ST. MARY'S COLLEGE (Autonomous)

(Re-accredited with 'A^{+}' Grade by NAAC)

Thoothukudi-628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

B.Sc. Microbiology

School of Biological Sciences

Outcome Based Curriculum

(W.e.f.2021)

Department of Microbiology
Course Structure (w.e.f. 2021)
Semester –I

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil	21ULTA11	பொதுத்தமிழ் தாள் - 1 இக்கால இலக்கியம் (செய்யுள், இலக்கணம், இலக்கிய வரலாறு, உரைநடை, சிறுகதை)	6	3	40	60	100
	French	21ULFA11	Introductory FrenchCourse					
II	General English	21UGEN11	Poetry, Prose, Extensive Reading and Communicative English-I	6	3	40	60	100
III	Core I	21UMIC11	Introduction to Microbiology	6	6	40	60	100
	Core Practical I	21UMICR1	Laboratory in Introduction to Microbiology	2	1	40	60	100
	Allied I	21UMIA11	Dairy Technology	4	3	40	60	100
	Allied Practical I	21UMIAR1	Laboratory in DairyTechnology	2	1	40	60	100
IV	Skill Enhancement Course	21UMIPE1	Professional Englishfor Microbiology-I	2	2	20	30	50
	Ability Enhancement Course-I	21UAVE11	Value Education	2	2	20	30	50
Total				30	21			

Semester II

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil French	21ULTA21 21ULFA21	பொதுத்தமிழ் தாள் 2 சமய இலக்கியங்களும் நீதி இலக்கியங்களும் (செய்யுள், இலக்கணம், இலக்கிய வரலாறு, உரைநடை, வாழ்க்கை வரலாறு) Intermediate French Course	6	3	40	60	100
II	General English	21UGEN21	Poetry, Prose, Extensive Reading and Communicative English - II	6	3	40	60	100
III	Core II	21UMIC21	Microbial Diversity	6	6	40	60	100
	Core Practical II	21UMICR2	Laboratory in Microbial Diversity	2	1	40	60	100
	Allied II	21UMIA21	Biochemistry	4	3	40	60	100
	Allied Practical II	21UMIAR2	Laboratory in Biochemistry	2	1	40	60	100
IV	Skill Enhancement Course - II	21UMIPE2	Professional English forMicrobiology - II	2	2	20	30	50
	Ability Enhancement Course - II	21UAEV21	Environmental Studies	2	2	20	30	50
			Total	**30**	**21**			

Semester III

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil	21ULTA31	பொதுத்தமிழ் தாள் 3 : காப்பியங்களும் சிற்றிலக்கியங்களும் (செய்யுள், இலக்கணம், இலக்கிய வரலாறு, உரைநடை, புதினம்)	6	4	40	60	100
	French	21ULFA31	Advanced French Language					
II	General English	21UGEN31	Poetry, Prose, Extensive Reading and CommunicativeEnglish-III	6	4	40	60	100
III	Core III	21UMIC31	Microbial physiologyand Metabolism	4	4	40	60	100
	Core Practical III	21UMICR3	Laboratory in Microbial physiology and Metabolism	2	2	40	60	100
	Allied III	21UMIA31	Genetic Engineering	4	3	40	60	100
	Allied Practical III	21UMIAR3	Laboratory in GeneticEngineering	2	1			
	Skill Based Elective	21UMIS31/ 21UMIS32	Bioinstrumentation /Vermi Technology	2	2	20	30	50
	NME I	21UMIN31	Food Microbiology	2	2	20	30	50
IV	Ability Enhancement Course - III	21UAWS31	Women's Synergy	2	2	20	30	50
	Self Study or On-line Course / Internship (Compulsory)	21UMISS1	Food PackagingTechnology		2		50	50
			Total	**30**	**26**			

Semester IV

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
I	Tamil	21ULTA41	பொதுத்தமிழ் தாள் 4: சங்க இலக்கியம்: (செய்யுள், இலக்கணம், இலக்கிய வரலாறு, உரைநடை, நாடகம்)	6	4	40	60	100
	French	21ULFA41	French Course and Literature					
II	General English	21UGEN41	Poetry, Prose, Extensive Reading and Communicative English-IV	6	4	40	60	100
III	Core IV	21UMIC41	Molecular Biology And Microbial Genetics	4	4	40	60	100
	Core Practical IV	21UMICR4	Laboratory in Molecular Biology And Microbial Genetics	2	2	40	60	100
	Allied IV	21UMIA41	Mushroom Technology	4	3	40	60	100
	Allied Practical IV	21UMIAR4	Laboratory in Mushroom Technology	2	1			
	Skill Based Elective	21UMIS41/ 21UMIS42	Practical in Medical Laboratory Technology / Practical in Parasitology	2	2	20	30	50
	NME II	21UMIN41	Clinical Microbiology	2	2	20	30	50
IV	Ability Enhancement Course - IV	21UAYM41	Yoga & Meditation	2	2	20	30	50
	Self Study / Online Course / Internship (Optional)	21UMISS2	Probiotics		+2		50	50
V	NCC, NSS & Sports				1			
	Extension ActivitiesCDP				+1			
			Total	**30**	**25+3**			

Semester V

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
III	Core V (Common Core)	21UBCS51	Psychology and Microbiology for health care	6	4	40	60	100
	Core VI	21UMIC51	Immunology	4	4	40	60	100
	Core VII	21UMIC52	Clinical Microbiology	4	4	40	60	100
	Core VIII	21UMIC53	Biostatistics andBioinformatics	4	4	40	60	100
	Core PracticalV	21UMICR5	Laboratory in Immunology and Clinical Microbiology	6	3	40	60	100
	Core Elective	21UMIE51/ 21UMIE52	Microbial Nanotechnology / Marine Microbiology	4	3	40	60	100
IV	Common Skill Based Course	21UCSB51	Computer for DigitalEra and Soft skills	2	2	20	30	50
	Self Study or On-line Course (Optional)	21UMISS3	Sea Food Processing	--	+2		50	50
Total				**30**	**24 +2**			

Semester VI

Part	Components	Course Code	Course Title	Hrs/ Week	Credits	Max.Marks		
						CIA	ESE	Total
III	Core IX	21UMIC61	Food Microbiology	4	4	40	60	100
	Core X	21UMIC62	Industrial Microbiology	4	4	40	60	100
	Core XI	21UMIC63	Environmental and Agricultural Microbiology	4	4	40	60	100
	Core XII	21UMIC64	Microbial Biotechnology	4	4	40	60	100
	Core PracticalVI	21UMICR6	Laboratory in Food Microbiology and Industrial Microbiology	4	2	40	60	100
	Core PracticalVII	21UMICR7	Laboratory in Environmental, Agricultural Microbiology and Microbial Biotechnology	4	2	40	60	100
IV	Project	21UMIP61		6	3	40	60	100
Total				**30**	**23**			

Semester	Hours	Credits	Extra Credits
I	30	21	---
II	30	21	---
III	30	24	2
IV	30	25	3
V	30	26	--
VI	30	23	--
Total	180	140	5

Courses	Number of Courses	Hours / week	Credits	Extra Credits
Tamil	4	24	14	--
English	4	24	14	--
Core	12T+7P	54T+22P	51T+13P	--
Core Skill Based	2	4	4	--
Core Elective	1	4	4	--
Group Project	1	6	3	--
Allied	4T+4P	16T+8P	12T+4P	--
NME	2	4	4	--
Skill Enhancement Course	2	4	4	--
Ability Enhancement Course	4	8	8	--
Common Skill Based	1	2	2	--
NCC, NSS & Sports		--	1	
Extension Activities		--		1
Self Study Papers (Optional)	2	--		4
Self Study Papers (Compulsory)	1	--	2	--
Total		180	140	5

LESSON PLAN

Objective Oriented Learning Process RBT

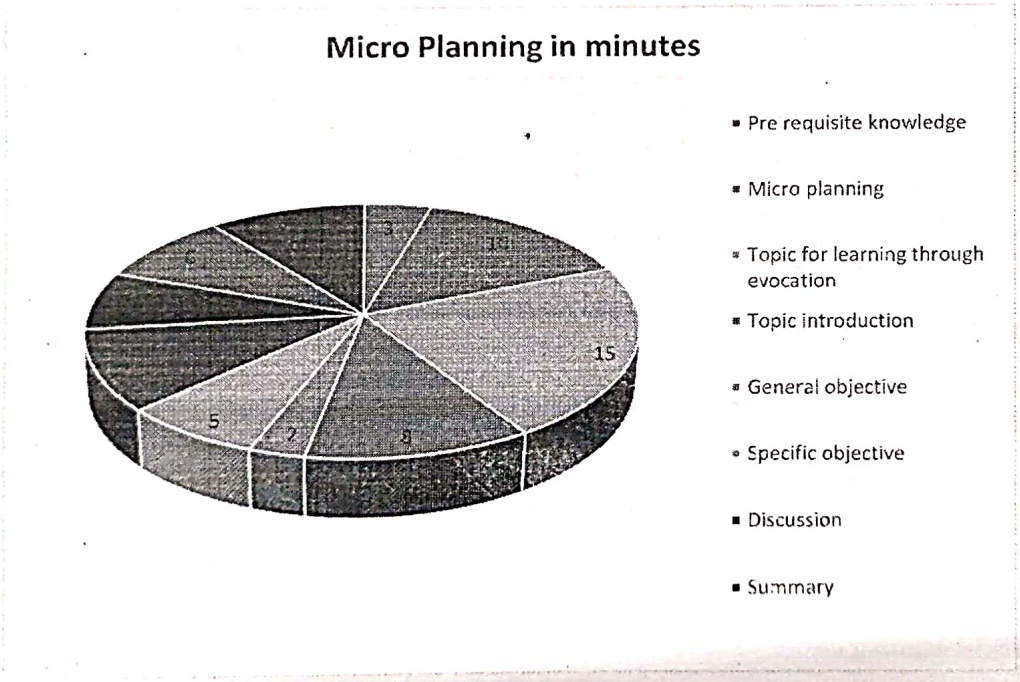
Programme	B.Sc. Microbiology
Semester	I
Subject Title	Major Core: Introduction to Microbiology
Code	21UMIC11
Hours	6
Total Hours	90
Credits	6
Max Marks	100
Unit & Title	Unit: III – Gram's staining
Name of the Faculty	Mr.EDWARD C
T-L tools	Lecture method, **Visual aid**:. PPT, Picture showing the principle and steps of staining method

Prerequisite Knowledge:

Understanding of prokaryotic cells and their structure, including cell walls.

Familiarity with the difference between Gram+ and Gram- bacteria based on cell wall composition:

Micro -planning



1. Topic for Learning through evocation

Start with a Thought-Provoking Question

"Why do some bacteria appear purple while others appear pink under the microscope?"

"What do you think makes bacteria behave differently when exposed to stains?"

Use Analogies to Simplify Complex Concepts

"Think of Gram-positive bacteria as a sponge that absorbs and holds onto the color, while Gram- negative bacteria are like a smooth plastic surface that lets the color wash away."

Visualize the Concept

The step-by-step process of Gram staining and its effects on different bacteria.

Activity: Present a diagram of a bacterial cell and ask learners to label parts

Engage with a Hands-On Activity

Provide learners with a step-by-step protocol for Gram staining.

Allow them to perform the staining procedure in the lab or using a simulation tool.

Thinking with Open-Ended Scenarios

This helps learners analyze and troubleshoot problems, deepening their understanding

2 Topic Introduction:

Gram's staining is a fundamental and widely used differential staining technique in microbiology, developed by the Danish bacteriologist Hans Christian Gram in 1884. It is employed to classify bacteria into two major groups: Gram-positive and Gram-negative, based on the structural differences in their cell walls. Gram's staining is based on the ability of bacterial cell walls to retain the primary stain (crystal violet) after treatment with a decolorizing agent (ethanol or acetone). The outcome depends on the structural composition of the bacterial cell wall:

Gram-positive bacteria: Have a thick peptidoglycan layer that retains the crystal violet-iodine complex, appearing purple under a microscope.

Gram-negative bacteria: Have a thinner peptidoglycan layer and an outer lipid membrane. They lose the crystal violet-iodine complex during decolorization and take up the counterstain (safranin), appearing pink.

2.1General Objective:

To differentiate bacteria into Gram-positive and Gram-negative groups based on their cell wall structure, thereby aiding in bacterial identification, classification, and diagnosis of infections.

2.2 Specific Objectives:

Enables the students to:

1. Recall the steps of Gram staining.
2. Describe the structural differences in the cell walls of Gram-positive and Gram-negative bacteria
3. Apply the Gram staining method to differentiate bacterial samples from clinical or environmental sources.
4. Compare the staining results of different bacterial samples to identify their Gram reaction (positive or negative).
5. Assess the quality of a Gram-stained slide for accuracy and reliability
6. Design a troubleshooting guide for common errors in the Gram staining procedure.

