Gyanmanjari Innovative University

Syllabus
Gyanmanjari Institute of Technology
Semester-1(B. Tech)

Subject: General Biology - BET2BT11301

Type of course: Major (Core)

Pre requisite: No advanced biological training is required, as this course introduces life sciences from fundamental principles, specifically accommodating students transitioning from a primary background in the sciences.

Rationale: This course establishes the biological framework essential for biotechnology. It translates science competencies into biological literacy, enabling students to successfully engage with advanced concepts in Biotechnology.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
4	0	2	5	100	50	150

Legends: CI-Classroom Instructions; T-Tutorial; P -Practical; C –Credit; SSE -Semester End Evaluation; CCE-Continuous Class Evaluation; V–Viva; CA-Continuous Assessment; ALA-Active Learning Activities.

Course Content:

Sr. no.	Course Content	Hrs.	% Weightage
1	**Fundamentals of Cell Biology** ***Theory Topics:*** Introduction to Cell Biology, Ultra structure of Prokaryotic cell, Ultra structure of Eukaryotic cell, Structure of Plant Cell and Functions of Cell Organelles, Animal Cell Structure and Functions of Cell Organelles, Cell Division and Cell Cycle, Cell Communication and Signal Transduction, Cellular Metabolism and Energy Production and Applications of Cell Biology in medicine, biotechnology, and research. ***Practical:*** **1. Osmosis Experiment Using Potato Osmoscope** Demonstration of endosmosis and exosmosis using Potato Osmoscope **2. Microscopic Observation of Plant and Animal Cells** Preparation of temporary mount of onion epidermal peel and identification of cell wall, nucleus, cytoplasm, and vacuole. And observation of bacterial cells using prepared slides and identification of cell shape and arrangement. **3. Visualization and Study of Prokaryotic Cells** Observation of bacterial cells using prepared slides and identification of cell shape and arrangement. **4. Observation of Chloroplasts in Leaf Cells** Students prepare a temporary mount of a fresh leaf and observe chloroplasts under a microscope to study their structure, arrangement, and distribution within plant cells. **5. Staining Techniques in Cell Biology** Simple staining of bacterial cells including gram staining of bacteria. Observation of stained cells will be under microscope. **6. Visualization and Study of Cell Division Stages** Observation of mitotic stages in onion root tip prepared slides.	18	20 %

7. Visualization and Interpretation of Signal Transduction Diagrams

Students examine signal transduction pathway diagrams to identify receptors, signaling molecules, and cellular responses, and interpret the flow of information within the cell.

8. Visualization of Mitochondria and Nucleus Through Permanent Slides

Students observe prepared microscopic slides to identify the nucleus and mitochondria and study their structure and functions in animal cells.

9. Demonstration of Enzyme Activity

Study the effect of temperature or pH on enzyme activity using catalase or amylase.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CEE
1	**Cell Organelle Study Activity:** Students will be asked to study the structure and function of organelles. Each student presents one organelle.	20	
2	**Osmosis activity**: Students will perform this activity by performing grapes dipped in water and thus learn principal of osmosis.		
3	**Presentations** : Students will create presentations on advanced topics like membrane transport and cell permeability.		10
	Total	20	10

Examination Style:

Cell Organelle Study Activity

Objective

- To understand the structure and functions of different cell organelles.
- To develop teamwork, communication, and presentation skills.
- To encourage collaborative learning through group discussion and

presentation.

Activity assigning

- Assign one organelle to each student.

Activity Procedure

1. Each student studies the assigned organelle.
2. Students collect information about:
    - Structure of the organelle
    - Functions
    - Location in the cell
    - Importance in cell activities

Learning Outcome:

After completing the cell organelle study activity, students will be able to identify and describe the structure and functions of major cell organelles and explain their roles in maintaining cellular activities. Students will also be able to compare different organelles, relate organelle functions to overall cell functioning, and effectively communicate biological concepts through individual presentations.

