccines, anti-idio type vaccines, edible vaccines, immunomodulators (cytokines), adjuvants to increase immunogenicity of vaccines. Antivirals: Interferons, 21 designing and screening for antivirals, mechanisms of action, antiretrovirals-mechanism of action and Drug resistance.

Reference & Text Books:

1. Virology principles and application John Carter and Venetia Saunders (2007) John Wiley and Sons publishers.
2. Real –Time PCR: Current technology and applications 1st edition (2009) edited by Julie Logan et al.,
3. Analytical techniques in DNA sequencing edited by Brian K. Nunnally
4. Medical Microbiology: with student consult by Patrick R. Murray Ph.D. (Author), Ken S. Rosenthal PhD Saunders;7th edition.
5. Antiviral Agents, Vaccines and Immunotherapies. Stephen K. Trying. October 2004.MarcelDekker.

Course Material:

1. International Congresson Taxonomy of Viruses; http://WWW.ncbi.nlm.nih.gov/ICTV
2. KnipeDavidM.,PeterM.Howley,DianeE.Griffin,RobertA.Lamb,MalcolmA.Martin,BernardRoizman,StephenE.Straus,(2007),Field'sVirology,5thEd.LippincottWilliams&Wilkins
3. Cann Alanj,(2000),DNA virus Replication, Oxford University press
4. https://www.yourgenome.org/facts/what-is-PCR-polymerase-chain-reaction.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

PO–ProgrammeOutcome,CO–CourseoutcomeS–Strong,M–Medium,L–Low

ELECTIVE I - **FOOD & NUTRITION**

a. Course code:

L	T	P	C
5	0	0	3

b. Course objectives:

1. To enable the students to learn the basic concepts of nutrition and different categories of foods.
2. To enable the students to gain knowledge of different nutrient contents and their importance.
3. To make them learn the basics of nutritive and calorific value.
4. To enable the students to know food adulterants and food poisoning, disadvantages & health problems.
5. To enable the students learn the food spoilage and preservation methods

c. Course prerequisites:

- To enable students to gain a deeper understanding about principles of nutrition and also to develop competence to carryout investigation in nutrition

d. Course Outcomes

Course Outcomes	Expected outcome	Cognitive Level
CO1	To differentiate the foods types and their nutritive value.	K1

CO2	To develop competence to carry out investigation innutrition	K4
CO3	To measure and calculate calorific value of different types of foods	K2 & K4
CO4	To identify the food adulterants and food poisoning	K3 & K5
CO5	To practice food sterilization, preservation and processing	K2, K4 & K5

e. Course outline:

Unit I 10 Hrs

Definition and basis of food and nutrition, Different Food groups and classification, Nutritional significance and physiological role of food groups, Protein Energy Malnutrition (PEM), definition and types, Treatment and preventive measures of PEM.

Unit II 8 Hrs

Introduction to Vitamins, fat soluble vitamins, Water soluble vitamins.

Unit III 13 Hrs

Introduction to calorific value and nutritive value, Bomb calorimeter, Measurement of calorific value and nutritive of foods, RQ value, BMR and SDA of food stuffs, their measurements and influencing factors, Nutritive value of proteins and amino acids, Balanced diet, composition of balanced diet for pregnant woman, infants, old age.

Unit IV 8 Hrs

Definitions of food adulterations and food poisoning, Sources of foods and types of adulterants, advantages and disadvantages of adulteration, Constituents of foods, carbohydrates, proteins, fats, oils, Flavours, colours and natural toxicants, Sources causes and remedies for acidity, gastritis, indigestion and constipation.

Unit V 8 Hrs

Introduction to food spoilage, food preservation and food processing, Causes and types of food spoilage, types of food preservation and food processing, Food sterilization and pasteurization.