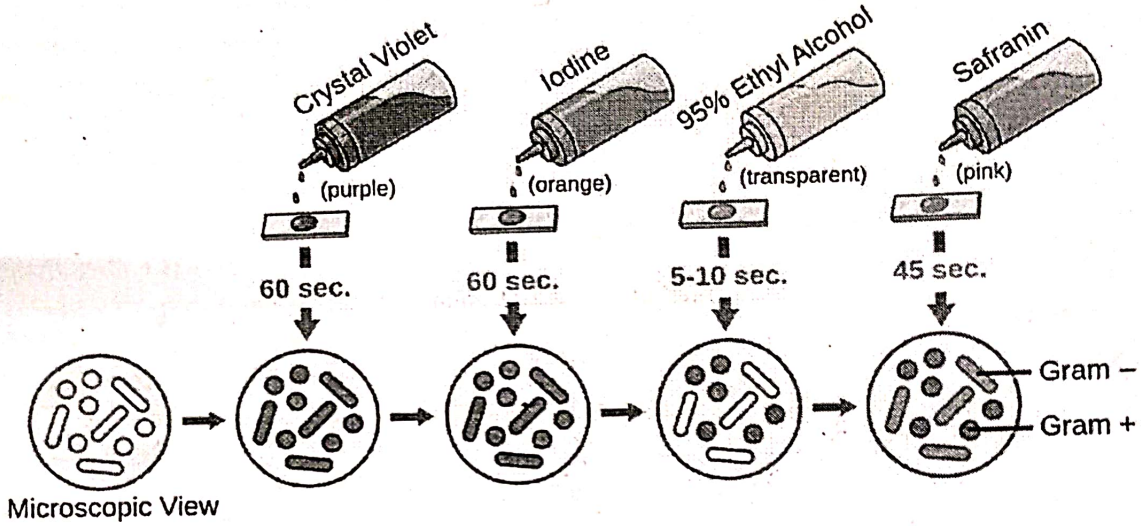
2.3: Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1			1,2	4	
B. Conceptual Knowledge		1, 2,3,4			2,3	
C. Procedural Knowledge			3,4	3, 4	4	6
D. Meta Cognitive Knowledge					5	

2.4: Key words:

Cell wall, Counter stain , Moderate stain , Decolorization and Peptidoglycan

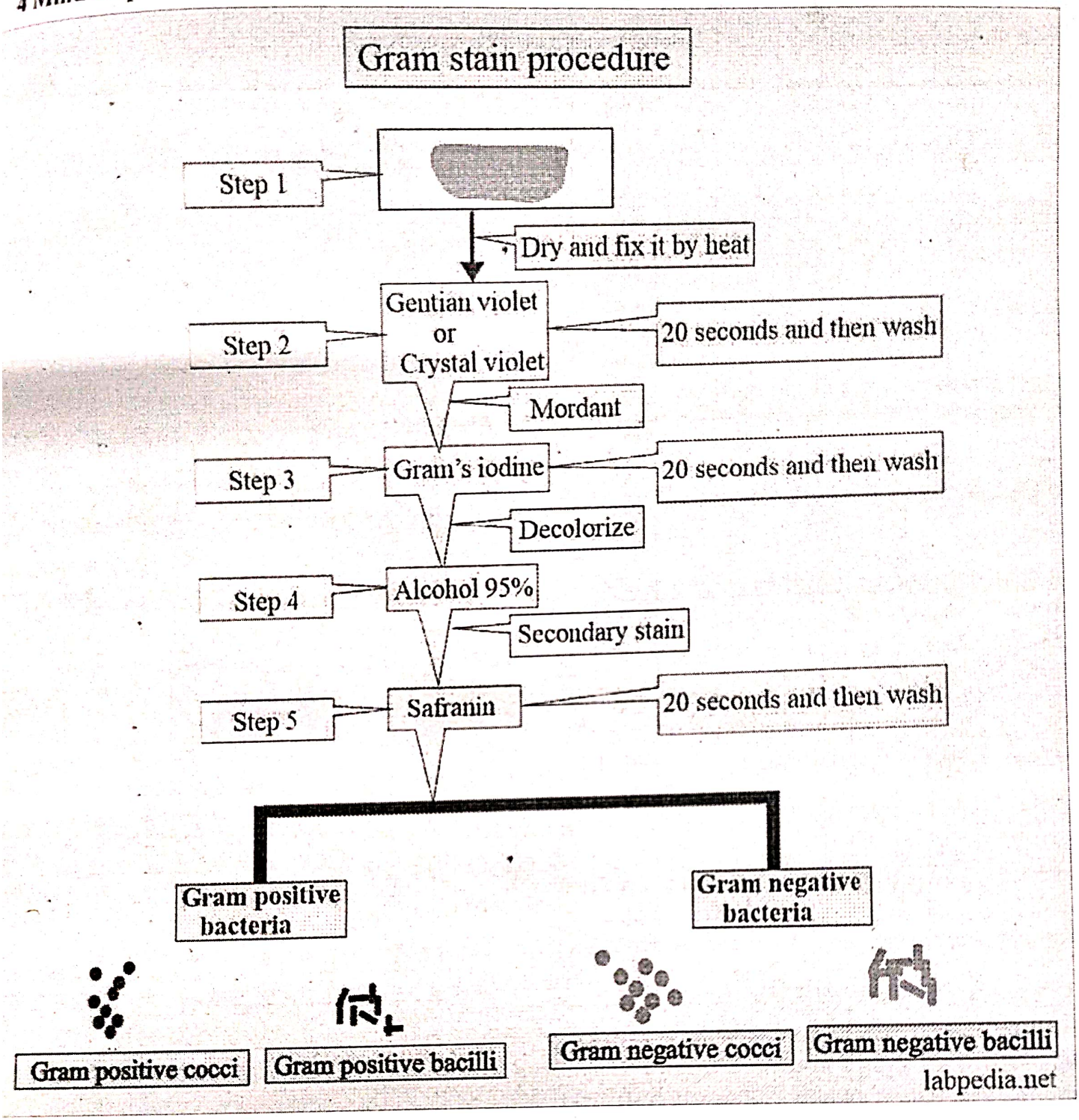
2.5: Key diagrams (if any):



3 Discussion:

The students will be asked questions regarding the chemical nature of bacterial and types of bacterial cell walls. One of the students will be asked to explain the steps involved in the method and interpretation of the result

4 Mind Map:


Gram stain procedure
Step 1
Dry and fix it by heat
Step 2
Gentian violet or Crystal violet
20 seconds and then wash
Mordant
Step 3
Gram's iodine
20 seconds and then wash
Decolorize
Step 4
Alcohol 95%
Secondary stain
Step 5
Safranin
20 seconds and then wash
Gram positive bacteria
Gram negative bacteria
Gram positive cocci
Gram positive bacilli
Gram negative cocci
Gram negative bacilli
labpedia.net

5. Summary:

Students will be asked to identify about different types of cell walls by showing previously stained slides and demonstrate the possible errors while performing the experiment

6 Assessment through Stimulating questions/Analogy/New ideas and Concepts:

Generating mental idea about creating an e-content of Grams staining technique

Producing the e-content and demonstrating the technical procedure

Provided with bacterial specimens with different cell wall content and asked to identify nature of cell walls

7 FAQ's:

1. Who introduced Gram's staining technique
a) Louis Pasteur b) Hans Christian Gram c) Robert Koch d) Alexander Fleming
2 What is the primary stain used in Gram's staining?
a) Safranin b) Methylene blue c) Crystal violet d) Gram's iodine
3 Which of the following bacteria is Gram-positive?
a) *Escherichia coli* b) *Staphylococcus aureus* c) *Pseudomonas aeruginosa* d) *Neisseria gonorrhoeae*
4 Why are some bacteria Gram-variable?
a) Due to differences in cell wall composition during growth phases b) Due to lack of peptidoglycan in their cell wall c) Due to contamination of reagents d) Due to the presence of endospores
5. Which component of Gram-negative bacteria prevents retention of the primary stain?
a) Thin peptidoglycan layer b) Thick peptidoglycan layer c) Outer lipid membrane d) Teichoic acids

8 References

1 Prescott L.M., Harley J.P., and Klein D.A., *Microbiology* New York: McGraw-Hill Inc, 7th edition,2008

2 Rajan S., Selvi Christy R. *Essentials of Microbiology*. Chennai: CBS Publishers and Distributers. 2015

3 Rao A.S. *Introduction to Microbiology*. New Delhi: PHI Learning PVT Ltd. 1997

EDWARD C

Verified by Subject Expert

Dr.Joys Selva Mary Albert

Approved by HOD

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Head
Deartment of Microbiology
St. Mary's College (Autonomous)
Thoothukudi

LESSON PLAN FOR MICROBIOLOGY

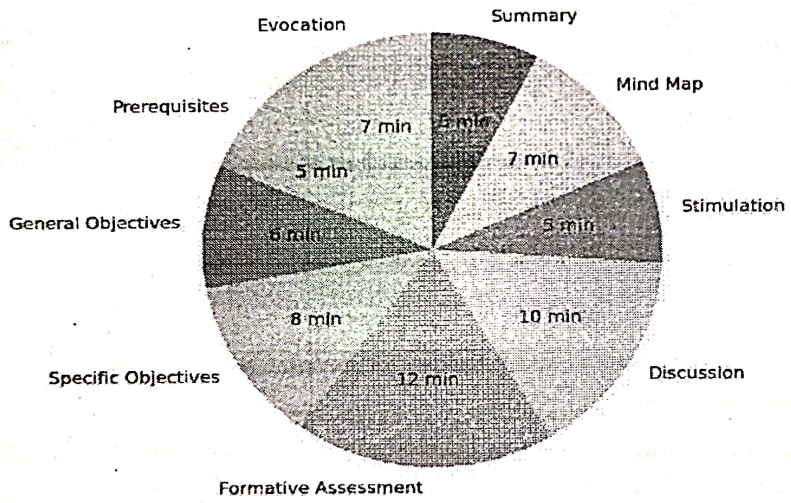
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	I
Subject Title	Allied I Dairy Technology
Code	21UMIA11
Hours	4
Total Hours	60
Credits	3
Max Marks	100
Unit & Title	Unit I : Difference between goat, buffalo and cow's milk
Name of the Faculty	Dr. Joys Selva Mary Albert
T-L tools	Lecture method, **Visual aid:** Picture of difference between goat, buffalo and cow's milk

Prerequisite Knowledge: Knowledge about difference between goat, buffalo and cow's milk

Micro-planning

MICRO PLANNING



1. Topic for Learning through evocation

Differences in fat content, protein structure, digestibility, and nutritional profile between goat, cow, and buffalo milk influence their taste, health benefits, and culinary uses. Understanding these differences is essential for consumers who may have specific dietary needs **or** health concerns regarding their choice of milk. Goat Milk: Known for its distinct, slightly tangy flavor, goat milk is often favored by people who have difficulty digesting cow's milk due to its smaller fat globules and lower lactose content. It is rich in calcium, vitamin A, and fatty acids, which are important for bone health and overall nutrition. Goat milk is often used in making cheese, especially in Mediterranean cuisines. Cow Milk: As one of the most widely consumed milks worldwide, cow milk is known for its neutral flavor and versatility. It provides a balanced amount of proteins, calcium, and vitamins, making it a staple in most diets. Cow milk is the foundation for a wide variety of dairy products such as cheese, yogurt, and butter. Buffalo Milk: Rich in fat, protein, and calcium, buffalo milk has a thicker, creamier consistency than both cow and goat milk. Its high fat content makes it ideal for making cheese (especially mozzarella) and other rich dairy products. Buffalo milk is often favored in countries like India and Italy for its creamy texture and nutritional benefits.

2. Topic Introduction:

Milk, a vital food source for humans, is produced by various animals, with goats, cows, and buffaloes being the most common dairy animals globally. While these milks share the fundamental role of providing essential nutrients, there are distinct differences in their nutritional composition, taste, digestibility, and usage that make each type unique. Understanding these differences is crucial for consumers, especially when it comes to choosing milk based on health benefits, dietary needs, and cultural preferences.

2.1. General Objective:

Enables the students to understand difference between goat, buffalo and cow's milk

2.2. Specific Objectives:

Enables the students to:

1. Outline the difference between goat, cow and buffalo's milk
2. Describe the nutrition of goat, cow and buffalo's milk
3. Summarize the taste and cost of goat, cow and buffalo's milk

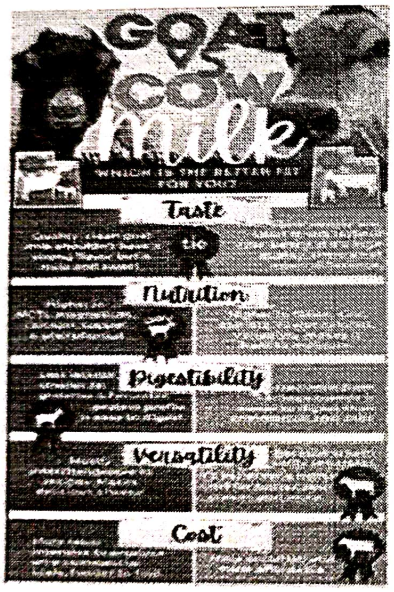
2.3. Taxonomy of objectives:

Taxonomy of objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1			1,2,3	4	
B. Conceptual Knowledge		1,2,3	3,4		2,3,4	
C. Procedural Knowledge				4		
D.MetaCognitive Knowledge					5	

2.4. Key words:

Fat, Protein, Calcium, Vitamins, Lactose, Creaminess, Flavor

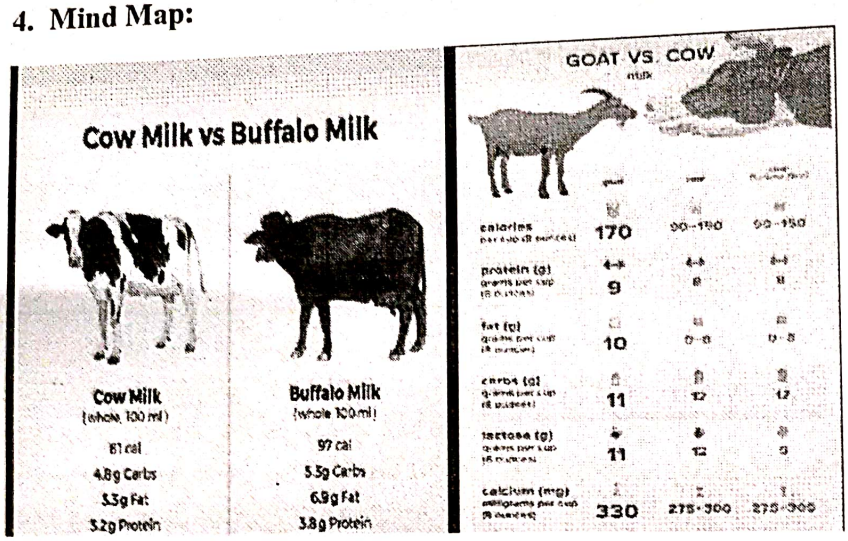
2.5. Key diagrams (if any):



3. Discussion:

The students will be asked to retrieve the difference between goat, cow and buffalo's milk mentioned in the content analysis. One member will be called from each group to present the nutrition and taste of goat, cow and buffalo's milk. Arrange the class to explain the difference between the goat, cow and buffalo's milk by its digestibility and cost.

4. **Mind Map:**



5. **Summary:** Executing the acquired knowledge by asking questions like 'How does the fat content in goat, buffalo, and cow's milk compare? Which type of milk has the highest protein content: goat, buffalo, or cow's milk? Which type of milk is richest in calcium: goat, buffalo, or cow's milk? How does the vitamin A content differ between goat, buffalo, and cow's milk?