Osmosis activity

Demonstration of Osmosis Using Grapes and Water

Objective

The objective of the osmosis activity is to help students understand the process of osmosis as the movement of water molecules across a selectively permeable membrane from a region of higher water concentration to a region of lower water concentration. Through observation and experimentation, students learn how differences in solute concentration influence water movement and how osmosis plays an important role in maintaining cellular functions in plants and animals.

Materials Required

- Fresh dry grapes (raisins can also be used)
- Bowl or beaker
- Clean water
- Tissue paper
- Measuring scale (optional)
- Notebook for observations

Procedure

1. Take a few fresh dry grapes and observe their size and appearance.
2. Record the initial observations.
3. Fill a bowl or beaker with clean water.
4. Dip the grapes completely in the water.
5. Leave them undisturbed for 4–6 hours or overnight.
6. Remove the grapes from the water and gently wipe them with tissue paper.
7. Observe and compare the size and texture of the grapes before and after soaking.

Learning Outcome

After completing the activity, students will be able to explain the principle of osmosis and identify the factors affecting the movement of water across a selectively permeable membrane. They will be able to observe and interpret experimental results, distinguish between hypotonic, hypertonic, and isotonic conditions, and relate the concept of osmosis to real-life biological processes such as water absorption by roots, food preservation, and maintenance of cell turgidity. Students will also develop skills in scientific observation, data recording, and drawing evidence-based conclusions.

Presentations :

On advanced topics like membrane transport and cell permeability . Includes passive Transport Mechanisms.

Diffusion

- Simple diffusion
- Factors affecting diffusion

Facilitated Diffusion

- Carrier proteins
- Channel proteins

Active Transport Systems

Primary Active Transport

- Sodium-potassium pump
- Calcium pump

	• Proton pump **Secondary Active Transport** • Symport • Antiport		
2	**Introduction to Bio molecules and Molecular Biology** ***Theory Topics:*** **Carbohydrates (Saccharides)**: • Structure: Monosaccharides (glucose, fructose), Disaccharides (sucrose, lactose), and Polysaccharides (starch, cellulose, glycogen). • Function: Primary energy source and structural component (cellulose in plants) • Dietary Importance and Industrial Applications of Carbohydrates. **Lipids**: • Introduction to Hydrophobic / amphipathic molecules, including fats, oils, and steroids. • Structure • Function • Dietary Importance and Industrial Applications of Lipids **Proteins (Polypeptides):** • Introduction and Composition • Structure of polypeptides • Function of polypeptides • Dietary Importance and Industrial Applications of Proteins **Nucleic Acids (DNA and RNA):** • Structure and Components of Nucleic Acids • DNA: Organization, Structure, and Functions • RNA: Types, Structure, and Functions • Role of Nucleic Acids in Genetic Information Transfer **Introduction to Molecular Biology and the Central Dogma** Introduction to the molecular basis of life, focusing on the flow of genetic information from DNA to RNA to proteins and its role in cellular functions. **Biomolecules in Health and Disease** Study of the role of carbohydrates, lipids, proteins, and nucleic acids in maintaining health and their involvement in various diseases and disorders.	18	20 %

Ethical and Social Aspects of Molecular Biology
Overview of ethical issues and societal implications associated with genetic engineering, gene therapy, cloning, and other molecular biology applications.

Cellular Organization at the Molecular Level
Examination of the molecular components of cells and their interactions in maintaining cellular structure, function, and regulation.

Applications of Biomolecules and Molecular Biology in Biotechnology and Medicine
Study of the use of biomolecules and molecular biology techniques in diagnostics, therapeutics, vaccine development, genetic engineering, and biotechnology industries.

Practical:

10. Qualitative Analysis of Carbohydrates

Students perform biochemical tests such as Molisch's, Benedict's, and Iodine tests to identify different types of carbohydrates.

11. Qualitative and Quantitative Analysis of Proteins

Biuret, Bradford, Ninhydrin, and Xanthoproteic tests are conducted to detect and measure proteins and amino acids in biological samples.

