



Three-Year Undergraduate Program

**Bachelor of Science
Biochemistry**

Faculty of Applied Sciences

Parul University

Vadodara, Gujarat, India

**Faculty of Applied Sciences,
Bachelor of Biochemistry**

1. Vision of the Department: Create and nurture a vibrant learning environment built on core values of science, with knowledge of advances in biological sciences is created and disseminated, with satisfaction in teaching and learning.

2. Mission of the Department:

M1	To offer best quality Mentoring of Graduate, Post-graduate and doctoral studies students.
M2	To provide research facilities to lead scientific discoveries making global impact
M3	To create skilled human resource to meet the demand of biological industry
M4	To establish collaborations with industries, all other stakeholders and closely work with them to develop most sought-of curriculum, improve the skills of students

3. Program Educational Objectives:

The statements below indicate the career and professional achievements that the B.Sc. Biochemistry curriculum enables graduates to attain.

PEO 1	To develop technical skills (critical investigation, communication, analytical and computer) and human relations skills (group dynamics, team building, organization and delegation) to enable students to transform the acquired knowledge into action.
PEO2	To inculcate critical analysis and communication skills into students to effectively present their views, both in writing and through oral presentations.
PEO3	To provide an environment for exploring the Research & Development attitude, to help the students in Research and Development field.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	Knowledge	Utilize foundational scientific principles to address intricate challenges through diverse solutions.
PLO 2	Problem Analysis	Evaluate and interpret experimental results, drawing conclusions based on acquired data, while also identifying, formulating, and analyzing scientific problems to arrive at solutions using diverse scientific principles.
PLO 3	Designing Solutions	Develop solutions and execute experiments that showcase their comprehension of the methods and processes involved.
PLO 4	Modern tool usage	Create, select, and apply appropriate techniques, resources and IT tools in the analysis and synthesis of data within limitations.

PLO 5	Communication Development	Skilled at clear communication through both written and oral formats, capable of explaining complex concepts in understandable terms, learners will effectively engage with the scientific community and society on scientific matters.
PLO 6	Employability	Considering our learners' diverse career goals, including scientific, technical, and quantitative roles, the institution informs them about relevant job opportunities through the Placement cell, offering skill enhancement and value-added courses in addition to science subjects to give them a competitive advantage in the job market.
PLO 7	Ethics	Cultivate a sense of healthy competition among students while also nurturing a strong ethical foundation, including an appreciation for scientific principles and their impact on societal, economic, and environmental issues, understand and practice ethical values in both professional and personal spheres, contributing to a responsible society.
PLO 8	Environment and Sustainability	Understand the impact of scientific solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 9	Soft-Skill Development	Develop soft skills like leadership, teamwork, and effective communication to excel in various roles and contribute to societal progress, enhancing academic, professional, and personal growth for self-improvement and collective advancement.
PLO 10	Science and Society	Apply logical thinking, knowledge, and skills in designing solutions for societal issues, including health, safety, and scientific responsibilities
PLO 11	Life-long Learning	Encouraging learners to seek knowledge for personal or professional growth includes promoting volunteering, self-motivation, societal values, and lifelong learning for enhanced competitiveness and employability amidst technological advancements.
PLO 12	Data Analysis and Interpretation	Analyzing and interpreting scientific data, drawing meaningful conclusions, and communicating results effectively.

5. Program Specific Learning Outcomes

PSO 1	Demand as	Design the solutions as per the recent industry defined problems.
PSO 2	Software skill	Test any apparatus and system with appropriate usage of software tools, and gather data for modelling
PSO 3	Analytical skill	Test any apparatus and system with appropriate usage of instruments, and gather data for analytical and research purpose.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester-1	22
Semester-2	23
Semester-3	27
Semester-4	25
Semester-5	26
Semester-6	29
Total Credits:	152

Category wise Credit distribution of the programme	
Major Core	118
Minor Stream	00
Multidisciplinary	00
Ability Enhancement Course	15
Skill Enhancement Courses	04
Value added Courses	00
Summer Internship*	00
Research Project/ Dissertation*	15
Total Credits:	152

7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11100102	Chemistry-I	3.00	3	-	-
2	11100103	Basics of Computer Application	2.00	2	-	-
3	11100106	Lab- I Cell Biology and introduction to Microbiology	2.00	-	3	-
4	11101103	Introduction to Microbiology	3.00	3	-	-
5	11102103	Cell Biology	3.00	3	-	-
6	11102104	Biochemistry I	3.00	3	-	-
7	11102105	Comprehensive Viva	2.00	-	-	2
8	11103104	Lab-2 (Biochemistry-I and Chemistry-I)	2.00	-	3	-
9	11193101	Communication Skills-I	2.00	2	-	-
Total			22.00	16	6	2

Semester 2						
Sr. No	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11100151	Chemistry-II	3.00	3	0	0
2	11102153	Animal Physiology	3.00	3	-	-
3	11102154	Plant Physiology	3.00	3	-	-
4	11102155	Biochemistry II	3.00	3	-	-
5	11102156	Biostatistics	3.00	3	-	-
6	11102157	Lab- I Animal Physiology and Plant Physiology	2.00	-	3	-
7	11102158	Comprehensive Viva	2.00	-	-	2
8	11103154	Lab-2 (Biochemistry-II and Chemistry-II)	2.00	-	3	-
9	11193151	Communication Skills-II	2.00	2	0	0
Total			23.00	17	6	2

Semester 3						
Sr. No	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11102207	Basics of Molecular Biology	3.00	3	-	-
2	11102209	Basics of Enzyme	3.00	3	-	-
3	11102210	Genetics	3.00	3	-	-
4	11102213	Lab- 2 Molecular biology and genetics	2.00	-	3	-
5	11102214	Comprehensive Viva	2.00	-	-	2
6	11103205	LAB -1 Environmental Biochemistry and Enzymology	2.00	-	3	-
7	11103216	Membrane Biology & Bioenergetics	3.00	3	-	-
8	11103217	Metabolism-I	3.00	3	-	-
9	11103230	Environmental Biochemistry 1	3.00	3	-	-
10	11103231	Advanced cell biology	3.00	3	-	-
Total			27.00	21	6	2

Semester 4						
Sr. No	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11102262	Immunotechnology-I	3.00	3	-	-
2	11102263	Basic Instrumentation	3.00	3	-	-
3	11102265	Principles of Genetic engineering	3.00	3	-	-
4	11102268	Lab-2 Basic Bioinformatics and Basic Instrumentation	2.00	-	3	-
5	11102269	Comprehensive Viva	2.00	-	-	2
6	11103207	Lab-1 (Immunology & Metabolism)	3.00	-	-	-
7	11103218	Metabolism II	3.00	3	-	-
8	11103252	Human Anatomy and Physiology	3.00	3	-	-
9	11102280	Basics of Bioinformatics	3.00	3	-	-
10	11102281	Ecology And Environment Management	3.00	3	-	-
Total			25.00	18	3	2

Semester 5						
Sr. No	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11102309	LAB-2(Recombinant DNA Technology and Developmental Biology)	3.00	-	3	-
2	11102310	Recombinant DNA Techniques	3.00	3	-	-
3	11102311	Immunotechnology-II	3.00	3	-	-
4	11102314	Tissue Culture Technology	3.00	3	-	-
5	11102317	Comprehensive Viva	2.00	-	-	2
6	11102320	Developmental Biology	3.00	3	-	-
7	11103301	Clinical Biochemistry	3.00	3	-	-
8	11103304	LAB-1(Clinical Biochemistry and Endocrinology)	3.00	-	3	-
9	11102330	Fundamentals of Genomics and Proteomics	3.00	3	-	-
10	11102331	Evolutionary Biology	3.00	3	-	-
Total			26.00	18	6	2

Semester 6						
Sr. No	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	11100351	Bioethics	3.00	3	-	-
2	11102357	Dissertation	15.00	-	15	-
3	11102358	Comprehensive Viva	2.00	-	-	2
4	11103352	Medical Biochemistry	3.00	3	-	-
5	11103353	Basics of Endocrinology	3.00	3	-	-
6	11102381	Animal Biotechnology	3.00	3	-	-
7	11103380	Nutritional Biochemistry	3.00	3	-	-
Total			29.00	12	15	2

8. Detailed Syllabus

Semester 1

(1)

a. Course Name: Chemistry-I

b. Course Code: 11100102

c. Prerequisite: Basic math skills & foundational science knowledge

d. Rationale: Fundamental goal to understand the properties, composition, structure, behavior, and changes of matter. Chemistry is a central science that serves as a bridge between physics and biology, providing insights into the molecular and atomic foundations of the physical world.

e. Course Learning Objective:

CLOBJ 1	Remember fundamental principles of atomic structure, including the arrangement of electrons, protons, and neutron
CLOBJ 2	Understand the organization of the periodic table and the trends in atomic and physical properties across periods and down groups.
CLOBJ 3	Apply the chemistry of main group elements, including trends in reactivity and the formation of compounds.
CLOBJ 4	Analyse various types of chemical bonding, including ionic, covalent, and metallic bonding.
CLOBJ 5	Evaluate basics of coordination compounds, including ligands, metal-ligand bonding, and isomerism in coordination complexes.
CLOBJ 6	Develop systematic understanding for the properties and reactions of common inorganic compounds, including acids, bases, and salts.

f. Course Learning Outcomes:

CLO 1	Remember list the fundamental concepts of atom and wave mechanics, including de Broglie's equation, Heisenberg's Uncertainty Principle, Aufbau Principle, Pauli's Exclusion Principle, and Hund's Rule for electron configuration.
CLO 2	Understanding of the quantum mechanical model of the atom, Schrödinger wave equation, and the concept of orbitals, quantum numbers, radial and angular wave functions, and Slater rule.
CLO 3	Apply knowledge of periodic properties to explain trends in atomic and ionic radii, ionization potential, electronegativity, and electron affinity. Apply the concepts to describe the general characteristics of group 1 and group 2 elements, including their occurrence, extraction, and production.
CLO 4	Analyze the significance of periodicity in chemistry, as well as the reactions and properties of alkali metals and alkaline earth metals. Analyze the applications of alkali metal and alkaline earth metal compounds in everyday life.

CLO5	Evaluate the limitations of the valence bond theory and understand the directional characteristics of chemical bonds, including ionic bonds, covalent bonds, coordinate covalent bonds, metallic bonds, and hydrogen bonds.
CLO6	Synthesize information on valence bond theory, directional characteristics of covalent bonds, and shapes of inorganic molecules using the Valence Shell Electron Pair Repulsion (VSEPR) theory, applying it to molecules like NH ₃ , H ₃ O ⁺ , SF ₄ , ClF ₃ , ICl ₂ , and H ₂ O

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit 1 Basics of Organic Chemistry (part-I) Classification, trivial names and IUPAC system of nomenclature of organic compounds. Hybridization, bond energy, polarity of bond, dipole moment of molecules, inductive effect, hydrogen bond, conjugation, resonance. Homolytic and heterolytic fission of bonds, electrophiles and nucleophiles, carbon ions and radicals- their stability, geometry and generation.	20%	9
2	Unit 2 Organic Chemistry Different types of Isomerism, Structural Isomers, Chain isomerism, Position isomerism, Functional isomerism, Metamerism Geometrical, Stereoisomerism, Configurational Isomers, Conformational Isomers, Concept of asymmetric carbon atom, Enantiomers, Diastereoisomers, Stereogenic atom.	23%	10
3	Unit 3 Basics of Inorganic Chemistry (part-I) Bohr's atomic model and limitation. Idea of de Broglie matter waves. Heisenberg's uncertainty principle. Multielectron system-Pauli's exclusion principle, Hund's rules of maximum multiplicity. Quantum Numbers, Stability of half filled full filled orbitals, Aufbau principle and its limitation. Electronic configuration of atoms.	22%	10
4	Unit 4 Basics of Inorganic Chemistry (part-II) Electronic and electrolytic conductors, Specific, equivalent and molar conduction, Kohlrausch law of independent migration of ions, ionic mobility and conductance, Transference number	11%	5
5	Unit 5 Basics of Physical Chemistry (Part-I) Phase, component, system, degrees of freedom. The phase rule. Phase diagram of one component system	11%	5

6	Unit 6 Radioactivity and Nuclear Structure of Atoms: Radioactive disintegration series, group displacement law, law of radioactive decay, half-life and average life of radio elements, radioactive equilibrium, and measurement of radioactivity. Stability of atomic nucleus, n/p ratio. Radioisotopes and their application	13%	6
	Total	100%	45

i. Text Book and Reference Book:

1.	Organic Chemistry, Robert T. Morrison and Robert N. Boyd, 6th Ed., Pearson Education, 2002.
2.	Concise Inorganic Chemistry by By J. D. Lee
3.	Principle of Physical Chemistry By Puri, Sharma and Pathania
4.	Organic Chemistry (Vol. I) By S M Mukherji, S P Singh and R P Kapoor
5.	Organic Chemistry By I L Finar
6.	Organic Chemistry By Solomons and Fryhle
7.	Organic Chemistry by By Morrison and Boyd

(2)

a. Course Name: Basics of Computer Application

b. Course Code: 11100103

c. Prerequisite: Basic Computer Literacy.

d. Rationale: The objective of this course is to familiarize students with concepts of fundamentals of

e. Microsoft Office, Excel, PowerPoint and Outlook for working of computer and its application.

f. Course Learning Objective:

CLOBJ 1	Remember understanding of what office automation entails, including the use of technology to streamline office tasks, improve efficiency, and enhance productivity
CLOBJ 2	Understand the advantages of office automation, such as increased accuracy, reduced manual labor, faster processing times, and improved communication and collaboration.
CLOBJ 3	Apply the role of office automation tools and technologies in contemporary workplaces, including their impact on workflow optimization, remote work, and digital transformation.

CLOBJ 4	Organize office automation systems to integrate with various business processes, including document management, workflow automation, customer relationship management, and enterprise resource planning.
CLOBJ 5	Evaluate the challenges and considerations associated with implementing office automation solutions, such as cost, compatibility, data security, and employee training.
CLOBJ 6	Develop Strategies for Successful Implementation: Students will develop strategies for successful implementation of office automation initiatives, including assessing organizational needs, selecting appropriate technologies, managing change, and evaluating outcomes.

g. Course Learning Outcomes:

CLO 1	Demonstrate understanding of the concept of office automation, including its components, functions, and applications in modern workplaces.
CLO 2	Understand the importance and benefits of office automation, recognizing its role in enhancing efficiency, productivity, and communication in organizations.
CLO 3	Analyse the challenges and considerations associated with office automation implementation, such as technological limitations, organizational culture, and security concerns.
CLO 4	Apply their knowledge of office automation to analyze and evaluate its integration with business processes, identifying opportunities for automation and efficiency improvements.
CLO 5	Evaluate the effectiveness of office automation solutions in addressing organizational needs and improving workflow processes, considering factors such as cost effectiveness, user satisfaction, and return on investment.
CLO 6	Synthesize their understanding of office automation concepts to develop strategies for successful implementation, including assessing organizational needs, selecting appropriate technologies, and managing change.

h. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

i. Course Content:

Sr.	Topics	W	T
1	Unit-1 Basic concept of computer: Introduction, different components of computer, basic design of computer	33	10
2	Unit-2 Introduction to Microsoft Office: Windows operation: Customizing the interface, windows explorer, computer upkeep & utilities Office operation: Microsoft word: concept of toolbar, character, paragraph & document formatting, drawing tool bar, header footer, document editing, page setup, short cut keys, text & graphics. Microsoft excel: concept of spread sheets, creating worksheet, well formatted documents, concept of row, column, cell & formula bar, using function, using shortcuts, chart, conditional formatting, goal seek, validation rule. Microsoft powerpoint: slide presentation, slide layout & design, custom animation, image importing, slide transition	67	20
	Total	100%	30

j. Text Book and Reference Book:

1.	Working with personal computer software By R.P. Soni, H. A. Arolkar and Sonal Jain
2.	PC software for Windows 98 made simple By R. K. Taxali
3.	Fundamentals of Computers by By Rajaraman

(3)

a. Course Name: Introduction to Microbiology

b. Course Code: 11101103

c. Prerequisite: Basic concept and essential of microbes

d. Rationale: Microbiology will give the fundamental concept on each topic. Unit covers the basics of microbes, their structure, habitat, growth, essential lab practices and experiment conditions.

e. Course Learning Objective:

CLOBJ 1	Acquaint students with basic concepts of microbial diversity and how the microbe concept emerged
CLOBJ 2	Complement the students with the basic knowledge about microbial growth and microscopy
CLOBJ 3	Introduce various microorganisms present in the ecosystem and acquaint with Common equipment used in routine microbiology laboratory

f. Course Learning Outcomes:

CLO 1	Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes
CLO 2	Know general characteristics of bacteria, their reproduction & nutritional requirement
CLO 3	Analyze the architecture of viruses, virus classification & their replication strategies.
CLO 4	Differentiate various culture media and their applications and also evaluate various means of sterilization

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit - 1 History of Development of Microbiology: Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner	25	11
2	Unit -2 Diversity of Microbial World Systems of classification Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms B. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance	25	11
3	Unit- 3 FUNGI Fungi Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic importance of fungi with examples in agriculture, environment,	25	11

	Industry, medicine, food, biodeterioration and mycotoxins.		
4	Unit- 4 Algae History of phycology with emphasis on contributions of Indian scientists; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae with suitable examples: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Applications of algae in agriculture, industry, environment and food. Protozoa: General characteristics with special reference to Amoeba, Paramecium, Plasmodium, Leishmania and Giardia. An overview of Scope of Microbiology	25	12
	Total	100%	45

i. Text Book and Reference Book:

1	Pelczar Jr, M J, Chan E C S, Krieg N R, (1986), Microbiology: An Application Based Approach, 5th edn. McGraw-Hill Book Company, NY
2	Ingraham J L and Ingraham C A Introduction to Microbiology: Thomson Brooks/Cole
3	Atlas R M, (2015), Principles of Microbiology 2nd Edition, McGraw Hill education, Mumbai
4	Surinder Kumar, Essentials of Microbiology, JP Medical Ltd, 30-Nov-2015 - Medical - 642 pages
5	Gerard J. Tortora, Berdell R. Funke, Christine L. Case, The Twelfth Edition of Tortora, Funke, and Case's Microbiology: An Introduction
6	Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, Prescott's Microbiology, McGraw-Hill Education, 17-Nov-2019 - Medical - 976 pages. 7. Patricia M. Tille Bailey & Scott's Diagnostic Microbiology.