6. **Assessment through Stimulating questions/Analogy/New ideas/and Concepts:**

- Generating mental ideas about creating an e-content on goat, buffalo and cow's milk
- Differentiating between goat, buffalo and cow's milk

7. **FAQ's:**

1. Which type of milk contains the highest fat content?
a) Goat milk b) Buffalo milk c) Cow milk d) All are equal
2. Which milk is known for having the most distinct, tangy flavor?
a) Goat milk b) Buffalo milk c) Cow milk d) Camel milk
3. Which milk has the highest protein content?
a) Goat milk b) Buffalo milk c) Cow milk d) Camel milk
4. Which milk is considered the easiest to digest for people with lactose intolerance?
a) Goat milk b) Buffalo milk c) Cow milk d) All are equally digestible
5. Which milk has the highest calcium content?
a) Goat milk b) Buffalo milk c) Cow milk d) All have the same calcium content

8. References: (Books/Periodicals/Journals)

1. Marth, E. H. and J. L. Steele. 2001. Applied Dairy Microbiology, 2nd ed. Marcel Dekker Inc.

2. De, Sukumar. *Outlines of Dairy Technology*. 2nd ed., Oxford University Press, 2009.

9. Verified by Subject Expert

Dr. Joys Selva Mary Albert

Approved by HOD

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Head
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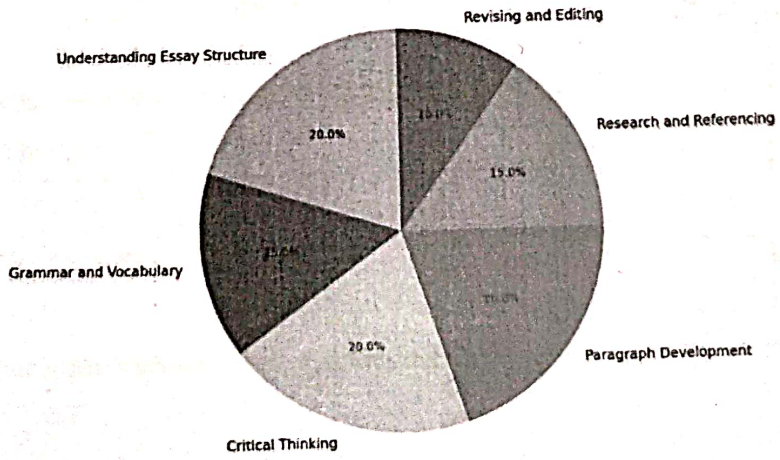
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	I
Subject Title	Skill Enhancement Course : Professional English for Microbiology - I
Code	21UMIPE1
Hours	2
Total Hours	30
Credits	2
Max Marks	50
Unit & Title	Unit III : Essay Writing (250 words) types of media
Name of the Faculty	Ms. A. Maria Heartina Adlin Vaz
T-L tools	Lecture method, **Audio Visual aid:** An expert video regarding essay writing. **Visual aid**: Presenting a mind map for students to understand the components of an essay.

Prerequisite Knowledge:

- Understanding simple, compound, and complex sentences.
- Avoiding run-ons and sentence fragments.
- Proper use of punctuation (periods, commas, quotation marks, etc.).
- Subject-verb agreement and proper tense usage.
- A strong grasp of commonly used words and their correct spelling.
- The ability to use varied and precise vocabulary.
- Types of Media

Microplanning:



1. Topic for Learning through evocation

An essay is a piece of writing that presents the writer's thoughts, arguments, or analysis on a specific topic. It is a structured form of writing, often used in academics, to explore ideas, explain concepts, or persuade readers. Essays are typically concise, focused, and organized into clear sections that allow the writer to communicate their message effectively.

2. Topic Introduction:

The word "essay" comes from the French word *essayer*, which means "to try" or "to attempt. "Essay writing is a fundamental skill that allows individuals to express their ideas, opinions, and knowledge in a clear and structured way. This reflects the exploratory nature of essays—they are a writer's attempt to present and develop ideas. Essays are widely used in academics, workplaces, and everyday communication to explain, persuade, or narrate. Writing essays not only improves critical thinking but also helps in organizing thoughts logically.

2.1 General Objective:

To develop the ability to express ideas, arguments, and perspectives clearly, coherently, and persuasively in written form.

2.2 Specific Objectives:

Students will be able to:

1. To write well-structured paragraphs with topic sentences, supporting details, and transitions.
2. To use proper grammar, punctuation, and vocabulary appropriate to the essay's tone and audience.
3. To organize an essay into three main sections: introduction, body, and conclusion.
4. To write strong conclusions that summarize main points and leave a lasting impression.
5. To analyze a topic critically by evaluating multiple perspectives or viewpoints.

2.3 Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1		2	3		
B. Conceptual Knowledge		2	4	2	2	
C. Procedural Knowledge			1	3		4
D. Meta Cognitive Knowledge					3	3

2.4 Key words:

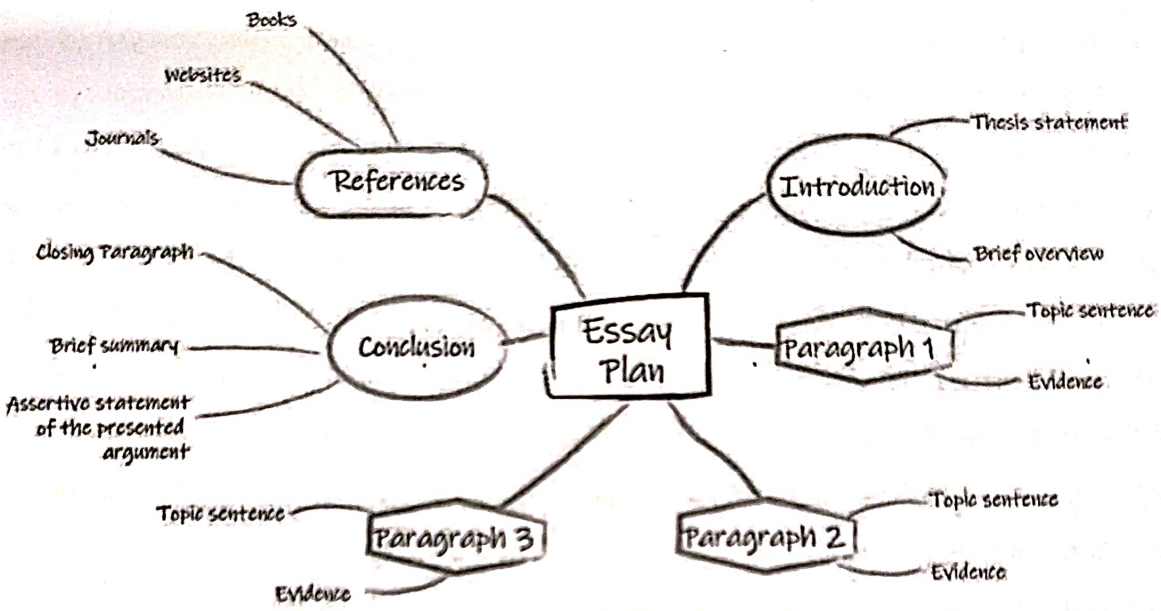
Introduction, conclusion, statement, paragraph, media

2.5 Key diagrams (if any): -

3. Discussion:

Encouraging the students to write an essay titled current topics and making them brainstorm about an essay.

4. Mind map



5. Summary

Exposing the students to the art of essay writing and explaining the concept of writing an essay. Making the students to critically think about every topic to get points to write an essay.

6. Assessment through Stimulating questions/Analogy/New ideas and Concepts:

- Asking questions like framing a new style of essay
- Questioning what kind of essay the students like to write.

7. FAQ's:

1. What is the main purpose of the introduction in an essay?

a) To provide supporting evidence

b) To summarize the essay

c) To introduce the topic and state the thesis

d) To conclude the essay

Answer: c) To introduce the topic and state the thesis

2. What is a thesis statement?

a) A sentence summarizing the main argument of the essay

b) A detailed description of the essay topic

c) A supporting piece of evidence

d) The conclusion of the essay

Answer: a) A sentence summarizing the main argument of the essay

3. Which of the following is NOT a type of essay?

a) Descriptive essay

b) Argumentative essay

c) Fictional essay

d) Narrative essay

Answer: c) Fictional essay

4. What is the purpose of a body paragraph in an essay?

a) To summarize the essay

b) To introduce the topic

c) To provide evidence and analysis supporting the thesis

d) To restate the thesis

Answer: c) To provide evidence and analysis supporting the thesis

5. Which of the following should be included in the conclusion of an essay?

a) New evidence

b) A summary of the main points

c) A detailed explanation of the introduction

d) A new thesis statement

Answer: b) A summary of the main points

6. What is the correct order of an essay's structure?

a) Conclusion → Body → Introduction

b) Introduction → Body → Conclusion

c) Body → Introduction → Conclusion

d) Introduction → Conclusion → Body

Answer: b) Introduction → Body → Conclusion

7. What does a topic sentence in a paragraph do?

a) Restates the thesis

b) Summarizes the entire essay

c) Introduces the main idea of the paragraph

d) Provides concluding thoughts

Answer: c) Introduces the main idea of the paragraph

8. Which type of essay is designed to persuade the reader to accept a particular point of view?

a) Expository essay

b) Argumentative essay

c) Narrative essay

d) Descriptive essay

Answer: b) Argumentative essay

9. In an argumentative essay, addressing opposing views is important because:

a) It weakens the essay

b) It shows the writer is unsure of their position

c) It strengthens the argument by addressing counterarguments

d) It is required for all essays

Answer: c) It strengthens the argument by addressing counterarguments

10. What is the role of transitions in essay writing?

a) To summarize the essay

b) To connect ideas between paragraphs and sentences

c) To introduce the thesis

d) To add citations

Answer: b) To connect ideas between paragraphs and sentences

11. What should you avoid in an academic essay?

a) Formal tone

b) Supporting evidence

c) Personal opinions without evidence

d) Structured paragraphs

Answer: c) Personal opinions without evidence

12. Which of the following is an example of a hook for an essay?

a) "This essay will discuss climate change."

b) "Did you know that the Earth's temperature has risen by 1.5°C in the last century?"

c) "In conclusion, climate change is a global issue."

d) "The thesis of this essay is about climate change."

Answer: b) "Did you know that the Earth's temperature has risen by 1.5°C in the last century?"

8. References: (Books/Periodicals/Journals)

1. Tamil Nadu State Council for Higher Education (TANSCHE), *Professional English for Life Science- I*

2. Rajan S., Selvi Christy R., *Essentials of Microbiology*. CBS Publishers and Distributers. 2015

9. Verified by Subject Expert

(A. MARIA HEARTINA ADLIN VAZ)

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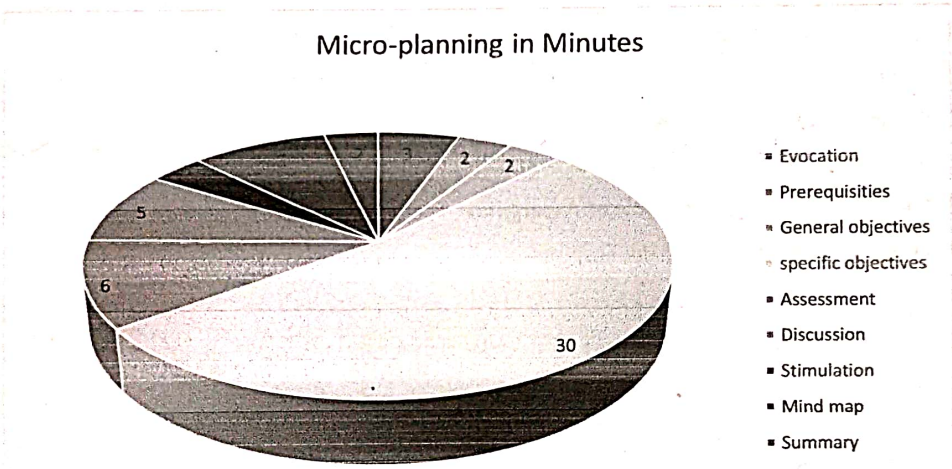
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	II
Subject Title	Core: Microbial Diversity
Code	21UMIC21
Hours	6
Total Hours	90
Credits	6
Max Marks	100
Unit & Title	Unit: III – molds (*Aspergillus*),
Name of the Faculty	Ms. R. Shynisha Begam
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the morphol life cycle of Aspergillus and evaluated by oral questioning.

Prerequisite Knowledge:
Knowledge about classification, features and sexual and asexual reproduction of Aspergillus

Micro -planning



1. Topic for Learning through evocation

Students were asked to recite about their knowledge in fungi. The fungal morpholog structure, cellular organization of fungi, the type of cell and how it differs from other microb Aspergillus is a genus of filamentous fungi found in soil, dust, compost, and food. It is an aer fungus that grows on high carbon sources like monosaccharides and polysaccharides

Aspergillus species are used in the fermentation industry for the production of orgar antibacterial product and pesticides, but they are also responsible of various plant and food s with the consequence of possible accumulation of mycotoxins.

The life cycle of Aspergillus is characterized by a rapid growth phase and the produ numbers of spores, contributing to its widespread distribution in the environment

2. Topic Introduction:

Aspergillus is a genus of fungi that includes over 200 species. Most Aspergillus harmless, but some can cause Opportunistic infections. There are several types of aspergillos allergic bronchopulmonary aspergillosis, chronic pulmonary aspergillosis, and invasive aspe

2.1.General Objective:

Enables the students to understand the morphology, life cycle, beneficial and harmful effect of Aspe

2.2.Specific Objectives:

Enables the students to:

1. Identifies the morphology of Aspergillus
2. Compares the beneficial and harmful effects of Aspergillus
3. Show the sexual reproduction of Aspergillus
4. Give an outline of the life cycle of Aspergillus
5. Describe the formation of conidiospore

2.3: Taxonomy of objectives:

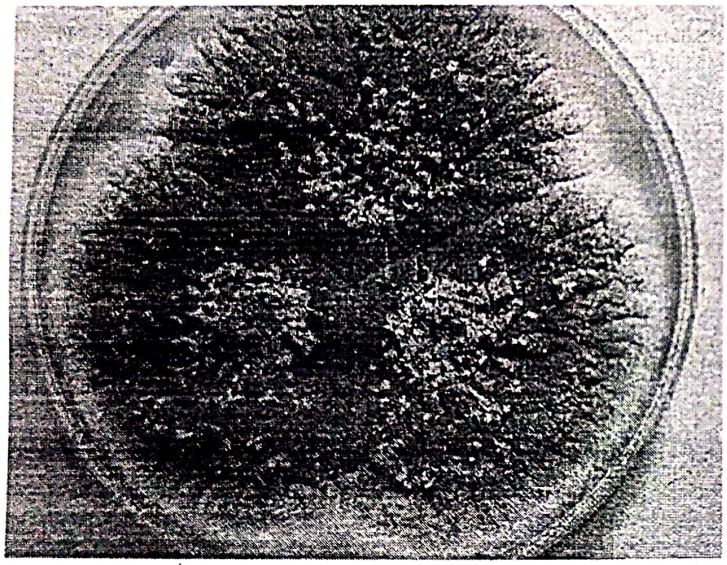
Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1			1,2,3	4	
B. Conceptual Knowledge	2,3	1, 2	3,4		2,3	
C. Procedural Knowledge		3,4		4	4	
D. Meta Cognitive Knowledge					5	