12. Qualitative Analysis of Lipids

Lipids are identified using Sudan stain, grease spot test, and emulsion test to understand their physical properties.

13. Isolation of Genomic DNA from Plant Cells/ Human Cheek Cells

DNA is extracted from onion, banana, or other plant tissues and visualized as precipitated strand. Similarly, Students collect cheek cells and isolate DNA to understand the basic principles of nucleic acid extraction.

14. Demonstration of Agarose Gel Electrophoresis

Students observe the separation of DNA fragments using agarose gel electrophoresis and learn the principle of molecular separation.

15. DNA Quantification Using Spectrophotometry

Students learn how DNA concentration and purity are measured using absorbance at specific wavelengths.

16. Paper Chromatography of Amino Acids

Amino acids are separated using paper chromatography to demonstrate molecular separation techniques.

17. Staining Techniques for Cellular Components

Use of stains such as methylene blue or iodine to visualize cellular structures.

18. Review of Biosafety Guidelines in Biotechnology Laboratories

In this activity, students study and review standard biosafety rules followed in biotechnology laboratories. This helps them understand safe laboratory practices, proper handling of biological materials, and prevention of contamination and laboratory hazards.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	**RNA and DNA Comparison Activity:** RNA and DNA Comparison Chart Activity through a Venn Diagram Activity where the Students place the Nucleic acid characteristics into DNA, RNA, or Both.	20	
2	**Crossword Puzzle on Molecular Biology Terms:** Students will solve a crossword puzzle containing key molecular biology terms such as DNA, RNA, nucleotide, gene, chromosome, amino acid etc.		
3	**Protein Structure Clay Model** Students will make a protein Structure Clay Model describing primary, secondary, tertiary and quaternary structures assigned to different students. The structural made would be compared		10

	to the reference image.		
	Total	20	10

Examination Style:

RNA and DNA Comparison Activity

Students paste the following characteristics on chits made from cardboard into charts mentioning different columns for DNA, RNA, or Both.

- Contains Adenine
- Double-stranded
- Contains Uracil
- Genetic Material
- Nucleotide Polymer
- Contains Ribose
- Contains Deoxyribose
- Involved in Protein Synthesis
- Contains Phosphate Group

Crossword Puzzle on Molecular Biology Terms

- DNA
- RNA
- Gene
- Chromosome
- Enzyme
- Ribosome
- Mutation

Learning Outcome

Improves scientific vocabulary and learn the basic differences between DNA and RNA.

Protein Structure Clay Model

Students prepare models showing:

- Primary structure
- Secondary structure
- Tertiary structure
- Quaternary structure

Learning Outcome

	Students understand the different structures of Protein.		
3	**Introduction to Genetics** ***Theory Topics:*** •Fundamentals and History of genetics and Hereditary •Genes, Alleles, and Chromosomes •Mendelian Inheritance: The laws of segregation and independent assortment explaining dominant and recessive traits (e.g., Punnett squares, single-gene disorders). • Non-Mendelian Genetics: Inheritance patterns that break classic rules, such as codominance, incomplete dominance, and sex-linked traits. ABO blood group in humans, Rh factor- Erythroblastosis fetalis, . • Population Genetics and Hardy–Weinberg Principle • Genetic Disorders: Conditions caused by specific gene mutations or chromosomal abnormalities, such as cystic fibrosis or Huntington's disease.. • Epigenetics: How environmental factors and behaviors can cause changes that affect how genes work without altering the underlying DNA sequence. • Human Genome and DNA Organization • Genetic Counseling and Modern Genetic Testing Techniques • Applications of Genetics in Biotechnology, Agriculture, and Medicine ***Practical:*** **19. Preparation of a Timeline of Major Discoveries in Genetics** In this activity, students prepare a chronological timeline of important discoveries in genetics, starting from early inheritance studies to modern advances such as DNA structure and genetic engineering. This helps them understand the historical development and key milestones in the field of genetics. **20. Observation of Chromosomes Using Prepared Slides** In this practical, students observe prepared microscope slides of chromosomes during different stages of cell division. This helps them identify chromosome structure, arrangement, and behavior during mitosis or meiosis. **21.Blood Group Determination and Analysis** In this practical, students determine ABO and Rh blood groups using standard antisera and observe agglutination reactions. This helps them understand blood group inheritance and the concept of multiple alleles in humans. **22.Twin Study Comparison Activity** Identification of ABO blood groups and interpretation of multiple allele inheritance.	18	20%

