DEPARTMENT OF MICRO BIOLOGY

Course Code							
Title of the Course				**EUKARYOTIC MICROORGANISMS**			
Offered to: (Programmes)				**B.Sc Honors – Microbiology**			
L	**4**	**T**	**4**	**P**	**0**	**C**	**3**
Year of Introduction:		**2024-25**		**Semester:**		**3**	
Course Category:		**Major**		**Course Relates to:**		**Global**	
Year of Revision:		**NA**		**Percentage:**		**NA**	
Type of the Course				**Skill Development**			
Crosscutting Issues of the Course				**Environment and Sustainability**			
Pre-requisites, if any				**Basics of Microbiology**			

Course Description:

An overview of the course content and objectives.

This course provides an in-depth exploration of fungi, algae, and protozoa, focusing on their biology, ecology, and significance. The course covers the habitat, classification, and reproduction of fungi, including fungal dimorphism. It examines the importance of fungi in biotechnology, agriculture, and as pathogens. Also focuses on algae, detailing their structure, reproduction, and photosynthesis. It highlights the importance of algae in various sectors and explores cultivation techniques. It investigates protozoa, emphasizing their characteristics, pathogenic species, and ecological roles. This course is essential for understanding these vital organisms in ecosystems and industries.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	To provide knowledge on classification and characterization of Eukaryotic microorganisms
2	To aquaint students about microbial habitats and reproductive mechanisms
3	To provide knowledge on pathogenic protozoa and their impact on health
4	To make students understand the significance of eukaryotic microorganisms in industry and environment.
5	To provide knowledge on the application of eukaryotic organisms in medicine and agriculture

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	1. Understand the characteristics, classification, and reproductive mechanisms of fungi, algae, and protozoa.	K2	1	1
CO2	2. Recognize the importance of fungi in biotechnology, including their roles in food production, medicine, and agriculture.	K3	1,2	1,2
CO3	Comprehend the significance of algae in various industries, the environment, and as a source of food.	K3	1,2	2
CO4	Identify pathogenic protozoa and understand their impact on human health and the environment.	K1	1	1

CO5	Understand the characterization and identification of all Eukaryotic microorganisms	K2	1	1

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	3							3	
CO2	2	2						2	2
CO3	2	2						2	2
CO4	3	2						3	
CO5	3							3	

Use the codes 3, 2, 1 for High, Moderate and Low correlation Between CO-PO-PSO respectively

Course Structure:

Unit – 1 : Fungi (12Hrs)

Content:

1. Habitat, distribution, nutritional requirements, fungal cell ultrastructure, fungal wall, Outline classification of Fungi
2. Reproduction in different fungal groups- Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes
3. Heterokaryosi s, heterothallism and parasexual mechanism.
4. Fungal dimorphism (Candida albicans)

Examples/Applications/Case Studies

- A

Serial Number	**Fungal Group**	**Types of Spore Formation**	**Example**	**Key Features**
1	Zygomycota			
2	Ascomycota			
3	Basidiomycota			
4	Deuteromycota			

ssignment on classification of fungi

- Assignment on fungal Reproduction

Examples/Applications/Case Studies:

Exercises/Project

Students work in groups of 2-3 students per group

1. Fill out the table (20 minutes). Try your best to complete all parts of the table.
2. When you're done, exchange your completed table with another group.
3. Correct any mistakes you may find in the answers (15 minutes). Do not return the corrected table yet to the group with which you exchanged answers.
4. Answer the clicker questions presented by your teacher on screen.
5. Examine your corrected table and correct any mistakes you may still find (5 minutes). Return the corrected table to the group with which you exchanged answers

Specific Resources: (web)

- https://en.wikipedia.org/wiki/Fungus
- https://www.britannica.com/science/fungus
- https://www.ncbi.nlm.nih.gov/books/NBK8125/

Unit – 2 : Importance of Fungi (12Hrs)

Content:

1. Role of fungi in

1.	Introduction to Mushroom Cultivation			
2	Substrate Preparation			
3	Sterilization of Substrate			
4	Inoculation			
5	Incubation			
6	Monitoring And Maintenance			

biotechnology: food, medicine and pharmaceutical industry (baking, brewing, antibiotics, alcohols, enzymes, organic acids, and pharmaceuticals

2. Beneficial Role of fungi in Agriculture: Biofertilizers, Myco toxins; Biological control of plant diseases
3. Mushrooms and its cultivation. (White button)
4. Fungi as plant and animal pathogens (Puccinia, Aspergillus

Examples/Applications/Case Studies:

- Assignment on role of fungi in Agriculture
- Assignment on role of fungi in Biotechnology

Activity on Mushroom Cultivation

Activity on role of fungi in Biotechnology

Specific Resources: (web)

- https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/General_Biology_1e_(OpenStax)/5%3A_Biological_Diversity/24%3A_Fungi/24.5%3A_Importance_of_Fungi_in_Human_Lifehttps://byjus.com/biology/economic-importance-of-

1	Pigment Extraction				

fungi/https://imafungus.biomedcentral.com/articles/10.5598/imafungu

Unit – 3 : Algae (12Hrs)

Content:

1. Algae- occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, food reserves, outline classification
2. Vegetative, asexual and sexual reproduction in Algae
3. Photosynthetic apparatus, and outline of Photosynthesis in Algae

Examples/Applications/Case Studies:

- Assignment on Algae structure
- Assignment on reproduction in Algae

Exercise on Algal pigments

2	Thin Layer Chromatography				
3	Spectrophotometer				
4	Analysis of Results				
5	Identification of Pigment Types				

Exercise-2

Match the type of sexual reproduction with the correct example

Type of reproduction	Example
Isogamy	a) Fucus
anisogamy	b) Chlamydomonas
Oogamy	c) Spirogyra
Conjugation	d) Volvox

Specific Resources: (web)

- https://en.wikipedia.org/wiki/Help:IPA/English
- https://www.livescience.com/54979-what-are-algae.html
- https://www.britannica.com/science/algae

Unit – 4: Importance and cultivation of Algae (12Hrs)

Content:

1. Importance of algae in agriculture, industry, environment and food with examples.
2. Algal culture techniques- Indoor, Outdoor, Closed, Open, Batch, continuous, Fed batch
3. Culture media and growth parameters for algal cultivation (Spirulina)

Examples/Applications/Case Studies:

- Assignment on algae culture
- Assignment on importance of algae in agriculture

Exercises/Projects:

1. Algae Growth Experiment

Objective: Understand the growth properties of algae.

Materials Needed:

Live microalgae culture
Water-soluble fertilizer
Light source (daylight-spectrum)
Aquarium air pump
Measuring tools (graduated cylinder, beakers

Activity: Students can set up different environments to grow algae, varying factors like light intensity, nutrient levels, and aeration. They can record growth rates and analyze which conditions are most favorable for algae growth

 [Exercise/Project2

1. Algae as Biofertilizers

Objective: Learn how algae can be used to enhance soil fertility.

Materials Needed:

- Live algae culture (e.g., blue-green algae)
- Soil samples
- Plant seeds (e.g., beans or peas)
- Measuring tools (graduated cylinders, beakers)
- Light source
- **Activity:** Students can mix algae with soil and plant seeds in different pots. They can compare the growth of plants in algae-treated soil versus untreated soil. This activity demonstrates how algae can improve soil fertility and promote plant growth

Specific Resources: (web)

- https://www.britannica.com/summary/algae#:~:text=Algae%20provide%20much%20of%20Earth's,found%20among%20plants%20and%20animals.

- https://byjus.com/neet/economic-importance-of-algae/
- https://www.jagranjosh.com/general-knowledge/economic-importance-of-algae-1555399986-1

Unit – 5 : Protozoa (12Hrs)

Content:

1. General characteristics with special reference to Amoeba
2. Pathogenic Protozoa- Plasmodium, and Leishmania
3. Importance of protozoa (in waste management, soil fertility and industry)
4. Culturing protozoans from natural sources-Hay water, pond water, Chalkley's solution

Examples/Applications/Case Studies

- Assignment on pathogenesis of plasmodium
- Assignment on protozoa culture

Exercises/Projects:

- [Exercise/Project 1]

1. Life Cycle Role-Play

2. Objective: **Understand the complex life cycle of Plasmodium.**

Materials Needed:

Role cards (e.g., sporozoite, merozoite, trophozoite, gametocyte, mosquito)
Diagrams of the Plasmodium life cycle

Activity: Students can act out the different stages of the Plasmodium life cycle. Each student takes on a role and demonstrates how the parasite moves from the mosquito to the human host and back[1]. This interactive activity helps students visualize and remember the stages of the parasite's development

- [Exercise/Project 2]

Imagine you have successfully cultured a thriving population of protozoa in your classroom. One day, you notice that the protozoa in one of your cultures have started to exhibit unusual behaviors—they are forming complex patterns and seem to be communicating with each other in a way that suggests a higher level of organization.

Question:1.What could be the possible explanations for this behavior? Consider both biological and non-biological factors. How would you design an experiment to test your hypothesis?

Question:2.Could there be an external influence, such as a chemical contaminant or a change in the environment, that is causing this behavior?

Specific Resources: (web)

- https://flexbooks.ck12.org/cbook/cbse-science-class-8/section/2.5/primary/lesson/protozoa/?gad_source=1&gclid=Cj0KCQjwiuC2BhDSARIsALOVfBL-Jb-bvigWlyAxuYiWmdYPiEs-jVWQd2EsdQRpGZouCQYt49UMpRsaAgwhEALw_wcB&utm_campaign=21404130218&utm_medium=cpc&utm_source=google&utm_term=
- https://ocm.govtsciencecollegedurg.ac.in/Document/496_055732.pdf
- https://byjus.com/question-answer/what-is-the-importance-of-protozoa/

References

1. Alexopoulus, C.J., Mims,C.W. and Blackwel, M, Introductory Mycology. John Wiley,New York.
2. Mehrotra, R.S. and K.R.Aneja An Introduction to Mycology. New Age International press, New Delhi
3. Webster, J. Introduction to fungi. Cambridge University Press. Cambridge, U.K. (1985).
4. Bessey E.A. Morphology and Taxonomy of fungi. Vikas Publishing House Pvt. Ltd.,NewDelhi.
5. Jhon Webster and R W S Weber. Introduction to Fungi. Cambridge University Press2007

SRI DURGA MALLESWARA SIDDHARTHA MAHILA KALASALA:: VIJAYAWADA-10
(An Autonomous College in the Jurisdiction of Krishna Unviersity, Machilipatnam)

Course Code							
Title of the Course				**EUKARYOTIC MICROORGANISMS**			
Offered to: (Programme/s)				**B.Sc Honors – Microbiology**			
L	**0**	**T**	**0**	**P**	**2**	**C**	**1**
Year of Introduction:		**2024-25**		**Semester:**		**3**	
Course Category:		**Major**		**Course Relates to:**		**Global**	
Year of Revision:		**NA**		**Percentage:**		**NA**	
Type of the Course				**Skill Development**			
Crosscutting Issues of the Course				**Environment and Sustainability**			
Pre-requisites, if any				**Basics of Microbiology**			

1	Pigment Extraction						
2	Thin Layer Chromatography						
3	Spectrophotometry						
4	Analysis of Results						
5	Identification of Pigment Types						

Course Description:
An overview of the course content and objectives.