2.4: Key words:

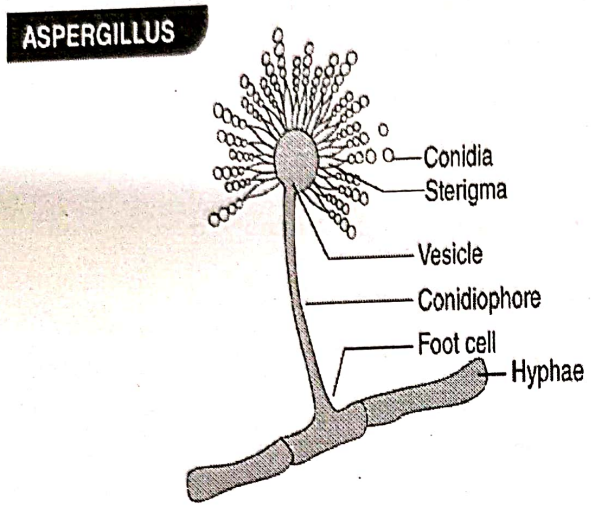
Aspergillus, habitat, useful character, harmful effects, Conidia, Ascospore, filamentous fungi

2.5: Key diagrams (if any):

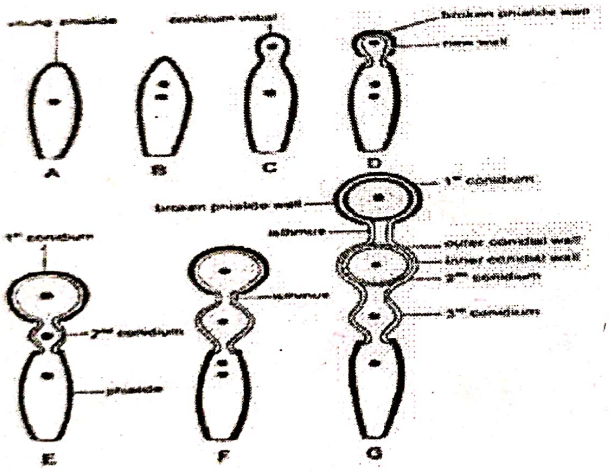
Macroscopic appearance of Aspergillus



Microscopic appearance of Aspergillus



Formation of asexual spore



3. Discussion:

The students will be asked questions regarding the. One of the students will be asked to draw any studied during the class.

4. Mind Map:

Morphology, sexual and asexual reproduction of Aspergillus

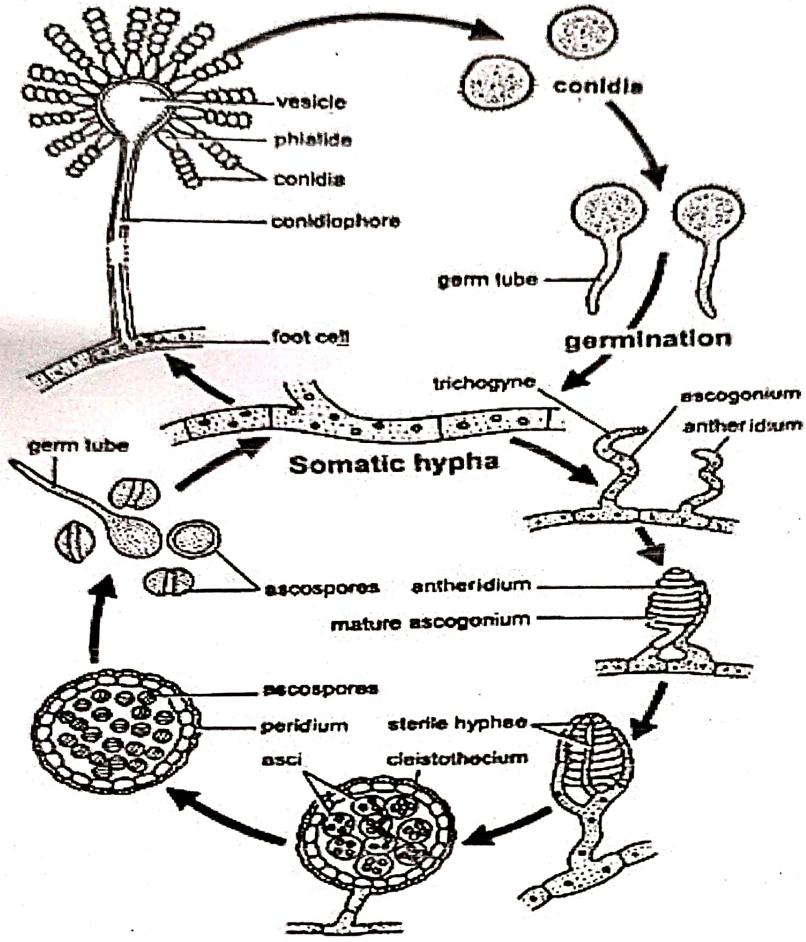


Fig. 14. Diagrammatic life cycle of *Aspergillus*

5. Summary:

Executing the acquired knowledge by asking questions like 'List out the steps in spor formation'. How is Aspergillus important in production of industrially important produ

6. Assessment through Stimulating questions/Analogy/New ideas and Concepts:

- Generating mental idea about creating an e-content of the life cycle of Aspergillus
- Producing the e-content.
- Differentiating the useful and harmful effects of the Aspergillus.
- Students were asked to explain the asexual reproduction of Aspergillus

7. FAQ's:

1. Aspergillosis primarily affects the _____ System

   a) Nervous b) urinary c) cardiovascular d) Respiratory

2. The lethal effects of Aflatoxins are

   a) Skin infection b) liver cancer c) urinary infection d) affect nerves

3. The staining technique used to observe Aspergillus

   a) LPCB staining b) Gram staining c) Giemsa staining d) Acid fast staining

4. Aspergillus are commonly found in

   a) Soil and decaying matter b) sea water c) skin d) blood

5. Sexual reproduction of Aspergillus results in the formation of

   a) Zygospore b) Conidiospore c) Basidiospore d) Ascospore

8. References

1. R.C. Dubey. Text Book of Microbiology 2004 S. Chand and Company Ltd.,
2. Alexopoulos, C.J., and Mims, C.W. New York. *IntroductoryMycology*,Wiley, 1979.
3. Jagadish Chandar. *A Text Book of Medical Mycology*. New Delhi: Inter Print. 1996
4. Pelczar Jr. M.J., Chan E.C.S., and Kreig N.R. *Microbiology* – New York: McGraw Hill Inc., 1993

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Ms. R. Shynisha Begam

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LESSON PLAN FOR MICROBIOLOGY

Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	II
Subject Title	Allied II Biochemistry
Code	21UMIA21
Hours	4
Total Hours	60
Credits	3
Max Marks	100
Unit & Title	Unit II : Polysaccharide
Name of the Faculty	Dr. Joys Selva Mary Albert
T-L tools	Lecture method, **Visual aid:** Picture of classification, structure and functions of polysaccharide

Prerequisite Knowledge: Knowledge about classification, structure and functions of polysaccharide

Micro-planning

1. Topic for Learning through evocation

Carbohydrates are a major source of food and an important form of energy for most living organisms. A carbohydrate is a biomolecule consisting of carbon, hydrogen, and oxygen atoms. The two basic compounds that makeup carbohydrates are – Aldehydes and Ketones. Carbohydrates are found in all-natural and processed foods. The three types of carbohydrate are:Monosaccharides– Glucose and galactose are examples of monosaccharides. Disaccharides– Sucrose and maltose are examples of disaccharides. Polysaccharides– Starch, glycogen, and cellulose are examples of polysaccharides.

Characteristics Of Polysaccharides

They are not sweet in taste.Many are insoluble in water.They are hydrophobic in nature.They do not form crystals on desiccation.Can be extracted to form a white powder.They are high molecular weight carbohydrates.Inside the cells, they are compact and osmotically inactive.They consist of hydrogen, carbon, and oxygen. The hydrogen to oxygen ratio being 2:1.

Functions Of Polysaccharides

The polysaccharides serve as a structural organization in animals and plants. Other functions of polysaccharides include:

1. They store energy in organisms.
2. Due to the presence of multiple hydrogen bonds, the water cannot invade the molecules making them hydrophobic.

3. They allow for changes in the concentration gradient which influences the uptake of nutrients and water by the cells.
4. Many polysaccharides become covalently bonded with lipids and proteins to form glycolipids and glycoproteins. These glycolipids and glycoproteins are used to send messages or signals between and within the cells.
5. They provide support to the cells. The cell wall of plants is made up of polysaccharide cellulose, which provides support to the cell wall of the plant. In insects and fungi, chitin plays an important role in providing support to the extracellular matrix around the cells.

2. Topic Introduction:

Carbohydrates are a major source of food and an important form of energy for most living organisms. A carbohydrate is a biomolecule consisting of carbon, hydrogen, and oxygen atoms. The two basic compounds that makeup carbohydrates are – Aldehydes and Ketones. Carbohydrates are found in all-natural and processed foods.

2.1. General Objective:

Enables the students to understand classification, structure and functions of polysaccharide

2.2. Specific Objectives:

Enables the students to:

1. Outline the polysaccharide classification
2. Describe the structure of polysaccharides
3. Summarize the functions of polysaccharide

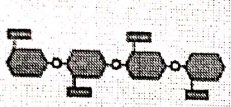
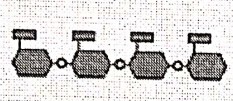
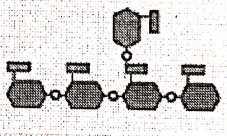
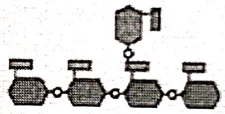
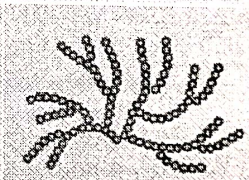
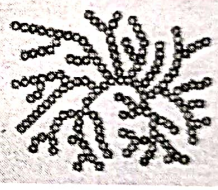
2.3. Taxonomy of objectives:

Taxonomy of objectives						
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1			1,2,3	4	
B. Conceptual Knowledge		1,2,3	3,4		2,3,4	
C. Procedural Knowledge				4		
D.MetaCognitive Knowledge					5	

2.4. Key words:

Polysaccharide, Homopolysaccharide, Heteropolysaccharide, Glucose, Starch, Cellulose, Glycogen.

2.5. Key diagrams (if any):

	Cellulose	Starch		Glycogen
		Amylose	Amylopectin	
Source	Plant	Plant	Plant	Animal
Subunit	β-glucose	α-glucose	α-glucose	α-glucose
Bonds	1-4	1-4	1-4 and 1-6	1-4 and 1-6
Branches	No	No	Yes (~per 20 subunits)	Yes (~per 10 subunits)
Diagram				
Shape				

Types Of Polysaccharides

Polysaccharides are categorized into two types: Homopolysaccharides, Heteropolysaccharides.

Homopolysaccharides

A polysaccharide that contains the same type of monosaccharides is known as a homopolysaccharide. Some of the important homopolysaccharides are:

1. **Glycogen**: It is made up of a large chain of molecules. It is found in animals and fungi.
2. **Cellulose**: The cell wall of the plants is made up of cellulose. It comprises long chains of β -glycosides.
3. **Starch**: It is formed by the condensation of amylose and amylopectin. It is found largely in plants, fruits, seeds, etc.
4. **Inulin**: It is made up of a number of fructofuranose molecules linked together in chains. It is found in the tubers of dahlia, artichoke, etc.

Heteropolysaccharides

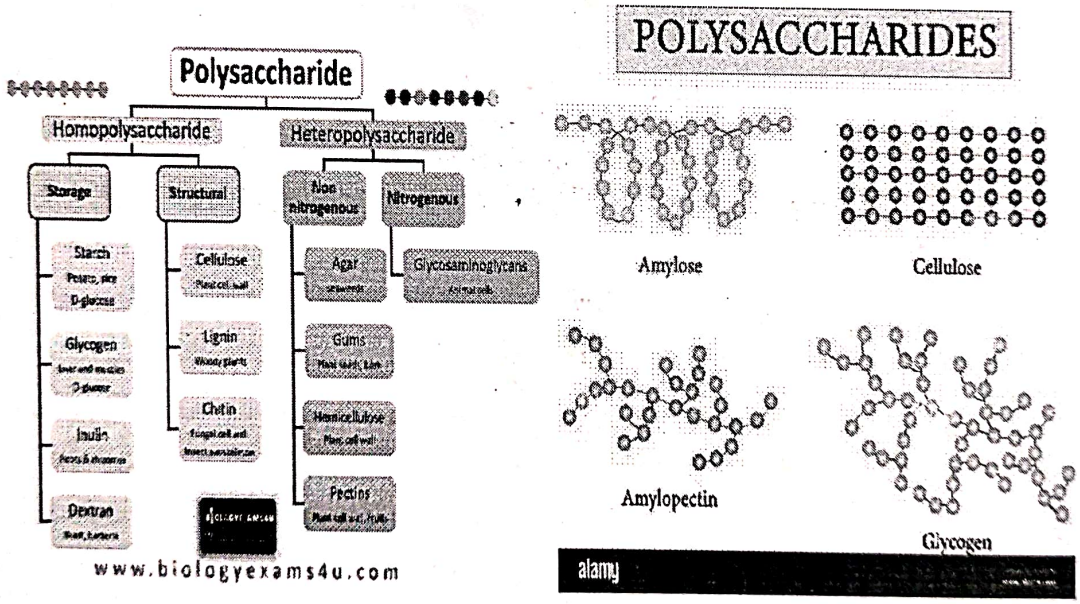
A polysaccharide that contains different types of monosaccharides is known as a heteropolysaccharide. Some of the important heteropolysaccharides are:

1. **Hyaluronic Acid:** It is made up of D-glucuronic acid and N-acetyl-glucosamine. It is found in connective tissues and skin.
2. **Heparin:** It is made up of D-glucuronic acid, L-iduronic acid, N-sulfo-D-glucosamine and is largely distributed in mast cells and blood.
3. **Chondroitin-4-sulfate:** Its component sugars are D-glucuronic acid and N-acetyl-D-galactosamine-4-O-sulfate. It is present in the cartilages.
4. **Gamma globulin:** N-acetyl-hexosamine, D-mannose, D-galactose are the component sugars of this polysaccharide. It is found in the blood.

3. Discussion:

The students will be asked to retrieve the classification of polysaccharides mentioned in the content analysis. One member will be called from each group to present the structure of polysaccharides. Arrange the class to explain the difference between the polysaccharides by its structure and functions.