(4)

- a. Course Name:** - Cell Biology
- b. Course Code:** 11102103
- c. Prerequisite:** Basic knowledge of biology and cells.
- d. Rationale:** The curriculum will provide a general understanding of the related disciplines with holistic knowledge generation in cells, organelles, and transport systems.
- e. Course Learning Objective:**

CLOBJ 1	Understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
CLOBJ 2	Remember the cellular components are used to generate and utilize energy in cells.
CLOBJ 3	Evaluate the cellular components underlying mitotic cell division.
CLOBJ 4	Apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

f. Course Learning Outcomes:

CLO 1	Understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
CLO 2	Understand a strong foundation on the basic unit of life
CLO 3	Remember a strong foundation for the functions of the cell.
CLO 4	Apply their knowledge of cell biology to selected examples of changes or losses in cell function
CLO5	Analyze knowledge about the cellular components underlying mitotic cell division

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit 1- Introduction to cell Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.	25	12
2	Unit -2 Cell Organelles Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion	25	12
3	Unit- 3 Cell Organelles Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure.	25	11

4	Unit -4 Cell Mechanisms Unit-4: Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, Mechanism of mitosis & meiosis, macromolecules, regulation of receptor expression and function. Signal transduction.	25	10
	Total	100%	45

i. Text Book and Reference Book:

1	Campbell Biology. 9th edition
2	Cell Biology" by Thomas Pollard, William Earnshaw, and Jennifer Lippincott- Schwartz
3	Molecular biology of cells: Lodish
4	"Molecular Biology of the Cell" by Bruce Alberts et al.
5	"The Cell: A Molecular Approach" by Geoffrey Cooper

(5)

a. Course Name: Biochemistry I

b. Course Code: 11102104

c. Prerequisite: Basic knowledge of biological molecules and its chemistry.

d. Rationale: Curriculum will provide a general understanding of the related disciplines with a holistic knowledge generation in biological sciences.

e. Course Learning Objective:

CLOBJ 1	Strengthen your understanding of fundamental mathematical concepts like number systems (fractions, decimals, and percentages), exponents, and logarithms.
CLOBJ 2	Enhance your ability to interpret and analyze quantitative information presented in various forms (tables, graphs, charts).
CLOBJ 3	Gain a solid grasp of algebraic concepts like variables, expressions, equations, and inequalities.
CLOBJ 4	Master problem-solving strategies like breaking down complex problems into smaller, manageable steps.

f. Course Learning Outcomes:

CLO 1	Students are able to differentiate between structure functions and uses of biomolecules like carbohydrates , lipids and proteins
CLO 2	Perform calculations accurately and efficiently using various mathematical operations
CLO 3	Interpret and analyze quantitative information presented in different formats (data tables, graphs, charts).

CLO 4	Calculate and interpret basic statistical measures like mean, median, mode, and standard deviation.
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g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit - 1 Introduction to Biochemistry Cellular and chemical foundations of life, Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment	14	6
2	Unit- 2 Carbohydrates and glycobiology : Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and nonreducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates.	33	14
3	Unit - 3 Lipids Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacylglycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments	25	12
4	Unit - 4 Amino acids & Proteins Structure and classification, physical, chemical and optical properties of amino acids & Proteins, Force stabilizing protein, structure and shape, different level of structural organization of Protein, Protein purification, Denaturation and renaturation of protein, fibrous and globular proteins.	28	13
	Total	100%	45

i. Text Book and Reference Book:

1	Campbell Biology. 9th edition
2	Molecular biology of cells: Lodish
3	"Molecular Biology of the Cell" by Bruce Alberts et al.
4	"Essential Cell Biology" by Bruce Alberts et al.
5	"The Cell: A Molecular Approach" by Geoffrey Cooper.

(6)

a. Course Name: Lab- I Cell Biology and introduction to Microbiology

b. Course Code: 11100106

c. Prerequisite: Basic handling and culturing of microbes and Cell biology.

d. Rationale: This curriculum will give the fundamental concept on each topics. Each practical is providing knowledge of importance of sterilization, and media preparation, staining, culturing and growth of different microbes

e. Course Learning Objective:

CLOBJ 1	Teach the students safety handling and regulation of laboratory facility.
CLOBJ 2	Learn to record, keep and analyze laboratory data with accuracy.
CLOBJ 3	Practice minimization of Errors related with handling of laboratory accessories and equipment's.
CLOBJ 4	Learn Standard Operating Procedures (SOPs) Laboratory equipment's.

f. Course Learning Outcomes:

CLO 1	Apply basics of equipment to observe cells and its organelle
CLO 2	Execute basic experiments to understand cellular mechanisms
CLO 3	Evaluate different cell and tissue from various living sources
CLO 4	Analyse the organelle and cellular components practically

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	3	2	-	-	20	-	30	50

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List:

Sr.	Name of the Experiment
1	Microbiology 1. Microbiology Good Laboratory Practices and Biosafety. 2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory. 3. Preparation of culture media for bacterial cultivation. 4. Sterilization of medium using Autoclave and assessment for sterility 5. Sterilization of glassware using Hot Air Oven and assessment for sterility 6. Sterilization of heat sensitive material by membrane filtration and assessment for sterility 7. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air. 8. Study of <i>Rhizopus</i> , <i>Penicillium</i> , <i>Aspergillus</i> using temporary mounts 9. Study of <i>Spirogyra</i> and <i>Chlamydomonas</i> , <i>Volvox</i> using temporary Mounts. 10. Study of the following protozoans using permanent mounts/photographs: <i>Amoeba</i> , <i>Entamoeba</i> , <i>Paramecium</i> and <i>Plasmodium</i>
2	Cell Biology 11. Structure and working of microscopes (Simple microscope, Compound microscope) 12. Observation of Prokaryotic and Eukaryotic cells and cell types (Living cells/Temporary/Permanent preparations). 13. Structure of a plant cell (through chart/model) 14. Structure of animal cell (through chart/model. 15. Structure of cell organelles adopting preparations/charts/models Mitochondria 16. Chloroplast o Ribosomes o Endoplasmic reticulum o Nucleus 17. Mitosis □ Squash preparation of Onion root-tip 18. Meiosis- Squash preparation of anther lobes.

i. Text Book and Reference Book:

1	Celis JE (ed) (1998) Cell Biology: A Laboratory Handbook, 2nd edn. San Diego: Academic Press
2	Lacey AJ(ed) (1999) Light Microscopy in Biology: A Practical Approach, 2nd edn. Oxford: Oxford University Press.
3	Paddock SW (ed) (1999) Methods in Molecular Biology, vol 122: Confocal Microscopy Methods and Protocols. Totowa, NJ: Humana Press.
4	Boon ME & Driver JS (1986) Routine Cytological Staining Methods. London: Macmillan

(7)

a. **Course Name:** Lab-2 (Biochemistry-I and Chemistry-I)

b. **Course Code:** 11103104

c. **Prerequisite:** Basic knowledge of biological molecules and its chemistry

d. **Rationale:** Curriculum will provide a general understanding of the related disciplines with a holistic knowledge generation in biological sciences.

e. Course Learning Objective:

CLOBJ 1	Understand the basic knowledge of biomolecules and its structure.
CLOBJ 2	Know about the biomolecules and their function.
CLOBJ 3	Know about different biochemical pathways
CLOBJ 4	Conduct experiments at biomolecular level.

f. Course Learning Outcomes:

CLO 1	Understand the concepts of cellular structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
CLO 2	Analyze the foundation on the basic unit of life.
CLO 3	Remembering biomolecules and their function
CLO 4	Apply biomolecular aspects in life processes.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	3	2			20	-	30	50

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List:

Sr.	Name of the Experiment
1.	Biochemistry-I: Preparation of standard buffers and determination of pH of a solution
2.	Biochemistry-I: Qualitative tests for Carbohydrates
3.	Biochemistry-I: Qualitative tests for Proteins and amino acids
4.	Biochemistry-I: Qualitative tests for Lipids
5.	Biochemistry-I: Titration curve of amino acids and determination of pK value.
6.	Biochemistry-I: Verification of Beer-Lambert's law.
7.	Biochemistry-I: Estimation of reducing sugars by DNSA method
8.	Biochemistry-I: Quantitative estimation of amino acids by Ninhydrin method
9.	Biochemistry-I: Estimation of RNA and DNA

10.	Biochemistry-I: Separation of sugars using paper chromatography
11.	Chemistry-I: Detection of elements and functional groups
12.	Chemistry-I: Detection of elements in an Organic compound
13.	Chemistry-I: Detection of the functional groups present in an organic compound

i. Text Book and Reference Book:

1	Biochemistry (2015) J.M. Berg, J.L. Tymoczko and L. Stryer, pub. W.H. Freeman.
2	Biochemistry (2011) D. Voet and J.G. Voet, pub. Wiley.
3	Molecular Cell Biology (2012) H. Lodish, et al, pub. W.H. Freeman.
4	Molecular Biology of the Cell (2014) B. Alberts et al., pub. Garland.
5	Practical Skills in Biomolecular Sciences (2012) R. Reed, D. Holmes, J. Weyers and A. Jones, pub. Prentice Hall.

(8)

- a. **Course Name:** Communication Skills-I
- b. **Course Code:** 11193101
- c. **Prerequisite:** Basic communication skills in English.
- d. **Rationale:** Basic comprehensive skills
- e. **Teaching & Examination Scheme:**

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
2	-	-	2	20	20	-	60	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination.

f. Course Content:

Sr.	Topics	W	T
1	Grammar Practice & Application	13	4
2	Listening Skills Telephonic Conversation	6	2
3	Speaking Skills Storytelling, Role Play, Presentation, ITEP (International Test of English Proficiency) – Speaking Task 1: To speak on a given topic for 1 minute, IELTS (International English Language Testing System) Task 1: To speak on a given topic for 2 to 3 minutes	41	12
4	Reading Reading Comprehension	6	2

5	Writing Skills Selection of topic, thesis statement, developing the thesis; introductory, developmental, transitional and concluding paragraphs, linguistic unity, coherence and cohesion, descriptive, narrative, expository and argumentative writing, Dialogue writing, Paragraph writing, ITEP – Writing Task 1: write a short note to respond to a simple situation or topic (75 to 100 words), E- mail, memorandum, notices, agenda.	34	10
	Total	100%	30

g. Text Book and Reference Book:

1.	Technical Communication : Principles And Practice By Sangeetha Sharma, Meenakshi Raman Oxford University Press, New Delhi (Green Cover Page)
2.	English for Academic Purposes-I By Deeptha Achar, et al, OBS
3.	The Leader in Test Preparation 2011 By Dr. Lin Lougheed, Barron's New Age International (P) Limited Publishers
4.	UTS Insearch English Prepare for IELTS: Academic module 2012 By University of Technology Sydney
5.	Developing Reading Skills: A Practical Guide to Reading Comprehension Exercises 1981 By Françoise Grellet Cambridge University Press
6.	Communication Skills for Technical Students By T.M. Farhathullah OBS

**Semester 2
(1)**

a. Course Name: Chemistry-II

b. Course Code: 11100151

c. Prerequisite: Basic math skills & foundational science knowledge

d. Rationale: Fundamental goal to understand the properties, composition, structure, behavior, and changes of matter. Chemistry is a central science that serves as a bridge between physics and biology, providing insights into the molecular and atomic foundations of the physical world.

e. Course Learning Objective:

CLOBJ 1	Grasp the meaning of basic vocabulary and Remember fundamental principles of atomic structure, including the arrangement of electrons, protons, and neutron
CLOBJ 2	Understand the organization of the periodic table and the trends in atomic and physical properties across periods and down groups.
CLOBJ 3	Apply the chemistry of main group elements, including trends in reactivity and the

	formation of compounds.
CLOBJ 4	Analyse various types of chemical bonding, including ionic, covalent, and metallic bonding.
CLOBJ 5	Evaluate basics of coordination compounds, including ligands, metal-ligand bonding, and isomerism in coordination complexes.
CLOBJ 6	Develop systematic understanding for the properties and reactions of common inorganic compounds, including acids, bases, and salts.

f. Course Learning Outcomes:

CLO 1	Remember list the fundamental concepts of atom and wave mechanics, including de Broglie's equation, Heisenberg's Uncertainty Principle, Aufbau Principle, Pauli's Exclusion Principle, and Hund's Rule for electron configuration.
CLO 2	Understanding of the quantum mechanical model of the atom, Schrödinger wave equation, and the concept of orbitals, quantum numbers, radial and angular wave functions, and Slater rule.
CLO 3	Apply knowledge of periodic properties to explain trends in atomic and ionic radii, ionization potential, electronegativity, and electron affinity. Apply the concepts to describe the general characteristics of group 1 and group 2 elements, including their occurrence, extraction, and production.
CLO 4	Analyze the significance of periodicity in chemistry, as well as the reactions and properties of alkali metals and alkaline earth metals. Analyze the applications of alkali metal and alkaline earth metal compounds in everyday life.
CLO 5	Evaluate the limitations of the valence bond theory and understand the directional characteristics of chemical bonds, including ionic bonds, covalent bonds, coordinate covalent bonds, metallic bonds, and hydrogen bonds.
CLO 6	Synthesize information on valence bond theory, directional characteristics of covalent bonds, and shapes of inorganic molecules using the Valence Shell Electron Pair Repulsion (VSEPR) theory, applying it to molecules like NH ₃ , H ₃ O ⁺ , SF ₄ , ClF ₃ , ICl ₂ , and H ₂ O

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit 1 Chemical Bonding: Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shell electron pair repulsion (VSEPR) theory to NH ₃ , H ₃ O ⁺ , SF ₄ , ClF ₃ , ICl ₂ and H ₂ O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electro-negativity difference. Ionic Solids – Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule, Metallic bond-free electron, valence bond and band theories. Weak Interactions – Hydrogen bonding, Vander Waals forces	16	7
2	Unit 2 Organic Chemistry : Structure and Bonding: Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, van der Waals interactions, inclusion compounds, clathrates, charge transfer complexes, resonances, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding. Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, anynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).	33	15
3	Unit 3 Stereochemistry: Optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro, diastereomers, meso compounds, resolution of enantiomer, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D and L and R and S systems of nomenclature. Geometric isomerism – determination of configuration of geometric isomers, E and Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism – conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae, Difference between configuration and conformation	33	15
4	Unit 4 Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena : PV isotherms of real gases, continuity of states, the isotherms of vander Waals equation,	18	8
	Total	100%	45

i. Text Book and Reference Book:

1.	Concise Inorganic Chemistry by By J. D. Lee
2.	Inorganic Chemistry By Puri and Sharma
3.	Principle of Physical Chemistry By Puri, Sharma and Pathania
4.	Organic Chemistry, Robert T. Morrison and Robert N. Boyd, 6th Ed., Pearson Education, 2002.
5.	Organic Chemistry By I L Finar
6.	Organic Chemistry By Solomons and Fryhle
7.	Organic Chemistry (Vol. I) By S M Mukherji, S P Singh and R P Kapoor

(2)

a. Course Name: Animal Physiology

b. Course Code: 11102153

c. Prerequisite: Basic knowledge of Animal physiology is the study of the internal physical and chemical functions of animals,

d. Rationale: The study of animal physiology is important because it helps us understand how animals function and how their biological processes work.

e. Course Learning Objective:

CLOBJ 1	Describe the basic principles of animal physiology, including homeostasis, feedback mechanisms, and the integration of organ systems.
CLOBJ 2	Explain the structure and function of major organ systems in animals (e.g., respiratory, circulatory, nervous, muscular, endocrine, digestive, and excretory systems).
CLOBJ 3	Compare physiological adaptations among different animal taxa in relation to their environments, such as thermoregulation, osmoregulation, and metabolic strategies.
CLOBJ 4	Analyze how cellular and molecular processes, including membrane transport, signal transduction, and energy metabolism, contribute to physiological functions.

f. Course Learning Outcomes:

CLO 1	Students will be able to explain the principles of homeostasis and the functional roles of different organ systems in animals.
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CLO 2	Students will describe the structure, function, and integration of major organ systems such as the nervous, circulatory, respiratory, digestive, and excretory systems.
CLO 3	Students will compare physiological adaptations in animals across various environmental contexts (e.g., aquatic, terrestrial, and extreme environments).
CLO 4	Students will analyze the role of cellular and molecular mechanisms in processes like membrane transport, energy production, and signal transduction.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit - 1 Digestion and Respiration Digestion and Respiration Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice Respiration: Exchange of gases, Transport of O ₂ and CO ₂ , Oxygen dissociation curve	25	12
2	Unit- 2 Circulation Circulation Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat	25	10
3	Unit- 3 Muscle physiology and osmoregulation Muscle physiology and osmoregulation Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Kidney as excretory organ	25	13
4	Unit- 4 Nervous and endocrine coordination Nervous and endocrine coordination Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters	25	10
	Total	100%	45

i. Text Book and Reference Book:

1	Animal Physiology: Mechanisms and Adaptations Richard W. Hill, Gordon A. Wyse, and Margaret Anderson
2	Animal Physiology Knut Schmidt-Nielsen
3	Principles of Animal Physiology Christopher D. Moyes and Patricia M. Schulte
4	Introduction to Animal Physiology Ian Kay
5	Eckert Animal Physiology: Mechanisms and Adaptations David Randall, Warren Burggren, and Kathleen French

(3)

a. Course Name: Plant Physiology

b. Course Code: 11102154

c. Prerequisite: Plant physiology is the study of how plants function, including their nutrition, movement, and growth

d. Rationale: Understanding plant physiology can help improve crop production and agricultural practices

e. Course Learning Objective:

CLOBJ 1	Explain the fundamental physiological processes of plants, such as photosynthesis, respiration, transpiration, and nutrient uptake.
CLOBJ 2	Describe water movement in plants, including concepts of osmosis, water potential, and mechanisms of water and nutrient transport through xylem and phloem.
CLOBJ 3	Explain the biochemical pathways involved in energy production and utilization in plants, including photosynthesis and cellular respiration.
CLOBJ 4	Analyze how plants respond to biotic and abiotic stresses such as drought, salinity, temperature extremes, and pathogens.
CLOBJ 5	Explore the physiological basis of interactions between plants and microorganisms, including symbiosis and pathogen defense.

f. Course Learning Outcomes:

CLO 1	Students will be able to describe the key physiological processes in plants, including photosynthesis, respiration, transpiration, and nutrient transport.
CLO 2	Understanding how plants defend themselves against pathogens, and the role of secondary metabolites in plant defense.
CLO 3	Understanding the metabolism of lipids and nitrogen, and the assimilation of mineral nutrients.
CLO 4	Understanding the processes of water, solute, and sugar transport in plants, as well as photosynthesis, respiration, and plant movements.
CLO 5	Students will demonstrate knowledge of how light, temperature, and soil composition influence plant growth and development.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit -1 Absorption of water, transpiration and ascent of sap: Absorption of water, transpiration and ascent of sap: Water - structure, physical properties and significance to plant life Movement of materials into and out of cells- diffusion, osmosis, osmotic pressure, plant cell as osmotic systems, significance of osmosis in plants Plasmolysis, its advantages and imbibition. Mechanism of water absorption - Active (osmotic and non osmotic) and passive absorption. External factors affecting water absorption. Transpiration - kinds of transpiration, mechanism of stomatal, transpiration and its significance and factors affecting the rate of transpiration, antitranspirants. Ascent of Sap, Path of Ascent Sap. Vital theories, root pressure theory, physical forces theory, transpiration pull and cohesion of water theory Absorption of mineral salts: - Mechanism of mineral salt absorption -ion- exchange, passive and active absorption, the carrier concept theory.	25	13
2	Unit-2 Photosynthesis Photosynthetic apparatus, Photosynthetic pigments and absorption of light energy. Excited states of atoms or molecules - Fluorescence, Phosphorescence, Quantum requirement and quantum yield, Red drop and Emerson's enhancement effect. Photosynthetic units - the Quantosomes, action spectrum. Mechanism of photosynthesis: Light reaction (Hill reaction) and Dark reaction (Calvin cycle), Blackman's law of limiting factors, factors affecting photosynthesis, significance of photosynthesis to mankind.	25	12
3	Unit- 3 Growth Plant Hormones: Natural growth hormones - Auxins, Gibberellins and cytokinins, ethylene, abscisic acid (ABA) (Discovery, Chemical nature, physiological role and practical applications). Photoperiodism and Vernalization : Classification of plants on the basis of photoperiods, importance of photoperiodism. Vernalization conditions necessary for vernalization, mechanism of vernalization, practical utility of vernalization.	25	10

4	Unit- 4 Plant movements & Stress physiology Movements in plant Movements of locomotion - Autonomic and Paratonic (tactic) Movements of curvature - Autonomic and paratonic (tropic) growth movements, Paratonic Variation movements (Nastic movements) and hygroscopic movements. Stress physiology :duction, water deficit and drought resistance, salt stress and salt resistance, cold injury and cold resistance, chilling injury and chilling resistance, freezing injury (frost) and freezing resistance, high temperature(heat) stress and high temperature(heat) resistance, heavy metal stress and heavy metal resistance.	25	10
	Total	100%	45

i. Text Book and Reference Book:

1	Plant Physiology and Development Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, and Angus Murphy
2	Introduction to Plant Physiology William G. Hopkins and Norman P.A. Hüner
3	Plant Physiology Frank B. Salisbury and Cleon W. Ross
4	Biochemistry and Molecular Biology of Plants ob B. Buchanan, Wilhelm Gruissem, and Russell L. Jones

(4)

a. Course Name: - Biochemistry II

b. Course Code: 11102155

c. Prerequisite: Knowledge of biological molecules and its chemistry

d. Rationale: Curriculum will provide a general understanding of the related disciplines with a holistic knowledge generation in biological sciences.

e. Course Learning Objective:

CLOBJ 1	Knowledge of biomolecules for living systems.
CLOBJ 2	Provide basic concepts of structural organization and characterization of proteins
CLOBJ 3	Learn about Oligosaccharides and lectin interactions in biochemical processes
CLOBJ 4	Understand the structure of DNA and RNA and their types

f. Course Learning Outcomes:

CLO 1	Create interest in Biochemistry and appreciation for chemical basis of biological processes.
CLO 2	Provide an in-depth understanding of chemical reaction mechanisms in biological processes.
CLO 3	Develop problem solving and analytical skills through case studies, research papers and hands on- experience.

CLO 4	Bridge the knowledge and skill gap between academic out and industry requirements.
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g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit- 1 Basic concepts of Metabolism: Basic concepts of Metabolism: Anabolism, catabolism, Energy coupling reaction in biology, central role of ATP in metabolism. Centr l metabolic cycles - Glycolysis, TCA cycle and pentose phosphate pathway	27	12
2	Unit- 2 Vitamins and Lipid Metabolism: Vitamins and Lipid Metabolism: Definition and classification of Vitamins, Structure and biochemical functions of Vitamins, Diseases related to Vitamins, Vitamin like compounds. Importance of Triglycerol, fatty acid, anabolism and catabolism (saturated and unsaturated).	18	8
3	Unit- 3 Amino acid metabolism Amino acid metabolism: Source of amino acid, Protein turn over, Transamination and deamination reaction, metabolism of ammonia, urea cycle and its regulation, link between urea cycle and TCA cycle, Biosynthesis of essential and nonessential Amino acid.	28	13
4	Unit-4 Metabolic disorders and intermediary metabolism: Metabolic disorders and intermediary metabolism: Metabolic disorder related to Carbohydrate metabolism, lipid metabolism, protein metabolism and nucleic acid metabolism, Intermediary metabolism.	27	12
	Total	100%	45

i. Text Book and Reference Book:

1	Campbell Biology. 9th edition
2	Molecular biology of cells: Lodish
3	Molecular Biology of the Cell" by Bruce Alberts et al.
4	Essential Cell Biology" by Bruce Alberts et al
5	The Cell: A Molecular Approach" by Geoffrey Cooper

a. Course Name: Biostatistics

b. Course Code: 11102156

c. Prerequisite: Basic knowledge of quantitative field such as statistics, mathematics, computer science, or a related field.

d. Rationale: Biostatistics is used to analyze health data and develop public health policies and initiatives.

e. Course Learning Objective:

CLOBJ 1	Students would be confident in all the basics of different branches of Life sciences, which is necessary for their higher studies and career
CLOBJ 2	Will be trained for the communication, statistics and computer skills needed for their employment
CLOBJ 3	Students know the ethics in biology, which must be practiced during their lifetime career.
CLOBJ 4	Students would be equipped with the skill sets which can generate employment for them in industry dealing with microbiology, biotechnology, food, beverages, agriculture, pharmacy, genetics, molecular biology, production and many other allied industries.

f. Course Learning Outcomes:

CLO 1	Conduct basic statistical analysis of data
CLO 2	Learn how to decide the sample size for different analysis purpose.
CLO 3	Learn making the graphical presentation of result data.
CLO 4	Tabulation of data and its presentation

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit -1 Introduction to Biostatistics Introduction to Biostatistics, Population and Sample Scope of Biostatistics, Population and Sample, types of data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Concept of Population in Biostatistics, Sampling Methods	25	12
2	Unit - 2 Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, Types of Error, large sample test and small sample test.	25	10
3	Unit- 3 Descriptive Statistics and Presentation Classification, Graphical Presentation, Measures of Central Tendency, Measures of Dispersion, Brief Description and Tabulation of Data & its graphical representation.	25	13
4	Unit- 4 Regression and Correlation Introduction to Regression, Linear Regression, Concept and types of correlation, Computation of Correlation Coefficients	25	10
	Total	100%	45

i. Text Book and Reference Book:

1	"Biostatistics: A Foundation for Analysis in the Health Sciences" Wayne W. Daniel, Chad L. Cross
2	"Principles of Biostatistics" Marcello Pagano, Kimberlee Gauvreau
3	"Essentials of Biostatistics in Public Health" Lisa M. Sullivan
4	"Biostatistics: Basic Concepts and Methodology for the Health Sciences" Manju Sharma
5	"Biostatistical Analysis" Jerrold H. Zar
6	"Statistical Methods for Rates and Proportions" Joseph L. Fleiss, Bruce Levin, Myunghee Cho Paik

(6)**a. Course Name:** Lab- I Animal Physiology and Plant Physiology**b. Course Code:** 11102157**c. Prerequisite:** Basic knowledge of structure and function of animal organs and organ systems**d. Rationale:** The rationale for lab work in animal and plant physiology is to understand the mechanisms of life processes, including the structure and function of organisms.**e. Course Learning Objective:**

CLOBJ 1	Demonstrate knowledge of basic physiological processes in animals and plants through practical experiments.
CLOBJ 2	Recognize the interdependence of physiological systems and their role in maintaining homeostasis and plant survival.
CLOBJ 3	Acquire hands-on experience in laboratory techniques used to study physiological phenomena, such as enzymatic activity, osmosis, and transpiration.
CLOBJ 4	Perform experiments to measure photosynthesis, transpiration, and water uptake.
CLOBJ 5	Investigate the impact of environmental factors on plant physiology, such as light intensity, temperature, and humidity.

f. Course Learning Outcomes:

CLO 1	To get basic knowledge about BFS and DFS algorithms.
CLO 2	To design game using AI and Machine learning concepts.
CLO 3	To develop program for representation methods.
CLO 4	To understand practical concepts of clustering.
CLO 5	To understand practical concepts of regression using scillaren kit.
CLO 6	To develop and design neural network based application using ANN

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	3	2	-	-	20	-	30	50

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment list:

Sr.	Name of the Experiment	W	T
1	Animal Physiology 1. ECG and Blood Pressure measurement 2. Estimation of Body mass index 3. Study of digestive, nervous, respiratory and endocrine system by chart and models	50	5

2	Plant Physiology 4. Basics of Plant Anatomy (Angiosperms and Gymnosperms) Tissue Water Potential - Red onion cells 5. Stomatal potential - microscopic study 6. Estimation of chlorophyll a and chlorophyll b 7. Measuring Stomatal Frequency in Broad Bean 8. Measuring Water Potential In Potato Tissue 9. Seed germination (Monocot and dicot)	50	10
	Total	100%	15

i. Text Book and Reference Book:

1	"Animal Physiology: Adaptation and Environment" Knut Schmidt-Nielsen
2	"Practical Zoology" S. Chand
3	"Introduction to Animal Physiology" Ian Kay
4	"Animal Physiology Laboratory Manual" Darrell S. Vodopich
5	"Plant Physiology and Development" Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, Angus Murphy

(7)

a. Course Name: Lab-2 (Biochemistry-II and Chemistry-II)

b. Course Code: 11103154

c. Prerequisite: Basic knowledge of lab techniques in biology and chemistry.

d. Rationale: Curriculum will provide an in-depth understanding of chemical reaction mechanisms in biological processes.

e. Course Learning Objective:

CLOBJ 1	Gain practical knowledge of advanced biochemical processes, including enzyme kinetics, protein purification, and metabolic pathways.
CLOBJ 2	Conduct experiments such as spectrophotometry, chromatography (e.g., thin-layer, gas, or HPLC), and electrophoresis for biomolecule analysis.
CLOBJ 3	Gain a deeper understanding of reaction mechanisms, kinetics, thermodynamics, and chemical equilibria through laboratory work.
CLOBJ 4	Master analytical chemistry techniques such as titrimetric analysis, UV-Vis spectrophotometry, and IR spectroscopy.

f. Course Learning Outcomes:

CLO 1	Perform advanced experiments such as enzyme assays, protein purification, and chromatography with accuracy and precision.
CLO 2	Understand the Calculate enzyme kinetic parameters (K_m and V_{max}) and understand the role of inhibitors in biochemical reactions.
CLO 3	Understand Synthesize and characterize organic and inorganic compounds through standard laboratory protocols.
CLO 4	Adhere to safety guidelines for chemical handling, waste disposal, and ethical reporting of experimental results.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	3	2	-	-	20	-	30	50

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List:

Sr.	Name of the Experiment	W	T
1	Biochemistry - II Estimation of Vitamin C by 2-6 Dichloroindophenol blue dye method. and Deviation.		
2	Biochemistry - II Estimation of Iron by Wong's method.		
3	Biochemistry - II Estimation of Urea by DAMO method.		
4	Biochemistry - II Estimation of Creatinine by alkaline picrate method		
5	Biochemistry - II Estimation of Lipid by phosphovalinine method.		
6	Biochemistry - II Estimation of total cholesterol by $FeCl_3$ or enzymatic method.		
7	Biochemistry - II Separation of amino acid by circular paper chromatograph		
8	Biochemistry - II Estimation of Blood Sugar		
9	Biochemistry - II Estimation of Uric Acid		
10	Biochemistry - II Detection of alpha-amylase activity in saliva.		

11	Inorganic Chemistry Semi micro Analysis – Cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI, Anion analysis.		
12	Organic Chemistry Laboratory techniques		
13	Organic Chemistry Calibration of Thermometer: 80-820 (Naphthalene), 113.5-1140 (Acetanilide), 132.5-1330 (Urea), 1000 (Distilled Water)		
14	Organic Chemistry Determination of melting point: Naphthalene 80-820, Benzoic acid 121.5-1220 Urea 132.5-1330, Succinic acid 184.5- 1850, Cinnamic acid 132.5-1330, Salicylic acid 157.5-1580, Acetanilide 113.5-1140, m-Dinitrobenzene 900 p-Dichlorobenzene 520, Aspirin 1350		
15	Organic Chemistry Determination of boiling point: Ethanol 780, Cyclohexane 81.40, Toluene 110.60, Benzene 800		
16	Organic Chemistry Mixed melting point determination: Urea-Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)		
17	Organic Chemistry Distillation: Simple distillation of ethanol-water mixture using water condenser, Distillation of nitrobenzene and aniline using air condenser		
18	Organic Chemistry Crystallization: Concept of induction of crystallization, Phthalic acid from hot water (using fluted filter paper and steamless funnel), Acetanilide from boiling water, Naphthalene from ethanol, Benzoic acid from water		
19	Organic Chemistry Decolorisation and crystallization using charcoal		
20	Organic Chemistry Decolorisation of brown sugar (sucrose) with animal charcoal using gravity filtration.		
21	Organic Chemistry Crystallization and decolorisation of impure naphthalene (100g of naphthalene mixes with 0.3 g of Congo Red using 1g decolorizing carbon) from ethanol.		
22	Organic Chemistry Sublimation (Simple and Vacuum): Camphor, Naphthalene, Phthalic acid and succinic acid.		

i. Text Book and Reference Book:

1	"Practical Biochemistry: Principles and Techniques" Keith Wilson, John Walker
2	"Biochemical Calculations" rwin H. Segel
3	"Laboratory Manual in Biochemistry" J. Jayaraman
4	"Vogel's Textbook of Quantitative Chemical Analysis" J. Mendham, R.C. Denney, J.D.

	Barnes, M.J.K. Thomas
5	"Practical Organic Chemistry" A.I. Vogel, B.S. Furniss, A.J. Hannaford
6	"Laboratory Manual of Organic Chemistry" R.K. Bansal

(9)

a. Course Name: Communication Skills-II

b. Course Code: 11193151

c. Prerequisite: The main prerequisite for learning a language is motivation.

d. Rationale: The building blocks of language, vocabulary are used to express ideas, share information, and understand others. It's important for all areas of communication, including listening, speaking, reading, and writing.

e. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
2	-	-	2	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

f. Course Content:

Sr.	Topics	W	T
1	Unit-1 Vocabulary and Grammar: Adjectives, Degree of Comparison, Conjunctions, vocabulary on 'How to talk about science and scientists'	27	8
2	Unit-2 Listening Skills: Speeches by the leaders (Audio – Video)	6	2
3	Unit-3 Speaking Skills: Speaking: (a) To speak on a given topic for 2 minutes, Category: Comparison-contrast and Problem – solution, (b) Cue Card (like IELTS exam) - To speak on a given topic, using the prompts to guide you, for 3 minutes, Presentation Task, Group Discussion	27	8
4	Unit-4 Writing Skills: (a) single Picture Description, (b) Picture description – comparison, Note Making, Precise Writing, Writing task: Comparison-contrast and Problem-solution	27	8

5	Unit-5 Writing a Book Review: List of Books Suggested for the Book Review: The Secret by Rhonda Byrne, Wings of Fire by A P J Abdul Kalam, Who Moved My Cheese by Dr Spancer Johnson, You Can Win by Shiv Khera, Stay Hungry Stay Foolish by Rashmi Bansal, I am Ok You are Ok by Thomas Harris, The Seven Habits of Highly Effective People by Stephen Covey , The Eighth Habit by Stephen Covey, Bhagvat Gita on Effective Leadership by Poojan Roka, The Kalam Effect by Nair, Tough Times Never Last But Tough People Do by Dr. Robert Schuller, What Employers Want But Business Schools Don 't Teach by Yasmin D'sousa and Amitabh Singh, Freedom is not Free by Shiv Khera, Be an Extraordinary Person in an Extraordinary World by Robert Schuller, Making Miracles by Arnold Fox and Barry Fox , The Road Less Travelled by M. Scott Peck to Name a few., I have a Dream by Rashmi Bansal, Connect the Dots by Rashmi Bansal, The saint, The Surfer and the CEO by Robin Sharma, Attitude is Everything by Jeff Keller NOTE: These are few references of books. Students can prepare book review on a book of their choice after consulting tutorial faculty	13	4
	Total	100%	30

g. Text Book and Reference Book:

1.	English for Academic Purposes-I By Deeptha Achar
2.	Technical Communication : Principles And Practice By Sangeetha Sharma, Meenakshi Raman
3.	Barron's The Leader in Test Preparation By Dr. Lin Lougheed
4.	UTS In search English Prepare for IELTS By Academic module 2012, University of Technology, Sydney
5.	Developing Reading Skills: A Practical Guide to Reading Comprehension Exercises By Françoise Grellet
6.	How to write better essays By Palgrave-Macmillan: Basingstoke Greetham
7.	Communication Skills By Parul Popat and Kaushal Kotadia
8.	Teaching Beginning Reading and Writing with the Picture World Inductive Model By Emily F. Calhoun

Semester 3
(1)

a. Course Name: Basics of Molecular Biology

b. Course Code: 11102207

c. Prerequisite: Basic knowledge of nucleic acid, DNA replication, translation and transcription.

d. Rationale: Students will be familiar general concept of molecular biology such as molecular nature of the gene and its mechanisms of gene replication, mutation, transcription and expression.

e. Course Learning Objective:

CLOBJ 1	Understand the Fundamental Concepts of Molecular Biology.
CLOBJ 2	Understand the molecular basis of gene expression regulation, including transcription factors, epigenetics, and RNA processing.
CLOBJ 3	Understand the role of molecular biology in genetic recombination, plasmid construction, and biotechnology applications.
CLOBJ 4	Apply molecular biology principles to biotechnology, genetic engineering, and medical research.
CLOBJ 5	Develop Problem-Solving and Critical Thinking Skills.

f. course Learning Outcomes:

CLO 1	Describe the structure and function of DNA, RNA, and proteins in genetic information flow (Central Dogma).
CLO 2	Analyze the molecular basis of mutations and their effects on protein function and genetic disorders.
CLO 3	Solve problems related to gene expression, mutations, and molecular pathway disruptions using molecular biology tools.
CLO 4	Discuss the molecular basis of diseases and strategies for diagnosis and therapy.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Introduction to DNA structure and replication DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.	25	11

2	Unit-2: DNA damage, repair and homologous recombination DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.	25	11
3	Unit-3: Introduction to Transcription and RNA processing RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.	25	12
4	Unit-4: Introduction to gene regulation and translation Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation., Posttranslational modifications of proteins	25	11
	Total	100%	45

i. Text Book and Reference Book:

1	"Molecular Biology of the Cell" Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter
2	"Molecular Biology of the Gene" James D. Watson, Tania A. Baker, Stephen P. Bell
3	"Lewin's Genes XII" Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick
4	"Molecular Biology: Principles and Practice" Michael M. Cox, Jennifer Doudna, Michael O'Donnell
5	"Essential Molecular Biology: A Practical Approach" Terry Brown

(2)

a. Course Name: Basics of Enzyme

b. Course Code: 11102209

c. Prerequisite: Students should have basic knowledge of Enzymes, Structure of enzymes, nomenclature, classification etc

d. Rationale: Understand individual reactions are controlled and integrated into the metabolic pathways of the cell.

e. Course Learning Objective:

CLOBJ 1	Understand Enzyme Structure and Function and Describe the chemical and physical properties of enzymes that enable catalysis.
CLOBJ 2	Understand how enzymes lower activation energy and facilitate biochemical reactions.
CLOBJ 3	Explain enzyme-substrate interactions, including the lock-and-key and induced-fit models.
CLOBJ 4	Develop practical skills in enzyme assays, activity measurements, and purification techniques.
CLOBJ 5	Analyze data from spectrophotometry or other tools to measure reaction rates and enzyme functionality.

f. course Learning Outcomes:

CLO 1	Describe Enzyme Structure and Function and Identify the components of enzyme structure, including the active site, coenzymes, and cofactors, and explain their roles in catalysis.
CLO 2	Describe the mechanisms by which enzymes lower activation energy and accelerate chemical reactions.
CLO 3	Understand the relevance of enzyme nomenclature and classification in biochemical research.
CLO 4	Explain the role of enzymes in metabolic regulation and cellular signaling.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit-1 An Introduction to enzymes: What are enzymes, brief history of enzymes, concepts of coenzymes, cofactors, holoenzymes, apoenzyme, activators, inhibitors, regulatory enzymes. Specificity of enzyme (active site) and models for enzyme specificity (Lock and key, induced-fit and transition-state stabilization hypothesis). Unisubstrate reaction and Bi substrate reactions briefs introduction to sequential and ping pong mechanisms with examples	25	10
2	Unit-2 Enzyme kinetics: Concept of activation energy for uncatalyzed and catalyzed (chemical and enzyme) reaction. Type of reaction (zeroorder, first-order and second order). Unisubstrate enzyme kinetics, factors affecting the rate of enzyme catalyzed reactions forms. derivation of Michaelis-Menten equation, significance of Vmax, Km and different plots (Lineweaver-Burk, EadieHofstee and Hanes plots). Enzyme inhibition and kinetics type of inhibition (reversible and irreversible), competitive, non-competitive, uncompetitive, mixed, partial, substrate, and allosteric.	25	12
3	Unit-3 Chemical Nature of enzyme catalysis: Mechanisms of catalysis (acid-base catalysis, electrostatic catalysis, covalent catalysis, enzyme catalysis), Metal- activated enzymes and metalloenzymes (alkali metal cations, alkaline earth metal cations and transition metal cations). Role of cofactors in enzyme catalysis with suitable examples: NAD/NADP (eg. alcohol/lactate dehydrogenase), FMN/ FAD (glutathione reductase), ATP/ADP/AMP.	25	12
4	Unit-4 Application of enzymes: Advantages of enzymes vs. chemical catalysts, Immobilized enzymes and cells: Methods of immobilization, use of immobilized enzymes, advantage and disadvantage of immobilized enzymes. Industrial applications of enzymes. Type of isoenzymes and clinical significance (eg. lactate dehydrogenase, creatinephospho kinase, alkaline phosphatase).	25	11
	Total	100%	45

i. List of Practical

1	Lehninger's Principles of Biochemistry Nelson, David and Cox., Macmillan NY By A.L. Lehninger, Nelson and Cox
2	Fundamentals of Biochemistry By Donald Voet, Judith Voet and Charlotte Pratt
3	Harper's illustrated Biochemistry (TextBook) By Robert K. Murray
4	Enzymes (TextBook) By Trevor palmer East west Press.
5	Enzymes Biotechnology (TextBook) By N Gray, M Calvin, SC Bhatia CBS Publishers and Distributors Pvt Limited, Pub. Year 2010

(3)

a. Course Name: Genetics

b. Course Code: 11102210

c. Prerequisite: Basic Knowledge of Biology

d. Rationale: Understand historical overview and laws of Inheritance, Gene interactions and basic principles of Genetics.

e. Course Learning Objective:

CLOBJ 1	Understand the Principles of Inheritance and Explain Mendelian and non-Mendelian inheritance patterns, including dominance, codominance, and polygenic traits.
CLOBJ 2	Understand the structure and function of genes, chromosomes, and DNA.
CLOBJ 3	Describe how genetic information is replicated, expressed, and transmitted across generations.
CLOBJ 4	Explain the concepts of genetic linkage, mapping, and recombination frequency.

f. course Learning Outcomes:

CLO 1	Acquire learning to isolate RNA, DNA, total nucleic acids and total RNA from bacteria, yeast and plant tissues and to characterize them.
CLO 2	Study the discovery of DNA as genetic material, DNA replication, transcription, DNA repair and translation.
CLO 3	Exposure with the importance of E. coli lac operon, PCR, expression vectors and their importance in Biotechnology. To produce insulin using recombinant DNA technology.
CLO 4	Acquaintance with the merits and demerits of transgenic crops.

CLO 5	Exposure to the concepts of genomics, proteomics, metabolomics and their importance in human health.
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g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Science of Genetics-Classical, Molecular and Evolutionary Genetics, History of Human Genetics Pedigrees- gathering family history, pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees, Autosomal and Sex Linked Inheritance, Mitochondrial and Chloroplast Inheritance	22	10
2	Unit-2: Mendel's Laws of inheritance, Deviation from Mendel's Dihybrid phenotype, Linkage, Sutton's view on linkage, Morgan's view on linkage, Bateson and Punnett's Coupling and Repulsion hypothesis.	22	10
3	Unit-3: Chromosome theory of Linkage, kinds of linkage, linkage groups, types of Crossing over, mechanism of Meiotic Crossing over, kinds of Crossing over, theories about the mechanism of Crossing over. Multiple allele, Lethal alleles, Epistasis, Atavism/Reversion, Penetrance (complete and incomplete), Expressivity, Pleiotropism.	33	15
4	Unit-4: Population and Evolutionary Genetics - Macro- and Micro -evolution in Mendelian population, Elemental forces of evolution - Mutation, Selection (Types of selection, selection coefficient, selection in natural populations), Genetic drift, Migration. Modes of speciation- Sympatric and Allopatric	23	10
	Total	100%	45

i. Text Book and Reference Book:

1	Genetics: Analysis and Principles (6 Ed) (by Robert J. Brooker. T)
2	Gupta, P.K. 1985. Cytology, Genetics and Cytogenetics. Rastogi Publications, Meerut.
3	Pundhan Singh, 2000. Elements of Genetics. Kalyani Publishers, Ludhiana
4	Principles of Genetics. Snustad Simmons. 2008. 6th Edition. John Wiley Publication.
5	Verma, P.S. and Agarwal, V.K. 2005. Cell Biology, Genetics, Molecular Biology,
6	Strickberger, M.W. 2004. Genetics. Prentice – Hall of India Pvt. Ltd., New Delhi.

(4)

a. Course Name: Lab- 2 Molecular biology and genetics

b. Course Code: 11102213

c. Prerequisite: Basic knowledge of nucleic acid, spectrophotometer and agarose gel electrophoresis

d. Rationale: Students will be familiar basic techniques used in molecular biology such as isolation of nucleic acid and its concentration estimation, agarose gel electrophoresis and PCR techniques.

e. Course Learning Objective:

CLOBJ 1	Develop an understanding of fundamental and applied aspects of genetics and molecular biology with the ability to use that knowledge in a wide range of modern science.
CLOBJ 2	The content include classical mendalian genetics, microbial and molecular genetics, and various aspects of molecular biology which include replication, transcription, translation, gene regulation, DNA binding motifs, DNA methylation and epigenetic regulation.
CLOBJ 3	The paper will be helpful for the students in understanding and applying the core concepts in their project and higher studies.
CLOBJ 4	Students learn how molecules operate and the chemical changes they undergo

f.course Learning Outcomes:

CLO 1	Completely read this course student will learn following knowledge in genetics and molecular biology:
CLO 2	Relate modern techniques to the understanding of genetics, and Hardy-Weinberg principle to explain changes in population genetics.
CLO 3	Microbial genetic process like generation of mutants for genetic analysis as well as to get an in-depth understanding about the molecular genetics.
CLO 4	Describe the principles of gene expression and regulation in prokaryotic and eukaryotic cells.

CLO 5	Apprise the importance of epigenetic and methylation systems in gene regulation.
CLO 6	Understand the importance of DNA binding motifs in gene regulation.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	3	2	-	-	20	-	30	50

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List:

Sr.	Name of the Experiment
1	Lab 1. Isolation of DNA from plants (Dellaporta method and CTAB method) 2. Isolation of DNA from blood 3. Agarose gel electrophoresis 4. SDS – PAGE 5. Estimation of DNA by DPA method % 3 6. Estimation of RNA by orcinol method 7. Quantification of DNA and RNA by UV spectrophotometer 8. Preparation of mitotic chromosomes from onion root tip 9. Preparation meiotic chromosomes from datura or hibiscus pollen grain 10. Preparation of metaphase chromosomes 11. Mutagenesis by gradient plate method 12. Replica plating 13. Study of microbiocidal effect of UV rays

i. Text Book and Reference Book:

1	Current Protocols in Molecular Biology by Ausbel S.M. and Brent R.
2	Molecular Biology, By Robert Weaver MCGraw-Hill, 5th Edition, 2012.
3	Molecular Biology of the Cell Author: Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter.
4	Molecular Biology of the Gene by J.D. Watson and H.H. Nancy.
5	Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John

	Walker 6th, Pub. Year 2015.
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(5)

- a. **Course Name:** LAB -1 Environmental Biochemistry and Enzymology
- b. **Course Code:** 11103205
- c. **Prerequisite:** Students should have basic knowledge of Environmental Biochemistry and Enzymes, Structure of enzymes, nomenclature, classification etc.
- d. **Rationale:** Enzymes play a key role in biological remediation, which is the process of restoring polluted environments.
- e. **Course Learning Objective:**

CLOBJ 1	Understand the biochemical mechanisms of pollutant degradation and detoxification in the environment.
CLOBJ 2	Perform biochemical assays to detect and quantify organic and inorganic components in soil, water, and air samples.
CLOBJ 3	Measure biochemical indicators of environmental health, such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), and enzymatic activity in ecosystems.
CLOBJ 4	Understand the role of enzymes in catalyzing environmental biochemical reactions.
CLOBJ 5	Develop skills in enzyme activity measurement using spectrophotometry and other analytical techniques.
CLOBJ 6	Study the effects of temperature, pH, and inhibitors on enzyme kinetics.

- f. **course Learning Outcomes:**

CLO 1	Perform biochemical assays to measure parameters such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), and nutrient levels in environmental samples.
CLO 2	Demonstrate knowledge of biochemical pathways involved in nutrient cycling and pollutant degradation.
CLO 3	Evaluate the effects of pH, temperature, and inhibitors on enzymatic reactions.
CLO 4	Explore the application of immobilized enzymes in biosensors and industrial settings related to environmental studies.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	3	2			20		30	50

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List::

Sr.	Name of the Experiment
1	1. Determination of COD 2. Testing of chlorine demand of water 3. Microbiological quality assurance of any of the commercially available Foods. 4. Determination of fecal coliforms by MPN technique/MF technique 5. Isolation of azotobacter and rhizobium. 6. Determination of specific activity of an Enzyme. 7. Determination of Enzyme activity in presence of activators. 8. Determination of activity in presence of inhibitors. 9. Determination of optimum pH. And temperature 10. Determination of Km and Vmax . 11. Study of competitive and non-competitive inhibitors. 12. Determination of lactic acid from milk. 13. Estimation of total carbohydrates from potato by anthrone method. 14. Extraction of starch from potato. 15. Determination of citric acid from citrus fruits. 16. Determination of lactose from milk. 17. Determination of fat in milk. 18. Determination of acid value/peroxidation/ saponification no. of fats.

i. Text Book and Reference Book:

1	"Environmental Biochemistry: A Laboratory Manual" K. C. M. A. R. (K.C. M. A. R.)
2	"Principles of Environmental Chemistry" James G. Speight
3	"Environmental Biochemistry and Microbial Ecology" N. A. S. Azad
4	"Fundamentals of Enzymology" Nicholas C. Price & Lewis Stevens
5	"Enzyme Kinetics: Principles and Applications" N. D. Z. N. J. K. & J. M. B.
6	"Environmental Biotechnology: Principles and Applications" Bruce E. Rittmann & Perry L. McCarty

(7)

a. Course Name: Membrane Biology & Bioenergetics

b. Course Code: 11103216

c. Prerequisite: Basic knowledge of Biology & Bioenergetics

d. Rationale: The curriculum will provide a general understanding of the related disciplines with holistic knowledge generation in cells, organelles, and transport systems.

e. Course Learning Objective:

CLOBJ 1	Understand the Basics of Life and Organismal Biology
CLOBJ 2	Understand the role of biomolecules in maintaining cellular structure and function.
CLOBJ 3	Understand Energy in Biological Systems
CLOBJ 4	Understand the processes of catabolism and anabolism and their roles in energy production and biomolecule synthesis.
CLOBJ 5	Understand the Role of ATP in Cellular Processes
CLOBJ 6	Explain the mechanisms of oxidative phosphorylation and the chemiosmotic theory.

f. course Learning Outcomes:

CLO 1	Describe the diversity and classification of life forms based on evolutionary principles.
CLO 2	Relate the properties of biomolecules to their biological significance.
CLO 3	Classify major biomolecules (carbohydrates, lipids, proteins, and nucleic acids) and describe their roles in cellular structure and function.
CLO 4	Analyze how energy is stored, transferred, and utilized within cells.
CLO 5	Describe the structure and function of ATP as the primary energy currency of cells.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	UNIT 1 Introduction to biomembranes Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems.	22	10
2	UNIT 2 Membrane structures Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture.	22	10
3	UNIT 3 Membrane transport Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na ⁺ -glucose symporter. ABC family of transporters - MDR, CFTR. Group translocation. Ion channels - voltage-gated ion channels (Na ⁺ /K ⁺ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin.	33	15
4	UNIT 4 Introduction to bioenergetics Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.	23	10
	Total	100%	45

i. Text Book and Reference Book:

1.	Lehninger Principles of Biochemistry, By David L. Nelson, Michael M. Cox, Publisher: W. H. Freeman Fourth Edition
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2.	Membrane structural Biology with biochemical and biophysical foundations By Mary Luckey
3.	An introduction to Biological membranes By William Stillwell
4.	Biochemistry By Berg, J.M., Tymoczko, J.L. and Stryer, L.