This course provides an in-depth exploration of fungi, algae, and protozoa, focusing on their biology, ecology, and significance. The course covers the habitat, classification, and reproduction of fungi, including fungal dimorphism. It examines the importance of fungi in biotechnology, agriculture, and as pathogens. Also focuses on algae, detailing their structure, reproduction, and photosynthesis. It highlights the importance of algae in various sectors and explores cultivation techniques. It investigates protozoa, emphasizing their characteristics, pathogenic species, and ecological roles. This course is essential for understanding these vital organisms in ecosystems and industries.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	To provide knowledge on classification and characterization of Eukaryotic microorganisms
2	To aquaint students about microbial habitats and reproductive mechanisms

3	To provide knowledge on pathogenic protozoa and their impact on health
4	To make students understand the significance of eukaryotic microorganisms in industry and environment
5	To provide knowledge on the application of eukaryotic organisms in medicine and agriculture

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	1. Understand the characteristics, classification, and reproductive mechanisms of fungi, algae, and protozoa	K2	1	1
CO2	2. Recognize the importance of fungi in biotechnology, including their roles in food production, medicine, and agriculture.	K3	1,2	1,2
CO3	Comprehend the significance of algae in various industries, the environment, and as a source of food.	K3	1,2	2
CO4	Identify pathogenic protozoa and understand their impact on human health and the environment	K1	1	1
CO5	Understand the characterization and identification of all Eukaryotic microorganisms	K2	1	1

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	3							3	
CO2	2	2						2	2
CO3	2	2						2	2
CO4	3	2						3	
CO5	3							3	

Use the codes 3, 2, 1 for High, Moderate and Low correlation

Lab 1: Preparation of Potato Dextrose Medium. (6hrs)
Specific Resources: https://youtu.be/lmhSv6-T7EQ?si=Ngapas_80vKP-H00
A Brief description: To prepare Potato Dextrose Medium (PDA), start by boiling 200 g of potatoes in 500 mL of distilled water for about 30 minutes to create a potato infusion. Strain the mixture to collect the liquid. Then, combine the infusion with 20 g of dextrose and, if a solid medium is needed, 15 g of agar. Adjust the total volume to 1 liter with distilled water and check the pH, adjusting to 5.6 if necessary. Sterilize the mixture by autoclaving at 121°C for 15-20 minutes. After cooling, pour the medium into sterile Petri dishes for use in cultivating fungi and yeasts.

Lab 2: Isolation and identification of pathogenic and non-pathogenic fungi. (6hrs)
Specific Resources: https://youtu.be/0s_mbAp7COw?si=2Fzu_Cyg4ZRAFkZI
A Brief description: Isolation and identification of pathogenic and non-pathogenic fungi involve several steps. First, collect samples from suspected sources, such as soil, plants, or infected tissues. Use selective media, like Potato Dextrose Agar, to culture the fungi. Incubate the plates under appropriate conditions (usually in the dark at room temperature). After growth, observe the morphological characteristics, such as colony color, texture, and sporulation. For identification, perform microscopic examination and possibly molecular techniques like PCR for specific

pathogens. Confirm pathogenicity through host inoculation tests or biochemical assays, while non-pathogenic fungi can be identified based on their morphological traits and ecological roles.

Lab 3: Study of host-pathogen interaction (6hrs)
Specific Resources: https://youtu.be/XvlY0zvKbm4?si=dpBjN0GHR5NBKyPe
A Brief description: The study of host-pathogen interaction focuses on understanding how pathogens, such as bacteria, viruses, and fungi, interact with their host organisms, including plants and animals. This research encompasses several key areas:

1. **Infection Processes:** Examining how pathogens invade hosts, establish infections, and evade immune responses.
2. **Host Defense Mechanisms:** Investigating the various strategies hosts use to defend against pathogens, including physical barriers and immune responses.
3. **Molecular Interactions:** Analyzing the biochemical signals and molecular interactions between hosts and pathogens that influence disease outcomes.
4. **Pathogenicity Factors:** Identifying the specific traits or molecules that enable pathogens to cause disease, such as toxins or adhesion factors.
5. **Co-evolution:** Understanding the evolutionary arms race between hosts and pathogens, which drives adaptations in both.

Studying these interactions is essential for developing effective treatments, vaccines, and disease management strategies in agriculture and medicine.

Lab 4 Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: Mucor, Saccharomyces, Penicillium, Agaricus and Alternaria. (6hrs)
Specific Resources: https://youtu.be/Wn_6PRmmQUY?si=maD5cAZ1AROrcb0I
A Brief description: The study of vegetative and reproductive structures in the genera Mucor, Saccharomyces, Penicillium, Agaricus, and Alternaria can be conducted using both temporary and permanent slides.

1. **Mucor:** Observe the filamentous hyphae (mycelium) and the asexual reproductive structures called sporangia, which contain sporangiospores.
2. **Saccharomyces:** Focus on the yeast cells, noting their unicellular, oval shape. Reproductive structures include budding cells and asci containing ascospores in sexual reproduction.
3. **Penicillium:** Examine the characteristic branched conidiophores that produce conidia (asexual spores). Look for the distinct brush-like appearance of the conidiophores.
4. **Agaricus:** Study the mushroom's fruiting body (basidiocarp), noting the gills where basidia produce basidiospores, as well as the mycelium structure.
5. **Alternaria:** Identify the dark, septate hyphae and the conidia, which are typically large, with a characteristic chain formation and varying shapes.

Using both slide types allows for detailed observations of cellular structures and reproductive strategies, enhancing understanding of their biology and ecology.

.**Lab 5:** purification and preservation of pure cultures of common fungi. (6hrs)
Specific Resources: https://youtu.be/MDowwItwcRg?si=gzW01R8psH9rwXh6**A Brief description:** Purification and preservation of pure cultures of common fungi involve several key steps:

1. **Isolation:** Use techniques like streak plating on selective media to obtain single colonies from mixed cultures. This helps to ensure purity.
2. **Subculturing:** Transfer isolated colonies to fresh media to confirm purity. Repeated subculturing may be necessary to obtain a stable pure culture.

3. **Preservation Techniques:**
   - **Refrigeration:** Store cultures at low temperatures (4°C) for short-term preservation.
   - **Freezing:** For long-term storage, fungal cultures can be frozen at -20°C or lower, often using cryoprotectants like glycerol.
   - **Lyophilization (Freeze-drying):** This method involves dehydrating the culture, allowing for long-term storage without refrigeration.
4. **Storage Conditions:** Ensure cultures are stored in sterile, airtight containers to prevent contamination and degradation.

Regularly check and rejuvenate stored cultures to maintain viability and ensure consistent results for future experiments or applications.

References:

1. K.R.Aneja ,Experiments in Microbiology ,Plant patology and biotechnology,New Age International publication Ltd
2. R.C.Dubey and D.K.Maheshwari,2002, Practical Microbiology,S.chand &company ltd
3. Cappuccino,Sherman,2006,Microbiology Alaboratory Mannual6th edition,Pearson Education

SRI DURGA MALLESWARA SIDDHARTHA MAHILA KALASALA, VIJAYAWADA 10
SEMESTER END EXAMINATION
MODEL QUESTION PAPER

Course Code: **Max. Marks: 70**
Title of the Paper: Eukaryotic organisms **Max.Time: 3 Hours**

Section A

ANSWER THE FOLLOWING **5X4=20M**

Q1. (a) Discuss the parasexual mechanism in fungi. **CO1, K2** **4M**
(OR)
(b) Describe dimorphic nature of Candida albicans. **CO1, K2** **4M**

2 .(a) Write a note on fungi that are animal pathogens.**CO2,K1** **4M**
(OR)
(b) Describe about fungal biofertilizers **CO2,K1** **4M**

3. (a)Give a note on ultra structure of algal cell.**CO3,K2** **4M**
(OR)
(b) Describe photosynthetic process in algae. **CO3,K2** **4M**

4. (a) explain algal cultivation by continuous culture method **CO4,K2** **4M**
(OR)
(b) Determine composition of culture media used for Spirulina cultivation. **CO4,K2** **4M**

5. (a) What is the role of protozoa in Waste management. **CO5,K2** **4M**
(OR)
(b) Explain the characteristics of Amoeba **CO5,K2** **4M**

Section B

Answer All questions. **5x10=50M**

Q6 (a) Describe the outline classification of fungi . **CO1, K2** 10M
(OR)
(b) Explain the reproductive structures and mechanism of reproduction in different classes of fungi. **CO1, K2** 10M

7. (a) Define note on role of fungi in various fields of biotechnology. **CO2,K1** 10M
(OR)
(b) Describe the cultivation of white button mushrooms,. **CO2,K1** 10M

8. (a) Give an outline classification of algae .**CO3,K2** 10M
(OR)
(b) Describe different modes of reproduction in algae with examples. .**CO3,K2** 10M

9. (a) Explain the importance of algae in agriculture, industry. **CO4,K2** 10M
(OR)
(b) Discuss algal culture techniques in small and large-scale production. **CO4,K2** 10M

10. (a) Detail about pathogenicity and life cycle , causative agent of malaria **CO5,K2** 10M
(OR)
(b) explain about process of culturing protozoans from natural resources **CO5,K2** 10M

Course Code							
Title of the Course				BIOMOLECULES AND ENZYMOLOGY			
Offered to: (Programme/s)				B.Sc Honors – Microbiology and Food Science and Technology			
L	4	T	0	P	0	C	3
Year of Introduction:		2024-25		Semester:		3	
Course Category:		Major & Minor		Course Relates to:		Global	
Year of Revision:		NA		Percentage:		NA	
Type of the Course				Employability			
Crosscutting Issues of the Course				Environment and Sustainability			
Pre-requisites, if any				Basics of Biochemistry			

Course Description:
An overview of the course content and objectives.

This course provides a comprehensive introduction to key biochemical compounds and their roles in biological systems. It covers carbohydrates, exploring their classification, structure, and significance, including monosaccharides, disaccharides, and polysaccharides. It delves into lipids and fatty acids, examining their properties, classifications, and functions, including triglycerides, phospholipids, and steroids. It focuses on amino acids and proteins, highlighting their structures and classifications. It discusses nucleic acids and vitamins, emphasizing their structures and metabolic roles. It explores enzymes, detailing their structures, classifications, mechanisms of action, and factors affecting their activity. This course is essential for understanding the molecular foundations of life.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	Providing the background knowledge on the general characteristics and classification of carbohydrates.
2	Providing the required knowledge on structure and importance of lipids and fatty acids in biological systems.
3	Acquainting the students, to identify the biochemical structure of amino acids and protein structure
4	Understanding the structure and functions of DNA and RNA, along with the role of vitamins in metabolic processes.
5	Analysing enzyme structure and classification, and evaluate the mechanisms of enzyme action, including factors that influence enzyme activity and inhibition.

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	1. Understand the classification and properties of carbohydrates, including monosaccharides, disaccharides, polysaccharides, and sugar derivatives	K2	1	1
CO2	2. Gain knowledge of lipids and fatty acids, including their classification, structures, functions, and their role in cell signaling and metabolism.	K1	1	1
CO3	3.Comprehend the structure and functions of amino acids and proteins, including their primary, secondary, tertiary, and quaternary structures.	K2	1	1
CO4	4. Learn about the structure and functions of nucleic acids, including DNA and RNA, as well as the concept of base composition and nucleic acid- protein interactions. They will also be introduced to the role of vitamins in metabolism.	K3	1	1
CO5	5. Understand the structure of enzymes, enzyme classification, and mechanisms of action. They will also learn about the factors influencing enzyme activity and various types of enzyme inhibition.	K2	1	1

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	3							3	
CO2	3							3	
CO3	3							3	
CO4	3							3	
CO5	3							3	

Use the codes 3, 2, 1 for High, Moderate and Low correlation Between CO-PO-PSO respectively.

Course Structure:

Unit – 1 : Carbohydrates (12Hrs)

Content:

1. General characters and outline classification of Carbohydrates
2. Monosaccharides- Glucose, fructose, ribose; Stereo isomerism of monosaccharides, epimers, mutarotation and anomers of glucose
3. Disaccharides- concept of reducing and non-reducing sugars; Sucrose, Lactose
4. Polysaccharides- Storage -Starch, glycogen, Structural – Cellulose, peptidoglycan and chitin

Examples/Applications/Case Studies:

- Assignment on Classification of carbohydrates
- Assignment on Polysaccharides

Exercises/Projects:

EXERCISE – 1
Instructions:
Students work in groups of 2-3 students per group
1. Fill out the table (20 minutes). Try your best to complete all parts of the table.
2. When you're done, exchange your completed table with another group.
3. Correct any mistakes you may find in the answers (15 minutes). Do not return the corrected table yet to the group with which you exchanged answers.
4. Answer the clicker questions presented by your teacher on screen.
5. Examine your corrected table and correct any mistakes you may still find (5 minutes). Return the corrected table to the group with which you exchanged answers.

Molecule	Type of biomolecule (be specific)	Functional groups found in molecule	Elements found in molecule	C:H:O ratio (approx.)	Monomers composing polymer	Type of linkage connecting monomers (be specific)	Type of Organisms Where molecule is found	Functions in living organisms
Glucose								
Glycogen								
Cellulose								
Chitin								
Sucrose								
Lactose								

EXERCISE – 2
You were given 3 samples and told that 1 of them is a monosaccharide, 1 is an oligosaccharide, and 1 is a protein. The samples are in test tubes marked 1, 2, and 3. You don't know which compound is in which tube. You were instructed to analyze the tubes in order to identify their content.
The results of your analysis are as follows:
Tube 1 tested positive for S.
Hydrolysis reactions occurred in tubes 1 and 3, but not tube 2.
Which tube contained the monosaccharide? The oligosaccharide?