23.Study of Incomplete Dominance and Co dominance using Genetic Cross Problems

Students solve genetic cross problems involving incomplete dominance and codominance using Punnett squares. They analyze genotypic and phenotypic ratios and understand inheritance patterns in which both alleles influence trait expression differently from simple dominant–recessive inheritance.

24.Monohybrid Cross and Punnett Square Analysis
Students perform monohybrid crosses using hypothetical traits and construct Punnett squares to predict genotypic and phenotypic ratios according to Mendel's Law of Segregation.

25. Dihybrid Cross and Independent Assortment Activity
Students analyze inheritance patterns involving two traits simultaneously and verify Mendel's Law of Independent Assortment using Punnett squares.

26. Pedigree Analysis of Human Traits

Students construct and interpret pedigrees to trace the inheritance of genetic traits through multiple generations.

27. Case Study Analysis of Genetic Disorders and Karyotype Analysis and Chromosomal Abnormalities

Students analyze inheritance patterns and clinical features of disorders such as hemophilia, sickle cell anemia, Huntington's disease, and cystic fibrosis. Students examine human karyotypes and identify chromosomal disorders such as Down syndrome, Turner syndrome, and Klinefelter syndrome.

28. Study of Sex-Linked Inheritance Through Pedigree Charts

Students investigate the inheritance of X-linked traits such as color blindness and hemophilia using pedigree analysis.

29. Hardy–Weinberg Problem-Solving Exercise

Students solve numerical problems involving allele frequencies, genotype frequencies, and carrier frequencies.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE

1 2	**Allele and gene understanding activity:** Students will gain knowledge by topics on genes and allele through Punnett Square Exercise. **Pedigree Analysis :** Students will learn inheritance pattern in families through chart construction of Family Pedigree.	20		
3	**Study of Genetic Disorders** Students will learn some disorders like Erythroblastosis fetalis , Color blindness etc through Genetic Disorder Case Study Analysis.		10	
	Total	20	10	

Examination Style:

Allele and gene understanding activity : Students solve simple genetic crosses such as:

- Bb × Bb
- Tt × tt

They determine genotype and phenotype ratios. Students will have to Correct Punnett square and interpretation.

Objective

Students will gain knowledge about:

- Meaning of genes and alleles
- Types of alleles (dominant and recessive)
- Inheritance of traits
- Role of genes in heredity
- Variation among individuals

Learning Outcome

Students understand the basics of genetics and crosses.

Pedigree Analysis : Students will learn inheritance pattern in families

Procedure

1. Students collect information about family traits such as:

    - Attached/free earlobes
    - Widow's peak
    - Tongue rolling
    - Dimples
    - Cleft chin

2. Record traits for parents, grandparents, and siblings.
3. Prepare a simple family tree showing the traits and record it in.docx format .
4. Discuss which traits appear dominant or recessive and document in a table format.

Learning Outcome

Students understand how traits pass from one generation to another.

Study of Genetic Disorders Students will learn some disorders like Erythroblastosis fetalis , Color blindness etc through Genetic Disorder Case Study Analysis.

Objectives

Students will be able to:

- Understand the genetic basis of selected disorders.
- Identify inheritance patterns.
- Analyze case studies and pedigrees.
- Develop observation and problem-solving skills.
- Relate genetics to real-life medical conditions.

Procedure:

. Present a case involving disorders such as:

- Hemophilia
- Sickle Cell Disease
- Huntington's Disease
- Color blindness
- Erythroblastosis fetalis

Students analyze the pedigree and predict inheritance risks.