4. Mind Map:



5. Summary: Executing the acquired knowledge by asking questions like ' Definition for polysaccharide. Differentiate between homopolysaccharide and heteropolysaccharide. What are the monomers of starch, glycogen and cellulose?

6. Assessment through Stimulating questions/Analogy/New ideas/and Concepts:

- Generating mental ideas about creating an e-content on the source of polysaccharides
- Differentiating homopolysaccharide and heteropolysaccharide

7. FAQ's:

1. When all the monosaccharides in a polysaccharide are same type, such type of a polysaccharide is called a _____
a) Glycogen b) Homoglycan c) Heteroglycan d) Oligosaccharide
2. In which of the following forms, glucose is stored in plants?
a) Glycogen b) Starch c) Dextrin d) Cellulose
3. In which of the following forms, glucose is stored in the liver?
a) Glycogen b) Starch c) Dextrin d) Cellulose
4. Which of the following are the structural polysaccharides?
a) Glycogen b) Starch c) Chitin d) Glucose
5. Which of the following is an analogous to starch?
a) Cellulose b) Glycogen c) Sucrose d) Chitin

8. References: (Books/Periodicals/Journals)

1. Berg, J. M., Hines, J., Tymoczko, J. L., Gatto Jr, G. J., & Stryer, L. (2023). *Biochemistry* (10th ed.). Palgrave Macmillan.

2. Nelson, D. L., Cox, M. M., & Hoskins, A. (2021). *Lehninger Principles of Biochemistry* (8th ed.). W.H. Freeman and Company.

3. Jain, J. L., Jain, N., & Jain, S. (2020). *Fundamentals of Biochemistry* (7th ed.). S. Chand Publishing.

9. Verified by Subject Expert

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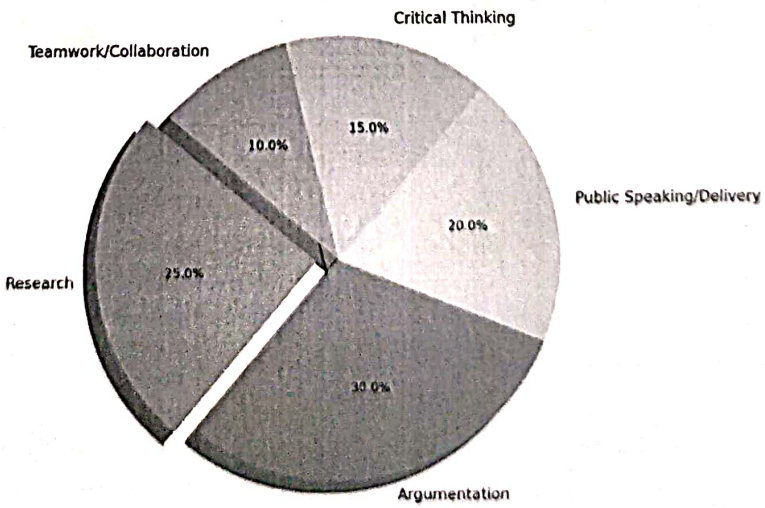
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	II
Subject Title	Skill Enhancement Course : Professional English for Microbiology - II
Code	21UMIPE2
Hours	2
Total Hours	30
Credits	2
Max Marks	50
Unit & Title	Unit II : Debate on pros and cons of Micro organisms
Name of the Faculty	Ms. A. Maria Heartina Adlin Vaz
T-L tools	Lecture method, **Audio Visual aid:** An expert video of debate. **Visual aid:** Presenting a mind map for students to understand about preparing for doing a debate.

Prerequisite Knowledge:

- Knowing the roles of the speakers
- Understanding how to anticipate and refute opposing points.
- Knowing how to use facts, statistics, quotes, and case studies to support arguments.

Microplanning:



1. Topic for Learning through evocation

Debate is a process that involves formal discourse, discussion, and oral addresses on a particular topic or collection of topics, often with a moderator and an audience. In a debate, arguments are put forward for opposing viewpoints. Historically, debates have occurred in public meetings, academic institutions, debate halls, coffeehouses, competitions, and legislative assemblies. Debates have also been conducted for educational and recreational purposes, usually associated with educational establishments and debating societies. These debates emphasize logical consistency, factual accuracy, and emotional appeal to an audience. Modern competitive debate also includes rules for participants to discuss and decide upon the framework of the debate. The term "debate" may also apply to a more continuous, inclusive, and less formalized process through which issues are explored and resolved across a range of agencies and among the general public.

2. Topic Introduction:

A debate introduction should clearly state the topic, introduce the debaters, and explain the format. It's also a good idea to grab the audience's attention and provide context.

2.1 General Objective:

To engage in a structured and respectful exchange of ideas on a particular topic, with the goal of persuading the audience or evaluating the merits of different perspectives

2.2 Specific Objectives:

Students will be able to:

- Present and defend a clear position on an issue.
- Put forth opposing viewpoints respectfully.
- To think critically and reflect among the audience.
- Promote the use of evidence and logic to support arguments.

2.3 Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge			3			
B. Conceptual Knowledge				4	2	
C. Procedural Knowledge			4			3
D. Meta Cognitive Knowledge				3	2	4

2.4 Key words:

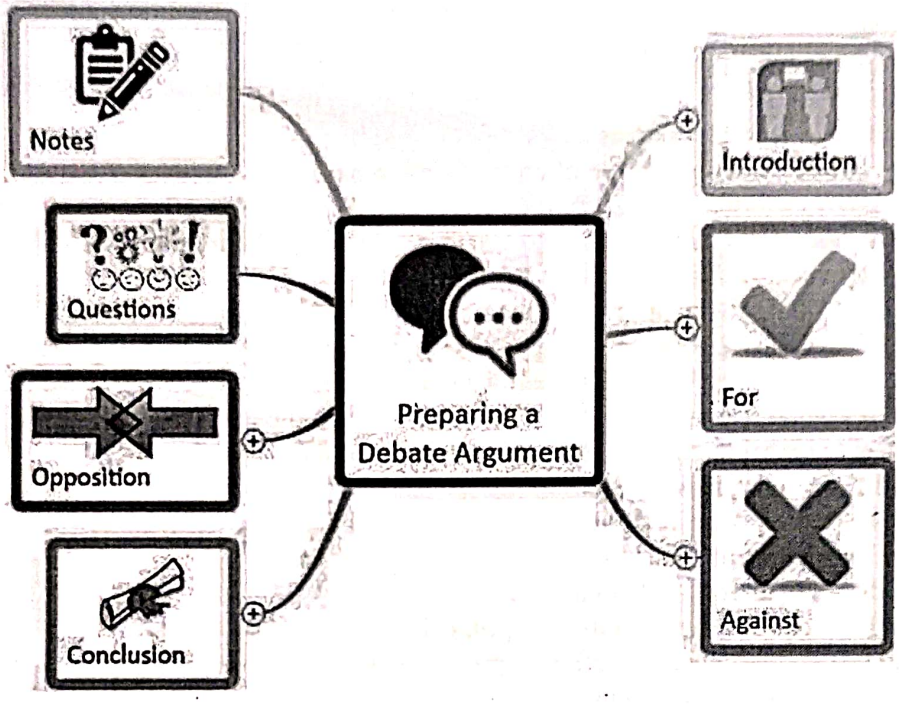
Argumenting, reasoning, tactics, structure, organization

2.5 Key diagrams (if any): -

3. Discussion:

Encouraging the students to do a debate in class titled current topics and making them reason out and react spontaneously.

4. Mind map



5. Summary

Exposing the students to the art of debate and explaining the concept of deabting. Making the students to critically think about every topic to get points to do a debate.

6. Assessment through Stimulating questions/Analogy/New ideas and Concepts:

- Asking questions like doing a new style of debate.
- Questioning what kind of debate the students like to do.

7. FAQ's:

1. What is the main purpose of a debate?
a) To argue for the sake of arguing
b) To persuade the audience by presenting logical arguments
c) To entertain the audience with humor
d) To memorize facts and recite them
Answer: b) To persuade the audience by presenting logical arguments
2. In a debate, what is a rebuttal?
a) The opening statement that sets the tone of the debate
b) The response to an opponent's argument to challenge or weaken it
c) The final remarks summarizing the debate

d) The collection of evidence presented to support a position
Answer: b) The response to an opponent's argument to challenge or weaken it
3. What does "burden of proof" refer to in a debate?
a) The requirement for both sides to agree on the facts
b) The responsibility to prove one's claims or position
c) The responsibility to present evidence without any objections
d) The ability to disrupt the opponent's argument
Answer: b) The responsibility to prove one's claims or position
4. Which of the following is not an example of a logical fallacy?
a) Ad hominem
b) Straw man
c) Citing credible sources
d) False dilemma
Answer: c) Citing credible sources
5. In a team debate, what is the role of cross-examination?
a) To introduce new arguments in favor of your side
b) To ask the opposing team questions to clarify or challenge their arguments
c) To provide evidence supporting your position
d) To make the final statement of the debate
Answer: b) To ask the opposing team questions to clarify or challenge their arguments
6. Which of the following best defines ethos in persuasion?
a) The use of logical reasoning and facts to persuade the audience
b) The appeal to emotion, making the audience feel a certain way
c) The credibility and trustworthiness of the speaker
d) The timing of presenting arguments for maximum effect
Answer: c) The credibility and trustworthiness of the speaker
7. What is the "affirmative" side in a debate?
a) The side that opposes the resolution or proposition
b) The side that supports the resolution or proposition
c) The side that moderates the debate
d) The side that presents the final argument
Answer: b) The side that supports the resolution or proposition
8. What is "signposting" in a debate?
a) The use of rhetorical devices to manipulate the audience
b) The process of clearly indicating the structure of your arguments
c) The final summary of the debate
d) The refutation of all opposing arguments
Answer: b) The process of clearly indicating the structure of your arguments
9. In a Lincoln-Douglas debate, what is the focus of the debate?
a) Policy change
b) Legal rights
c) Ethical and value-based dilemmas
d) Economic strategies
Answer: c) Ethical and value-based dilemmas
10. Which of the following is not a part of a debate's structure?
a) Opening statement
b) Counterargument
c) Repetition of the same point
d) Closing statement
Answer: c) Repetition of the same point

8. References: (Books/Periodicals/Journals)

1. Tamil Nadu State Council for Higher Education (TANSCHE), Professional English for LifeScience- I

2. Rajan S., Selvi Christy R., Essentials of Microbiology. CBS Publishers and Distributers. 2015

9. Verified by Subject Expert

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LESSON PLAN

Objective Oriented Learning Process RBT

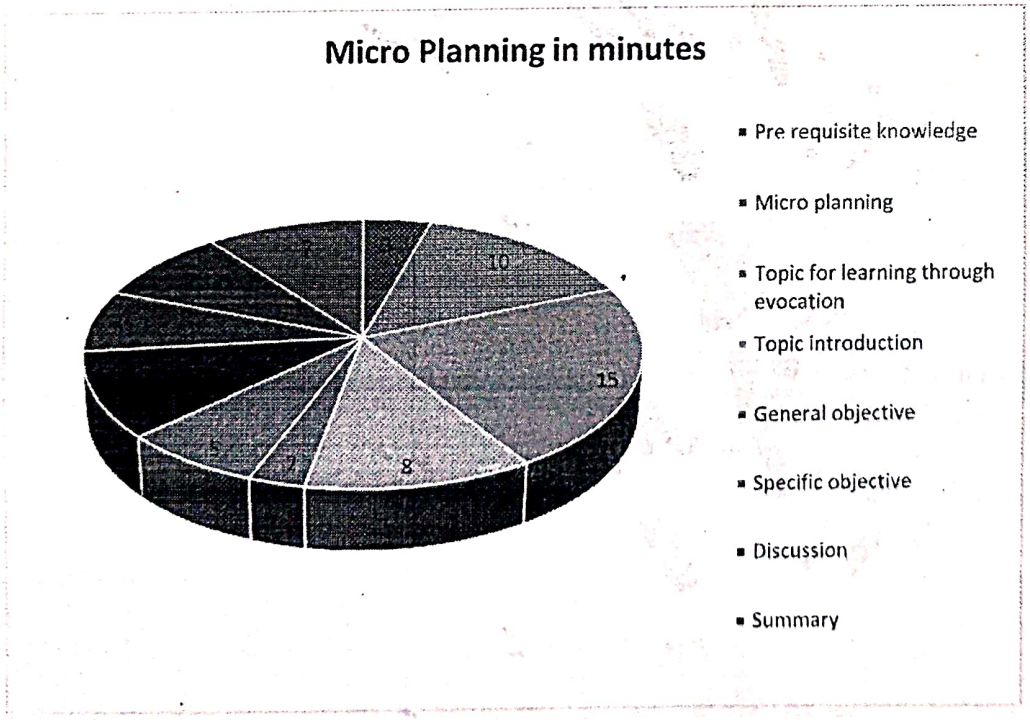
Programme	B.Sc. Microbiology
Semester	III
Subject Title	Major Core: Microbial Physiology and Metabolism
Code	21UMIC31
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit: IV – Mechanism of sporulation
Name of the Faculty	Mr.EDWARD C
T-L tools	Lecture method, **Visual aid:** PPT, Picture showing the principle and mechanism of sporulation

Prerequisite Knowledge:

Solid foundation on the layers of an endospore (e.g., core, cortex, spore coat, exosporium).

Knowledge on composition and functions of layers.

Micro -planning



1. Topic for Learning through evocation

Start with a Thought-Provoking Question

"Why do some bacteria produce endospore while others dont?"

"What environmental factors trigger sporulation ?"

Step-by-Step Breakdown of Sporulation Mechanism

(Engage learners with visuals, animations, or interactive discussions)

Testing Understanding

Conduct an interactive quiz or case study on sporulation in various species (e.g., Bacillus subtilis or Clostridium botulinum).

Discuss how sporulation is applied in fields like food safety, medicine, and biotechnology.

Reflect and Relate

How sporulation contributes to microbial survival and evolution.

Role of sporulation in industrial applications

2 Topic Introduction:

Sporulation is a complex, highly regulated process by which certain bacteria, particularly members of the genera Bacillus and Clostridium, form endospores as a survival strategy under adverse environmental conditions. These endospores are dormant, highly resistant structures that enable the bacteria to withstand extreme stress, such as nutrient depletion, heat, desiccation, radiation, and chemical disinfectants. The mechanism of sporulation can be divided into six distinct stages, each characterized by specific morphological and molecular changes: Initiation, Axial filament formation, Cell division , Engulfment of forespore,Cortex and coat formation , Maturation and release of the spore

2.1General Objective:

To understand the biological process of sporulation, including its triggers, stages, regulatory mechanisms, and the structural and functional adaptations of endospores, in order to appreciate its role in bacterial survival, medical significance, and industrial applications.