A. 1 and 2
B. 2 and 3
C. 1 and 3
D. Not enough information is provided.

Specific Resources: (web)

- https://www.medicalnewstoday.com/articles/161547
- https://byjus.com/biology/carbohydrates/
- https://www.britannica.com/science/carbohydrate

Unit – 2 : Lipids and fatty acids (12Hrs)

Content:

1.Definition and classification of lipids. Structure and properties of lipids. Importance of lipids in biological systems.

2. Introduction to fatty acids: definition, structure, and nomenclature. Saturated and unsaturated fatty acids.

3.Triglycerides: structure, function, and metabolism. Phospholipids: structure, function, and role in cell membranes. Steroids(Cholesterol): structure, biosynthesis, and physiological roles. Waxes: structure, functions, and applications.

Examples/Applications/Case Studies:

- Assignment on Classification of lipids
- Assignment on Phospholipids

Exercises/Projects:

EXERCISE – 1

Students work in groups of 2-3 students per group

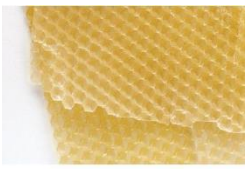
1. Fill out the table (20 minutes). Try your best to complete all parts of the table.
2. When you're done, exchange your completed table with another group.
3. Correct any mistakes you may find in the answers (15 minutes). Do not return the corrected table yet to the group with which you exchanged answers.
4. Answer the clicker questions presented by your teacher on screen.
5. Examine your corrected table and correct any mistakes you may still find (5 minutes). Return the corrected table to the group with which you exchanged answers.

Type of biomolecule found in molecule	Functional groups molecule	Elements Molecule found in (be specific)	C:H:O ratio (approx.)	Molecular arrangement (description of main components)	Type of linkage (be specific)	Type of organisms where molecule is found	Functions in living organisms
Cholesterol							
Oleic acid							
Cephalin							
Stearin							

EXERCISE – 2

Which of the pairs to the right (image/chemical structure is matched)

(A)



Beeswax

(B)

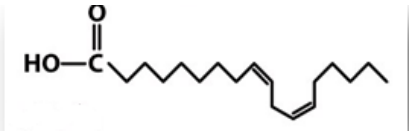
Safflower oil

(C)

Butter

(D)

Safflower oil



Specific Resources: (web)

- https://www.britannica.com/science/lipid
- https://bio.libretexts.org/Bookshelves/Human_Biology/Human_Biology_(Wakim_and_Grewal)/03%3A_Chemistry_of_Life/3.06%3A_Lipids
- https://www.fao.org/4/x5738e/x5738e05.htm

Unit – 3: Amino acids and Proteins (12Hrs)

Content:

1. Biochemical structure and notation of standard protein amino acids
2. General characteristics of amino acids and proteins.
3. Primary, secondary, tertiary and quaternary structures of Protein
4. Non protein amino acids: D-alanine and D- glutamic acid.

Examples/Applications/Case Studies:

- Assignment on Classification of Amino acids
- Assignment on Structure of protein

Exercises/Projects:

EXERCISE – 1

Students work in groups of 2-3 students per group

1. Fill out the table (20 minutes). Try your best to complete all parts of the table.
2. When you're done, exchange your completed table with another group.
3. Correct any mistakes you may find in the answers (15 minutes). Do not return the corrected table yet to the group with which you exchanged answers.
4. Answer the clicker questions presented by your teacher on screen.
5. Examine your corrected table and correct any mistakes you may still find (5 minutes). Return the corrected table to the group with which you exchanged answers.

Amino acid	Abbreviatio	Chemical	Special	Essential /	Polarity of	Glucogenic/

	n 3 Letters	structure 1 Letter	group	Non-essential amino acid	amino acid	Ketogenic amino acid
Valine						
Tyrosine						
Methionine						
Arginine						
Glutamic acid						
Tryptophan						
Proline						

EXERCISE – 2
Activity Title: "Fold the Protein"
Objective: Students will learn about the four levels of protein structure by drawing and labeling each level on paper.
Materials: Paper, Pens or pencils, Colour markers (optional, for more clarity)

Procedure: Drawing Protein Structures

- Draw the Primary Structure (5 minutes)
- Ask students to draw a straight chain of 5-7 amino acids (as simple circles or squares connected by lines).
- Have them label each "amino acid" with a letter (e.g., G for glycine, A for alanine, etc.).
- Explain that this is the primary structure (the amino acid sequence).

- Draw the Secondary Structure (5 minutes)
- Ask students to fold their chain into either an alpha-helix or beta-sheet:
- Draw a spiral to represent an alpha-helix or a zigzag patternfor a beta-sheet.
- Label this as the secondary structure and note the type of folding (alpha-helix or beta-sheet).

- Draw the Tertiary Structure (5 minutes)
- Ask students to fold the secondary structure into a complex 3D shape by adding loops and bends to the chain. This represents the tertiary structure.
- Encourage students to label interactions like hydrophobic/hydrophilic interactions, hydrogen bonds, and disulphide bridges.

- Draw the Quaternary Structure (5 minutes)
- For the quaternary structure, students should draw two or more tertiary structures interacting together.
- This can be represented by drawing two folded chains that interact with each other (e.g., hemoglobin with multiple subunits).

Specific Resources: (web)

- https://www.ncbi.nlm.nih.gov/books/NBK26830/
- https://www.fao.org/4/x5738e/x5738e04.htm#1.1%20classification
- https://projects.iq.harvard.edu/files/lifesciences1abookv1/files/5_-_proteins_and_amino_acids_revised_9-24-2018.pdf

Unit – 4: Nucleic acids and Vitamins (12Hrs)
Content:

1. Structure and functions of DNA and RNA.
2. Base composition. A+T and G+C rich genomes
3. Concept and types of vitamins and their role in metabolism

Examples/Applications/Case Studies:

- Assignment on Structure of DNA
- Assignment on Different types of vitamins

Exercises/Projects:

EXERCISE – 1
Activity Title: "Build a DNA Model"
Objective: Students will learn about the structure of DNA by creating a simple paper model that demonstrates the double helix and complementary base pairing.
Materials: Paper, Pens or pencils, Colored markers or crayons (optional, for color-coding), Scissors (optional, for cutting)
Procedure: Create the DNA Model

STEP 1: Draw the DNA Backbone
- Ask students to draw two vertical lines (about 6 inches long) on their paper. These represent the sugar-phosphate backbones of the DNA.
- Have them label the top of one line as 5' (five-prime) and the bottom as 3' (three-prime). On the other line, label the top as 3' and the bottom as 5', to show the anti-parallel nature of DNA.

STEP 2: Add the Base Pairs
- Between the two lines, have students draw horizontal lines connecting the two vertical lines to represent the base pairs.
- In each space, students should write one of the following pairs: A-T or C-G. Explain that A always pairs with T, and C always pairs with G.
- You can ask students to draw at least 6 base pairs for a short DNA sequence.

STEP 3: Color-Coding
- If colored markers are available, students can color-code the bases:
- Use one color for Adenine (A), another for Thymine (T), another for Cytosine (C), and another for Guanine (G).
- They can also color the sugar-phosphate backbone in another color to differentiate it from the base pairs.

STEP 4: Twist the DNA
- For a more visual representation, students can gently twist their paper model to simulate the double helix structure of DNA.
- If they used scissors to cut out the backbone and base pairs, they can actually twist the paper to see the 3D shape.

Review and Discussion:
- After students finish their models, discuss the following concepts:
- Complementary base pairing: How A pairs with T, and C pairs with G.
- Antiparallel strands: How one strand runs 5' to 3', and the other runs 3' to 5'.
- How the structure of DNA allows it to store genetic information and replicate during cell division.

EXERCISE – 2

Students work in groups of 2-3 students per group

1. Fill out the table (20 minutes). Try your best to complete all parts of the table.
2. When you're done, exchange your completed table with another group.
3. Correct any mistakes you may find in the answers (15 minutes). Do not return the corrected table yet to the group with which you exchanged answers.
4. Answer the clicker questions presented by your teacher on screen.
5. Examine your corrected table and correct any mistakes you may still find (5 minutes). Return the corrected table to the group with which you exchanged answers.

Vitamins	Chemical Name	Solubility	Functions	Food Sources	Deficiency symptoms
Vitamin - A					
Vitamin -K					
Vitamin - C					
Vitamin - E					
Vitamin - D					
Vitamin - B					

Specific Resources: (web)

- https://byjus.com/chemistry/function-nucleic-acids/
- https://www.britannica.com/science/nucleic-acid
- https://byjus.com/chemistry/nucleic-acids/

Unit – 5: Enzymes (12Hrs)

Content:

1. Structure of enzyme, Apoenzyme and cofactors, prosthetic group , coenzyme -NAD, metal cofactors; Definitions of terms – enzyme unit and specific activity
2. Classification of enzymes, Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis.
3. Effect of pH and temperature on enzyme activity.
4. Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric.

Examples/Applications/Case Studies:

- Assignment on Classification of enzymes
- Assignment on Inhibition of enzyme activity

Exercises/Projects:

EXERCISE – 1

Students work in groups of 2-3 students per group

1. Fill out the table (20 minutes). Try your best to complete all parts of the table.
2. When you're done, exchange your completed table with another group.
3. Correct any mistakes you may find in the answers (15 minutes). Do not return the corrected table yet to the group with which you exchanged answers.
4. Answer the clicker questions presented by your teacher on screen.

5. Examine your corrected table and correct any mistakes you may still find (5 minutes). Return the corrected table to the group with which you exchanged answers.

Enzyme Class	Type of reaction catalysed	Example enzyme	Enzyme commission number	Substrate	Product	Enzymatic reaction
Oxidoreductase						
Transferases						
Hydrolases						
Lyases						
Isomerases						
Ligases						

EXERCISE – 2

Students work in groups of 2-3 students per group

1. Fill out the table (20 minutes). Try your best to complete all parts of the table.
2. When you're done, exchange your completed table with another group.
3. Correct any mistakes you may find in the answers (15 minutes). Do not return the corrected table yet to the group with which you exchanged answers.
4. Answer the clicker questions presented by your teacher on screen.
5. Examine your corrected table and correct any mistakes you may still find (5 minutes). Return the corrected table to the group with which you exchanged answers.

Type of enzyme inhibition	Inhibitor binding site	Effect on Vmax	Effect on Km	Can it be overcome by increasing substrate	Examples
Competitive					
Non-Competitive					
Un-Competitive					

Specific Resources: (web)

- https://en.wikipedia.org/wiki/Help:Introduction
- https://www.britannica.com/science/enzyme
- https://allen.in/jee/chemistry/enzyme-catalyst?utm_source=Google&utm_medium=cpc&utm_campaign=EDM_PURCHASE_GOOGLE_PMAX_ALL_ALL_SACHET_Class10_BoardPrep_PAN-INDIA_2425_202408&gad_source=1&gclid=Cj0KCQjwiuC2BhDSARIsALOVfBL3wnjVslOeM_EsELs-bf-Ok_qDt2_Fhh6p5aXIWL8GUQLPDmm9kZAaAuGTEALw_wcB]

Text Books:

1. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2 nd Edition, CBS Publishers and Distributors, New Delhi.

2. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

Reference Books:

1. Microbial Physiology and Metabolism, W.C. Brown Publications,Iowa, USA.

2. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
3. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons
4. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.

Course Code							
Title of the Course				BIOMOLECULES AND ENZYMOLOGY PRACTICAL			
Offered to: (Programme/s)				B.Sc Honors – Microbiology and Food Science and Technology			
L	0	T	0	P	2	C	1
Year of Introduction:		2024-25		Semester:		3	
Course Category:		Major & Minor		Course Relates to:		Global	
Year of Revision:		NA		Percentage:		NA	
Type of the Course				Employability			
Crosscutting Issues of the Course				Environment and Sustainability			
Pre-requisites, if any				Basics of Biochemistry			

Course Description:

An overview of the course content and objectives.