Learning Outcome:

Students will be able to analyze genetic disorders using pedigree and case-

	study approaches, identify their inheritance patterns, predict transmission risks, and explain the role of genetic counseling and diagnostic techniques in disease management.		
4	**Introduction to plant and animal physiology** *Theory Topics:* **Plant Physiology** **Water Relations in Plants** :,Importance of water , Diffusion and osmosis, Water potential and Transpiration and its significance. **Mineral Nutrition:** Essential mineral elements, Macronutrients and micronutrients, Deficiency symptoms and Mechanism of mineral uptake . **Photosynthesis**: Definition and importance, Chloroplast structure, Light reaction, Dark reaction (Calvin cycle) and Factors affecting photosynthesis. **Respiration in Plants :** Glycolysis , Krebs cycle ,Electron transport system ,Aerobic and anaerobic respiration **Plant Growth and Development:** Plant hormones: Auxins, Gibberellins, Cytokinins, ABA, Ethylene ,Seed dormancy and germination, Photoperiodism and vernalization ,Growth movements in plants **Animal Physiology** **Digestive System** Structure and functions of digestive organs Digestion and absorption of carbohydrates, proteins, and fats **Respiratory System:** Mechanism of breathing ,Transport of respiratory gases ,Respiratory pigments ,Disorders of respiration **Circulatory System:** Composition and functions of blood ,Structure of heart, Cardiac cycle ,Blood pressure and pulse **Excretory System:** Structure of kidney and nephron and Formation of urine Osmo regulation **Nervous System:** Structure of neuron ,Transmission of nerve impulse Central and peripheral nervous systems ,Reflex action . **Endocrine System:** Endocrine glands, Functions of hormones and Hormonal regulation in the body **Homeostasis and Physiological Regulation** • Concept of homeostasis • Feedback mechanisms (positive and negative) • Thermoregulation • Water and electrolyte balance **Practical:** **30. Demonstration of Diffusion Using Potassium Permanganate**	18	20%

Students observe the movement of potassium permanganate crystals in water to understand the process of diffusion and the effect of concentration gradients. Also Students observe plasmolysis and deplasmolysis in onion epidermal cells using different salt concentrations to understand water potential.

31. Study of Stomatal Distribution and Structure

Students prepare leaf epidermal peels and observe stomata under a microscope to understand their role in transpiration and gas exchange.

32. Demonstration of Mineral Uptake by Roots

Students observe dye uptake by plant roots to understand the mechanism of absorption and transport of minerals.

33. Effect of Light Intensity on Photosynthesis

Students observe oxygen bubble production in aquatic plants under different light intensities to understand factors affecting photosynthesis.

34. Detection of Starch as Evidence of Photosynthesis

Students perform the iodine test on leaves exposed to light and darkness to demonstrate starch formation during photosynthesis.

35. Demonstration of Aerobic and Anaerobic Respiration

Students compare respiration in germinating seeds and yeast cultures under aerobic and anaerobic conditions.

36. Seed Germination Experiment

Students investigate factors such as water, temperature, hormones and oxygen on seed

37. Measurement of Human Physiological Parameters

Students measure pulse rate, respiratory rate, and blood pressure before and after mild physical activity to understand cardiovascular and respiratory responses.

38. Study of Autonomic Responses

Observe changes in pupil size under different light intensities.

39. Interpretation of Clinical Data Related to Kidney and Hormonal Functions

Students will analyze and interpret clinical laboratory reports related to kidney and endocrine functions. Parameters such as blood urea, serum creatinine, glomerular filtration rate (GFR), urine analysis results, blood glucose levels, thyroid hormone levels (T3, T4, TSH), insulin levels, and other relevant biochemical markers will be examined. Students will compare the values with normal reference ranges, identify abnormalities, and correlate the findings with common disorders such as kidney disease, diabetes mellitus, hypothyroidism, and hyperthyroidism. This practical helps students understand the role of diagnostic tests in assessing organ function and maintaining homeostasis.