(8)

a. Course Name: Metabolism-I

b. Course Code: 11103217

c. Prerequisite: Students should have basic knowledge of different biomolecules and their structures. |

d. Rationale: Learning biochemical pathways helps to understand metabolism, energy production and nutrition. Dysregulation of biochemical pathways give rise to metabolic disorders. To diagnosis of those diseases and develop therapeutic target, knowledge of these pathways is crucial.

e. Course Learning Objective:

CLOBJ 1	Explain the interconnections between metabolic pathways and their roles in cellular and organismal homeostasis.
CLOBJ 2	Understand the principles of enzyme regulation, including allosteric control, covalent modification, and feedback inhibition.
CLOBJ 3	Explain how energy is captured, stored, and utilized in cells through ATP and other energy carriers.
CLOBJ 4	Describe the biosynthesis and degradation of carbohydrates, lipids, proteins, and nucleotides.

f. course Learning Outcomes:

CLO 1	Understand the role of these pathways in cellular energy production and macromolecule synthesis.
CLO 2	Describe the integration of carbohydrate, lipid, protein, and nucleotide metabolism.
CLO 3	Understand how enzymes, hormones, and cellular signals regulate metabolic pathways.
CLO 4	Relate these adaptations to physiological changes at the cellular and systemic levels.
CLO 5	Understand the use of biochemical pathways in biotechnological innovations, including synthetic biology.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	

3	-	-	3	20	20	-	60	-	100
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L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	UNIT 1 Carbohydrate metabolism: Glycolysis, TCA cycle, metabolism of glycogen, gluconeogenesis, pentose phosphate pathway, glyoxylate pathway, Mitochondrial electron transport, oxidative phosphorylation, inhibitors. Regulation of committed step in each pathway.	22	10
2	UNIT 2 Metabolism of lipids: Biosynthesis of fatty acids, Fatty acid elongation. Difference in fatty acid synthesis in plants and animals, Brief mention of α CO oxidation of fatty acids, β oxidation of palmitic acid and its energy balance sheet, Metabolism of ketone bodies, Cholesterol synthesis (structure not needed) and significance, Synthesis of steroid hormones from cholesterol.	22	10
3	UNIT 3 Metabolism of proteins: Protein-turn over, proteolytic enzymes. transamination, oxidative deamination, reductive amination, non-oxidative deamination and decarboxylation of amino acids Urea cycle and GS/GOGAT pathway. Brief outline of metabolism of aromatic amino acids (reaction sequences with structures) metabolic fate of amino acids- glucogenic, ketogenic and gluco-ketogenic, biosynthesis of amino acids.	33	15
4	UNIT 4 Metabolism of nucleotide: Biosynthesis of purine and pyrimidine nucleotides de novo and salvage pathway, end products of purine and pyrimidine metabolism. Regulation of committed step in each pathway. action sequences with structures) metabolic fate of amino acids- glucogenic, ketogenic and gluco-ketogenic, biosynthesis of amino acids.	23	10
	Total	100%	45

i. Text Book and Reference Book:

1.	Lehninger Principles of Biochemistry, By David L. Nelson, Michael M. Cox, Publisher: W. H. Freeman Fourth Edition
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2.	Fundamentals of Biochemistry By A. C. Deb
3.	Fundamentals of Biochemistry By Donald Voet, Judith Voet and Charlotte Pratt
4.	Biochemistry By U. Satyanarayana
5.	Biochemistry By Lubert Stryer and Berg

(9)

a. Course Name: Environmental Biochemistry 1

b. Course Code: 11103230

c. Prerequisite: Foundational Knowledge in Biology and Chemistry

d. Rationale: Environmental Biochemistry serves as a bridge between biochemistry and environmental science, emphasizing the role of biochemical processes in maintaining and influencing ecological balance.

e. Course Learning Objective:

CLOBJ 1	Understand the Biochemical Foundations of the Environment
CLOBJ 2	Explore Biochemical Mechanisms in Ecosystems
CLOBJ 3	Analyze Pollutants and Their Biochemical Impact
CLOBJ 4	Understand Biodegradation and Bioremediation
CLOBJ 5	Apply Biochemical Knowledge to Environmental Challenges

f. course Learning Outcomes:

CLO 1	Describe the biochemical principles underlying nutrient cycles such as the carbon, nitrogen, and phosphorus cycles.
CLO 2	Understand the role of microbes, enzymes, and biochemical reactions in maintaining ecological balance.
CLO 3	Understand the interactions between biological organisms and their chemical environment.
CLO 4	Understand processes such as bioaccumulation, biomagnification, and the biochemical basis of toxicity.
CLO 5	Develop critical thinking and teamwork skills through research and case studies.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	UNIT 1 Ecosystem: Concept of an ecosystem, Structure and function of an ecosystem, Procedures, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction types, characteristics features, structure and function of the following ecosystem: (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	22	10
2	UNIT 2 Social Issue and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain harvesting, watershed management, Resettlement and rehabilitation of people its problems and concerns. Case studies, Environmental ethics: Issues and possible solutions Consumerism and waste products: Environment ethics, issues and possible solutions, Wasteland reclamation, Consumerism and waste products, Environment Protection Act. Air (Prevention and Control of Pollution) Act: Water (Prevention and Control of Pollution) Act: Wildlife protection Act. Forest Conservation Act: Issues involved in enforcement of environmental legislation: (Public awareness). Solutions. Wasteland reclamation:	22	12
3	UNIT 3 Renewable and non-renewable resources: Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people. Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing effects of modern agriculture, fertilizer-pesticide of problems, water logging salinity, case studies.	33	15

	Energy resources: Growing energy needs, renewable and nonrenewable energy source, use of alternate energy sources, case studies. Land resources: Land as a resource, and degradation, man induced landslides, soil erosion and desertification.		
4	UNIT 4 Biodiversity and its Conservation: Definition, genetic species and ecosystem diversity, Biographical classification of India, Value of biodiversity, consumptive use, productive use social ethical, aesthetic and option values, Biodiversity at global national and local levels, India as a mega diversity nation: Hot-spots.	33	10
	Total	100%	45

i. Text Book and Reference Book:

1.	Environmental Science: A study of interrelationships By Eldon D. Enger and Bradely F. Smith
2.	A textbook of Environmental Science By Vidya Thakur
3.	Environmental Science and Engineering By Anjali Bagad
4.	Environmental Science By Daniel Chiras
5.	Holt Environmental Science By Karen Arms

(10)

a. Course Name: Advanced cell biology

b. Course Code: 11103231

c. Prerequisite: Basic knowledge of biology and cells.

d. Rationale: The curriculum will provide a general understanding of the related disciplines with holistic knowledge generation in cells, organelles, and transport systems.

e. Course Learning Objective:

CLOBJ 1	Understanding about the structure and function of organelles, membranes, and macromolecules in cells.
CLOBJ 2	Students may learn about the processes of DNA replication, transcription, RNA processing, and translation.
CLOBJ 3	Students may learn about cell-cell communication and interaction, including the mechanisms and molecules involved in attraction and repulsion, neuronal migration, and axon pathfinding.

CLOBJ 4	Students may learn to apply their knowledge of cell biology to analyze examples of changes in cell function.
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f. course Learning Outcomes:

CLO 1	Develop the basics understanding of cell and its components
CLO 2	Describe & explain cell at structural and functional level
CLO 3	Explain the broad knowledge on the molecular interaction between cells.
CLO 4	Understand the applications and limitations of the experimental approaches used by modern cell biologists
CLO 5	Communicate, effectively, an understanding of recent research in cell biology.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Membrane Transport Membrane models; evolution of different membrane lipids, Ultrastructure of plasma membrane, chemical constituents of plasma membrane, function of plasma membrane. Membrane protein, transport protein. Transport across plasma membrane (i.e. active & passive) Endocytosis, Phagocytosis & pinocytosis. Different types of cell junctions.	25	15
2	Unit-2: Cell organelles & their functions Ribosomes eukaryotic & prokaryotic. Protein targeting & translocation. Morphology of endoplasmic reticulum. Function of RER & SER. Morphology of golgi complex & its function in protein secretion. Peroxisomes & targeting of peroxisomal proteins. Lysosomes its structure & function.	25	15

3	Unit-3: Nucleus, Mitochondria & Extracellular Matrix Nucleus, nuclear envelope, transport through nuclear pore, nucleolus. Mitochondria & mitochondrial protein. Chloroplast & its structure. Types of plastids. Extracellular matrix of plant cell wall. Extracellular matrix of animal i.e. collagens, elastins, laminins, fibronectin	25	15
4	Unit-4: Cell Cycle, Immune Cells & Stem Cells Cell cycle (mitosis & meiosis) , cell cycle checkpoints, Cdk and cyclin complexes and their role in cell cycle regulation. Mechanism of apoptosis & its different pathways. Cancer and its types. Properties of cancer cells. Molecular basis of cancer. Cells of the immune system T-cell, B-cell, NK cell, monocytes, dendritic cell, macrophages, basophil, eosinophil, neutrophil, mast cell. Understanding of the stem cells. Types of stem cells.	25	15
	Total	100%	45

i. Text Book and Reference Book:

1	Culture of Animal Cells by R. Ian Freshney
2	Biomolecular Crystallography by Bernhard Rupp
3	Essential Cell Biology by Bruce Alberts
4	Experiments in Plant Tissue Culture by John H. Dodds
5	Molecular and Cell Biology for Dummies by Rene Fester Kratz

SEMESTER 4

(1)

a. Course Name: Immunotechnology-I

b. Course Code: 11102262

c. Prerequisite: Basic understanding of immunology, biochemistry, and molecular biology techniques.

d. Rationale: To equip students with the knowledge and skills to apply immunological techniques in biomedical research and diagnostics.

e. Course Learning Objective:

CLOBJ 1	Comprehend the fundamental mechanisms of the immune response, including innate and adaptive immunity.
CLOBJ 2	Gain proficiency in immunological techniques.
CLOBJ 3	Develop the ability to design, conduct, and analyze various immune assays for research and diagnostic purposes.
CLOBJ 4	Apply Immuno Technology methods to address research questions and solve

	problems in biochemistry and biomedical sciences.
CLOBJ 5	Learn to critically evaluate and interpret data obtained from immunological experiments and assays.
CLOBJ 6	Explore the clinical applications of immunotechnology in disease diagnosis, vaccine development, and therapeutic interventions.

f.course Learning Outcomes:

CLO 1	Learn basic immune system functions and responses.
CLO 2	Conduct key immunological techniques like ELISA and Western blotting.
CLO 3	Interpret data from immunological experiments.
CLO 4	Use immunotechnology in research and diagnostics.
CLO 5	Investigate clinical applications in diagnostics and therapeutics.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Overview of Immune system: History and scope of Immunology, Types of immunity: innate, acquired, Comparative immunity. Immune dysfunction and its consequences. Cells and Organs of Immune system: Cells of the immune system lymphoid cells: B, T and null cells, Primary lymphoid organs, secondary lymphoid organs-lymph nodes, spleen mucosal associated lymphoid tissues. Immunoglobulin superfamily.	25%	11
2	Unit-2:Immunoglobulin structure & function & Complement system: Basic and fine structure of immune-globulin: light chains, heavy chains and sequences, Antigen determinants on Immunoglobulin: Isotopic, allotypic, Idiotypic . Complement system: Components of Complement, Complement activation (classical pathway, alternative pathway, lectin pathway), Regulation of complement activation.	25%	12
3	Unit-3:Immunoglobulin Classes and Biological Activity: Immunoglobulin classes: IgG, IgA, IgM, IgD,IgE. Immunoglobulin mediated effectors functions opsonization, antibodies activate complement, Antibody dependent cell mediated cytotoxicity.	25%	11

4	Unit-4: Antigen Antibody Interactions: Strength of antigen and antibody interactions: Antibody affinity, antibody avidity, Cross reactivity. Precipitation reactions, agglutination reactions, Immuno-diffusion and Immuno electrophoretic technique, Radioimmunoassay, Enzyme linked Immunosorbant Assay (ELISA), Immuno precipitation.	25%	11
	Total	100%	45

i. Text Book and Reference Book:

1.	Immunology And Immunotechnology By Ashim K. Chakravarty
2.	Immunology And Immunotechnology By Shyamasree Ghosh
3.	Textbook Of Immunology : Including Immunotechnology & Immunotherapy By Ajoy Paul
4.	Immunology And Immuno-Technology By Desalegn Amenu And Ayantu Nugusa
5.	Immunotechnology By Sneha Lata Arya Dr

(2)

a. Course Name: Basic Instrumentation

b. Course Code: 11102263

c. Prerequisite: Basic understanding of physics and chemistry principles.

d. Rationale: To equip students with fundamental skills in using and understanding scientific instruments essential for laboratory research and analysis.

e. Course Learning Objective:

CLOBJ 1	Comprehend the underlying principles and mechanisms of common laboratory instruments.
CLOBJ 2	Gain proficiency in operating essential laboratory equipment such as spectrophotometers, centrifuges, and chromatographs.
CLOBJ 3	Learn methods for accurate data acquisition and interpretation from various instruments.
CLOBJ 4	Understand the procedures for maintaining and calibrating laboratory instruments to ensure precision and accuracy.
CLOBJ 5	Implement safety protocols and best practices in the use of laboratory instruments.
CLOBJ 6	Apply instrumentation techniques to conduct experiments and analyze results in scientific research.

f.course Learning Outcomes:

CLO 1	Understand the principles behind common laboratory instruments.
CLO 2	Demonstrate proficiency in operating key laboratory equipment.
CLO 3	Acquire and interpret data accurately from various instruments.
CLO 4	Perform maintenance and calibration of laboratory instruments.
CLO 5	Implement safety protocols and best practices in instrument use.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
4	-	-	4	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1 UNIT 1 Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pHmeter, absorption and emission spectroscopy	25%	11
2	Unit-2 UNIT 2 Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.	25%	12
3	Unit-3 UNIT 3 Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC	25%	11
4	Unit-4 UNIT 4 Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing	25%	11
	Total	100%	45

i. Text Book and Reference Book:

1.	The Basics of Instrumentation and Control Engineering: Measure, Control and Automate by John Mulindi
2.	Basic Instrumentation and Calibration: Instrumentation simplified..... (1st Edition) by Kishore Karuppaswamy Edition
3.	Basic Laparoscopy & Instrumentation by Sadashiv Patil
4.	Basics Of Clinical Biochemistry & Instrumentation (For Paramedical Students) by Poonam Bachcheti and Aruna Singh
5.	Clinical Biochemistry: Techniques And Instrumentation - A Practical Course by <u>John S Varcoe</u>

SEMESTER 4

(3)

a. Course Name: Principles of Genetic engineering

b. Course Code: 11102265

c. Prerequisite: Basic understanding of molecular biology and genetics.

d. Rationale: To provide students with foundational knowledge and practical skills in manipulating genetic material for research and biotechnology applications.

e. Course Learning Objective:

CLOBJ 1	Understand key concepts and techniques in genetic engineering.
CLOBJ 2	Learn methods for DNA isolation, manipulation, and analysis.
CLOBJ 3	Gain proficiency in gene cloning and vector design.
CLOBJ 4	Explore applications of genetic engineering in medicine and agriculture.
CLOBJ 5	Study the ethical and regulatory aspects of genetic engineering..
CLOBJ 6	Develop problem-solving skills in genetic manipulation experiments.

f.course Learning Outcomes:

CLO 1	Comprehend the fundamental principles and techniques of genetic engineering.
CLO 2	Perform DNA isolation, manipulation, and analysis.
CLO 3	Demonstrate proficiency in gene cloning and vector construction.
CLO 4	Apply genetic engineering techniques to solve real-world problems.
CLO 5	Evaluate ethical and regulatory considerations in genetic engineering.

a. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
4	-	-	3	20	20	-	60	-	100

b. Course Content:

Sr.	Topics	W	T
1	Unit-1 Introduction to Genetic Engineering: Isolation and purification of nucleic acid(genomic/plasmid DNA and RNA), Quantification and storage of nucleic acids, Enzymes in genetic engineering: exo and endo nucleases, Restriction nucleases, DNA polymerase I,II and III, Klenow fragment, helicases, topoisomerases, Reverse Transcriptase, Taq polymerase	25%/	12
2	Unit-2 Techniques in DNA sequencing: Blotting techniques, Polymerase chain reaction (PCR) and its applications, Variations in PCR and their applications, RT-PCR, inverse PCR, DNA fingerprinting and microarrays.Sanger's dideoxy method, Maxam - Gilbert method, DNA sequencing method	25%	11
3	Unit 3: Genetic Engineering of Plants: Plant transformation, Reversible male sterility in plants, antisense RNA, Agricultural applications of Genetic Engineering. Genetic engineering & crop improvement	25%	11
4	Unit 4: Genetic engineering of Animals: <i>In vitro</i> fertilization (IVF) and embryo transfer (ET), Sex determination in animals, Assisted reproductive technology (ART), Somatic cloning of animals, Microinjection technology, Knock in and knock out animal, Stem cell technology, Hybridoma technology, Vaccine production, Gene therapy	25%	11
	Total	100%	45

c.Text Book and Reference Book:

1.	Principles of Biotechnology and Genetic Engineering by Dr. A. Jayakumaran Nair
2.	Genetic Engineering: Principles and Methods by Jane K. Setlow
3.	Genetic Engineering: Volume 1: Principles Mechanism, and Expression by Tariq Ahmad Bhat and Jameel M. Al-Khayri
4.	Principles of Plant Genetics and Breeding by George Acquaah
5.	Genetic Engineering: Principles and Methods by Jane Setlow

SEMESTER 4

(4)

a. Course Name: Lab-2 Basic Bioinformatics and Basic Instrumentation

b. Course Code: 11102268

c. Prerequisite: Basic knowledge of molecular biology, computer skills, and familiarity with laboratory techniques.

d. Rationale: To equip students with practical skills in using bioinformatics tools and laboratory instruments essential for analyzing biological data and conducting experiments.

e. Course Learning Objective:

CLOBJ 1	Gain familiarity with key bioinformatics software and databases.
CLOBJ 2	Learn to conduct DNA and protein sequence analysis.
CLOBJ 3	Develop proficiency in operating essential laboratory instruments.
CLOBJ 4	Acquire skills to interpret and analyze biological data using computational tools.
CLOBJ 5	Implement basic instrumentation techniques in experimental procedures.
CLOBJ 6	Practice safety protocols and proper handling of bioinformatics tools and laboratory equipment.

f.course Learning Outcomes:

CLO 1	Demonstrate proficiency in using key bioinformatics software and databases.
CLO 2	Conduct accurate DNA and protein sequence analyses.
CLO 3	Efficiently operate essential laboratory instruments.
CLO 4	Analyze and interpret biological data using computational methods.
CLO 5	Implement basic instrumentation techniques and adhere to lab safety protocols.

a. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	3	3	-	-	20	-	30	50

b. Experiment List:

Sr.	Name of the Experiment
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1	Lab 2
	1 Sequence information resource.
	2 Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
	3 Understanding and using: PDB, Swissprot, TREMBL
	4 Retrieval of information from nucleotide databases.
	5 Using various BLAST and interpretation of results.
	6 Multiple sequence alignment using Clustal W
	7 Sequence alignment using BLAST

c.Text Book and Reference Book:

1.	Bioinformatics for Immunomics: 3 (Immunomics Reviews:) by Darren D.R. Flower, Matthew Davies, et al.
2.	Introduction to Basics of Pharmacology and Toxicology by Mageshwaran Lakshmanan, Deepak Gopal Shewade, et al.
3.	Biotechnology Fundamentals by Firdos Alam Khan
4.	Biomedical Signal Processing: Innovation and Applications by Ivan Selesnick, Iyad Obeid, et al.
5.	Computational Methods for Mass Spectrometry Proteomics by Ingvar Eidhammer, Kristian Flikka, et al.

SEMESTER 4

(5)

a. Course Name: Lab-1 (Immunology & Metabolism)

b. Course Code: 11103207

c. Prerequisite: Basic knowledge of immunology, metabolic pathways, lab techniques, and data analysis.

d. Rationale: To provide practical experience, apply theoretical knowledge, enhance lab skills, develop data analysis proficiency, and prepare for advanced research.

e. Course Learning Objective:

CLOBJ 1	Understand the principles of immunological assays and metabolic processes.
CLOBJ 2	Perform laboratory techniques used in immunology and metabolism studies.