This course provides a comprehensive introduction to key biochemical compounds and their roles in biological systems. It covers carbohydrates, exploring their classification, structure, and significance, including monosaccharides, disaccharides, and polysaccharides. It delves into lipids and fatty acids, examining their properties, classifications, and functions, including triglycerides, phospholipids, and steroids. It focuses on amino acids and proteins, highlighting their structures and classifications. It discusses nucleic acids and vitamins, emphasizing their structures and metabolic roles. It explores enzymes, detailing their structures, classifications, mechanisms of action, and factors affecting their activity. This course is essential for understanding the molecular foundations of life.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	Providing the background knowledge on the general characteristics and classification of carbohydrates.
2	Providing the required knowledge on structure and importance of lipids and fatty acids in biological systems.
3	Acquainting the students, to identify the biochemical structure of amino acids and protein structure
4	Understanding the structure and functions of DNA and RNA, along with the role of vitamins in metabolic processes.
5	Analysing enzyme structure and classification, and evaluate the mechanisms of enzyme action, including factors that influence enzyme activity and inhibition.

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	1. Understand the classification and properties of carbohydrates, including monosaccharides, disaccharides, polysaccharides, and sugar derivatives	K2	1	1

CO2	2. Gain knowledge of lipids and fatty acids, including their classification, structures, functions, and their role in cell signaling and metabolism.	K1	1	1
CO3	3.Comprehend the structure and functions of amino acids and proteins, including their primary, secondary, tertiary, and quaternary structures.	K2	1	1
CO4	4. Learn about the structure and functions of nucleic acids, including DNA and RNA, as well as the concept of base composition and nucleic acid- protein interactions. They will also be introduced to the role of vitamins in metabolism. metabolism.	K3	1	1
CO5	5. Understand the structure of enzymes, enzyme classification, and mechanisms of action. They will also learn about the factors influencing enzyme activity and various types of enzyme inhibition.	K2	1	1

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	3							3	
CO2	3							3	
CO3	3							3	
CO4	3							3	
CO5	3							3	

Use the codes 3, 2, 1 for High, Moderate and Low correlation Between CO-PO-PSO respectively.

Course Structure

Unit 1: Carbohydrates (10Hrs)
Lab 1: Qualitative tests for sugars (Glucose, lactose)

- **Dataset**: https://youtu.be/ojhdTFmkY1c?si=h1TSMcPcIx0jFL3k

- **A Brief Description:** Qualitative tests for sugars like glucose and lactose help identify their presence in a sample.

Glucose:

1. **Benedict's Test:** When glucose is mixed with Benedict's reagent and heated, a color change from blue to green, yellow, or brick-red indicates the presence of reducing sugars like glucose.
2. **Fehling's Test:** Similar to Benedict's, this test uses Fehling's solution and produces a red precipitate when glucose is present.

Lactose:

1. **Benedict's Test:** Lactose also reacts positively in Benedict's test, producing a color change, but may require more time due to its lower reducing ability compared to glucose.
2. **Lactose Test Strips:** Specific test strips can detect lactose by changing color upon exposure, confirming its presence.

Unit 3: Amino acids and Proteins (10Hrs)
Lab 2: Qualitative Analysis of Amino acids (Tryptophan, Proline)

- **Dataset**: https://youtu.be/j5xEqTXNAwE?si=KUQpQLYHm-2cdM6-
- **A Brief Description:** Qualitative analysis of amino acids like tryptophan and proline involves specific tests to identify their presence in a sample.

Tryptophan:

1. **Ninhydrin Test:** Tryptophan produces a blue or purple color when treated with ninhydrin, indicating the presence of free amino groups.
2. **Sakaguchi Test:** This test detects tryptophan by forming a reddish-purple color when tryptophan reacts with a solution of α-naphthol and sodium hypochlorite.

Proline:

1. **Ninhydrin Test:** Proline gives a yellow color instead of blue or purple due to its secondary amine structure, allowing for differentiation from other amino acids.
2. **Collins Test:** This involves treating the sample with ninhydrin and a specific reagent to yield a pink color, confirming the presence of proline.

These tests help distinguish these amino acids based on their unique chemical reactions.
Unit 4: Nucleic acids and Vitamins (5Hrs)
Lab 3: Colorimetric estimation DNA by diphenylamine method

- **Dataset**: https://youtu.be/Q799WUT8VQo?si=NPpbIpOuRx1yGBvS
- **A Brief Description:** The diphenylamine method is a colorimetric technique used for the estimation of DNA in a sample. This method relies on the reaction of diphenylamine with deoxyribose, a sugar component of DNA. When DNA is treated with concentrated sulfuric acid and diphenylamine, a blue-colored complex forms, indicating the presence of DNA. The intensity of the color produced is proportional to the DNA concentration in the sample. After incubation, the absorbance is measured using a spectrophotometer at a specific wavelength (typically around 600 nm). This allows for quantification by comparing the absorbance to a standard curve generated from known DNA concentrations.

Unit 4: Amino acids and Proteins (5Hrs)
Lab 4: Colorimetric estimation of proteins by Biuret method

- **Dataset** https://youtu.be/RSAo9qPV5R4?si=Rmee0riTbqmBG0uL
- **A Brief Description:** The Biuret method is a colorimetric technique used to estimate protein concentration in a sample. This method relies on the presence of peptide bonds in proteins. When proteins react with Biuret reagent (a mixture of copper sulfate, sodium hydroxide, and potassium sodium tartrate), a light blue color develops due to the formation of a complex between copper ions and the peptide bonds.

Procedure:

1. **Sample Preparation:** The protein sample is diluted as needed.
2. **Reagent Addition:** Biuret reagent is added to the sample.
3. **Incubation:** The mixture is allowed to incubate for a few minutes.

4. **Measurement:** The absorbance is measured at a wavelength of 540 nm using a spectrophotometer.

The intensity of the blue color is directly proportional to the protein concentration, allowing for quantification by comparing the absorbance to a standard curve created with known protein concentrations. This method is widely used due to its simplicity and sensitivity.

References:

4. K.R.Aneja ,Experiments in Microbiology ,Plant patology and biotechnology,New Age International publication Ltd
5. R.C.Dubey and D.K.Maheshwari,2002, Practical Microbiology,S.chand &company ltd
6. Cappuccino,Sherman,2006,Microbiology Alaboratory Mannual6th edition,Pearson Education

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SRI DURGA MALLESWARA SIDDHARTHA MAHILA KALASALA,
VIJAYAWADA 10
SEMESTER END EXAMINATION
MODEL QUESTION PAPER

Course Code: **Max. Marks: 70**
Title of the Paper: Biomolecules and Enzymology **Max.Time: 3 Hours**

SECTION – A

ANSWER THE FOLLOWING: **5X4=20M**

Q1 (a) Differentiate Reducing and Non-reducing sugars with examples. **CO1, K2** 4M

OR

(b) Define monosaccharides and explain structure of glucose. **CO1, K1** 4M

Q2 (a) Explain different types of fatty acids. **CO2, K2** 4M

OR

(b) Discuss structure, function of Triglycerides. **CO2,K2** 4M

Q3 (a) Discuss the general characteristics of amino acids. **CO3,K2** 4M

OR

(b) Explain non-protein amino acids with examples **CO3,K2** 4M

Q4 (a) Classify different types of RNA. **CO4, K3** 4M

OR

(b) Detail role of Vitamin – B **CO4, K2** 4M

Q5 (a) Express the characters of co-enzymes & co-factors. **CO5, K3** 4M

OR

(b) Determine the effect of temperature on enzyme activity. **CO5, K3** 4M

Section – B

ANSWER THE FOLLOWING: **5X10=50M**

Q6. (a) Classify the carbohydrates and state their functions. **CO1, K3** 10M

(OR)

(b). Compare and contrast the structures and functions of storage and structural polysaccharides. **CO1, K2** 10M

Q7. (a) Classify the lipids based on their chemical structure and properties. **CO2, K3** 10M

(OR)

(b) Discuss the structure and function of phospholipids, focusing on their role in cell membrane. **CO2, K2** 10M

Q8. (a) Illustrate the biochemical structure of standard protein amino acids along with notation used to represent amino acids. **CO3, K3** 10M

(OR)

(b) Express a brief note on primary, secondary, tertiary and quaternary structure of proteins. **CO3, K3** 10M

Q9. (a) Draw and explain structure of DNA, including its double helix shape, nucleotide components and base pairing. **CO4, K3** 10M

(OR)

(b) Classify vitamins into water-soluble and fat-soluble. Write a note on their role in metabolism. **CO4, K3** 10M

Q10. (a) Classify enzymes based on their catalytic activities and substrate specificity, using the Enzyme Commission (EC) numbering system. **CO5, K3** 10M

(OR)

(b) Draw a neat labelled diagrams and explain different types of enzyme inhibitions. **CO5, K3** 10M

Course Code							
Title of the Course				**MICROBIAL AND ANALYTICAL TECHNIQUES**			
Offered to: (Programme/s)				**B.Sc Honors – Microbiology**			
L	**4**	**T**	**0**	**P**	**0**	**C**	**3**
Year of Introduction:		**2024-25**		**Semester:**		**3**	
Course Category:		**Major**		**Course Relates to:**		**Global**	
Year of Revision:		**NA**		**Percentage:**		**NA**	
Type of the Course				**Skill development**			
Crosscutting Issues of the Course				**Environment and Sustainability**			
Pre-requisites, if any				**Basics of Microbiology**			

Course Description:

An overview of the course content and objectives.

This course offers a comprehensive overview of essential techniques in microbiology and analytical methods. The course introduces microscopy, covering bright field and electron microscopy principles, mechanisms, and staining techniques. It explores sterilization and disinfection methods, including physical and chemical agents for microbial control. It focuses on microbiological techniques for pure culture isolation, maintenance, and anaerobic cultivation. It examines spectrophotometry and chromatography, detailing principles and applications of various methods. It also discusses centrifugation, electrophoresis, and the use of radioisotopes, highlighting their roles in microbiological research. This course is vital for understanding laboratory techniques in microbiology.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	Understanding the principles and applications of various microscopy techniques, including bright field and electron microscopy.
2	Providing knowledge on different sterilization and disinfection methods, including their physical and chemical agents.
3	Acquainting the students, to develop skills in pure culture isolation, maintenance, and the cultivation of various microorganisms.
4	Understanding the principles and applications of spectrophotometry and chromatography techniques.
5	Understanding the principles and uses of centrifugation, electrophoresis, and radioisotopes in microbiological research.

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	1. Understand the principles and applications of microscopy techniques, including bright field microscopy and electron microscopy (SEM and TEM), as well as staining techniques.	K2	1,2	1,2
CO2	Know various sterilization and disinfection techniques, including physical methods (dry heat, moist heat, filtration, radiation) and chemical methods (disinfectants, alcohols, aldehydes, fumigants, phenols, halogens, heavy metals).	K1	1,2	1,2
CO3	3. Perform pure culture isolation, maintenance and preservation of cultures, cultivation of anaerobic bacteria.	K3	1,2	1,2
CO4	4. Understand the principles and applications of spectrophotometry and chromatography techniques, including UV-visible spectrophotometry, colorimetry, turbidometry, paper chromatography, and column chromatography.	K2	1,2	1,2
CO5	5. Gain knowledge of centrifugation principles and applications, electrophoretic techniques (agarose and SDS polyacrylamide gel), and the principles and applications of radioisotopes	K3	1,2	1,2

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	3	2						3	2
CO2	3	2						3	2
CO3	3	2						3	2
CO4	3	2						2	2
CO5	3	2						2	2

Use the codes 3, 2, 1 for High, Moderate and Low correlation Between CO-PO-PSO respectively

Course Structure:

Unit – 1 : Microscopy (12Hrs)

Content:

1 Microscopy: Principle, mechanism and applications of Bright field microscope.
2 Principle, mechanism and applications of electron microscope (SEM and TEM). Micrometry.
3 Staining Techniques – Simple, negative and Differential staining techniques (Gram staining, spore staining, Acid fast staining).

Examples/Applications/Case Studies:

- Assignment on electron microscopy
- Assignment on staining techniques

Exercises/Projects:

EXERCISE – 1

Students work in groups of 2-3 students per group

1. Fill out the table (20 minutes). Try your best to complete all parts of the table.
2. When you're done, exchange your completed table with another group.
3. Correct any mistakes you may find in the answers (15 minutes). Do not return the corrected table yet to the group with which you exchanged answers.
4. Answer the clicker questions presented by your teacher on screen.
5. Examine your corrected table and correct any mistakes you may still find (5 minutes). Return the corrected table to the group with which you exchanged answers.