2.2 Specific Objectives:

Enables the students to:

1. Recall the definition of sporulation and its importance in bacterial survival.
2. Illustrate the morphological changes that occur during each stage of sporulation.
3. Demonstrate the ability to label and explain diagrams of sporulation stages.
4. Differentiate between the processes occurring in the mother cell and the forespore during sporulation.
5. Evaluate the effectiveness of sterilization techniques against bacterial endospores.
6. Design a flow chart explaining the steps of sporulation

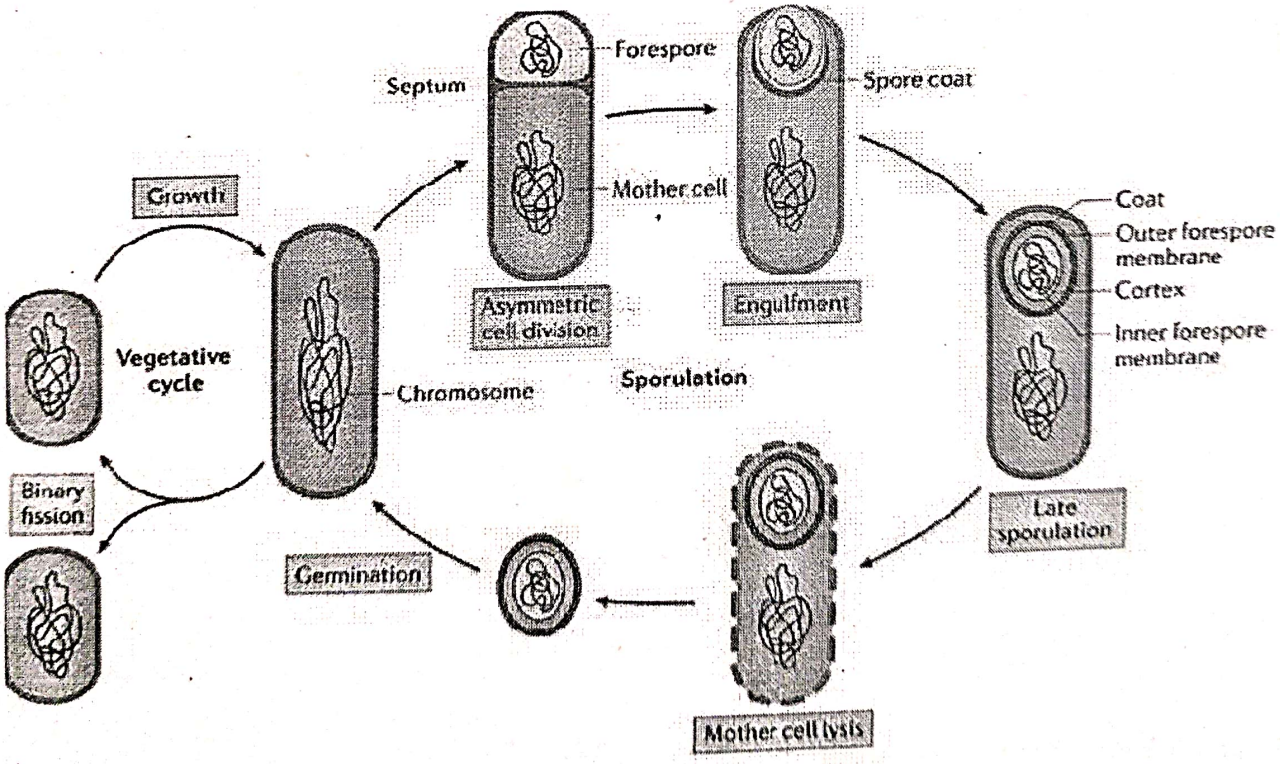
2:3 Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1			1,2	4	
B. Conceptual Knowledge		1, 2,3,4			2,3	
C. Procedural Knowledge			3,4	3, 4	4	6
D. Meta Cognitive Knowledge					5	

2.4 Key words:

Endospore, Cortex, Engulfment of fore spore, Septum formation, Lysis of mother cell

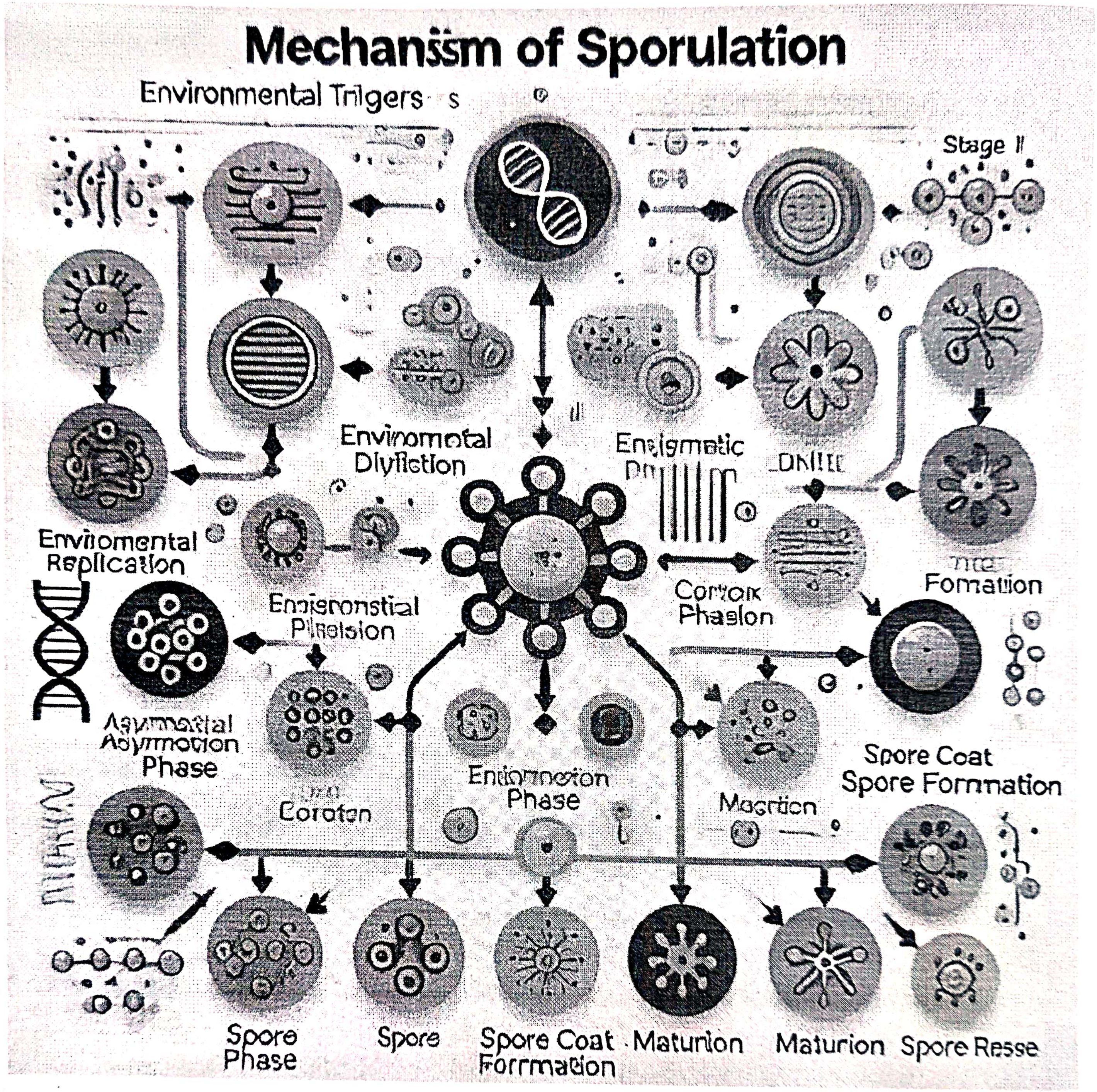
2:5 Key diagrams (if any):



3 Discussion:

The students will be asked questions regarding the endospore structure and its importance. One of the students will be asked to explain the steps involved in the formation of endospore

4 Mind Map:


Mechanssm of Sporulation
Environmental Trigers
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Envinomotal Diyfiction
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Spore Coat Spore Formation
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Coroton
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Spore Phase
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Spore Coat Formation
Maturion
Maturion
Spore Resse

5 Summary:

Students will be asked to identify about different position of spore in the cell by showing previously stained slides and demonstrate the possible changes in the cell cytoplasm and plasma membrane during endospore formation

6 Assessment through Stimulating questions/Analogy/New ideas and Concepts:

- Generating mental idea about creating an e content by making video
- Producing the e-content and demonstrating the sporulation procedure
- Provided with sporulating and non-sporulating bacterial cells and asked to identify them

7 FAQ's:

1. What is the primary trigger for sporulation formation
a) Nutrient depletion b) high temperature c) Desiccation d) High salty
2 During bacterial sporulation, the forespore is formed by:
A) Binary fission B) Asymmetric cell division C) Symmetric cell division D) Budding
3 In which stage of sporulation does the mother cell engulf the forespore?
A) Cortex formation B) Engulfment C) Spore coat synthesis D) Release
4The peptidoglycan layer in the spore is known as the:
A) Core B) Cortex C) Spore coat D) Periplasm
5. What happens to the mother cell after sporulation is complete?
A) It divides into two cells B) It releases the mature spore C) It remains dormant D) It merges with the spore

8 References

1. Meena Kumari S. *Microbial Physiology*.Chennai:1st edition MJP Publishers. 2006.
2. Lansing M. Prescott John.P. Harley and Donald A, Klein. *Microbiology*. Newyork : (5thedition). McGraw – Hill Company, 2003.
3. Dubey R.C. and Maheswari, S. *A. Text Book of Microbiology*. New Delhi: S.Chand & Co, 2003.
4. Pelczar Jr., M.J. Chan E.C.S., and Kreig N.R. *Microbiology*. NewYork : McGraw- Hill Inc,

EDWARD C
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Lesson Plan

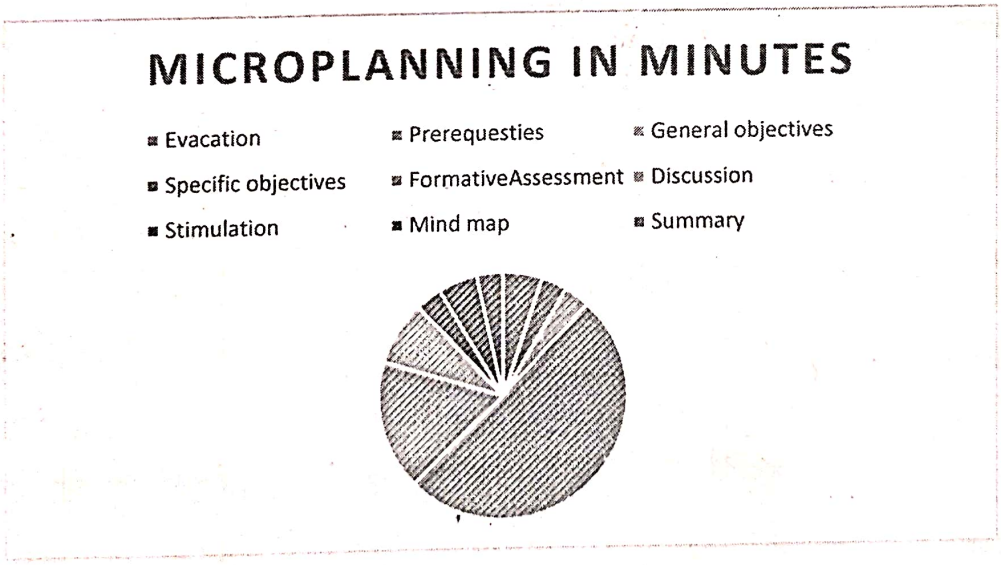
Objective oriented earning Process RBT

Programme	B.Sc., Microbiology
Semester	III
Subject Title	Allied-III-Genetic Engineering
Code	21UMIA31
Total Hours	4 hrs
Credits	3
Max Marks	100
Unit & Title	Unit-II Cloning Vocation for DNA (Plasmid)
Name of the Faculty	Dr.T.P.Kumri Phuspharani
T-L Tools	Lecture method, **Visual aid,** PPT, Picture showing he evolution of setele

Prerequisite Knowledge :

Knowledge of plasmid and its importance

Micro-Planning :



1. Topic for Learning through evocation :

Cloning vectors are limited to the size of insert that they can carry. Depending on the size and the application of the insert the suitable vector is selected for a particular purpose Genetic vectors are delivering foreign DNA into recipient cells. The different types of vectors available for cloning are plasmids bactriophoges BACS, TACS and MACS.Students were asked to vectors can replicate autonomously and typically included.

2. Topic Introduction :

1. Gnetic vectors are Vehicles for delivering foreign DNA into recipient cell.
2. All vectors are carrier DNA molecules.
3. It must be self replicating inside

2. 1. General Objective :

Enables the students to understand the vectors.

2.2 Specific Objectives :

Enables the students to

1. describe the vectors
2. Know the types if vectors
3. Show the process of vectors
4. Distinguish the carious type of cloning vectors

2.3 Taxonomy of objectives :

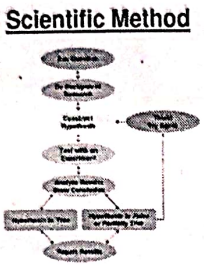
Taxonomy of objectives						
Knowledge Dimension	**The Cognitive process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1			3.4,5		
B. Conceptual Knowledge		3,4			1,2	
C.Procedural Knowledge			4			
D. Meta Cognitive Knowledge					4,5	

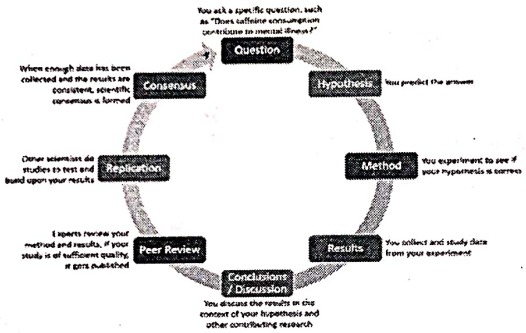
2.4 Keywords:

Vectors, plasmid, origin ,replication

Data Collective, Design, sampling methods, qualitative analysis, validity, case study, Data interpretation.