Textbook:

1. Albanese, Anthony A Ed, Protein and Amino Acid Nutrition Academic Press NewYork 1959.
2. DevlinT.M.,Biochemistry by Stryer Text book of Biochemistry with clinical correlations.
3. Lehninger, Principles of Biochemistry, by 4th Ed.By Nelson D.L. and Cox.M.M.
4. Murray R.K.,Grammer,D.K.,Mayer P.A.,Rodwell V.W., Harpers Biochemistry, alange medical book 26th Ed.Mc.GrawHill, Health Professions Division.
5. West.E.S.,Todal,W.R.,MasonH.S.andVanBrygenJ.T.,TextBookofBiochemistry.
6. Mayer,J.,Human Nutrition, Charles, C. Thomas, spring field.
7. Michael,J.Gibney, Barrie, M.Margetis, John, M. Kearney. Lenore Arab. Public Health Nutrition. Black well science, Blackwell Publishing Company (2004).
8. Frazier, We, Food Microbiology, Tata McGraw Hill1978.
9. Meyer, LilianH. Ed.(1987),Food chemistry. Indian Ed.CBS Publishers and distributors

Reference Book:

1. Seemayadav:- Food Chemistry, anmol publishing (P)Ltd, New Delhi

2. CarH.Synder: the extraordinary chemistry for ordinary things, JohnWiley &sonsinc, NewYork,1992.
3. Sivasankar–food processing and preservation–PHI learning(P)LTD, NewDelhi–11001.

Course Material: website links, e-Books and e-journals

1.https://chico-primo.hosted.exlibrisgroup.com

Practical I: Biochemistry, Cell & Molecular Biology and Microbiology

Biochemistry

1. Determination of Chl.a, Chl.b & total Chl. By Arnon method.
2. Estimation of Carbohydrates
3. Estimation of salivary amylase activity in relation to, substrate /pH /Temperature
4. Estimation of blood glucose & urea
5. Estimation of LDH.
6. Estimation of total serum proteins
7. Estimation of creatinine in urine.
8. Paper /thin layer chromatography

Cell and Molecular biology

1. Isolation of Genomic DNA from E.coli
2. Isolation of plasmid DNA from E.coli
3. Elution & quantification of DNA from agarose gel.
4. Preparation of competent cells and transformation
5. PCR
6. Isolation of Total RNA from bacteria
7. Synthesis of cDNA by Reverse transcription polymerase chain reaction

Microbiology

1. Sterilization techniques
2. Preparation of culture media (Selective and Enriched media)
3. Staining techniques -Simple, Differential, Negative staining and Motility studies
4. Determination of Bacterial growth curve
5. Enumeration of bacteria from environmental samples- soil, water, air and milk.
6. Pure culture techniques -Streak, pour plate and spread plate.
7. Biochemical tests for identification of bacteria (IMViC,TSI,Catalase,Oxidase)
8. Antimicrobial assay, phenol coefficient, agar plate sensitivity method.
9. Water quality analysis–MPN method.
10. Milk quality analysis–MBRT method

Reference

1. Introduction to Practical Biochemistry, E. F Plummer Mu, Plummer Tata Mc Graw-Hill Education, 1998.
2. Essential cell biology: a practical approach volume 1: cell structure. John Davey, J. Michaellord. Oxford university press, USA, 2003
3. Principles and techniques of biochemistry and molecular biology (7^{th}ed). keith Wilson (editor), john walker (editor), Cambridge university press, 2010.
4. Microbiology-A Laboratory manual P. Gunasekaran. Newage publications,New delhi, 1995. Molecular cloning-A Laboratory manual. Sambrook, J , Fritsch. E.F, and T. Maniatis,

2nd Edition. Coldspring Harbor Laboratory press, New York, 1989.
5. Laboratory exercise of Microbiology, J.P. Harley and L.M. Prescott, 5th Edition, the McGraw-Hill companies,2002.
6. Microbiology: A Laboratory Manual, J.G. Cappuccino and N. Sherman, Addison-Wesley,2002.
7. Laboratory Manual of Experimental Microbiology, R.M. Atlas, A.E. Brown and L.C. Parks, 1995.Mosby,St.Louis,2002.
8. Laboratory manual in General Microbiology, N. Kannan, Panima publishers.
9. Bergey‟s Manual of Determinative Bacteriology. Ninth Edition J.G.Holt, N.R.Krieg., Lippincott Williams, Wilkinpublishers, 2000.