Questions	**options**	**Answers**	**explanations**
1. What is the main advantage of Scanning Electron Microscopy (SEM) over Transmission Electron Microscopy (TEM)?	A) Higher resolution B) 3D imaging C) Faster sample preparation D) Better contrast		
2. Which type of electron microscope would you use to examine the internal structure of a cell?	A) SEM B) TEM C) STM D) AFM		
3. In which type of electron microscope does the electron beam scan over the surface of a sample, producing secondary electrons?	A) TEM B) SEM C) XPS D) FIB		
4. What is a major disadvantage of Transmission Electron Microscopy (TEM) compared to Scanning Electron Microscopy (SEM)?	A) Lower resolution B) Requires extensive sample preparation C) Cannot image biological samples D) More expensive		
5. Which type of electron microscope uses a transmitted electron beam to create an image?	A) SEM B) TEM C) STM D) XPS		

EXERCISE – 2

1. **What is the primary purpose of differential staining techniques in microbiology?**
   - A) To measure the size of microorganisms
   - B) To differentiate between different types of cells or microorganisms
   - C) To culture bacteria
   - D) To sterilize laboratory equipment
2. **Which of the following staining techniques is used to distinguish between Gram-positive and Gram-negative bacteria?**
   - A) Acid-fast staining
   - B) Gram staining
   - C) Endospore staining
   - D) Simple staining
3. **In the Gram staining procedure, what is the role of iodine?**
   - A) To stain the cells
   - B) To decolorize the cells

- C) To act as a mordant that fixes the primary stain
- D) To wash out the stain

Specific Resources: (web)

- https://en.wikipedia.org/wiki/Microscopy
- https://microbenotes.com/electron-microscope-principle-types-components-applications-advantages-limitations/

Unit – 2 : Sterilization and disinfection techniques (12Hrs)

Content:

1.Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Virucide, Bacteriostatic and Bactericidal agent. Physical methods of microbial control: Dry heat-Incineration, Hot air oven; Moist heat- Pressure cooker, autoclave; Filter sterilization- laminar air flow, Membrane filter; Radiation methods – UV rays, Gamma rays.

2. Chemical methods of microbial control: disinfectants, types and mode of action : alcohols, aldehydes, fumigants, phenols, halogens and heavy metals.

Examples/Applications/Case Studies:

- Assignment on physical sterilization
- Assignment on chemical sterilization

Exercises/Projects:

EXERCISE – 1

METHODS	TEMPERATURE	MATERIALS USED FOR STERILIZATION
Hot air oven		
Inspissation		
Pasteurization **A)Flash method** **B)Holder method**		
Tyndalization		
Autoclave		
Boiling		

EXERCISE – 2

Activity: Exploring Chemical Sterilization

Objective:

To understand the principles and effectiveness of different chemical sterilants.

Specific Resources: (web)

- https://www.colorado.edu/ehs/resources/disinfectants-sterilization-methods#:~:text=Steam%20sterilization%20for%20at%20least,been%20found%20to%20be%20effective.
- https://www.sciencedirect.com/topics/chemistry/sterilization-and-disinfection
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7158362/

Unit – 3 : Microbiological techniques (12Hrs)

Content:

1 Pure culture isolation: Streaking, serial dilution and plating methods, micromanipulator; cultivation.

2 Maintenance and preservation/stocking of pure cultures: sub culturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature, Culture collection centers(MTCC, ATCC)

3 Cultivation of anaerobic bacteria;. Buffers in culture medium. Cultivation of fungi, Actinomycetes, yeasts.

Examples/Applications/Case Studies:

- Assignment on Pure culture isolation techniques
- Assignment on Maintenance and preservation of pure cultures

Exercises/Projects:

EXERCISE – 1

	Description	**Frequency**	**Notes**
Preparation of Stock Culture			
Storage of Stock Culture			
Subculturing			
Cryopreservation			

EXERCISE – 2 exercise on colony counting using Quebec colony counter

Culture Plate	**No. of colonies**
Culture Plate - 1	
Culture Plate - 2	
Culture Plate - 3	

Specific Resources: (web)

- https://conductscience.com/microbiology-techniques/?srsltid=AfmBOoqAhLhH7QTpsbdpPzKqbP-6mwBxBsV8tBw5nJI4ecyeXqftgSVB
- https://spada.uns.ac.id/pluginfile.php/266059/mod_resource/content/1/Maintenance%20and%20Preservation%20of%20Pure%20Cultures%20of%20Bacteria.pdf#:~:text=Pure%20cultures%20can%20be%20successfully,slowed%20down%20but%20not%20stopped.
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2687301/

Unit – 4: Spectrophotometry & Chromatography (12Hrs)

Content:

1 Spectroscopy – Principles, laws of light absorption, Instrumentation and applications of UV-visible spectrophotometer. Colorimetry .

2 Chromatography: Principles and applications of paper chromatography (Ascending, Descending and 2-D), Thin layer chromatography.

3 Principle and applications of column chromatography (Partition, adsorption, ion exchange, exclusion and affinity chromatography)..

Examples/Applications/Case Studies:

- Assignment on Spectroscopy
- Assignment on Chromatography

Exercises/Projects:

EXERCISE – 1

Application	**Type of Chromatography**
1. Analyzing volatile compounds in essential oils	a. Gas Chromatography (GC)

2. Separating pigments in plant extracts	b. Paper Chromatography
3. Identifying amino acids in a mixture	c. Thin Layer Chromatography (TLC)
4. Purifying pharmaceutical compounds	d. Liquid Chromatography (LC)

EXERCISE – 2

Project on estimating bacterial growth using calorimeter

Time	O.D Value
2 Hours	
4 Hours	
6 Hours	
8 Hours	
10 Hours	

Specific Resources: (web)

- https://www.sciencedirect.com/topics/earth-and-planetary-sciences/spectrophotometry
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4883093/
- https://www.sciencedirect.com/science/article/abs/pii/S0167924497800108#:~:text=The%20objective%20of%20chromatography%20is,phase%20and%20a%20moving%20phase.

Unit – 5 : Centrifugation, Electrophoresis & Radio isotopes (12Hrs)

Content:

1 Centrifugation-Principles, types and applications.

2 Electrophoretic technique (agarose and SDS polyacrylamide gel) its Components, working principle and applications

3 Radioisotopes– characters and applications of radioisotopes, principle of autoradiography

Examples/Applications/Case Studies:

- Assignment on Electrophoretic techniques
- Assignment on autoradiography

Exercises/Projects:

EXERCISE – 1

Centrifugation of blood

RPM	Components separated
1200	
1500	
2000	
2500	
3000	

EXERCISE – 2

Role of Radioisotopes in molecular diagnosis

Radioisotopes	Role in diagnosis

Specific Resources: (web)

- https://www.sciencedirect.com/science/article/abs/pii/S0075753508703036
- https://ehss.energy.gov/ohre/roadmap/achre/intro_9_4.html
- https://www.cambridge.org/core/books/abs/principles-and-techniques-of-biochemistry-and-molecular-biology/centrifugation/6E6EEDCDADD02F952F4A4C75F9D8113A

Course Code							
Title of the Course				**MICROBIAL AND ANALYTICAL TECHNIQUES PRACTICALS**			
Offered to: (Programme/s)				**B.Sc Honors – Microbiology**			
L	**0**	**T**	**0**	**P**	**2**	**C**	**1**
Year of Introduction:		**2024-25**		**Semester:**		**3**	
Course Category:		**Major**		**Course Relates to:**		**Global**	
Year of Revision:		**NA**		**Percentage:**		**NA**	
Type of the Course				**Skill development**			
Crosscutting Issues of the Course				**Environment and Sustainability**			
Pre-requisites, if any				**Basics of Microbiology**			

Course Description:

An overview of the course content and objectives.

This course offers a comprehensive overview of essential techniques in microbiology and analytical methods. The course introduces microscopy, covering bright field and electron microscopy principles, mechanisms, and staining techniques. It explores sterilization and disinfection methods, including physical and chemical agents for microbial control. It focuses on microbiological techniques for pure culture isolation, maintenance, and anaerobic cultivation. It examines spectrophotometry and chromatography, detailing principles and applications of various methods. It also discusses centrifugation, electrophoresis, and the use of radioisotopes, highlighting their roles in microbiological research. This course is vital for understanding laboratory techniques in microbiology.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	Understanding the principles and applications of various microscopy techniques, including bright field and electron microscopy.
2	Providing knowledge on different sterilization and disinfection methods, including their physical and chemical agents.
3	Acquainting the students, to develop skills in pure culture isolation, maintenance, and the cultivation of various microorganisms.
4	Understanding the principles and applications of spectrophotometry and chromatography techniques.
5	Understanding the principles and uses of centrifugation, electrophoresis, and radioisotopes in microbiological research.

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	1. Understand the principles and applications of microscopy techniques, including bright field microscopy and electron microscopy (SEM and TEM), as well as staining techniques.	K2	1,2	1,2
CO2	Know various sterilization and disinfection techniques, including physical methods (dry heat, moist heat, filtration, radiation) and chemical methods (disinfectants, alcohols, aldehydes, fumigants, phenols, halogens, heavy metals).	K1	1,2	1,2
CO3	3. Perform pure culture isolation, maintenance and preservation of cultures, cultivation of anaerobic bacteria,	K3	1,2	1,2
CO4	4. Understand the principles and applications of spectrophotometry and chromatography techniques, including UV-visible spectrophotometry, colorimetry, turbidometry, paper chromatography, and column chromatography.	K2	1,2	1,2
CO5	5. Gain knowledge of centrifugation principles and applications, electrophoretic techniques (agarose and SDS polyacrylamide gel), and the principles and applications of radioisotopes	K3	1,2	1,2

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	3	2						3	2
CO2	3	2						3	2
CO3	3	2						3	2
CO4	3	2						2	2
CO5	3	2						2	2

Use the codes 3, 2, 1 for High, Moderate and Low correlation Between CO-PO-PSO respectively

Unit 1: (3Hrs)

Lab 1: Study of bright field, dark field and phase contrast, Electron microscope micrographs to visualize microbial cells.

- **Dataset**: https://youtu.be/I1YOvG10Y6U?si=x2v770CXlITa2zVj

• **A Brief Description:** The study of bright field, dark field, and phase contrast microscopy involves different techniques to visualize microbial cells. Bright field microscopy provides a clear view of stained specimens, highlighting structural details, while dark field microscopy enhances contrast by illuminating the sample with oblique light, making transparent cells more visible. Phase contrast microscopy allows visualization of live, unstained cells by converting phase shifts in light to brightness differences, enhancing detail without staining. Electron microscopy, on the other hand, uses electron beams to achieve much higher resolution micrographs, revealing fine structural details of microbial cells at the nanometer scale, offering ultimate insights into their morphology.

Unit 1: (4Hrs)
Lab 2: Simple staining & Negative staining
• **Dataset**: https://youtu.be/kaOJDG_PnDQ?si=HLkp7BbHZ5jbKCGE
• **A Brief Description: Simple Staining** and **Negative Staining** are two basic techniques used in microscopy to visualize microbial cells.

Simple Staining: This technique involves applying a single stain (such as methylene blue or crystal violet) to a heat-fixed microbial sample. The stain binds to cellular components, enhancing contrast and making the cells more visible under a microscope. Simple staining is useful for determining cell shape, arrangement, and basic structural features.

Negative Staining: In negative staining, an acidic dye (like India ink or nigrosin) is used, which does not penetrate the cells. Instead, it stains the background, leaving the microbial cells clear and more defined against a dark background. This technique is particularly effective for visualizing capsules, and it maintains the natural shape and size of the cells, making it suitable for observing delicate structures.

Unit 1: (4Hrs)
Lab 3: Gram's staining
• **Dataset**: https://youtu.be/sxa46xKfIOY?si=dbyNIonL163CnZ7X
• **A Brief Description: Gram's Staining** is a differential staining technique used to classify bacteria into two major groups: Gram-positive and Gram-negative.

Procedure:

1. **Crystal Violet Staining:** The bacterial smear is first stained with crystal violet, which penetrates all cells.
2. **Iodine Treatment:** Iodine is then applied to form a complex with the crystal violet, enhancing its retention in cells.
3. **Decolorization:** The slide is treated with alcohol or acetone, which washes out the dye from Gram-negative cells but not from Gram-positive cells.
4. **Counterstaining:** Finally, a counterstain, usually safranin, is applied. This stains the now colorless Gram-negative cells.