40. Measurement of Reaction Time

Determination of visual or auditory reaction times and their variation under different conditions.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1 2	**Transpiration Activity** Students will observe the formation of water droplets on the inner surface of a leaf bag. Students will assign a score based on the amount of condensation observed. **Measurement of Pulse Rate** Students will measure Pulse Rate after Relay Race of all the students through common pulse points in the body and document it .	20	
3	**Role Play Activity** Students will simulate biological processes through movement, dialogue, and interaction, helping them visualize how different components work together to maintain life processes.		10
	Total	20	10

Examination Style:

Transpiration Activity

Objective: To study transpiration in plants.

Materials: Potted plant, polythene bag, thread.

Procedure:

1. Cover leaves with a polythene bag.
2. Tie the bag tightly.
3. Observe water droplets after a few hours.

Learning Outcome: Demonstrates loss of water through leaves

Measurement of Pulse Rate

Objective: To study the effect of exercise on heart rate.

Materials: Stopwatch.

Procedure:

1. Students will form teams of 4 to perform the relay race.
2. Each student measure the resting pulse rate of team members.
3. Perform the race
4. Measure pulse again of team members.
5. Document both the pulse rates in a table in a journal.

Learning Outcome: Understanding cardiovascular response to exercise.

Role Play Activity

Objective: Identify the functions of hormones, blood cells, plant tissues, and digestive organs and know the functions .

Procedure:

1. Divide the class into four groups based on the assigned topic:

- Hormones
- Blood Cells
- Plant Tissues
- Digestive System Organs

2. Assign individual roles to students within each group.

- Hormones: Insulin, Glucagon, Adrenaline, Thyroxine, etc.
- Blood Cells: RBC, WBC, Platelets, Plasma.
- Plant Tissues: Xylem, Phloem, Epidermis, Parenchyma, etc.
- Digestive Organs: Mouth, Esophagus, Stomach, Liver, Pancreas, Small Intestine, Large Intestine.

3. Provide each student with a role card or name tag indicating their biological component and its primary function.
4. Allow 10–15 minutes for preparation, during which students discuss their roles and plan how to demonstrate their functions.
5. Ask each group to develop a short scenario (3–5 minutes) showing how the components interact in a biological process.
6. Conduct the role-play presentations:

- Hormones demonstrate regulation of body functions (e.g., blood glucose control).
- Blood cells demonstrate circulation, immunity, and blood clotting.
- Plant tissues demonstrate transport of water and food in plants.
- Digestive organs demonstrate the movement and digestion of food.

7. Encourage students to use actions, dialogue, and movement to represent the functions of their assigned roles.

8. Have the audience observe and identify the functions being demonstrated by each participant.

9. Facilitate a discussion after each presentation, asking students questions about the roles and interactions shown.

10. Ask students to summarize the biological process represented by their group and explain the contribution of each component.

11. Conduct a short assessment or reflection activity (oral questions, worksheet, or quiz) to evaluate understanding of the concepts demonstrated.

12. Conclude the activity by reviewing key concepts and highlighting the importance of interaction among biological components in maintaining life processes.

Learning Outcome: By the end of the activity, students will be able to describe the functions of hormones, blood cells, plant tissues, and digestive organs and explain interactions among biological structures.

5	**Introduction to Ecology and Ecosystems** *Theory Topics* **Basics of Ecology**: Definition and scope of ecology ,Branches of ecology Levels of ecological organization: Organism ,Population ,Community ,Ecosystem ,Biosphere ,Habitat and niche ,Biotic and abiotic factors. **Ecosystem Structure and Function**: Concept and types of ecosystems **Components of ecosystem**: Producers, Consumers ,Decomposers Energy flow in ecosystem Food chain and food web Ecological pyramids and Productivity of ecosystems. **Types of Ecosystems** Forest ecosystem Grassland ecosystem ,Desert ecosystem and Aquatic ecosystem. **Productivity and Nutrient Cycling** • Primary productivity • Secondary productivity • Gross productivity • Net primary productivity **Methods in Ecological Studies** • Quadrat method • Transect method • Biodiversity assessment • Ecological data analysis **Biogeochemical Cycles** • Water cycle • Carbon cycle • Nitrogen cycle • Phosphorus cycle **Biodiversity and Conservation** • Levels of biodiversity • Importance of biodiversity • Threats to biodiversity • Conservation strategies **Environmental Pollution** • Air pollution • Water pollution	18	20 %