ELECTIVE 1I - **BASIC ANALYTICAL METHODS**

a. Course code:

L	T	P	C
4	0	0	3

b. Course objectives:

1. Knowledge on the basics of all the instrumentation concepts, in biology
2. To understand the core concepts of biological instruments and their principles.

c. Course prerequisites:

1. Basic knowledge about biological instruments and their principles.
2. Understanding the basic concept of various techniques

d. Course outcomes

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

Course outcomes	Expected outcome	Cognitive level
CO1	Introduction and various types of Electrochemical techniques	K1 & K2
CO2	Impart understanding on centrifugation instruments and techniques	K3 & K4
CO3	Separation of Biomolecules	K3 &K6
CO4	Analytical methods on Spectroscopic Analysis	K2
CO5	Understand the application and Detection on Bioinstrumentation	K3, K5 & K6
CO6	Propose biosensors to check pollution, food quality, and agriculture practices	K6

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

e. Course outline:

Unit I 12 Hrs

Electrochemical techniques- basic principles- The pH electrode- Ion-selective gas- sensing and oxygen electrodes. Elementary details of biosensors. Beer-Lambert law, light absorption, and its transmittance. Basic principles & brief outline of instrumentation of UV- Visible Spectroscopy: Infrared Spectroscopy. NMR. Mass spectrometry. Spectrofluorometric, Flame photometry, Atomic Absorption

spectrophotometry–Principles, instrumentation, and applications

Unit II 12 Hrs

Introduction & classification of chromatography. Theory, instrumentation & applications of Column chromatography, TLC, Paper chromatography, GC, HPTLC, HPLC-detection methods, and systems qualitative and quantitative aspects applications

Unit III 12 Hrs

Centrifugation- basic principles-instrumentation-centrifugation units. Nature of particles centrifugation methods and accessories. Sedimentation velocity-sedimentation equilibrium-cell fractionation method. Differential, density gradient, isopycnic, and equilibrium centrifugation. Preparative and analytical ultracentrifugation techniques. Isoelectric focusing, blotting methods, western-southern and northern-application-methods in life sciences and biotechnology.

Unit IV 12 Hrs

General principles. Factors affecting the migration rate – sample, electric field, buffer, and supporting medium. Tiselius moving boundary electrophoresis. PAGE.SDS–PAGE. Pulse-field gel electrophoresis. Cellulose acetate Membrane electrophoresis. Agarose gel electrophoresis

Unit V 12 Hrs

Radio isotopic techniques: Introduction to radioisotopes, Detection. Measurement and uses of radioisotopes, Counting efficiency and autoradiography. Principles of microscopy, Fluorescent, Transmission and Scanning electron microscopy, confocal microscopy. Biotechnological Applications Microscopy. Microtome analysis and measurement of images

f. Mapping of course outcomes to POs and PSOs

Mapping of COs to POs

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

(L – Low, M – Medium, H – High)

Mapping of COs to PSOs

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

CO5	M	H	M	H	M	H	H	H
CO6	H	H	M	H	H	H	H	H

(L – Low, M – Medium, H – High)

g. Textbooks/References:

1. Fulekar MH, and Bhawana Pandey Bioinstrumentation, Wiley
2. Keith Wilson, John Walker, 2010. Principles and Techniques of Biochemistry and Molecular Biology (7th Edition), Cambridge University Press
3. David L. Nelson, Michael M. Cox. Menninger (2008). Principles of Biochemistry, Fifth edition W. H. Freeman, New York.
4. Experiments in Biochemistry: A Hands-On Approach byhawn O. Farrell, Ryan T. Ranallo, Paperback: 324 pages, Publisher: Brooks Cole. 20
5. Metzler D.E. 2001, the chemical reactions of living cells –Academic Press. 2nd edition.
6. Stryer L,1999, Biochemistry-W.H. Freeman & Company, New York. 1. • 4th edition
7. L.Veerakumari l, (2006) Bioinstrumentation MJP Publisher Kindle edition
8. Jefrey. M., Backer el al., 1996. Biotechnology- A Laboratory Course. Academic Press, New York.
9. Holcapek, M., Byrdwell, Wm. C. 2017. Handbook of Advanced Chromatography /Mass Spectrometry Techniques, Elsevier.