Results:

- **Gram-positive bacteria** retain the crystal violet stain and appear purple due to their thick peptidoglycan layer.
- **Gram-negative bacteria** take up the safranin counterstain and appear pink, characterized by a thinner peptidoglycan layer and an outer membrane.

Unit 2: (3Hrs)
Lab 4: Sterilization of medium using Autoclave, Sterilization of glassware using Hot Air Oven
- **Dataset**: https://youtu.be/qpDkvectqGE?si=wG5zq0cfcR4WVBn-
- **A Brief Description:**

Sterilization of Medium Using Autoclave: The autoclave sterilizes growth media and other heat-resistant materials using steam under high pressure (typically 121°C at 15 psi) for a specified time (usually 15-20 minutes). This method effectively kills bacteria, viruses, fungi, and spores by denaturing proteins and disrupting cellular structures, ensuring that the medium is free from contamination before use in microbial cultures.

Sterilization of Glassware Using Hot Air Oven: The hot air oven sterilizes glassware and metal instruments by using dry heat, typically at 160-180°C for 1-2 hours. This method kills microorganisms through oxidation of cellular components. It is effective for items that can withstand high temperatures without moisture, ensuring thorough sterilization and preventing contamination in microbiological procedures.

Unit 3: (4Hrs)
Lab 5: Isolation of pure cultures of bacteria by streaking method.
- **Dataset**: https://youtu.be/bm99zrq3ijo?si=OpdfFQ48qiMWUkwp
- **A Brief Description:** The **streaking method** is a widely used technique for isolating pure cultures of bacteria from a mixed population.

Procedure:

1. **Preparation:** A sterile agar plate is prepared, and a bacterial sample is obtained using a sterile inoculating loop.
2. **Streaking:** The loop is used to streak the sample across the surface of the agar in a specific pattern (often a quadrant method) to dilute the bacteria as you move across the plate.
3. **Incubation:** The plate is then incubated at an appropriate temperature, allowing individual bacterial cells to grow into separate colonies.

Unit 3: (3Hrs)
Lab 6: Isolation of bacteria from natural habitat by spread and pour plate method (using serial dilution method)
- **Dataset**: https://youtu.be/lCVl3l7GmRI?si=XOj-zBqqR9obB1OF
- **A Brief Description:** Isolation of Bacteria from Natural Habitat Using Spread and Pour Plate Methods involves culturing microorganisms from environmental samples through a series of dilutions.

Serial Dilution:

1. **Sample Preparation:** A natural sample (e.g., soil or water) is mixed with a sterile diluent (usually saline or broth).
2. **Dilution Series:** Serial dilutions are performed, where aliquots of the sample are diluted stepwise to reduce the concentration of bacteria.

Spread Plate Method:

1. **Inoculation:** A small volume (typically 0.1 mL) of the diluted sample is spread evenly across the surface of an agar plate using a sterile spreader.
2. **Incubation:** The plate is incubated to allow colonies to grow.

Pour Plate Method:

1. **Inoculation:** A small volume of the diluted sample is mixed with molten agar and poured into a Petri dish.
2. **Solidification and Incubation:** Once the agar solidifies, the plate is incubated, allowing both surface and subsurface colonies to develop.

Unit 4: (3Hrs)

Lab 7: Separation of amino acids by paper chromatography

- **Dataset**: https://youtu.be/w2wAYViQBXM?si=kBhzNZIR-BJqaq1w
- **A Brief Description:** Separation of Amino Acids by Paper Chromatography is a technique used to identify and separate individual amino acids from a mixture based on their differing affinities for the stationary and mobile phases.

Procedure:

1. **Preparation of the Chromatography Paper:** A strip of chromatography paper is marked with a baseline using a pencil.
2. **Sample Application:** A small spot of the amino acid mixture is applied on the baseline.
3. **Development:** The paper is placed in a solvent (the mobile phase), allowing the solvent to rise by capillary action. As it moves, it carries the amino acids with it.
4. **Separation:** Different amino acids travel at different rates due to variations in solubility and adsorption to the paper, resulting in distinct spots.

Visualization: After the solvent front has moved a sufficient distance, the paper is dried, and amino acids can be visualized using ninhydrin or UV light, allowing for identification based on the distance traveled relative to the solvent front.

Unit 5: (3Hrs)

Lab 8: Separation of bacterial cells (cell pellet) from broth culture by using a laboratory scale centrifuge.

- **Dataset**: https://youtu.be/BLgOqY8oQVY?si=UGt9r18bBjsuZcic
- **A Brief Description:** Separation of Bacterial Cells from Broth Culture Using a Laboratory Scale Centrifuge involves the process of centrifugation to isolate bacterial cells from their growth medium.

Procedure:

1. **Sample Preparation:** A broth culture containing bacteria is collected in a sterile centrifuge tube.
2. **Centrifugation:** The tube is placed in a centrifuge and spun at a specified speed (typically 3,000–10,000 RPM) for a predetermined time (usually 10–20 minutes). The centrifugal force causes the heavier bacterial cells to sediment at the bottom, forming a cell pellet.
3. **Supernatant Removal:** After centrifugation, the supernatant (liquid above the pellet) is carefully removed, leaving the pellet intact.

Unit 5: (3Hrs)

Lab 9: Separation of DNA fragments by Agarose gel electrophoresis.

- **Dataset**: https://youtu.be/vq759wKCCUQ?si=Gfzig2ONzkU5vFM5
- **A Brief Description: Separation of DNA Fragments by Agarose Gel Electrophoresis** is a technique used to separate DNA fragments based on size.

Procedure:

1. **Preparation of Agarose Gel:** Agarose powder is dissolved in a buffer solution, poured into a mold, and allowed to solidify, creating a gel with pores.
2. **Sample Loading:** DNA samples mixed with a loading dye are pipetted into wells in the gel.

3. **Electrophoresis:** An electric current is applied, causing negatively charged DNA fragments to migrate through the gel toward the positive electrode. Smaller fragments move faster and travel further than larger ones.
4. **Visualization:** After the run is complete, the gel is stained (often with ethidium bromide or another dye) and illuminated under UV light to visualize the separated DNA bands.

SRI DURGA MALLESWARA SIDDHARTHA MAHILA KALASALA, VIJAYAWADA 10

SEMESTER END EXAMINATION

MODEL QUESTION PAPER

Course Code: **Max. Marks: 70**

Title of the Paper: Microbial and analytical techniques **Max.Time: 3 Hours**

Section A

ANSWER THE FOLLOWING **5x4=20M**

1. (a) Discuss the principle and working of Brightfield microscope?**CO1,K2** 4M

(OR)

(b) Explain Simple staining technique **CO1,K2** 4M

2. (a) Write a note on Filter sterilization methods **CO2,K1** 4M

(OR)

(b) Define about radiation techniques **CO2,K1** 4M

3. (a) Describe Serial dilution method **CO3,K2** 4M

(OR)

(b) Discuss the cultivation method of yeast **CO3,K2** 4M

4. (a) State the applications of UV-Visible spectrophotometry**. Co4,k3** 4M

(OR)

(b) Give an account of colorimetry and its applications **Co4,k3** 4M

5 .(a) What are the characteristics and applications of radioisotopes**. Co5,k3** 4M

(OR)

(b) Explain the principle of autoradiograph and its significance. **. Co5,k3** 4M

Section B

ANSWER THE FOLLOWING **5x10=50M**

Q6 (a) Compare and contrast Scanning electron microscopy (SEM) and Transmission electron microscopy (TEM). **CO1,K2** 10M

(OR)

(b) Describe differential staining techniques used to identify microorganisms. **CO1,K2** 10M

7, (a) Describe the mechanisms of microbial control using Physical sterilization methods. **CO2,K1** 10M

(OR)

(b) Define mode of action of different types of chemical disinfectants in controlling microorganisms**. CO2,K1** 10M

8. (a) Give a brief note on maintenance and preservation of pure cultures. **CO3,K2** 10M

(OR)

(b) Explain the cultivation methods used to cultivate the anaerobic bacteria in laboratory. **CO3,K2** 10M

9. (a)Define chromatography. Explain the different modes of paper chromatography including ascending, descending and 2-D. **. Co4,k3** 10M

(OR)

(b) Discuss the principles underlying column chromatography and describe its applications in various fields. **. Co4,K3** 10M

10. (a) What are the principles underlying centrifugation and describe different types of centrifugation techniques with applications. **. Co5,k3** 10M

(OR)

(b) Describe the components, working principle and applications of Agarose gel electrophoresis. .
Co5,k3 10M

SRI DURGA MALLESWARA SIDDHARTHA MAHILA KALASALA:: VIJAYAWADA-10
(An Autonomous College in the Jurisdiction of Krishna Unviersity, Machilipatnam)

Course Code							
Title of the Course				**CELL BIOLOGY AND GENETICS**			
Offered to: (Programme/s)				**B.Sc Honors – Microbiology**			
L	**4**	**T**	**0**	**P**	**0**	**C**	**3**
Year of Introduction:		**2024-25**		**Semester:**		**3**	
Course Category:		**Major**		**Course Relates to:**		**Global**	
Year of Revision:		**NA**		**Percentage:**		**NA**	
Type of the Course				**Employability**			
Crosscutting Issues of the Course				**Environment and Sustainability**			
Pre-requisites, if any				**Basics of Biology**			

Course Description:

An overview of the course content and objectives.

This course provides an in-depth understanding of cell structure, function, and genetic principles. It covers cell theory, organelles, the cell cycle, and cytoskeletal organization. It explores cell membrane functions, nuclear structure, and the basics of cancer development, including oncogenes and tumor suppressor genes. It focuses on protein sorting, intracellular signaling pathways, and programmed cell death, alongside specialized chromosome types. It introduces Mendelian genetics, inheritance patterns, and complex genetic concepts such as epistasis and pleiotropy. It examines linkage, crossing over, the Hardy-Weinberg Law, and mechanisms of sex determination. This course is essential for understanding cellular and genetic processes in biology.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	Providing the background knowledge on the cell theory, identify various cell organelles, and explain their functions.
2	Understanding the stages of the cell cycle and the structure and role of the cytoskeleton.
3	Providing knowledge on the structure and functions of the cell membrane, including transport mechanisms and the nuclear envelope.
4	Understanding Mendelian genetics, including inheritance patterns, alleles, and the chromosome theory of inheritance.
5	Understanding linkage, crossing over, the Hardy-Weinberg Law, and mechanisms of sex determination.

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	1. Understand cell theory, cell organelles, the cell cycle, and the role of the cytoskeleton...	K2	1	1
CO2	2.Students will comprehend the structure and functions of the cell membrane, nuclear envelope, and nucleolus, as well as gain basic knowledge of cancer development.	K2	1	1

CO3	3. Learn about protein sorting, intracellular signal transduction pathways, programmed cell death, stem cells, and specialized chromosomes	K1	1	1
CO4	4. Gain knowledge of Mendelian genetics, including mono-hybrid and dihybrid crosses, inheritance patterns, and allele frequencies.	K1	1	1
CO5	5. Understand the concepts of linkage, crossing over, the Hardy-Weinberg Law, natural selection, genetic drift, and the mechanisms of sex determination and inheritance.	K2	1	1

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	2							2	
CO2	2							2	
CO3	2							2	
CO4	2							2	
CO5	2							2	

Use the codes 3, 2, 1 for High, Moderate and Low correlation Between CO-PO-PSO respectively

Course Structure:

Unit – 1 : (12Hrs)

Content:

1. Cell theory and cell organelles (Mitochondria, Chloroplasts, Lysosomes, Glyoxysomes and Peroxisomes, Golgi apparatus and ER).
2. Cell cycle and its regulation.
3. Cytoskeleton: Structure and organization of actin, myosin and intermediate filaments, microtubules, and their role.