- Soil pollution
- Noise pollution
- Control measures

Applied Ecology

- Agroecology
- Urban ecology
- Restoration ecology
- Conservation ecology

Practical:

41. Quadrat Method for Plant Population Estimation

Students use quadrats to estimate the abundance and distribution of plant species in a defined area.

42. Biodiversity Assessment of a Local Area

Students record and identify plant and animal species present in a campus or garden ecosystem and calculate species richness.

43. Construction of Food Chains

Students identify producers, consumers, and decomposers in an ecosystem and construct simple food chains.

44. Development of Food Web Models

Students prepare food web diagrams to understand feeding relationships and ecosystem stability.

45. Ecological Pyramid Construction

Students construct pyramids of number, biomass, and energy for different ecosystems using provided data.

46. Energy Flow in Ecosystems Activity

Students trace the movement of energy through trophic levels and calculate energy transfer efficiency using the 10% law.

47. Water Quality Assessment of an Aquatic Ecosystem

Students measure basic parameters such as pH, temperature, turbidity, or

dissolved oxygen (where facilities are available) to evaluate ecosystem health.

48. Ecosystem Model Preparation

Students prepare physical or digital models representing ecosystem components, trophic levels, and ecological interactions.

49. Analysis of Soil Characteristics and Vegetation

Students collect and analyze soil samples for properties such as pH, moisture, and texture, and relate these characteristics to the types and distribution of vegetation present in the study area.

50. Belt Transect Analysis of Vegetation Composition

Students lay a belt transect across a selected habitat and record the plant species present within the transect area. The collected data are used to assess species composition, abundance, and distribution patterns, providing insights into vegetation structure and community organization.

51. Study of Phosphorus Presence in Different Soil Samples

Students collect soil samples from different locations such as gardens, agricultural fields, grasslands, or barren land and analyze them for phosphorus content using a phosphate testing kit or suitable chemical reagents. The results are recorded, tabulated, and compared among the different soil types.

52. Species Richness and Diversity Index Calculation

Students collect or use existing ecological data to determine the number of species present in a habitat (species richness) and calculate biodiversity indices such as the Shannon–Wiener or Simpson's Index. The results are used to assess and compare biodiversity levels among different habitats or communities.

53. Monitoring Lichen Distribution as an Indicator of Air Quality

Students survey and record the presence, abundance, and diversity of lichens on tree bark or other surfaces at different locations. The observed lichen distribution is used as a biological indicator to assess relative air quality, as lichens are sensitive to atmospheric pollutants.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	**Food Chain and Food Web Model**	2	

	Students will identify the producers, consumers and decomposers in the food chain/food web and manually construct food chain and food web in a journal.	0			
2	**Compost Preparation Activity** Students learn about microbial decomposition, waste management, and sustainable agricultural practices through hands-on preparation and monitoring of a compost pit or compost container.				
3	**Biodiversity Documentation Project** The Biodiversity Documentation Project is a field-based activity in which students observe, identify, record, and document the variety of living organisms present in a selected area such as a campus, garden, park, or local ecosystem. Students collect information on plants, animals, insects, birds, and microorganisms through photographs, sketches, and observation records.		10		
	Total	20	10		

Examination Style:

Food Chain and Food Web Model

Objective:

The objective of this activity is to help students understand the flow of energy and transfer of nutrients among organisms in an ecosystem through food chains and food webs. It enables students to identify the roles of producers, consumers, and decomposers, understand feeding relationships, and appreciate the interdependence of organisms for ecosystem stability and survival.