CLOBJ 3	Analyze the outcomes of immunological and metabolic experiments.
CLOBJ 4	Apply theoretical knowledge to design and conduct experiments.
CLOBJ 5	Develop proficiency in handling laboratory equipment and reagents..
CLOBJ 6	Communicate scientific findings effectively through written and oral presentations..

f.course Learning Outcomes:

CLO 1	Master key techniques in immunology and metabolism studies.
CLO 2	Apply theoretical concepts to practical lab experiments.
CLO 3	Speak confidently on stage
CLO 4	Demonstrate effective problem-solving in experimental design and execution.
CLO 5	Communicate experimental results clearly and professionally.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	-	3	-	-	20	-	30	50

h. Course Content:

Sr.	Topics	W	T
1	Unit 1 Immunology:	100%	24
	Determination of Blood Group		
	2 Immunology:		
	Estimation of haemoglobin by Sahli's method		
	3 Immunology:		
	Total count of RBCs and WBCs		
	4 Immunology:		
	Differential count of WBCs		
	5 Immunology:		
	Demonstration of antigen antibody interactions: Ouchterlony technique		

i. Text Book and Reference Book:

1.	Fetal Nutrition, Metabolism, and Immunology by Richard K. Miller
2.	Fetal Nutrition, Metabolism, and Immunology by unknown author
3.	Fetal Nutrition, Metabolism, and Immunology: The Role of the Placenta by Richard Kendall Miller
4.	Dietary Hydrolysable Tannins: Effects on Physiology, Metabolism and Haemato-immunology of a Freshwater Carp, Labeo rohita by Ashisa Kumar Prusty
5.	Human Reproductive System, Genomic Endocrinology and Cancer Types by Stephen J. Williams, Sudipta Saha, et al.

SEMESTER 4

(7)

a. Course Name: Metabolism II

b. Course Code: 11103218

c. Prerequisite: Basic understanding of biochemistry and metabolic pathways.

d. Rationale: To deepen students' knowledge of advanced metabolic processes and their regulation, essential for understanding cellular and physiological functions.

e. Course Learning Objective:

CLOBJ 1	Comprehend advanced metabolic pathways and their regulatory mechanisms.
CLOBJ 2	Study the integration and coordination of metabolic processes..
CLOBJ 3	Investigate the regulation of key enzymes in metabolism.
CLOBJ 4	Apply metabolic concepts to physiological and pathological conditions.
CLOBJ 5	Understand the principles of energy production and utilization in cells.
CLOBJ 6	Enhance skills in analyzing and interpreting metabolic data.

f.course Learning Outcomes:

CLO 1	Demonstrate understanding of advanced metabolic pathways and their regulation
CLO 2	Analyze the integration and coordination of various metabolic processes.
CLO 3	Explain the regulation and function of key metabolic enzymes.
CLO 4	Assess principles of energy production and utilization within cells.
CLO 5	Apply metabolic concepts to understand physiological and pathological states.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1 Mitochondrial energy transduction: ATP as universal currency of the cell, Free energy in biological system, ATP hydrolysis, Role of high energy phosphate compounds in coupled reactions, Inter conversion of Adenine and Guanine nucleotides, and Electron flow as ATP source.	25	11
2	Unit-2 Mitochondrial structure with respect to site of oxidative phosphorylation, Structure of ATP synthase, Electron transferring reactions, Electron carriers, Electron transport complex, Incomplete reduction of Oxygen, Oxidative phosphorylation, Malate-Oxaloacetate-Aspartate shuttle, ATP yield and P:O ratio, Respiratory inhibitors.	25	12
3	Unit-3 Basal metabolic rate, dietary carbohydrates, fibers, dietary lipids, essential fatty acids, nitrogen balance, essential amino acids, protein malnutrition, balanced diet, enzymatic hydrolysis and uptake of dietary carbohydrates, monosaccharide, triacylglycerols, dietary proteins	24	10
4	Unit-4 vitamins A functions including visual process, vitamin D and its role in calcium metabolism, vitamin E, vitamin K and gamma carboxylation, Introduction to antivitamins and hypervitaminosis, Minerals: Classification, daily requirement, Calcium and phosphate: sources, uptake, excretion, function, Serum calcium regulation, Iron: sources, uptake and transport.	26	12
	Total	100%	45

i. Text Book and Reference Book:

1.	Understanding Human Metabolism: Old Institutions, New Challenges by Keith N. Frayn
2.	Glucose Revolution by Jessie Inchauspé

3.	The Obesity Code: Unlocking the Secrets of Weight Loss by Jason Fung
4.	Metabolical: The Lure and the Lies of Processed Food, Nutrition, and Modern Medicine by Robert H. Lustig
5.	Nutritional Biochemistry (Kindle Edition) by D.C. Sharma

SEMESTER 4
(8)

a. Course Name: Human Anatomy and Physiology

b. Course Code: 11103252

c. Prerequisite: Basic understanding of biology and cell biology.

d. Rationale: To provide students with comprehensive knowledge of the structure and function of the human body, essential for understanding health, disease, and clinical practices.

e. Course Learning Objective:

CLOBJ 1	Understanding the structure and organization of the human body.
CLOBJ 2	Study the function and interrelationship of major human organ systems.
CLOBJ 3	Investigate the physiological processes that maintain homeostasis.
CLOBJ 4	Understand the structure and function of cells, tissues, and organs.
CLOBJ 5	Gain knowledge of the nervous and endocrine systems' role in regulation and control.
CLOBJ 6	Apply anatomical and physiological concepts to health and disease scenarios.

f.course Learning Outcomes:

CLO 1	Identify and describe the structures of the human body and organ systems.
CLO 2	Demonstrate an understanding of the functions of major organ systems.
CLO 3	Analyze physiological mechanisms maintaining homeostasis.
CLO 4	Interpret the role of cells and tissues in the body's overall function.
CLO 5	Apply anatomical and physiological knowledge to clinical and health-related contexts.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1 Hematology: Erthocytes: erythropoiesis, structure and function of RBCs, formation of hemoglobin, destruction and fate of RBCs, anemias, polycythemias. Renal Physiology and Fluid Balanace: Body fluid compartments: Water balance, regulation of fluid balance, Urine formation, Regulation of extracellular sodium and osmolarity, Renal mechanisms for the control of blood volume, blood pressure and ionic composition, Regulation of acid-base balance, Micturition, Diuretics, Renal failure.	24	11
2	unit-2 Cardio-vascular Physiology: Properties of cardiac muscle, Cardiac cycle, Heart as a pump , Cardiac output, Nutrition and metabolism of heart, Specialized tissues of the heart ,Generation and conduction of cardiac impulse , Control of excitation and conduction Electrocardiogram , Arrhythmia, Neurohumoral regulation of cardiovascular function , Microcirculation and lymphatic system, Regional circulations , Cardiac failure, Circulatory shock Functional anatomy of respiratory system: Pulmonary ventilation , Alveolar ventilation , Mechanics of respiration , Pulmonary circulation, Pleural fluid , Lung edema , Principles of gas exchange , Oxygen and carbon-dioxide transport, Regulation of respiration , Hypoxia , Oxygen therapy and toxicity , Artificial respiration.	25	11
3	Unit-3 Nerve and Muscle Physiology: Resting membrane potential, Action potential ,Classification of nerve fibres , Nerve conduction, Degeneration and regeneration in nerves , Functional anatomy of skeletal muscle , Neuro-muscular transmission and blockers , Excitation-contraction coupling , Mechanisms of muscle contraction , Smooth muscle General, Sensory and Motor Physiology: General design of nervous system , Interneuronal communication , Classification of somatic senses , Sensory receptors, Sensory transduction, Information processing, Dorsal column and medial lemniscal system ,Thalamus, Somatosensory cortex , Somatosensory association areas, Pain , Organization of spinal cord for motor function , Reflexes and reflex arc , Brain stem and cortical control of motor function, Cerebellum , Basal ganglia, Maintenance of posture and equilibrium , Motor cortex. Special Senses: Optics of vision, Receptors and neural functions of retina, Colour vision Visual pathways, Cortical visual function . Functions of external and middle	27	12

	ear , Cochlea, Semicircular canals, Auditory pathways, Cortical auditory function. Primary taste sensations, Taste buds, Transduction and transmission of taste signals, Perception of taste, Peripheral olfactory mechanisms, Olfactory pathways ,Olfactory perception		
4	Unit-4 Gastro-intestinal System: General principles of G-I function, Mastication and swallowing, Salivary secretion , Gastric mucosal barrier, Pancreatic and billiary secretion, Gastrointestinal motility, Digestion and absorption, Functions of Colon, Pathophysiology of peptic ulcer and diarrheal disease, Liver functions Endocrines and Reproduction: Classification of Hormones, Mechanism of Hormone action, Measurement of hormones in Blood, Endocrine functions of the hypothalamus, Pituitary, Thyroid, Adrenals, The endocrine pancreas, Pathophysiology of diabetes, Parathyroid, calcitonin, Vitamin D and calcium metabolism, Pineal gland, Testosterone and male sex hormones, Spermatogenesis, Hyper and hypogonadism, Menstrual cycle, Female sex hormones, Pregnancy, Functions of Placenta, Parturition, Lactation	24	11
	Total	100%	45

i. Text Book and Reference Book:

1.	Human anatomy and Physiology By Elaine N. Marieb and Katja Hoehn
2.	Fundamentals of Anatomy and Physiology By Martini, Nath and Bartholomew
3.	Animal physiology By Verma, Tyagi and Aggarwal
4.	A textbook of Animal physiology By A. K. Berry
5.	Animal physiology By Mohan P. Arora
6.	Animal physiology By Goyal and Shastry
7.	Animal physiology By R. C. Sobti

8.	Principles of anatomy and physiology By Tortora
9.	Biological Science By Taylor

SEMESTER 4
(9)

a. Course Name: Basics of Bioinformatics

b. Course Code: 11102280

c. Prerequisite: Familiarity with molecular biology concepts, basic computer skills, and understanding of statistical methods.

d. Rationale: To equip students with the skills to analyze biological data, apply computational tools, and interpret results in a biological context.

e. Course Learning Objective:

CLOBJ 1	Understand key bioinformatics concepts and their applications.
CLOBJ 2	Utilize bioinformatics tools and databases for biological data analysis.
CLOBJ 3	Apply computational methods to analyze genomic and proteomic data.
CLOBJ 4	Interpret and visualize bioinformatics data accurately.
CLOBJ 5	Develop problem-solving skills for bioinformatics challenges.
CLOBJ 6	Communicate bioinformatics findings effectively through reports and presentations.

f.course Learning Outcomes:

CLO 1	Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics.
CLO 2	Classify different types of Biological Databases.
CLO 3	To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
CLO 4	Able to solve aptitude questions
CLO 5	Able to crack the technical exam for IT companies

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	

3	-	-	3	20	20	-	60	-	100
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h. Course Content:

Sr.	Topics	W	T
1	Unit-1: History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web	22	10
2	Unit 2 : Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry	33	15
3	Unit-3: Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.	22	10
4	Unit- 4: Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools	23	10
	Total	100%	45

i. Text Book and Reference Book:

1.	"Bioinformatics: Sequence and Genome Analysis" by David W. Mount
2.	"Bioinformatics for Dummies" by Jean-Michel Claverie and Cedric Notredame
3.	"Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins" by Andreas D. Baxevanis and B.F. Francis Ouellette
4.	"Essential Bioinformatics" by Jin Xiong
5.	"Introduction to Bioinformatics" by Arthur M. Lesk
6.	"Bioinformatics: The Machine Learning Approach" by Pierre Baldi and Søren Brunak
7.	"Understanding Bioinformatics" by Marketa Zvelebil and Jeremy O. Baum

8.	"Bioinformatics: Sequence, Structure and Databanks: A Practical Approach" edited by Des Higgins and Willie Taylor
9.	"Statistical Methods in Bioinformatics: An Introduction" by Warren J. Ewens and Gregory R. Grant

SEMESTER 4 (10)

a. Course Name: Ecology And Environment Management

b. Course Code: 11102281

c. Prerequisite: Basic understanding of ecological principles and environmental science concepts.

d. Rationale: To equip students with knowledge and skills to manage and solve environmental issues through ecological principles.

e. Course Learning Objective:

CLOBJ 1	Understand ecological principles and their applications.
CLOBJ 2	Analyze ecosystem structures and functions.
CLOBJ 3	Evaluate human impacts on ecosystems and biodiversity.
CLOBJ 4	Apply environmental management strategies to real-world problems.
CLOBJ 5	Develop sustainable solutions for environmental challenges.
CLOBJ 6	Communicate ecological and environmental management concepts effectively.

f.course Learning Outcomes:

CLO 1	Grasp key concepts in ecology and environmental management.
CLO 2	Analyze and assess ecosystem health and sustainability.
CLO 3	Implement environmental management practices effectively.
CLO 4	Develop solutions to mitigate human impact on the environment.
CLO 5	Communicate findings and strategies in ecology and environmental management clearly.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Our Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere Scope of Ecology. Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem. Types of ecosystem including habitats. Cybernetics & Homeostasis. Biological control of chemical environment.	25	11
2	Unit-2 : Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies, Trophic structure & energy pyramids, Ecological energetic, principles pertaining to limiting factors, Bio-geochemical cycles (N, C, P cycles).	25	11
3	Unit-3: Pollution & environmental Health related to Soil, Water, Air, Food, Pesticides, Metals, Solvents, Radiations, Carcinogen, Poisons. Detection of Environmental pollutant. Indicators & detection systems. Bio-transformation, Plastic, Aromatics, Hazardous wastes Environmental cleanup : Case studies	25	12
4	Unit-4: Environmental biotechnologies, Biotechnologies in protection and preservation of environment. Bioremediation, Waste disposal.	25	11
	Total	100%	45

i. Text Book and Reference Book:

1.	"Essentials of Ecology" by Michael J. Cain, William D. Bowman, and Sally D. Hacker
2.	"Environmental Science: Earth as a Living Planet" by Daniel B. Botkin and Edward A. Keller
3.	"Principles of Ecology" by Eugene P. Odum
4.	"Ecology: The Economy of Nature" by Robert E. Ricklefs
5.	"Environmental Management: Science and Engineering for Industry" by S. N. Ghosal
6.	"Introduction to Environmental Management" by S. K. Agarwal
7.	"Conservation Biology: Foundations, Concepts, Applications" by Fred Van Dyke
8.	"Global Environmental Issues" by Peter A. C. Ross and Sarah E. Metcalfe

SEMESTER 5

(1)

a. Course Name: LAB-2(Recombinant DNA Technology and Developmental Biology)

b. Course Code: 11102309

c. Prerequisite: Basic knowledge of molecular biology, genetics, and cell biology concepts.

d. Rationale: To provide hands-on experience with recombinant DNA techniques and developmental biology principles for advancing biotechnological and research applications.

e. Course Learning Objective:

CLOBJ 1	Understand the principles and techniques of recombinant DNA technology.
CLOBJ 2	Gain practical skills in cloning, PCR, and gene expression analysis.
CLOBJ 3	Study developmental processes at the molecular and cellular level.
CLOBJ 4	Apply recombinant DNA methods to investigate gene function.
CLOBJ 5	Analyze experimental results in the context of developmental biology.
CLOBJ 6	Communicate findings from recombinant DNA and developmental biology experiments effectively.

f.course Learning Outcomes:

CLO 1	Demonstrate proficiency in recombinant DNA techniques and applications.
CLO 2	Effectively design and conduct experiments related to gene cloning and expression.
CLO 3	Analyze and interpret data from molecular biology and developmental biology experiments.
CLO 4	Apply developmental biology principles to study organismal growth and differentiation.
CLO 5	Present experimental results clearly, both in written and oral formats.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	3	3	-	-	20	-	30	50

h. Course Content:

1.	Recombinant DNA technology Minipreparation of plasmids
2.	Recombinant DNA technology Preparation of Insert and Vector for restriction enzyme directed cloning
3.	Recombinant DNA technology Preparation of chemically competent cells for transformation of E. coli (DH5 α and DH10 β)
4.	Recombinant DNA technology Ligation reaction of restriction enzyme digested insert and vector
5.	Recombinant DNA technology CaCl ₂ mediated transformation of recombinant plasmid
6.	Recombinant DNA technology Blue-White screening
7.	Recombinant DNA technology Replica Plating
8.	Recombinant DNA technology Preparation of Insert and Vector for PCR directed cloning
9.	Recombinant DNA technology Electrophoresis (Agarose and PAGE)
10.	Recombinant DNA technology Gel elution of DNA bands
11.	Developmental Biology Floral morphology of dicot and monocot flower
12.	Developmental Biology T.S. of an anther of Hibiscus rosasinensis
13.	Developmental Biology Artificial pollination by emasculation (bagging method)
14.	Developmental Biology Pollen germination (In vitro/ In vivo)
15.	Developmental Biology Pollen viability test
16.	Developmental Biology Drosophila development study by chart and model
17.	Developmental Biology Stages of developments of humans during pregnancy

i. Text Book and Reference Book:

1.	"Molecular Cloning: A Laboratory Manual" by Michael R. Green and Joseph Sambrook
2.	"Recombinant DNA: Genes and Genomes - A Short Course" by James D. Watson, Amy A. Caudy, Richard M. Myers, and Jan A. Witkowski

3.	"Principles of Gene Manipulation and Genomics" by Sandy B. Primrose and Richard Twyman
4.	"Gene Cloning and DNA Analysis: An Introduction" by T.A. Brown
5.	"Recombinant DNA Technology" by Keya Chaudhuri
6.	"Developmental Biology" by Scott F. Gilbert
7.	"Principles of Development" by Lewis Wolpert, Cheryll Tickle, and Alfonso Martinez Arias
8.	"Essential Developmental Biology" by Jonathan M. W. Slack and Leslie Dale
9.	"Developmental Biology: A Very Short Introduction" by Lewis Wolpert and Juan Carlos Izpisua-Belmonte

SEMESTER 5

(2)

a. Course Name: Recombinant DNA Techniques

b. Course Code: 11102310

c. Prerequisite: Basic knowledge of nucleic acid, DNA replication, translation and transcription

d. Rationale: Students will be familiar general concept of molecular biology such as molecular nature of the gene and its mechanisms of gene replication, mutation, transcription and expression.

e. Course Learning Objective:

CLOBJ 1	Understand the principles and techniques of recombinant DNA technology.
CLOBJ 2	Gain practical skills in cloning, PCR, and gene expression analysis.
CLOBJ 3	Study developmental processes at the molecular and cellular level.
CLOBJ 4	Apply recombinant DNA methods to investigate gene function.
CLOBJ 5	Analyze experimental results in the context of developmental biology.
CLOBJ 6	Communicate findings from recombinant DNA and developmental biology experiments effectively.

f.course Learning Outcomes:

CLO 1	Demonstrate proficiency in recombinant DNA techniques and applications.
CLO 2	Effectively design and conduct experiments related to gene cloning and expression.
CLO 3	Analyze and interpret data from molecular biology and developmental biology experiments.
CLO 4	Apply developmental biology principles to study organismal growth and differentiation.