Examples/Applications/Case Studies:

- Assignment on cell organelles
- Assignment on cytoskeleton

Exercises/Projects:

EXERCISE – 1

Organelle Name	**Structure**	**Function**	**Location**
Nucleus			
Mitochondria			
Chloroplast			
Ribosome			
Endoplasmic Reticulum (ER)			
Golgi Apparatus			
Lysosome			

EXERCISE – 2

Mitosis Puzzle Activity

Materials Needed:

- Colored paper or cardstock
- Scissors
- Markers or colored pencils
- Glue or tape
- Large poster board (optional)

Steps:

1. **Create Puzzle Pieces**: Cut out puzzle pieces from colored paper. Each piece should represent a different stage of mitosis: prophase, metaphase, anaphase, and telophase. You can also include interphase as a starting point.
2. **Label and Illustrate**: On each puzzle piece, write the name of the stage and draw a simple illustration of what happens during that stage. For example, for prophase, you might draw chromosomes condensing and the nuclear envelope breaking down.
3. **Mix and Match**: Mix up the puzzle pieces and have students work individually or in groups to put them in the correct order. They should also be able to explain what happens in each stage.
4. **Discussion**: Once the puzzles are completed, have a class discussion about each stage of mitosis. Ask students to describe what happens during each stage and why it's important.
5. **Optional Poster**: For a more permanent display, students can glue their puzzle pieces onto a large poster board in the correct order. This can serve as a visual aid in the classroom.

Specific Resources: (web)

- https://socialsci.libretexts.org/Bookshelves/Anthropology/Biological_Anthropology/Book%3A_Biological_Anthropology_(Saneda_and_Field)/I%3A_Evolutionary_Theory/1.5%3A_Cell_Biology_and_Basic_Genetics#:~:text=There%20are%20two%20types%20of,Eukaryotes%20include%20everyone%20else.
- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBMA1101.pdf
- https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/cell-genetics

Unit – 2 : (12Hrs)

Content:

1. Structure and functions Cell membrane, proton pumps associated (Na-K, Cacalmodulin etc. and their distribution), phagocytosis, pinocytosis, exocytosis.
2. Nuclear envelope, structure of nuclear pore complex, Nucleolus.
3. Elementary knowledge of development and causes of cancer; Oncogenes and suppressor genes

Examples/Applications/Case Studies:

- Assignment on Structure and functions Cell membrane
- Assignment on Oncogenes and suppressor genes

Exercises/Projects:

EXERCISE – 1

- Model presentation on proton pump through cell membrane.

EXERCISE – 2

Component	Description	Function
Nuclear Envelope		
Nuclear Pore		
Nucleolus		

Specific Resources: (web)

- https://flexbooks.ck12.org/cbook/ck-12-cbse-biology-class-9/section/1.5/primary/lesson/other-cell-structures-and-organelles/?gad_source=1&gclid=Cj0KCQjwiuC2BhDSARIsALOVfBIuJDTTTaA66_gF0A9iZN3fk9FJsLr3dtgCRNyf5kKNav4sc6Ok4eoaAkyyEALw_wcB&utm_campaign=21404130218&utm_medium=cpc&utm_source=google&utm_term=
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2944363/#:~:text=The%20most%20prominent%20of%20these,nuclear%20pore%20complexes%20(NPCs).
- https://www.learnoncology.ca/modules/basic-oncology-principles

Unit – 3 : (12Hrs)

Content:

1. Protein sorting and Transport Intracellular signal transduction pathways (GPCR , ERK Pathway, mTOR Signaling)
2. Programmed Cell Death; Stem cells.
3. Specialized chromosomes (polytene, lampbrush)

Examples/Applications/Case Studies:

- Assignment on signal transduction pathways
- Assignment on Programmed Cell Death

Exercises/Projects:

EXERCISE – 1

Activity: Mapping Signal Transduction Pathways

Materials:

- Blank paper
- Pens and colored pencils or markers

Procedure:

- Distribute blank paper and pens/colored pencils to each student.
- Ask students to draw their own diagram of a signal transduction pathway, including:
  - **Reception**: Ligand binding to receptor
  - **Transduction**: Series of relay molecules
  - **Response**: Activation of cellular responses

EXERCISE – 2

	Polytene,	Lampbrush
Structure		
Function		

Specific Resources: (web)

- https://www.ncbi.nlm.nih.gov/books/NBK9897/

- https://en.wikipedia.org/wiki/Programmed_cell_death
- https://www.aakash.ac.in/important-concepts/biology/special-chromosomes#:~:text=The%20giant%20chromosomes%20are%20the,of%20most%20animals%2C%20except%20mammals

Unit – 4: (12Hrs)

Content:

1. Mendalien Genetics , Mono hybrid and Dihybrid cross , Law of dominance segregation and Independent assortment.
2. Chromosome theory of inheritance, Pedigree analysis, Incomplete dominance and co-dominance,
3. Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Allele frequencies, Genotype frequencies.

Examples/Applications/Case Studies:

- Assignment on Mendalien laws
- Assignment on Chromosome theory of inheritance

Exercises/Projects:

EXERCISE – 1

This activity investigates crosses between pea plants that are different in two trait characteristics (a dihybrid cross) with each pair having one dominant and one recessive allele—and how each gene pair acts independently of the other. Phenotypes in the resultant generations will be, on average, in a ratio of 9:3:3:1, demonstrating the independence, or *independent assortment*, of these two gene pairs.

Materials needed (per team of two students)

- Two (2) four-sided pyramidal dice—each numbered point represents a possible gene pair that the parents *could* pass on.

Die number	Genotype	Phenotype
1	**RY**	**Round Yellow**
2	**Ry**	**Round green**
3	**rY**	**wrinkled Yellow**
4	**ry**	**wrinkled green**

1. Which traits (seed form and seed color) are dominant? _____ _____
   Which traits are recessive? _____ _____
2. What is the genotype of the F_1 generation following Mendel's P cross of a pure dominant pea plant (RRYY) with a double recessive plant (rryy)? Hint: this is easy, think about what alleles each parent will contribute and put them together in a new genotype →
   What would be the only phenotype observed from this cross?
3. Complete the Punnett square showing possible outcomes for the F_2 generation (cross RrYy x RrYy).

Calculate the ***expected*** phenotypic ratio based on the outcome of the Punnett square.

: **:** **:** 1 green wrinkled

RRYY			
			rryy

4. Use the two four-sided dice to generate some random data that simulates the uniting of gene pairs in a new organism (zygote). **Read the dice by reading the number on the point of each die that is facing up.** The two numbers correspond to a pair of alleles as shown in the chart in the materials section. Thus a roll of 1, 4 would represent RY and ry coming together as the ***genotype*** RrYy. The ***phenotype*** for this combination is Round Yellow, so that is the column where the mark is written.

➢ Toss the dice about **80 times** and record the phenotypes generated by each roll in the chart below (use a tally mark ' for each one). **If you accidentally go over 80, use all data you have.**

	Round Yellow **1,1 1, 2 1,3 1,4 2,3**	Round green **2,2 2,4**	wrinkled Yellow **3,3 3,4**	wrinkled green **4,4**
Totals →				

Use your totals and calculate the phenotypic ratio observed from the dice toss (use 2 decimal places).

: : :

5. **Put your data on the board as directed by your teacher.** Total all the class data and recalculate the phenotypic ratio for the whole class total.

➢ Explain (referencing rules of probability as related to sample size) any differences seen from group to group and overall compared to the predicted outcome. In other words, why is the class total (or may be certain individual groups) closer to the "perfect" 9:3:3:1 ratio than others are?

EXERCISE – 2

In this activity you will see how the laws of chance relate to biological occurrences. Mendel realized the role of chance in heredity and it was a radical concept for its time.

Materials (per team of two students)

Two coins (which can be different types).

Background information and Questions

Fortunately for casino operators, many people do not truly understand the statistics behind random chance. For an event that is truly random (contrary to the rumor, coins flips really are random), the previous results have no bearing on the next outcome. A coin that has flipped tails up three times in a row doesn't "know" that it is "due" so the next flip is still random.

What are the odds of a normal coin landing heads up after being flipped?

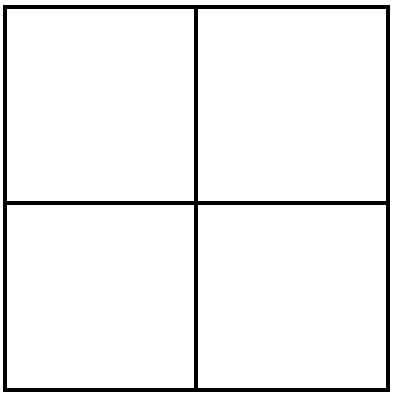
What is the probability (odds) of two coins both landing heads up after being flipped? (Hint: the probability of a sequential event is the probability of each event separately, multiplied together.)

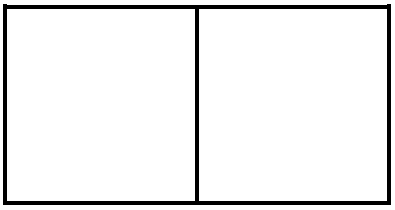
What is the probability of three coins all landing heads up after being flipped?

Imagine three coins are flipped, but one at a time. The first two coins both land heads. What are the odds of the last coin landing heads up?

Procedure

1. Complete the Punnett squares below. (A = any generic dominant trait; a = any generic recessive trait)
   a) Aa x Aa cross
   b) Aa x aa cross





a) Record the genotype and phenotype ratios for the Aa x Aa cross.
b) Record the genotype and phenotype ratios for the Aa x aa cross.

2. Create a Punnett square to predict the outcome of tossing two coins (assume heads is one allele and tails is the other, neither is dominant).
3. Flip or toss your two coins **100** times (Yes, you have to do it 100 times). Put tallies in the top boxes and then count the tallies and write the number in the total row of the table.

	Heads/Heads	Heads/Tails	Tails/Tails
Actual total			
Predicted			

3. Fill in the **predicted number** (based out of 100 flips) of each category based on your Punnett square from question #1.
   - Do the actual results match your prediction? **Explain** why they do or do not.
4. If you toss the coins 1000 times instead of 100, would you expect the actual and predicted numbers to match more closely than you saw after 100 flips, be the same as after 100, or become very different? **Explain**.

Specific Resources: (web)

- https://www.nature.com/scitable/topicpage/gregor-mendel-and-the-principles-of-inheritance-593/
- https://pressbooks-dev.oer.hawaii.edu/biology/chapter/chromosomal-theory-and-genetic-linkage/#:~:text=The%20Chromosomal%20Theory%20of%20inheritance%2C%20proposed%20by%20Sutton%20and%20Boveri,assortment%2C%20and%20occasionally%2C%20linkage.
- https://byjus.com/biology/allele-definition/

Unit – 5: (12Hrs)

Content:

1. Linkage and Crossing over, Molecular mechanism of crossing over. Recombination frequency as a measure of linkage intensity,
2. Hardy-Weinberg Law, role of natural selection, Genetic drift. Speciation
3. Sex determination – Sex linked inheritance, extra chromosomal Inheritance

Examples/Applications/Case Studies:

- Assignment on Molecular mechanism of crossing over
- Assignment on Sex determination

Exercises/Projects:

EXERCISE – 1

- Genetic drifts in pathogenic microorganisms

EXERCISE – 2

- Genetic recombination in various pathogenic microorganisms

Specific Resources: (web)

- https://www.vedantu.com/neet/difference-between-linkage-and-crossing-over
- https://www.nature.com/scitable/definition/hardy-weinberg-equilibrium-122/#:~:text=The%20Hardy%2DWeinberg%20equilibrium%20is,the%20absence%20of%20disturbing%20factors.
- https://byjus.com/biology/sex-linked-inheritance/#:~:text=Sex%2Dlinked%20genes%20are%20located,are%20transmitted%20via%20males%20only.

References:

1. A.J.F Griffiths, S. R Wessler, S. B Carroll & J. Doebley, An Introduction to Genetic Analysis,. 10th Ed., W.H. Freeman & Company (New York) 2010
2. Geoffrey M. Cooper and Robert E. Hausman - The cell a molecular approach.
3. Bruce Alberts , Rebecca Heald, et al. Molecular Biology Of The Cell.
4. Benjamin Lewin Genes
5. Eldon John Gardner, Michael J. Simmons, D. Peter Snustad Principles of Genetics
6. Karp G, John Wiley Cell Biology
7. Jane B. Reece (Author), Martha R. Taylor (Author), Eric J. Simon (Author), Jean L. Dickey , Campbell Biology: Concepts and Connections
8. Veer Bala Rastogi, Genetics B D Singh, Genetics

Course Code							
Title of the Course				**CELL BIOLOGY AND GENETICS PRACTICAL**			
Offered to: (Programme/s)				**B.Sc Honors – Microbiology**			
L	**0**	**T**	**0**	**P**	**2**	**C**	**1**
Year of Introduction:		**2024-25**		**Semester:**		**3**	
Course Category:		**Major**		**Course Relates to:**		**Global**	
Year of Revision:		**NA**		**Percentage:**		**NA**	
Type of the Course				**Employability**			
Crosscutting Issues of the Course				**Environment and Sustainability**			
Pre-requisites, if any				**Basics of Biology**			

Course Description:
An overview of the course content and objectives.