2.5 Key diagrams (if any):

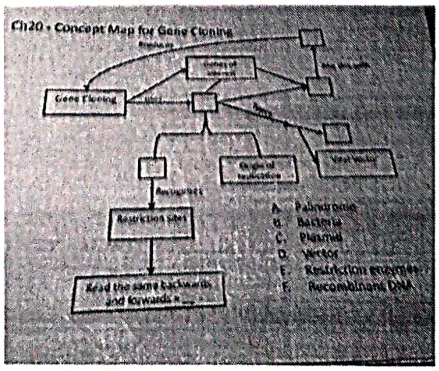


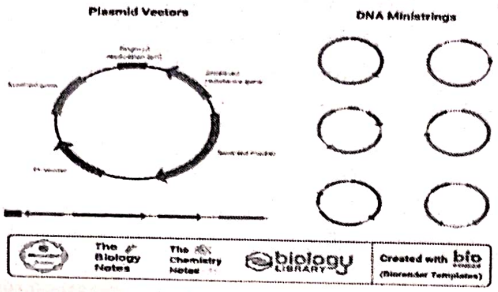


3. Discussion

The students will be asked question regarding cloning velum and its types. One of the students will be asked to draw any type of vectors.The students will be asked question regarding cloning velum and its types. One of the students will be asked to draw any type of vectors.

4. Mind Map :





5. Summary :

Students will be asked to identify how virtue clone us the mind map.

6. Assessment through stimulating question/New ideas and concepts :

- ❖ Generating mental idea abacus creating an e-content of working of cloning vector
- ❖ Producing e-content.

7. FAQ'S :

1. The sequence of DNA from where replication starts is called
(or) selertable marker (b) origin of replication (c) TER sequence
(d) Genetic sequence
2. Viruses which infect bacteria are called
(a) Bacteria (b) Archara (c) PUC (d) Bacteriophages
3. ----------Organism has higher number of vactors
(a) Years (b) Mammalian cells (c) E.Coli (d) turgi
4. ---------- antibiotic resistance is pressed in PBRS22
(a) Ampicillin (b) Kanamycin (c) Lecture (d) Generaycin

8. References:(Books/periodicals/Journals)

1. Dr. Verma P.S. and De. Agarwal V.K. Gentic Enginnering New Delhi chant and company Ltd 2009

2.Glick B.R. and Pasternak J.J. Molecular Biotochnobhy principles and Application of Recombinant DNA washing for DC ASMP press, 2017

3. Brow, T.A. gene cloning USA: Third Edition chapmanand hall publication, 2016

Verified by Subject Expert

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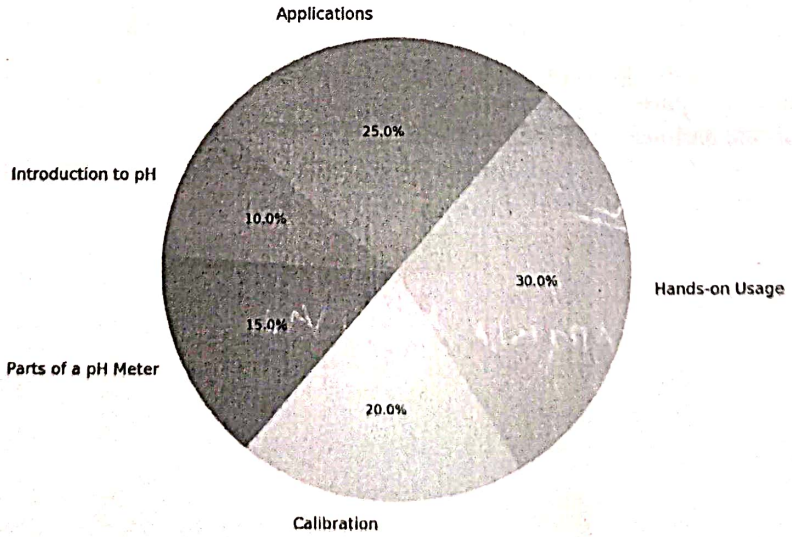
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	III
Subject Title	Skill Based Elective: Bioinstrumentation
Code	21UMIS31
Hours	2
Total Hours	30
Credits	2
Max Marks	50
Unit & Title	Unit I : pH meter
Name of the Faculty	Ms. A. Maria Heartina Adlin Vaz
T-L tools	Lecture method, **Audio Visual aid:** video showing about working of pH meter. **Visual aid:** Showing a real pH meter and demonstrating the handling, calibration and usage instructions. Making the students to check the pH for a given solution.

Prerequisite Knowledge:

- Knowledge about pH.
- Basic understanding of acids, bases, and the pH scale.
- Familiarity with laboratory safety protocols.

Microplanning:



1. Topic for Learning through evocation

The term pH stands for "potential of hydrogen" and is a measure of the hydrogen ion (H^+) concentration in a solution. It quantifies the acidity or alkalinity of a solution on a scale from 0 to 14. Acidic Solutions (pH < 7) have a high concentration of H^+ ions. Examples: Lemon juice (pH ~2), vinegar (pH ~3). Neutral Solutions (pH = 7): Equal concentrations of H^+ and OH^- ions. Example: Pure water. Basic (Alkaline) Solutions (pH > 7): Have a high concentration of hydroxide ions (OH^-). Examples: Baking soda (pH ~9), soap (pH ~10-11).

Importance of pH includes maintaining balance in ecosystems (e.g., soil pH affects plant growth, and water pH impacts aquatic life), essential in food production, pharmaceuticals, cosmetics, and chemical manufacturing, pH balance in blood and body fluids is critical for physiological functions (normal blood pH ~7.35-7.45), ensures precise control of reactions in laboratories and industrial processes.

A pH meter is a scientific instrument used to measure the hydrogen ion concentration (pH) of a solution, indicating whether it is acidic, neutral, or basic. pH is measured on a scale from 0 to 14.

2. Topic Introduction:

A pH meter is an instrument used to measure hydrogen ion activity in solutions - in other words, this instrument measures acidity/alkalinity of a solution. The degree of hydrogen ion activity is ultimately expressed as pH level, which generally ranges from 1 to 14.

2.1 General Objective:

To introduce students to the working mechanism and applications of a pH meter.

2.2 Specific Objectives:

Students will be able to:

1. Define the concept of pH and its significance.
2. Identify the parts of a pH meter.
3. Calibrate and use a pH meter effectively.
4. Interpret pH readings and discuss their applications in various fields (e.g., biology, chemistry, environmental science).

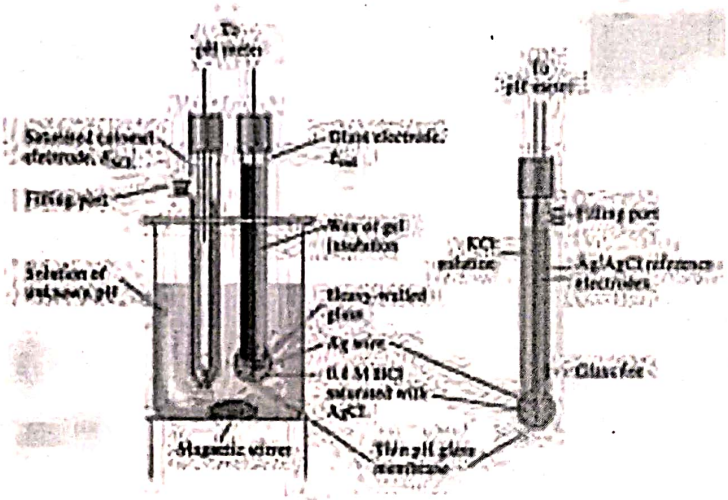
2.3 Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1	2		1,2	3,4	
B. Conceptual Knowledge		3	4	2		
C. Procedural Knowledge			3,4	5	2	
D. Meta Cognitive Knowledge			5			

2.4 Key words:

pH Scale, Acidity, Alkalinity, Neutral, Hydrogen Ion (H^+), Hydroxide Ion (OH^-), pH Meter Electrode, Glass Electrode, Reference Electrode, Buffer Solution, Acidic Solution, Basic Solution, Neutral Solution

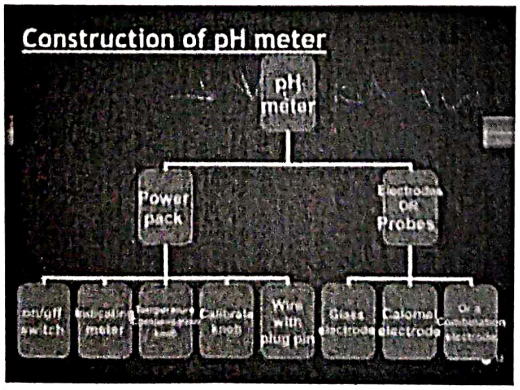
2.5 Key diagrams (if any):



3. Discussion:

Encouraging the students to engage in thoughtful discussions about the principles, uses, and applications of pH meters while developing analytical and collaborative skills. Ask students to brainstorm how they would use a pH meter to address a real-world issue, such as acid rain monitoring or soil testing for agriculture.

4. Mind map



5. Summary

Recalling the topic in the class and asking some questions and clearing the doubts asked by the students. Hands on practice in how to operate a pH meter.

6. Assessment through Stimulating questions/Analogy/New ideas and Concepts:

- Measuring pH of different solutions helps in understanding of the working of pH meter.
- Learning the construction of pH meter will enhance knowledge on this topic

7. FAQ's:

1) _____coined the term pH

a) Sorenson b) White c) Henry d) Richard.

2) _____ is otherwise called as test electrode

a) Glass electrode b) Calomel electrode c) Silver electrode d) reference electrode

3) _____ is also called as reference electrode

a) Calomel electrode b) Glass electrode c) Combined electrode d) Silver electrode

4) The electrical potential of calomel electrode is _____

a) -0.250V b) +0.550V c) +0.250V d) -0.150V

5) pH = _____

a) -log[OH-] b) log[H+] c) - log[H-] d) - log[H+]

8. References: (Books/Periodicals/Journals)

1. Jayaraman J (2011). Laboratory Manual in Biochemistry, 2 nd Edition. Wiley Eastern Ltd., New Delhi .
2. Ponmurugan. P and Gangathara PB (2012). Biotechniques.1 st Edition. MJP publishers.
3. Veerakumari, L (2009).Bioinstrumentation- 5th Edition - MJP publishers.
4. Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition.Himalaya publishing home.
5. Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S.Himalaya Publishing House, Mumbai.

9. Verified by Subject Expert

A. MARIA HEARTINA ADLIN VAZ

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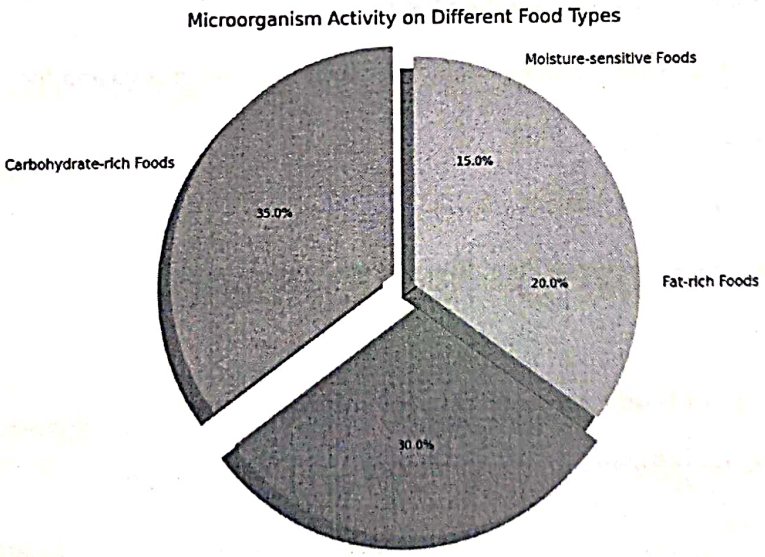
Objective Oriented Learning Process RBT

Programme	B.Sc.Microbiology
Semester	III
SubjectTitle	NME I FOOD MICROBIOLOGY
Code	21UMIN31
Hours	2
Total Hours	30
Credits	2
MaxMarks	30
Unit & Title	UnitI:Food as a substrate for microorganism
Nameof the Faculty	T.P. kumari Puspha Rani.
T-Ltools	Lecture method, **Audio Visual aid: Lecture Method**: Overview of microbial growth on food.**Visual Aids**: Images of food spoilage and fermentation processes.**Practical Demonstration**:Observing microbial growth on bread, fruit, or yogurt under a microscope.Simple fermentation experiment (e.g., making yogurt or bread). and evaluated by oral questioning, presentingthereportofgroupdiscussionandcheckingtheobservationnote.

PrerequisiteKnowledge: Students should have basic knowledge of food composition (carbohydrates, proteins, fats) and an understanding of microorganisms.



1. Topic for Learning through evocation

Food provides the essential nutrients required by microorganisms for growth, reproduction, and survival.

The growth of microorganisms on food leads to two major outcomes:

- **Spoilage**: Changes in texture, flavour, odour, and appearance.
- **Pathogenicity**: Growth of harmful microbes that produce toxins or cause foodborne illnesses.

Food is a substrate for microorganisms because it provides nutrients for their growth. Microorganisms can be found in food, and they can also grow in food, which can cause the food to spoil.

How microorganisms use food

- Microorganisms use nutrients in food like proteins, carbohydrates, lipids, water, minerals, vitamins, and nitrogen
- Some microorganisms use sugars, alcohols, and amino acids as energy sources
- Others use complex carbohydrates like starches and cellulose as energy sources
- A few microorganisms can use fats as an energy source

How microorganisms can spoil food

- Microorganisms can increase in number, which can use up nutrients and change the food's flavor
- Microorganisms can produce enzymatic changes that can break down the food or create new compounds

How to prevent microorganisms from spoiling food

- Prevent contamination by minimizing contact between microorganisms and food
- Eliminate microorganisms from food
- Adjust storage conditions to prevent growth
- Consider the temperature, relative humidity, and packaging of the food

2. TopicIntroduction:

Define the concept of food as a substrate for microorganisms.

Highlight key factors influencing microbial growth in food, such as:

- Nutrient composition.
- Environmental conditions (temperature, pH, moisture, oxygen).

Explain the dual nature of microorganisms:

- Spoilage agents (e.g., moulds on bread).
- Beneficial agents (e.g., yeast in bread fermentation).

2.1 General Objective:

Enable students to understand how food serves as a medium for microbial growth and the implications of such growth.