CLO 5	Present experimental results clearly, both in written and oral formats.
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g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1 Unit -1 Introduction to rDNA Technology Molecular tools and applications -restriction enzymes, ligases, polymerases, alkaline phosphatase. Understanding of gene and Genome, Gene transfer methods, Use of Agrobacterium tumefaciens Ti plasmids, Strategies for gene transfer to plant cells, Plasmids. Types of vectors	25	11
2	Unit-2 Labelling and detection of N.A purification: Radio labeling (random primer, nick translation, end labeling) and Non radio labeling. Hybridization techniques, Construction of genomic DNA libraries and cDNA libraries. screening of recombinants, Cloning strategies: DNA cloning a) Sticky ends b) Blunt ends c) Homopolymeric tailing d) Use of adapters & linkers.	24	11
3	Unit-3 Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR, Principles of Southern, Northern and Western blotting techniques. Mutagenesis: random mutagenesis and directed mutagenesis, DNA fingerprinting	24	11
4	Unit-4 Applications of rDNA technology: Chromosome Jumping , Chromosome walking, Concept of transgenic plants and Transgenic animal, Engineering of β carotene, Foot printing analysis, Medical and forensic applications of rDNA technology, Production of enzymes, Therapeutic products for use in human health care	27	12
	Total	100%	45

i. Text Book and Reference Book:

1.	"Molecular Cloning: A Laboratory Manual" by Michael R. Green and Joseph Sambrook
2.	"Recombinant DNA: Genes and Genomes - A Short Course" by James D. Watson, Amy A. Caudy, Richard M. Myers, and Jan A. Witkowski
3.	"Gene Cloning and DNA Analysis: An Introduction" by T.A. Brown
4.	"Principles of Gene Manipulation and Genomics" by Sandy B. Primrose and Richard Twyman
5.	"DNA Cloning: A Practical Approach" edited by D.M. Glover and B.D. Hames

SEMESTER 5

(3)

a. Course Name: Immunotechnology-II

b. Course Code: 11102311

c. Prerequisite: Basic knowledge of immunity, antigen - antibody and their interactions

d. Rationale: To provide advanced knowledge and practical skills in immunotechnological techniques for complex research and diagnostic applications.

e. Course Learning Objective:

CLOBJ 1	Understand advanced techniques in immunological research and diagnostics.
CLOBJ 2	Apply immunological assays for detecting specific antigens and antibodies.
CLOBJ 3	Develop skills in monoclonal antibody production and applications.
CLOBJ 4	Utilize advanced molecular techniques for immune response analysis.
CLOBJ 5	Explore the role of immunotechnology in vaccine development and therapy.
CLOBJ 6	Communicate complex immunological findings effectively in research settings

f.course Learning Outcomes:

CLO 1	Proficiently apply advanced immunological techniques in research and diagnostics.
CLO 2	Design and conduct experiments involving monoclonal antibody production.
CLO 3	Analyze and interpret immune response data using molecular techniques.
CLO 4	Develop insights into the application of immunotechnology in vaccine development and therapies.
CLO 5	Effectively communicate advanced immunological concepts and findings in both written and oral formats.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Generation of B- cell and T- cell response: Antigens, Immunogenicity vs. Antigenicity. Primary and Secondary immune response. Epitopes (properties of Bcell and T-cell epitopes),. Major Histocompatibility Complexes.	20	9
2	Unit-2: Hypersensitivity& Immunodeficiency diseases: An allergy, types of hypersensitivity (Type I, II, III,IV). Primary immunodeficiencies- humoral, cellular & combined immunodeficiencies, Disorders of complement, Disorders of phagocytosis.	27	12
3	Unit-3: Transplantation & Autoimmune diseases. Immunology of transplantation, Classification of transplants, Types of grafts, Allograft reactions, Histocompatibility antigens, Histocompatibility testing, Graft-vreus-Host reaction. Autoimmunity- Mechanism of autoimmunity, Classification of autoimmune diseases, Autoimmune diseases- Rheumatoid Arthritis, Myasthenia Gravis, Systemic LupesErythematus, Multiple sclerosis. Treatment of Autoimmune diseases.	29	13
4	Unit-4: Cancer & immune system Origin & terminology, malignant transformation of cell, Oncogenes & cancer induction, Tumors of the immune system, Tumor antigens-tumor specific & tumor associated antigens, Immune response in malignancy, immunological surveillance , Immunotherapy of cancer.	24	11
	Total	100%	45

i. Text Book and Reference Book:

1.	"Immunotechnology: Principles, Concepts and Applications" by Atta-ur-Rahman and Shazia Anjum
2.	"Antibody Engineering: Methods and Protocols" edited by Benny K. C. Lo
3.	"Practical Immunology" by Frank C. Hay and Olwyn M. R. Westwood
4.	"Advanced Techniques in Immunology" by Dr. Rajni Singh and Dr. Parul Jain

SEMESTER 5

(4)

a. Course Name: Tissue Culture Technology

b. Course Code: 11102314

c. Prerequisite: Basic knowledge of plant tissues, lab techniques and their implications

d. Rationale: To provide students with the practical knowledge and skills to apply tissue culture techniques in research, biotechnology, and agriculture.

e. Course Learning Objective:

CLOBJ 1	Understand the principles and techniques of plant and animal tissue culture.
CLOBJ 2	Develop skills in aseptic techniques and media preparation for tissue culture.
CLOBJ 3	Apply tissue culture methods to propagate plants and study cell behavior.
CLOBJ 4	Use tissue culture for genetic manipulation and cloning in research.
CLOBJ 5	Analyze the role of tissue culture in biotechnology and agricultural improvement.
CLOBJ 6	Communicate tissue culture research findings effectively in scientific contexts

f.course Learning Outcomes:

CLO 1	Demonstrate proficiency in plant and animal tissue culture techniques.
CLO 2	Conduct successful tissue culture experiments with proper aseptic techniques.
CLO 3	Apply tissue culture technology for plant propagation and genetic studies.
CLO 4	Analyze the applications of tissue culture in biotechnology and agriculture.
CLO 5	Present tissue culture research and results effectively through reports and presentations.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Introduction to cell and Tissue culture: <i>In-vitro</i> Methods in plant tissue culture, Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokinins and Gibberellins). Clonal Propagation of elite species (Micro Propagation). organogenesis, embryogenesis, advantages and disadvantages of micropropagation.	25	11
2	Unit-2: Tissue and micropropagation: Organ Culture – Anther, Embryo and Endosperm culture and their applications Organogenesis . Suspension culture, callus formation, regeneration, production of haploids, protoplast culture and somatic hybridization, In vitro haploid production Androgenic methods: Anther culture role of tissue culture in agriculture, horticulture and forestry Transgenic plants	25	12
3	Unit-3: Various techniques of animal cell and tissue culture: Culture media, growth factors, laboratory facilities. Primary Culture – Cell lines, and cloning disaggregation of tissue, isolation of tissue, enzyme disaggregation, and mechanical disaggregation. Secondary Culture – transformed animal cells and continuous cell lines	25	11
4	Unit-4: Application of tissue culture techniques: Brief idea about recombinant DNA products in medicine (insulin, somatostatin, vaccines), Concept of Gene therapy, Production of recombinant vaccines – hepatitis, Concept of transgenic animals, In vitro fertilization and embryo transfer in humans Production and Applications of monoclonal antibodies	25	11
	Total	100%	45

i. Text Book and Reference Book:

1.	"Plant Tissue Culture: Techniques and Experiments" by Roberta H. Smith
2.	"Animal Cell Culture: A Practical Approach" edited by John R. W. Masters
3.	"Plant Tissue Culture: Theory and Practice" by S.S. Bhojwani and M.K. Razdan
4.	"Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications" by R. Ian Freshney

SEMESTER 5

(5)

a. Course Name: Developmental Biology

b. Course Code: 11102320

c. Prerequisite: Basic understanding of cell biology, genetics, and molecular biology concepts.

d. Rationale: To provide students with an in-depth understanding of the molecular and cellular mechanisms underlying development in multicellular organisms.

e. Course Learning Objective:

CLOBJ 1	Understand the principles of development from fertilization to organogenesis.
CLOBJ 2	Study the molecular signals and genes involved in developmental processes.
CLOBJ 3	Analyze the cellular and tissue-level mechanisms of development.
CLOBJ 4	Explore model organisms used in developmental biology research.
CLOBJ 5	Apply experimental techniques to study developmental processes.
CLOBJ 6	Communicate developmental biology concepts effectively in research and clinical settings.

f.course Learning Outcomes:

CLO 1	Demonstrate knowledge of key developmental processes and stages.
CLO 2	Analyze molecular pathways involved in development and differentiation.
CLO 3	Conduct experiments to study development using model organisms.
CLO 4	Apply developmental biology principles to solve research challenges.
CLO 5	Present developmental biology research findings clearly and effectively.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Fertilization and Cleavage: Early development, Fertilization, Types of cleavage, Gastrulation: Cell movement and formation of germ layers in frog, chick and mouse, concept of determination, competence and differentiation, Development of vertebrate nervous system, Formation of neural tube, Formation of brain region, Tissue architecture of the central nervous system	30	12
2	Unit-2: Developmental Biology of model organisms: Caenorhabditis: Vulva formation, Drosophila: Maternal genes and formation of body axes, Segmentation genes, Homeotic genes function, Imaginal disc development, Vertebrates: Axes formation and Limb formation in chick	25	13
3	Unit-3: Stem Cells: Types of stem cells and their applications, Totipotency, Stem cell therapy, Clinical embryology	20	9
4	Unit-4: Plant developmental biology: Life cycle of angiosperms, Root apical meristem, Shoot apical meristem, totipotency, developmental plasticity, the vegetative-to-reproductive transition, plant growth regulation, floral development, Inter-cell-layer communication during floral development	25	11
	Total	100%	45

i. Text Book and Reference Book:

1.	"Developmental Biology" by Scott F. Gilbert and Michael J.F. Barresi
2.	"Principles of Development" by Lewis Wolpert and Cheryll Tickle
3.	"Essential Developmental Biology" by Jonathan M. W. Slack

4.	"Developmental Biology: A Very Short Introduction" by Lewis Wolpert
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SEMESTER 5
(7)

a. Course Name: Clinical Biochemistry

b. Course Code: 11103301

c. Prerequisite: Basic understanding of biochemistry, cell biology, and human physiology.

d. Rationale: To provide students with the knowledge and skills required to understand the biochemical basis of diseases and apply diagnostic techniques in clinical settings.

e. Course Learning Objective:

CLOBJ 1	Understand the biochemical basis of human health and disease.
CLOBJ 2	Study biochemical markers used in disease diagnosis and monitoring.
CLOBJ 3	Apply clinical biochemical techniques for laboratory diagnostics.
CLOBJ 4	Analyze the role of enzymes, hormones, and metabolites in disease.
CLOBJ 5	Interpret laboratory results to diagnose and monitor medical conditions.
CLOBJ 6	Communicate clinical biochemistry findings effectively in healthcare settings.

f.course Learning Outcomes:

CLO 1	Demonstrate understanding of key biochemical processes in human health.
CLO 2	Apply biochemical diagnostic techniques in clinical laboratory settings.
CLO 3	Analyze the role of biomarkers in disease detection and treatment.
CLO 4	Interpret clinical biochemical data to support patient diagnosis.
CLO 5	Present clinical biochemistry findings clearly in professional healthcare environments.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit 1 In born error metabolism: of protein, Amino acid, nucleic acid. Occurrence, pattern of inheritance , disorders of amino acids metabolism- phenyl ketouria, Maple syrup, urine disease, cystinosis etc.	25	11
2	Unit 2 Disorders of carbohydrates and lipid metabolism: Porphyrias and Gout Molecular disease Sickle cell anemia and thalassemias, adenosine deaminase deficiency, systemic lupus erythematosus Liver and kidney tests- their significance	25	11
3	Unit 3 Endocrine disorders: Pancreatic, <i>Diabetes mellitus</i> , mellituria, hypoglycemia, glucose tolerance test, thyroid -hypo and -hyper, parathyrodism, parathyroid- abnormalities of parathyroid functions	25	12
4	Unit-4 Blood related disorders: Abnormal hemoglobin and hemoglobinopathies, anemias, polycythemia, erythremia, eosinophilia, schistosomiasis, leucopenia, leukemias, hemophilia, thrombocytopenia, thromboembolic conditions.	25	11
	Total	100%	45

i. Text Book and Reference Book:

1.	Clinical Biochemistry: Metabolic and clinical aspects By William J. Marshall and Stephen K. Bengert
2.	Clinical Biochemistry: An illustrated text By Allan Gaw et. al.
3.	Clinical Biochemistry By Nanda Maheshwari
4.	Practical clinical Biochemistry By Ranjana Chawala
5.	Clinical Biochemistry By R. Luxton
6.	Clinical Biochemistry By Nessar Ahmad

SEMESTER 5**(8)****a. Course Name:** LAB-1(Clinical Biochemistry and Endocrinology)**b. Course Code:** 11103304**c. Prerequisite:** Basic understanding of biochemistry, endocrinology, and human physiology.**d. Rationale:** To provide hands-on experience in clinical biochemical analysis and endocrinology, enhancing diagnostic skills for disease management.**e. Course Learning Objective:**

CLOBJ 1	Understand the principles of biochemical tests and assays in clinical diagnostics.
CLOBJ 2	Apply techniques to measure biochemical markers and hormones in clinical samples.
CLOBJ 3	Study endocrine system disorders and their biochemical basis.
CLOBJ 4	Develop proficiency in laboratory methods for diagnosing metabolic and hormonal diseases.
CLOBJ 5	Analyze and interpret biochemical and hormonal data in clinical scenarios.
CLOBJ 6	Communicate laboratory results clearly in clinical and healthcare settings.

f.course Learning Outcomes:

CLO 1	Demonstrate proficiency in performing biochemical and endocrinological assays.
CLO 2	Apply clinical laboratory techniques to diagnose biochemical and hormonal disorders.
CLO 3	Analyze and interpret data from clinical biochemical tests and hormone assays.
CLO 4	Understand the clinical relevance of biochemical markers in disease diagnosis.
CLO 5	Communicate clinical biochemistry and endocrinology findings clearly to healthcare professionals.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
		3	3			20		30	50

h. Course Content:

1.	Clinical Biochemistry Analysis of blood for clotting and prothrombin time
2.	Clinical Biochemistry Analysis of blood haemoglobin and derivative
3.	Clinical Biochemistry Clinical Biochemistry: Analysis of serum for Calcium and Phosphorous
4.	Clinical Biochemistry Analysis of plasma for fibrinogen
5.	Clinical Biochemistry Analysis of blood sugar by chemical and enzymatic method.
6.	Clinical Biochemistry Analysis of serum for RFT (Creatinine , Creatine, uric acid).
7.	Clinical Biochemistry Analysis of serum for LFT (bilirubin, total protein- albumin and globulin, GOT, GPT, acid and alkaline phosphatase).
8.	Clinical Biochemistry Analysis of serum lipid profiles- Total Cholesterol , HDL cholesterol and LDL cholesterol, Triacylglyceride).
9.	Clinical Biochemistry Analysis of serum for creatine kinase.
10.	Clinical Biochemistry Determination of ABO, Rh blood group
11.	Endocrinology Lipid profile-TAG, Lipoproteins, Cholesterol
12.	Endocrinology Glucose tolerance test
13.	Endocrinology Vitamin D assay
14.	Endocrinology Assay of estrogen
15.	Endocrinology Estimation of Calcium
16.	Endocrinology HCG test for pregnancy

i. Text Book and Reference Book:

1.	"Clinical Biochemistry: Metabolic and Clinical Aspects" by William J. Marshall and Stephen K. Bangert
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2.	"Tietz Textbook of Clinical Chemistry and Molecular Diagnostics" edited by Carl A. Burtis, David E. Bruns, and Edward R. Ashwood
3.	"Clinical Endocrinology: A Practical Guide" by M. A. Lerner
4.	"Fundamentals of Clinical Chemistry" by Thomas L. Van Hove, Paul L. Luong, and N. P. Rao
5.	"Clinical Biochemistry: An Illustrated Colour Text" by J. Michael Waterhouse
6.	"Endocrinology: Adult and Pediatric" by J. Larry Jameson, Leslie J. De Groot, and other authors

SEMESTER 5 (9)

a. Course Name: Fundamentals of Genomics and Proteomics

b. Course Code: 11102330

c. Prerequisite: Basic knowledge of genome sequencing. major differences between prokaryotic and eukaryotic genomes

d. Rationale: To provide foundational understanding of genomics and proteomics techniques for analyzing genes, proteins, and their functions in biological systems.

e. Course Learning Objective:

CLOBJ 1	Understand the principles of genomics and proteomics techniques.
CLOBJ 2	Learn methods for sequencing genomes and analyzing gene expression.
CLOBJ 3	Study protein structure, function, and interactions using proteomic tools.
CLOBJ 4	Apply bioinformatics tools for genomic and proteomic data analysis.
CLOBJ 5	Understand the role of genomics and proteomics in disease research and biotechnology.
CLOBJ 6	Communicate findings from genomic and proteomic studies effectively.

f.course Learning Outcomes:

CLO 1	Demonstrate knowledge of key techniques in genomics and proteomics.
CLO 2	Apply methods for sequencing, gene expression analysis, and protein characterization.
CLO 3	Analyze genomic and proteomic data using bioinformatics tools.
CLO 4	Understand the applications of genomics and proteomics in medical and biotechnological research.