ELECTIVE 1I - **VERMICULTURE TECHNOLOGY**

a. Course code:

L	T	P	C
4	0	0	3

b. Course Objectives

1. To enable the students learn about Vermiculture compositing.
2. To enable the students to know the humus cycle, soil transformation
3. To enable the students analyze the nutritional composition of vermicompost.
4. To enable the students to learn Vermiculture technology.
5. To enable the students to learn the harvest of vermicompost.

c. Course prerequisites: To exploit possibilities and assist in building up a Vermiculture technology in significant contribution to thegeneral economy.

d. Course outcomes

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

Course outcomes	Expected outcome	Cognitive level

CO1	The student will be able to understand the Vermiculture and 4R's of recycling	K1 & K2
CO2	The student will be able to identify the decomposing organic matter and humus formation	K3 & K4
CO3	The student will be able to differentiate nutritional value of vermicompost and fertilizer	K3 &K6
CO4	The student will be able to practice the Vermiculture composting and maintain conditions	K2
CO5	5. The student will be able to produce Vermiculture compost, harvest the compost and application	K3, K5 & K6

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

e. Course outline:

Unit I 5 hours

Introduction to Vermiculture technology, definition, meaning and history, Economic importance of Vermiculture, their value in soiltexture, Concept of recycling, Concept of four r' s reduce, reuse, recycle and restore.

Unit-II 5 hours

Introduction to matter, types of matter, Introduction to Humus, Humus cycle, Sources, quality of products for Humus formation, Ground population, and transformation process in organic matter.

Unit – III 5 hours

Introduction of plant fertilizers, nutritional value and their importance, Vermicompost composition and its nutritional value, Importance of vermicompost as fertilizer for plants, Comparison of vermicompost with other fertilizers.

Unit – IV 5 hours

Introduction to vermibeds, sources, types, Preparation of vermibeds, measurements, Maintenance of vermicompost, Compositing conditions, moist, temperature, aeration.

Unit-V 5 hours

Vermicompost identification, conditions, and separation, compost packing, sources and methods, Compost storage, conditions and durations, Vermicompost handling and transport.

f. Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong , M – Medium, L – Low (may be avoided)

g. Text books:

1. Kevin, A and K.E.Lee (1989) " Earthworm for Gardeners and Fisherman" (CSIRO,Australia, Division of Soils)
2. Rahudakar V.B. (2004). Gandul khatashivay Naisargeek Paryay, Atul Book Agency,Pune.
3. Satchel, J.E. (1983) "Earthworm Ecology" Chapman Hall, London.

4. Wallwork, J.A. (1983) "Earthworm Biology" Edward Arnold (Publishers) Ltd. London.
5. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
6. .Bhatnagar & Patla,2007.Earthworm vermiculture and vermin-composting, Kalyani Publishers, New Delhi

Reference Books:

1. Bhatt J.V. & S.R. Khambata (1959) "Role of Earthworms in Agriculture" Indian Council of Agricultural Research, New Delhi 2.
2. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) " Verms and Vermicomposting" Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, Jyoti Vihar, Orissa.
3. Edwards, C.A. and J.R. Lofty (1977) "Biology of Earthworms" Chapman and Hall Ltd., London.
4. Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney. 5. Kevin, A and K.E.Lee (1989) " Earthworm for Gardeners and Fisherman" (CSIRO, Australia, Division of Soils)
5. Mary Violet Christy,2008. Vermitechnology,MJP Publishers, Chennai.
6. Aravind Kumar, 2005.Verms & Vermitechnology, A.P.H. Publishing Corporation, New Delhi.

Course Material: website links, e-Books and e-journals

1. Vermiculture Technology, Earthworms, Organic Wastes, and Environmental Management Edited By Clive A. Edwards, Norman Q. Arancon, Rhonda L. Sherman
2. https://www.scirp.org/journal/paperinformation.aspx?paperid=2490, **DOI:** 10.4236/ti.2010.13019

ELECTIVE 1I - **VALIDATION OF MEDICINAL PLANTS**

a. Course code:

L	T	P	C
4	0	0	3

b. Course Objectives

1. To enable the students to understand the importance of medicinal plants.
2. To enable the students to identify the medicinal plants.
3. To enable the students to learn the techniques of validation of medicinal plants.
4. To enable the students to learn the cultivation methods and maintenance of medicinalplants.
5. To enable the students to understand the importance of medicinal plant in human health.

c. Course prerequisites:

- The course aims to introduce the students to the identification and validation of medicinal plant and to understand the cultivation and propagation techniques.
- To understand the importance of medicinal plants in human health care.