This course provides an in-depth understanding of cell structure, function, and genetic principles. It covers cell theory, organelles, the cell cycle, and cytoskeletal organization. It explores cell membrane functions, nuclear structure, and the basics of cancer development, including oncogenes and tumor suppressor genes. It focuses on protein sorting, intracellular signaling pathways, and programmed cell death, alongside specialized chromosome types. It introduces Mendelian genetics, inheritance patterns, and complex genetic concepts such as epistasis and pleiotropy. It examines linkage, crossing over, the Hardy-Weinberg Law, and mechanisms of sex determination. This course is essential for understanding cellular and genetic processes in biology.

Course Aims and Objectives:

S.NO	COURSE OBJECTIVES
1	Providing the background knowledge on the cell theory, identify various cell organelles, and explain their functions.
2	Understanding the stages of the cell cycle and the structure and role of the cytoskeleton.
3	Providing knowledge on the structure and functions of the cell membrane, including transport mechanisms and the nuclear envelope.
4	Understanding Mendelian genetics, including inheritance patterns, alleles, and the chromosome theory of inheritance.
5	Understanding linkage, crossing over, the Hardy-Weinberg Law, and mechanisms of sex determination.

Course Outcomes

At the end of the course, the student will be able to…

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO1	1. Understand cell theory, cell organelles, the cell cycle, and the role of the cytoskeleton...	K2	1	1
CO2	2.Students will comprehend the structure and functions of the cell membrane, nuclear envelope, and nucleolus, as well as gain basic knowledge of cancer development.	K2	1	1
CO3	3. Learn about protein sorting, intracellular signal transduction pathways, programmed cell death, stem cells, and specialized chromosomes.	K1	1	1
CO4	4. Gain knowledge of Mendelian genetics, including mono-hybrid and dihybrid crosses, inheritance patterns, and allele frequencies.	K1	1	1
CO5	5. Understand the concepts of linkage, crossing over, the Hardy-Weinberg Law, natural selection, genetic drift, and the mechanisms of sex determination and inheritance.	K2	1	1

For BTL: K1: Remember; K2: Understand; K3: Apply; K4: Analyze; K5: Evaluate; K6: Create

CO-PO MATRIX									
CO NO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	2							2	
CO2	2							2	
CO3	2							2	
CO4	2							2	
CO5	2							2	

Use the codes 3, 2, 1 for High, Moderate and Low correlation Between CO-PO-PSO respectively

Unit 1: (5Hrs)
Lab 1: Cell counting and Viability
• **Dataset**: https://youtu.be/7HI47iuQYqc?si=tdLZXVcEx-CbGDSA
• **A Brief Description:** Cell counting and viability assessment are essential techniques in cell biology and biomedical research.
Cell Counting involves quantifying the number of cells in a given volume of culture. This can be done using methods like hemocytometer counting, automated cell counters, or flow cytometry. Accurate cell counts are crucial for experiments requiring specific cell densities.
Cell Viability measures the proportion of live cells in a population, often using dyes such as trypan blue or propidium iodide, which distinguish between live (unstained) and dead (stained) cells. Assessing cell viability is vital for evaluating the health of cultures, the effects of treatments, and the effectiveness of drugs.
Together, these techniques provide insights into cell health and behavior, informing research and therapeutic developments.

Unit 1: (5Hrs)
Lab 2: Mitosis from onion root tips
• **Dataset**: https://youtu.be/hqbt7wtznrs?si=VPB7dy79suxUDEFd
• **A Brief Description:** Mitosis in onion root tips is a classic demonstration of cell division, as these tips contain rapidly dividing cells. The process involves several stages:

1. **Prophase**: Chromatin condenses into visible chromosomes, and the nuclear envelope begins to break down.
2. **Metaphase**: Chromosomes align at the cell's equatorial plane, attached to spindle fibers.
3. **Anaphase**: Sister chromatids are pulled apart to opposite poles of the cell.
4. **Telophase**: Chromatids reach the poles, the nuclear envelope re-forms, and chromosomes decondense.

Finally, cytokinesis occurs, resulting in two daughter cells. This observation helps visualize the stages of mitosis and understand cell cycle regulation.

Unit 1: (5Hrs)
Lab 3: Meiosis of onion root tips
• **Dataset**: https://youtu.be/XOAAIeZXoxU?si=7rBmf_RDEhTSNFh1
• **A Brief Description:** Meiosis in onion root tips is a crucial process for sexual reproduction, occurring in the formation of gametes. It consists of two successive divisions: meiosis I and meiosis II, each with distinct phases.

1. **Meiosis I**:

- **Prophase I**: Chromosomes condense, homologous chromosomes pair up (synapsis), and crossing over occurs, exchanging genetic material.
- **Metaphase I**: Paired homologous chromosomes align at the cell's equatorial plane.
- **Anaphase I**: Homologous chromosomes are pulled apart to opposite poles.
- **Telophase I**: The cell divides into two haploid cells, each with half the number of chromosomes.

2. **Meiosis II** (similar to mitosis):
- **Prophase II**: Chromosomes condense again, and the nuclear envelope dissolves if it was re-formed.
- **Metaphase II**: Chromosomes align at the equatorial plane.
- **Anaphase II**: Sister chromatids are separated and pulled to opposite poles.
- **Telophase II**: The two cells divide again, resulting in four haploid daughter cells.

Meiosis in onion root tips illustrates the reduction of chromosome number and genetic diversity, fundamental for sexual reproduction.

Unit 1: (5Hrs)

Lab 4: Study of ultrastructure of cell (Plasma membrane, Nucleus, Nuclear Pore Complex, Chloroplast, Mitochondrion, Golgi bodies, Lysosomes, SER and RER)

• **Dataset**: https://youtu.be/iA8hFSHS6Ho?si=NtXruXBTcOjcUj3A

• **A Brief Description:** The study of the ultrastructure of cells involves examining the detailed structures within cells using techniques like electron microscopy. Here's a brief overview of key organelles:

1. **Plasma Membrane**: A phospholipid bilayer embedded with proteins that regulates the entry and exit of substances, maintaining homeostasis.
2. **Nucleus**: The control center of the cell, housing genetic material (DNA) and surrounded by a double membrane (nuclear envelope) with pores that facilitate communication and transport.
3. **Nuclear Pore Complex**: Large protein structures embedded in the nuclear envelope that regulate the transport of molecules between the nucleus and the cytoplasm, allowing the passage of RNA and proteins.
4. **Chloroplast**: Organelles in plant cells responsible for photosynthesis, containing thylakoids (where light reactions occur) and stroma (site of the Calvin cycle). They have a double membrane and their own DNA.
5. **Mitochondrion**: The powerhouse of the cell, generating ATP through respiration. It has a double membrane, with an inner membrane folded into cristae to increase surface area for energy production.
6. **Golgi Bodies**: Stack-like structures that modify, package, and distribute proteins and lipids received from the endoplasmic reticulum. They play a critical role in secretion and lysosome formation.
7. **Lysosomes**: Membrane-bound organelles containing digestive enzymes that break down waste materials and cellular debris, functioning in cellular cleanup and recycling.
8. **Smooth Endoplasmic Reticulum (SER)**: A network of membranes involved in lipid synthesis, metabolism, and detoxification processes. It lacks ribosomes, giving it a smooth appearance.
9. **Rough Endoplasmic Reticulum (RER)**: Studded with ribosomes, it is involved in the synthesis and processing of proteins destined for secretion or for use in the cell membrane.

These organelles work together to maintain cellular function and integrity, each contributing to the overall metabolism and life of the cell.

Unit 1: (5Hrs)
Lab 5: Demonstration of DNA fingerprinting.
• **Dataset**: https://youtu.be/SGWafMKKhno?si=PM47TxQEFTKxEZdq

• **A Brief Description:** DNA fingerprinting is a technique used to identify individuals based on unique patterns in their DNA. The process typically involves the following steps:

1. **Sample Collection**: DNA is extracted from biological samples, such as blood, saliva, or hair.
2. **PCR Amplification**: Specific regions of the DNA, often containing variable number tandem repeats (VNTRs) or short tandem repeats (STRs), are amplified using polymerase chain reaction (PCR).
3. **Gel Electrophoresis**: The amplified DNA fragments are separated by size using gel electrophoresis, where an electric current pulls the negatively charged DNA through a gel matrix.
4. **Visualization**: The separated DNA fragments are stained and visualized, often using UV light, creating a distinct banding pattern unique to each individual.
5. **Comparison**: The resulting DNA profiles are compared to identify similarities or differences, useful in applications like paternity testing, forensic analysis, and genetic research.

This technique relies on the principle that no two individuals (except identical twins) have the same DNA fingerprint, making it a powerful tool for identification and analysis.

Unit 4: (5Hrs)
Lab 6: Pedigree chart analysis.
• **Dataset**: https://youtu.be/Gd09V2AkZv4?si=2gdGCuCjcZzKuVZF
• **A Brief Description:** Pedigree chart analysis is a visual representation of family relationships and the inheritance of traits or genetic conditions across generations. Here's a brief overview of its components and uses:

Components of a Pedigree Chart:

- **Symbols**:
  - Circles represent females.
  - Squares represent males.
  - Shaded symbols indicate individuals expressing a specific trait or condition.
  - Half-shaded symbols represent carriers (if applicable).
- **Lines**:
  - Horizontal lines connect mating pairs.
  - Vertical lines connect parents to their offspring.

Uses of Pedigree Analysis:

- **Genetic Counseling**: Helps assess the risk of inherited conditions by analyzing family history.
- **Inheritance Patterns**: Identifies whether traits follow dominant, recessive, X-linked, or other inheritance patterns.
- **Research**: Assists in studying the genetics of diseases and traits within specific populations or families.

SRI DURGA MALLESWARA SIDDHARTHA MAHILA KALASALA,
VIJAYAWADA 10
SEMESTER END EXAMINATION
MODEL QUESTION PAPER

Course Code: **Max. Marks: 70**
Title of the Paper: cell biology and Genetics **Max.Time: 3 Hours**

ANSWER THE FOLLOWING:

Section A 5X4=20M

Q1 (a) Discuss the structure and function of the Mitochondria**.CO1,K2** 4M
(OR)
(b) Explain the role of myosin in muscle contraction. **.CO1,K2** 4M

2 . (a) Describe the process of phagocytosis. **CO2,K2** 4M
(OR)
(b) Give the structure and functions of cell membrane **CO2,K2** 4M

3. (a) Write about significance of specialized chromosomes with examples **CO3,k1** 4M
(OR)
(b) Describe the concept of stem cells and their role in tissue regeneration. **CO3,k1** 4M

4. (a) Define multiple alleles with an example of ABO blood group system**. CO4,K1** 4M
(OR)
(b)Describe about mendelin dihybrid cross **. CO4,K1** 4M
5. (a)Describe genetic drift and its effects on allele frequencies**. CO5,K2** 4M
(OR)
(b) Explain linkage and crossing over and explain how they are related to genetic recombination **. CO5,K2** 4M

Section B 5X10=50M

Q6 (a). Explain the stages of the cell cycle and the key events that occur during each stage. **.CO1,K2** 10M
(OR)
(b) Describe the structure and function of the cytoskeleton**.CO1,K2** 10M
Q7 (a) Discuss the role of proton pumps, such as the sodium-potassium pump and calcium-calmodulin pump, in maintaining ion gradients **CO2,K2** 10M
(OR)
(b) Give a note on ultra structure of Nucleus with neat labelled diagram **CO2,K2** 10M

Q8 (a) Describe the intracellular signal transduction pathways , focusing on their activation and downstream signaling cascades. **CO3,k1** 10M
(OR)
(b) Define apoptosis and describe the molecular mechanisms involved **CO3,k1** 10M
Q9 (a) Define how Mendel's experiments with pea plants led to the formulation of his laws and their significance in understanding inheritance patterns. **. CO4,K1** 10M
(OR)
(b) Describe the chromosome theory of inheritance and explain how it related to Mendel's principles of inheritance. **. CO4,K1** 10M
Q10 (a) Explain the Hardy-Weinberg law and its significance in population genetics, **. CO5,K2** 10M
(OR)
(b) Discuss sex-linked inheritance patterns and provide examples of traits that are inherited through sex chromosomes **. CO5,K2** 10M