Materials

- Chart paper
- Colored pens
- Pictures of organisms

Activity

1. Identify producers, consumers, and decomposers.
2. Construct food chains in chart paper/ journal.
3. Combine them into a food web.
4. Discuss ecological balance and disturbances.

Learning Outcome

Students learn ecosystem interactions and energy flow.

Compost Preparation Activity

Objective: The objective of this activity is to help students understand the process of composting and the role of microorganisms in the decomposition of organic waste. It also aims to develop awareness about sustainable waste management practices and the importance of compost as a natural fertilizer for improving soil health.

Materials

- Vegetable waste
- Dry leaves
- Soil
- Compost container

Procedure

1. Layer organic waste and soil.
2. Maintain moisture.
3. Observe decomposition over several weeks.
4. Record temperature and odor changes

Outcome

After completing the activity, students will be able to explain the process of compost formation, identify suitable biodegradable materials for composting, and demonstrate basic compost preparation techniques. They will also appreciate the environmental benefits of recycling organic waste into nutrient-rich compost for agricultural and gardening purposes.

Biodiversity Documentation Project

Objective: The objective of the Biodiversity Documentation Project is to enable students to explore, identify, and document the variety of living organisms present in a selected habitat. Through systematic observation and recording, students develop skills in species identification, classification, and field documentation while gaining an understanding of the ecological importance of biodiversity. The activity also promotes awareness of conservation practices and the need to protect biological resources for maintaining ecosystem balance and environmental sustainability.

Procedure:

1. Select a study area such as the college campus, garden, park, pond, or

	nearby natural habitat. 2. Divide students into small groups and assign observation zones. 3. Provide students with observation sheets, notebooks, cameras/mobile phones, and identification guides. 4. Observe and record different species of plants, insects, birds, fungi, and other organisms present in the area. 5. Note important details such as common name, scientific name (if known), habitat, abundance, and distinguishing features. 6. Take photographs or prepare sketches of the observed organisms. 7. Classify the recorded organisms into appropriate categories (flora, fauna, insects, birds, etc.). 8. Compile all observations into a biodiversity documentation report, chart, or digital presentation. 9. Analyze the collected data and discuss patterns of species diversity and abundance. 10. Present the findings and discuss the importance of conserving local biodiversity. **Learning Outcome** After completing the project, students will be able to identify and classify a variety of organisms found in their local environment and document biodiversity using scientific methods. They will develop field observation and data-recording skills, understand the ecological significance of species diversity, and recognize the importance of biodiversity conservation for maintaining healthy ecosystems.		

Suggested Specification Table with Marks(Theory):100

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	15%	15%	20%	15%	15%	20%

Course Outcome:

After learning the course the students should be able to:	
CO1	Students will know about cell biology on basic level
CO2	Students will understand basic structures of Bio molecules
CO3	Students will acquire knowledge in genes and allele
CO4	Students will acquire details about plant and animal physiology
CO5	Students will grab knowledge regarding ecosystem

Instructional Method: The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc. From the content 10% topics are suggested for flipped mode instruction. Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, ecourses, Virtual Laboratory The internal evaluation will be done on the basis of Active Learning Assignment

Reference Books:

1. Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Orr, R. B. (2020). *Campbell Biology* (12th ed.). Pearson.
2. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). *Molecular Biology of the Cell* (7th ed.). W.W. Norton & Company.
3. Hillis, D. M., Heller, H. C., Hacker, S. D., Hall, D. W., Laskowski, M. J., & Sadava, D. E. (2020). *Life: The Science of Biology* (12th ed.). W.H. Freeman and Company.
4. Nelson, D. L., & Cox, M. M. (2021). *Lehninger Principles of Biochemistry* (8th ed.). W.H. Freeman and Company.
5. Raven, P. H., Johnson, G. B., Mason, K. A., Losos, J. B., & Singer, S. R. (2020). *Biology* (12th ed.). McGraw-Hill Education.