d. Course outcomes

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

Course outcomes	Expected outcome	Cognitive level

CO1	The student will be able to gain knowledge about importance of medicinal plant parts and its medicinal value.	K1 & K2
CO2	The student will be able to classify the medicinal plants on Bentham and Hooker andPractice herbarium techniques.	K3 & K4
CO3	The student will be able to identify the medicinal values of plants using different validationTechniques.	K3 &K6
CO4	The student will be able to cultivate and propagate the medicinal plants	K2
CO5	The student will be able to practice the usage of medicinal plants in treatment of human Diseases	K3, K5 & K6

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

e. Course outline:

UNIT I 5 hours

Introduction to Medicinal plants, meaning, definition and types, Medicinal properties of plants and their importance, Medicinal values in plant parts, fruits, stem, leaves and roots, Leaf, fruit, root and stem modifications, aerial and underground.

UNIT-II 5 hours

Introduction to Medicinal plant identification, Elementary knowledge of binomial nomenclature, Bentham and Hooker classification, Herbarium, preparation and preservation.

UNIT – III 5 hours

Introduction to validation of medicinal plants, Macroscopic characteristics of medicinal plants, Microscopic characteristics ofmedicinal plants, Chemical compounds and tests of medicinal plants, Chromatographic techniques for validation TLC, HPLC, HPTLC & gas, Chromatography.

UNIT – IV 5 hours

Introduction to medicinal plant cultivation, Cultivation techniques, and factors affecting cultivation of medicinal plants, Propagation of medicinal plants and different methods ofpropagation, Management and Maintenance of medicinal plants.

UNIT-V 5 hours

Importance of medicinal value in plants, Medicinal properties of plants in human health and its role, advantages, Role of medicinal plants in prevention and treatment of human diseases, Traditional knowledge and utility of Indian medicinal plants.

Text book:

1. Trivedi P.C. (2009) Indian Medicinal Plants, Woodside, New York, United States
2. Samant, S. S. U. Dhar and L. M. S. Palni, (1998) "Medicinal Plants of Indian Himalaya: Diversity Distribution Potential Values," Gyanodaya Prakashan, Nainital,
3. Kirtikar, K.R. and Basu, B.D. (1935) Indian Medicinal Plants, Vol. II. Lalit Mohan Publication, Allahabad, 1347-1348.
4. Sivarajan, V. V. Indira Balachandran (1994) Ayurvedic Drugs and their Plant Sources Oxford & IBH Publishing Company
5. Godagama, Bishen Singh Mahendrpal Singh (2004). The Handbook of Ayurveda Shantha Dehradun
6. Vardhana, Sarup and Sons (2008).Direct uses of medicinal plants and their identification by, Ansari Road, Dariyaganj, New Delhi

Reference Book:

1. A.C. Dutta, A Class Book of Botany.. Oxford University Press.
2. C.K. Atal & B.M. Kapoor Cultivation of Medicinal Plants by.

3. Hartmann, H.T & Kester, D.E (1989). Plant Propagation – Principles and Practices. PrenticeHall of India.
4. Awadesh N, Ghoeami A and Sharma R, Indigenous Health Care and Ethnomedicine, Sarupand Sons.
5. Medicinal Plants Cultivation: A Scientific Approach by S.S. Purohit, (2004).
6. Bruneton Jean, Caroline K. Hatton, Pharmacognosy, Phytochemistry, Medicinal plants.Lavoisier, 1999.ISBN 1898298637.
7. Nikolaus J. Sucher, Maria C. Carles, Genome-Based Approaches to the Authentication ofMedicinal Plants. Planta Med., 74: 603–623; 2008.
8. WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants, World HealthOrganization, Geneva, 2003.
9. Iqbal Ahmad, FarrukhAqil, and Mohammad Owais, Modern Phytomedicine: Turning Medicinal Plants intoDrugs. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2006. ISBN-10: 3-527-31530-6.
10. Ved D.K. & Goraya, G.S. Demand & supply of medicinal plants in India, NMPB, New Delhi & FRLHT,Bangalore, India, 2008.

Course Material: website links, e-Books and e-journals

1. Planta Medica, Issue 13 · Volume 79 · August 2013. https://www.thieme-connect.com/products/ejournals
2. https://www.sciencedirect.com/book/9780128008744/evidence-based-validation-of-herbal-medicine.
3. https://www.tandfonline.com/doi/citedby/10.1080/13880200902800196?scroll=top&needAccess=true.

f. Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low