CLO 5	Present genomic and proteomic research findings clearly and effectively.
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g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.	25	12
2	Unit-2: Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.	25	10
3	Unit-3: Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.	25	12
4	Unit-4: Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.	25	11
	Total	100%	45

i. Text Book and Reference Book:

1.	"Bioinformatics: Sequence and Genome Analysis" by David W. Mount
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2.	"Genomics: A Very Short Introduction" by John M. Archibald
3.	"Proteomics: Principles and Applications" by Richard Twyman
4.	"Genomes 4" by T.A. Brown
5.	"Introduction to Proteomics: Tools for the New Biology" by Daniel C. Liebler
6.	"Bioinformatics for Biologists" by Pavel Pevzner

SEMESTER 5 (10)

a. Course Name: Evolutionary Biology

b. Course Code: 11102331

c. Prerequisite: Basic understanding of genetics, ecology, and principles of biology.

d. Rationale: To provide students with an understanding of the mechanisms, patterns, and processes driving evolution and its role in shaping biodiversity.

e. Course Learning Objective:

CLOBJ 1	Understand the principles and mechanisms of evolution, including natural selection and genetic drift.
CLOBJ 2	Study the genetic basis of evolutionary changes and speciation.
CLOBJ 3	Analyze the role of mutations, genetic variation, and adaptation in evolution.
CLOBJ 4	Explore the evolutionary history of life on Earth and the fossil record.
CLOBJ 5	Apply evolutionary theory to modern biological and ecological problems.
CLOBJ 6	Communicate evolutionary concepts and research findings effectively.

f.course Learning Outcomes:

CLO 1	Demonstrate a strong understanding of evolutionary mechanisms and theory.
CLO 2	Analyze the genetic basis of evolution and the processes of speciation.
CLO 3	Apply evolutionary concepts to understand ecological and biological phenomena.
CLO 4	Interpret evolutionary patterns in the fossil record and modern organisms.
CLO 5	Present evolutionary biology concepts and research findings clearly in academic and research contexts.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Fundamental evolutionary processes in natural populations and their influence on biological diversity by using molecular methods. Variation within and between populations: theories, analyses and interpretations of molecular data to understand mechanisms responsible for the maintenance and loss of genetic polymorphism within populations and genetic differentiation among populations in time and space.	20	11
2	Unit-2: Variations- nature and types. Mechanisms that decrease and increase variations (natural selection, genetic drift, mutation, recombination and gene flow). Speciation: Modes of speciation, isolating mechanisms, speciation in time.	30	11
3	Unit-3: Macro and micro-evolution: definitions, mechanisms and importance. Evidences, patterns of evolution and extinctions over the geological period. Phylogeny: introduction and concepts of phylogeny. Phylogenetic trees, cladistics and phylogenetic reconstructions, hierarchy of species, transitional forms and molecular phylogeny. Biodiversity: Genetic, species and ecosystem diversity. Biodiversity at global, national levels. Biogeographic classification of India, India as a mega diversity nation.	20	11
4	Unit-4: National Parks, Wild life Sanctuaries and Biosphere Reserves, Hotspots of Biodiversity. Threats to biodiversity- habitat loss, poaching and man-wildlife conflicts. Endangered and Endemic species of India: Common plant and animal species. Conservation of Biodiversity, insitu and exsitu conservation, Keystone species, measurement of biodiversity. Environmental Priorities, strategies and Environmental Legislation (Acts) in India, Environmental Impact Assessment. Bioremediation: Concept need and scope, environmental applications.	30	12
	Total	100%	45

i. Text Book and Reference Book:

1.	"The Selfish Gene" by Richard Dawkins
2.	"Evolutionary Biology" by Douglas J. Futuym
3.	"The Origin of Species" by Charles Darwin
4.	"Principles of Evolution: From the Perspective of the Human Genome" by Sudhir Kumar
5.	"Evolution: The Modern Synthesis" by Julian Huxley
6.	"Evolutionary Analysis" by Scott Freeman and Jon C. Herron

SEMESTER 6

(1)

a. Course Name: Bioethics

b. Course Code: 11100351

c. Prerequisite: Basic understanding of biology, healthcare, and ethical principles.

d. Rationale: To equip students with the tools to critically analyze ethical issues in the fields of medicine, biology, and biotechnology, fostering responsible decision-making.

e. Course Learning Objective:

CLOBJ 1	Understand the foundational principles of bioethics, including autonomy, justice, and beneficence.
CLOBJ 2	Analyze ethical dilemmas in medical, biological, and biotechnological contexts.
CLOBJ 3	Evaluate the ethical implications of new medical technologies and biotechnologies.
CLOBJ 4	Explore ethical issues related to human rights, genetic engineering, and stem cell research.
CLOBJ 5	Develop the ability to make ethical decisions in healthcare and research settings.
CLOBJ 6	Communicate ethical reasoning and decisions effectively in professional contexts.

f.course Learning Outcomes:

CLO 1	Demonstrate a thorough understanding of bioethical principles and theories.
CLO 2	Identify and analyze ethical issues in medicine, genetics, and biotechnology.
CLO 3	Evaluate the social and moral implications of medical advancements.

CLO 4	Apply bioethical decision-making frameworks to real-world scenarios.
CLO 5	Present ethical arguments and decisions clearly, using appropriate professional language.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1 Biotechnology and Society: Introduction to science, technology and society, biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, biotechnology in international relations, globalisation and development divide.	25	11
2	Unit-2 Bioethics: Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc. Ethical issues – ethical issues against the molecular technologies. Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National and International. Legal issues – legal actions taken by countries for use of the molecular technologies. Social issues - public opinions against the molecular technologies. Intellectual Property Rights – Why IPR is necessary, TRIPS and IPR, IPR – national and international scenario, IPR protection of life forms.	25	11
3	Unit-3 Biotechnology and Bioethics: The expanding scope of ethics from biomedical practice to biotechnology, ethical conflicts in biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global biotech issues.	25	12
4	Unit-4 Biosafety concepts and issues: Rational vs. subjective perceptions of risks and benefits, relationship between risk,	25	11

	hazard, exposure and safeguards, biotechnology and biosafety concerns at the level of individuals, institutions, society, region, country and the world. Biosafety in the laboratory institution: Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution Biosafety regulations in the handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad		
	Total	100%	45

i. Text Book and Reference Book:

1.	Biotechnology and Safety Assessment By Thomas J.A. and Fuch, R.L
2.	Biological safety Principles and practices By Fleming D.A. and Hunt D.L
3.	Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH
4.	Encyclopedia of Bioethic

SEMESTER 6
(2)

a. Course Name: Dissertation

b. Course Code: 11102357

c. Prerequisite: The section of a dissertation explains why a specific concept, issue, or problem is important in the field of research.

d. Rationale: Every thesis or dissertation must include an abstract that appears exactly as in the sample Abstract Page. It is a summary of your work intended to inform the prospective reader of its content. Abstracts include a statement of the research and a brief summary of methods used, results and conclusions.

e. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
-	-	15	15			100		200	300

f. Text Book and Reference Book:

1.	Biotechnology and Safety Assessment By Thomas J.A. and Fuch, R.L
2.	Biological safety Principles and practices By Fleming D.A. and Hunt D.L
3.	Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH
4.	Encyclopedia of Bioethic

SEMESTER 6
(3)

a. Course Name: Medical Biochemistry

b. Course Code: 11103352

c. Prerequisite: Basic understanding of biochemistry, cell biology, and human physiology.

d. Rationale: To provide students with a comprehensive understanding of biochemical processes in the human body, with a focus on disease mechanisms and clinical applications.

e. Course Learning Objective:

CLOBJ 1	Understand the biochemical processes involved in human metabolism.
CLOBJ 2	Study the molecular basis of diseases and their biochemical markers.
CLOBJ 3	Analyze the role of enzymes, hormones, and nutrients in human health.
CLOBJ 4	Apply biochemical knowledge to clinical diagnostics and disease management.
CLOBJ 5	Develop skills in laboratory techniques used for biochemical analysis.
CLOBJ 6	Communicate medical biochemistry findings effectively in clinical contexts.

f.course Learning Outcomes:

CLO 1	Demonstrate understanding of key metabolic pathways in human biochemistry.
CLO 2	Analyze biochemical markers and their role in disease diagnosis.
CLO 3	Apply biochemical principles to clinical and diagnostic settings.
CLO 4	Interpret laboratory results related to metabolic and biochemical disorders.
CLO 5	Present medical biochemistry findings clearly in healthcare and research contexts.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1 Mineral metabolism: Dietary food sources, daily requirement, functions and metabolism of sodium potassium and chloride & homeostasis of sodium, potassium and chloride. Dietary food sources, daily requirement, functions and metabolism of calcium, phosphorus & magnesium & homeostasis of calcium, phosphorus & magnesium. Dietary food sources, daily requirement, functions and metabolism of trace elements (chromium, cobalt, copper, fluoride, iodine, iron, manganese, molybdenum, selenium, zinc) & homeostasis of trace elements (chromium, cobalt, copper, fluoride, iodine, iron, manganese, molybdenum, selenium, zinc). Clinical conditions related to plasma level alterations of sodium, potassium and chloride, calcium, phosphorus & magnesium, trace elements (chromium, cobalt, copper, fluoride, iodine, iron, manganese, molybdenum, selenium, zinc)	25	11
2	Unit-2 Vitamins & Its Disorders sources, biochemical functions, daily requirement and deficiency manifestations of water soluble vitamins (Thiamine, Riboflavin, Niacin, Pantothenic acid, Pyridoxine, Biotin, Folic acid, Cobalamin and vitamin C). sources, biochemical functions, daily requirement and deficiency manifestations of fat soluble vitamins (Vitamin A, D, E & K).	25	11
3	Unit-3 Heme metabolism and its disorders: Biosynthesis of heme (iron containing porphyrin), its regulation. Mention function of heme in the body. Disorders of heme biosynthesis, various types of porphyrias. heme (iron containing porphyrin) catabolism. Describe various types of jaundice and discuss the tests performed for the diagnosis of jaundice.	25	12

4	Unit-4 Nucleic Acid Metabolism and Its Disorders The important steps in de novo biosynthesis of purine and pyrimidine nucleotides and their regulation. The enzymes of the nucleotide biosynthesis that are inhibited by anticancer drugs. salvage pathway for the synthesis of purine nucleotides with its significance. The catabolism of purine and pyrimidine nucleotides. Lesch Nyhan syndrome with cause, symptoms and treatment. levels of uric acid in blood & urine and presence of urate crystals in synovial fluid in gout. Uric acid in blood & urine, activity of blood HGPRTase, urate to creatinine concentration ratio, and molecular genetic testing in Lesch Nyhan syndrome.	25	11
	Total	100%	45

i. Text Book and Reference Book:

1.	"Medical Biochemistry" by John W. Baynes and Marek H. Dominiczak
2.	"Harper's Illustrated Biochemistry" by Robert K. Murray, David A. Bender, and Kathleen M. Botham
3.	"Medical Biochemistry: With STUDENT CONSULT Online Access" by Sankha Dasgupta
4.	"Textbook of Medical Biochemistry" by N. V. Bhagavan and Chung-Eun Ha

SEMESTER 6

(5)

a. Course Name: Basics of Endocrinology

b. Course Code: 11103353

c. Prerequisite: Basic understanding of human physiology, biology, and biochemistry.

d. Rationale: To provide students with fundamental knowledge of the endocrine system, its hormones, and their roles in regulating bodily functions and homeostasis.

e. Course Learning Objective:

CLOBJ 1	Understand the structure and function of the endocrine glands and hormones.
CLOBJ 2	Study the mechanisms of hormone secretion, action, and regulation.
CLOBJ 3	Learn about the physiological roles of major hormones in human health.
CLOBJ 4	Analyze the pathophysiology of common endocrine disorders.
CLOBJ 5	Understand the diagnostic tools used to assess endocrine function.
CLOBJ 6	Communicate endocrine concepts effectively in clinical and research settings.

f.course Learning Outcomes:

CLO 1	Demonstrate knowledge of the structure and function of the endocrine system.
CLO 2	Understand hormone synthesis, secretion, and regulation mechanisms.
CLO 3	Recognize the physiological and pathological effects of endocrine hormones.
CLO 4	Identify common endocrine disorders and their clinical features.
CLO 5	Present endocrine system concepts and findings clearly in clinical contexts.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1 Introduction: Definitions, a brief history of endocrinology, research landmarks, Methods in endocrinology, classes of hormones, cascades and feedback loops, Hormone - sources, synthesis, receptors and target tissues.	25	13
2	Unit-2 The steroid hormones: Sources, structure, synthesis, regulation, receptors and effects on target tissues, Steroids and the athlete Steroids, the releasing hormones, structure of the hypothalamus . Steroids and reproductive behavior.	25	12
3	Unit-3 Posterior and anterior pituitary hormones: Morphology of the pituitary, structure and function, Genomic and non- genomic mechanisms. The anterior pituitary as the central regulatory center Thyroid hormones: structure, control, release and function: Hypo- and hyperthyroidism	25	10
4	Unit-4 Pancreatic hormones: Insulin and glucagon, Diabetes, GI hormones and calcium regulation. The adrenal glands: glucocorticoids, structure and function. Stress hormones and interactions with other regulatory pathways. Androgen, gonadal differentiation and free-martins. Prostaglandins, pineal gland, cell growth factors	25	10
	Total	100%	45

i. Text Book and Reference Book:

1.	"Basic Medical Endocrinology" by H. Maurice Goodman
2.	"Endocrinology: An Integrated Approach" by Stephen P. Woosley and J. M. Tomlinson
3.	"Endocrinology: Adult and Pediatric" by J. Larry Jameson and Leslie J. De Groot
4.	"Textbook of Endocrine Physiology" by William J. Kovacs and Sergio R. Ojeda
5.	"Principles of Medical Endocrinology" by David S. Cooper
6.	"Endocrinology: A Short Course" by Lila M. L. and Keith L. Moore

SEMESTER 6

(6)

a. Course Name: Animal Biotechnology

b. Course Code: 11102381

c. Prerequisite: Basic understanding of molecular biology, genetics, and cell biology.

d. Rationale: To provide students with knowledge of biotechnological applications in animals, focusing on genetic manipulation, disease management, and biopharmaceutical production.

e. Course Learning Objective:

CLOBJ 1	Understand the principles of genetic engineering and cloning in animals.
CLOBJ 2	Study the application of biotechnology in improving animal health and productivity.
CLOBJ 3	Learn about transgenic animals and their role in research and industry.
CLOBJ 4	Analyze the ethical, regulatory, and environmental aspects of animal biotechnology.
CLOBJ 5	Develop skills in laboratory techniques for animal cell culture and gene editing.
CLOBJ 6	Communicate animal biotechnology concepts effectively in research and clinical settings.

f.course Learning Outcomes:

CLO 1	Demonstrate understanding of genetic engineering techniques in animals.
CLO 2	Apply biotechnology methods to improve animal health, breeding, and productivity.
CLO 3	Analyze the role of transgenic animals in scientific research and biopharmaceutical

	production.
CLO 4	Understand the ethical, legal, and environmental issues related to animal biotechnology.
CLO 5	Present animal biotechnology research findings clearly in professional contexts.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1: Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.	25	9
2	Unit 2 Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.	25	12
3	Unit-3 Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.	25	12
4	Unit-4 Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.	25	12
	Total	100%	45

i. Text Book and Reference Book:

1.	"Animal Biotechnology: Science and Commercialization" by E. C. J. Haug
2.	"Animal Biotechnology and Biodiversity Conservation" by N. S. R. S. Reddy and G. S. P. R. K. Kumar
3.	"Principles of Animal Biotechnology" by S. S. Yadav

4.	"Transgenic Animal Technology: A Laboratory Handbook" by Carl A. Pinkert
5	"Genetic Engineering of Animals" by M. W. Griffiths and J. J. L. D. C. D.
6	"Biotechnology of Animal Reproduction" by G. P. Misra and S. S. Yada

SEMESTER 6

(7)

a. Course Name: Nutritional Biochemistry

b. Course Code: 11103380

c. Prerequisite: Basic understanding of biochemistry, human physiology, and nutrition.

d. Rationale: To provide students with a deep understanding of the biochemical processes underlying nutrition, metabolism, and their impact on human health.

e. Course Learning Objective:

CLOBJ 1	Understand the biochemical basis of nutrient metabolism in the human body.
CLOBJ 2	Study the role of vitamins, minerals, proteins, fats, and carbohydrates in human health.
CLOBJ 3	Analyze the impact of nutrition on cellular functions and energy production.
CLOBJ 4	Learn about the biochemical mechanisms behind nutrient deficiencies and excesses.
CLOBJ 5	Explore the connection between nutrition, metabolism, and chronic diseases.
CLOBJ 6	Communicate nutritional biochemistry findings effectively in clinical and research contexts.

f.course Learning Outcomes:

CLO 1	Demonstrate knowledge of nutrient metabolism and its regulation.
CLO 2	Analyze the biochemical roles of essential nutrients in human health.
CLO 3	Apply biochemical principles to understand nutritional disorders and their prevention.
CLO 4	Understand the biochemical basis of chronic diseases related to nutrition.
CLO 5	Present nutritional biochemistry concepts clearly in clinical, research, and public health settings.

g. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
L	T	P	C	Internal Marks			External Marks		
				T	CE	P	T	P	
3	-	-	3	20	20	-	60	-	100

h. Course Content:

Sr.	Topics	W	T
1	Unit-1 Nutritional aspects of carbohydrates: Biochemical functions the relative importance of different carbohydrates in diet, utilization of absorbed carbohydrates in the body, regulation of blood glucose level of blood dietary fibre and their biochemical effect in human nutrition.	25	12
2	Unit-2 Nutritional aspects lipids: Fats in the body and food, biochemical function of fats, role of in diet, effect of trans fatty acids, blood lipids, transport and storage of lipids, role of liver in lipid metabolism, omega fatty acids	24	12
3	Unit-3 Nutritional aspects proteins: Nutritional significance of amino acids , specific function of some important amino acids, complementary value of proteins, methods of proteins (BV, NB, PER, NPR)	24	12
4	Unit-4 Role of vitamins: Minerals in health and disorders biochemical function of water detoxification Biochemical features: Some diet related disorders like protera-calorie malnutrition diabetes , cardiovascular disease goiture, anemia etc.	27	9
	Total	100%	45

i. Text Book and Reference Book:

1.	"Modern Nutrition in Health and Disease" by A. Catherine Ross, Benjamin Caballero, and Robert J. Cousins
2.	"Nutritional Biochemistry" by Tom Brody

3.	"Textbook of Clinical Nutrition and Functional Medicine" by David S. Jones and David R. S. Taylor
4.	"Biochemical and Physiological Aspects of Human Nutrition" by Martha H. Stipanuk and Marie A. Caudill
5	"Handbook of Nutritional Biochemistry" by S. K. Bhatia
6	"Nutritional Biochemistry and Metabolism with Clinical Applications" by David A. Schwartz