2.1 Specific Objectives:

Enables the students to:

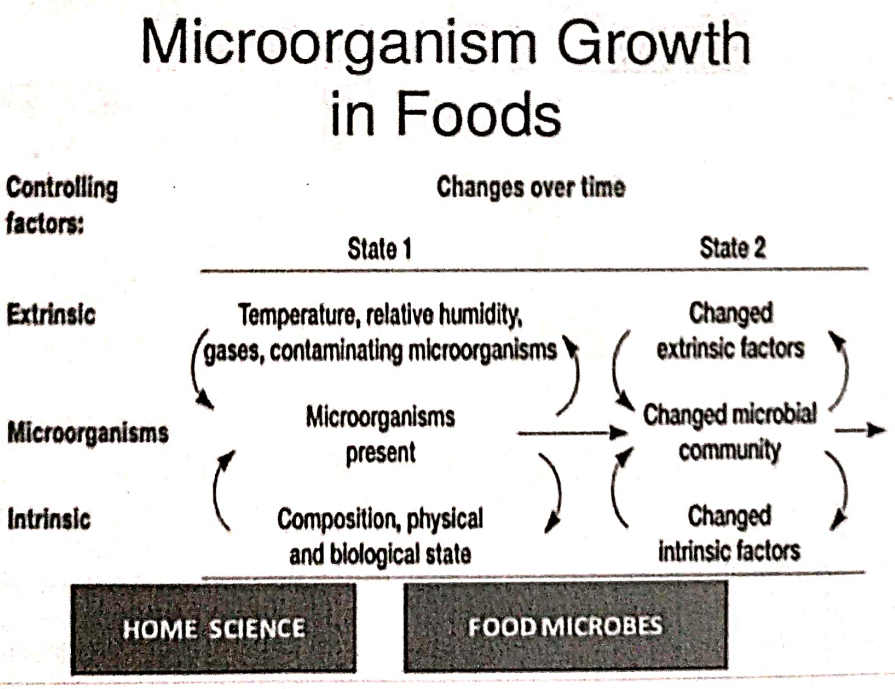
1. **Describe how food composition influences microbial growth.**
2. **Identify environmental factors that favour microbial activity in food.**
3. Differentiate between spoilage microbes and pathogens.
4. **Explain preservation methods used to control microbial growth in food.**
5. Recognize the role of beneficial microbes in food production.

2.3 Taxonomyofobjectives:

Taxonomyof Objectives						
Knowledge Dimension	TheCognitiveProcessDimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1,2			1,2,3	4	
B. Conceptual Knowledge		2,3,4			2,3,4	
C. Procedural Knowledge			2,3,4	4		
D.MetaCognitive Knowledge					5	

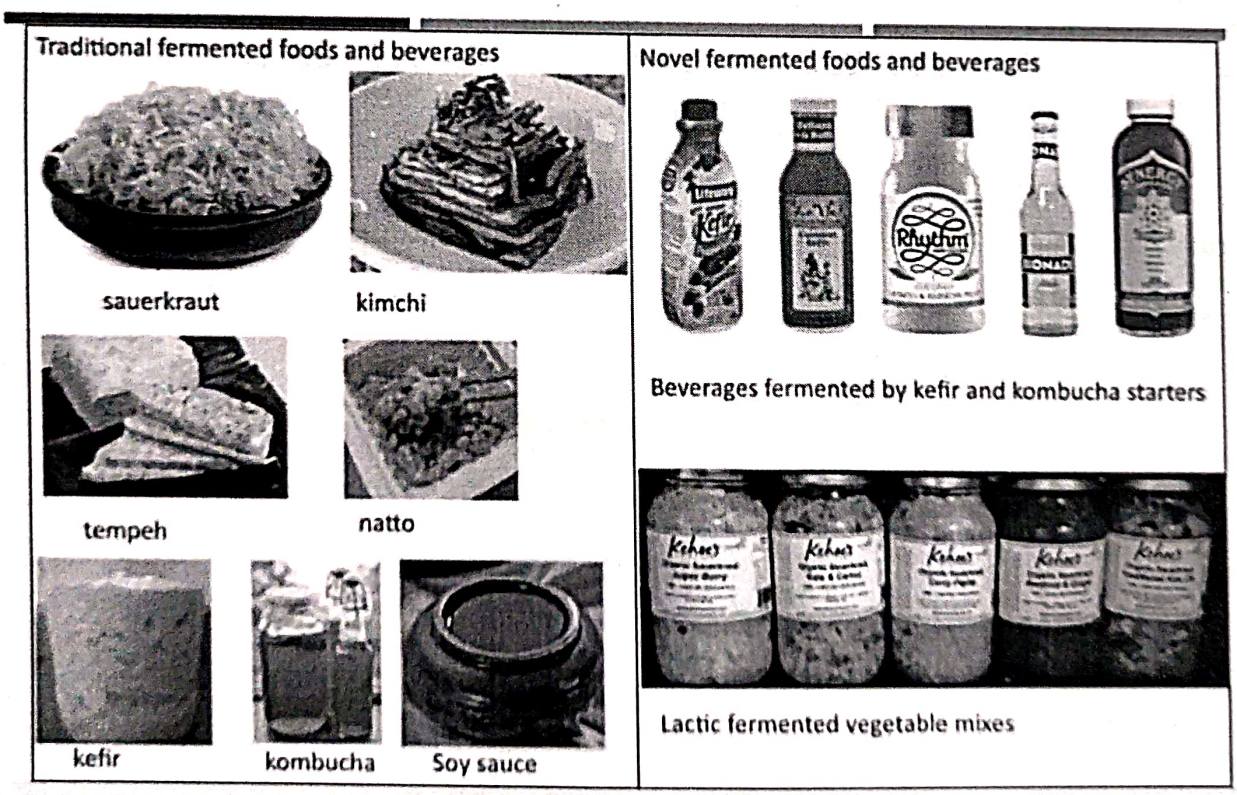
2.4:Key words: Microorganisms, Substrate, Food spoilage, Pathogens, Fermentation

2.5:Keydiagrams(if any):



The food for us is also a food for microorganism. Microorganisms are associated with plants and animals in nature. They play important role for survival of plants and animals. Our food mainly consists of materials from plants and animals and it is obvious that food can contain microorganisms. Some microorganisms serve us as food, some present in food are helpful and some others are harmful to our health. Microorganisms present in food use them as source of nutrients or their growth media and grow. Growth of microorganisms in food can result in improving the quality of food and in some cases can deteriorate their quality depending on the type of microorganism. Growth of harmful microorganisms in food can result in spoilage and sometimes cause several diseases on consumption of such food.

Food spoilage by microorganisms is due to increase in their numbers, utilizing nutrients, causing enzymatic changes resulting in bad flavors due to breakdown of some food materials or synthesis of new compounds. Due to such microbial activities, food become unfit for human consumption. Microorganisms bring about oxidation of reduced carbon, nitrogen, sulfur compounds present in dead plants and animals in nature and become important part in recycling of these elements.



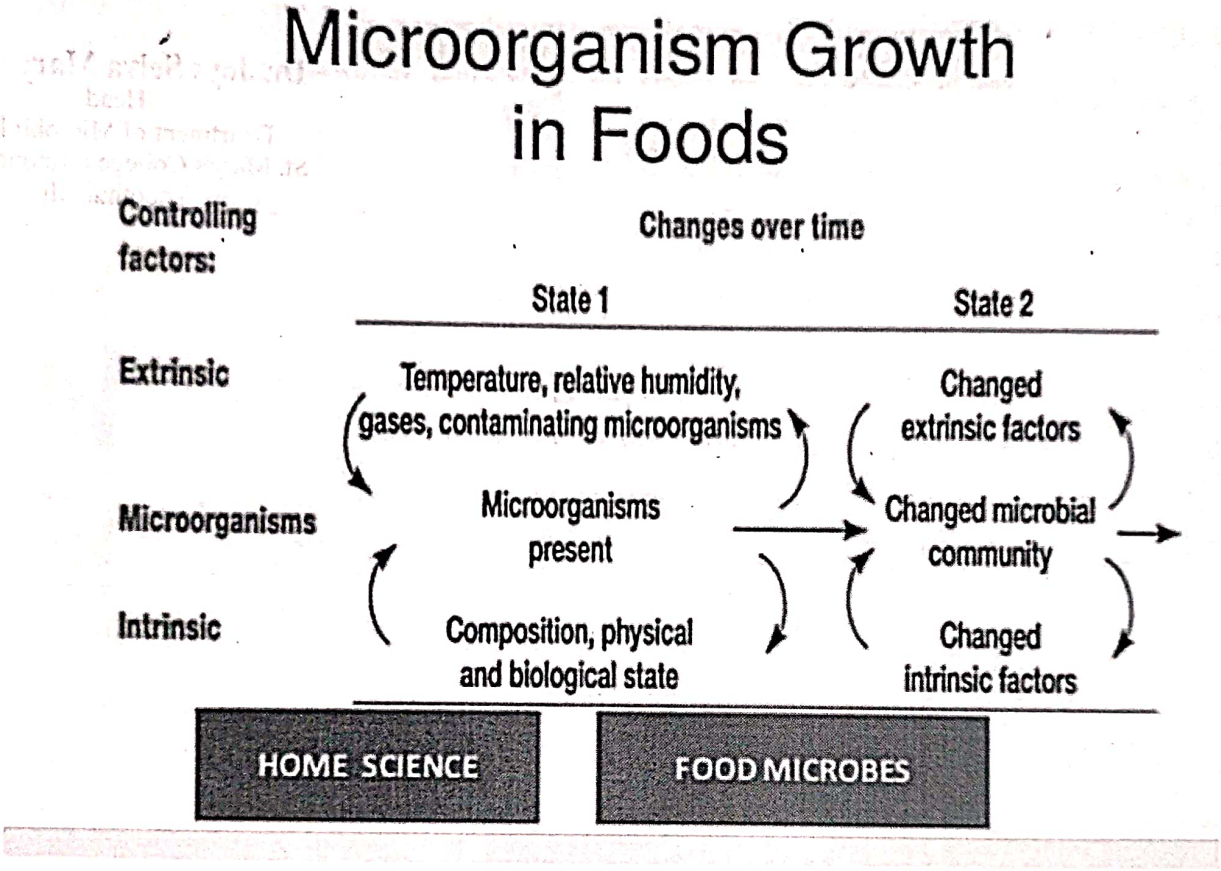
Several factors related to the environment and the conditions in which food is stored influence the growth of micro-organisms in food. These factors can be divided into intrinsic and extrinsic elements. Intrinsic factors are those that are characteristic of the food itself; extrinsic factors are those that refer to the environment surrounding the food. The parameters of plant and animal tissues that are an inherent part of the tissues are referred as intrinsic parameter. These parameters are as follows: • Nutrient content 2 • pH • Moisture content and water activity (aw) • Oxidation–reduction potential (Eh) • Antimicrobial constituents • Biological structures The extrinsic parameters of foods are not substrate

dependent. They are those properties of the storage environment that affect both the foods and their microorganisms. Those of greatest importance to the welfare of food borne organisms are as follows: • Temperature • Relative humidity • Presence and concentration of gases • Presence and activities of other microorganisms

Discussion:

The students will be asked to retrieve the scientific terms, facts, and concepts mentioned in the content analysis. One member will be called from each group to present the outcome of the group.Food provides an ideal substrate for the growth of microorganisms because it contains essential nutrients such as carbohydrates, proteins, fats, vitamins, and minerals. Microorganisms, including bacteria, fungi, and yeasts, utilize these nutrients for growth and metabolism, leading to various effects such as food spoilage, fermentation, and foodborne diseases.

MindMap:



5. Summary:

- Food as a nutrient source for microorganisms.
- Environmental factors influencing microbial growth.
- Preservation methods and their effectiveness.

6. AssessmentthroughStimulatingquestions/Analogy/NewideasandConcepts:

Why do some foods spoil faster than others?

How does fermentation benefit food production?

7. FAQ's:

1. What types of microorganisms grow on carbohydrate-rich foods?
   a) Viruses b) Bacteria c) Molds and yeasts d) Parasites
2. What factor is most important in preventing microbial spoilage in dried foods?
   a) Temperature b) Moisture content c) pH d) Nutrient composition
3. Which microorganism is commonly used in bread production?
   a) *Escherichia coli* b) *Saccharomyces cerevisiae* c) *Aspergillus niger* d) *Clostridium botulinum*

References:(Books/Periodicals/Journals)

1. Frazier, W.C and Westhoff, D.C Food microbiology, 4th edition, New Delhi. Tata Mac Graw Hill, 2008.
2. Adams, M.R and Moss M.O Food Microbiology New Age International (p) Limited Publishers. 1995
3. Banwart, G.J., Basic Food Microbiology, New Delhi. CBS Publishers and Distributors, 2nd Edition 1989.
4. Robinson R.K Dairy Microbiology, London. Elsevier Applied science, 1990
3. Edward Arnold, Hobbs BC Roberts D Food Poisoning and Food Hygiene, London., 1993.

VerifiedbySubject Expert

T.P. kumari Puspha Rani.

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LESSON PLAN SAMPLE FOR SCIENCE

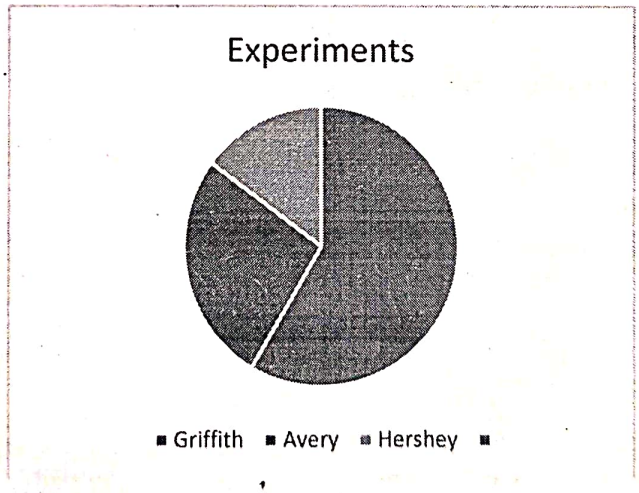
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	IV
Subject Title	Major Core: Molecular Biology and Microbial Genetics
Code	21UMIC41
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit I: Experiments of Griffith, Avery, Hershey and Chase
Name of the Faculty	Dr.C.Siluvai Kirubagari Aneeshia
T-L tools	Lecture method, **Audio Visual aid:** video showing about experiments of Griffith, Avery, Hershey and Chase. **Visual aid:** Picture of Griffith experiment and evaluated by oral questioning, presenting the report of group discussion and checking the observation note.

Prerequisite Knowledge:

Knowledge about DNA – genetic material

Micro -planning



1. Topic for Learning through evocation

Early Experiments: Early 20th century experiments revealed that the genetic material is likely to be a nucleic acid.

Griffith's Experiment (1928): Demonstrated transformation in bacteria, showing that genetic material could be transferred.

Avery, MacLeod, and McCarty (1944): Identified DNA as the transforming factor, suggesting that DNA was the genetic material.

Hershey-Chase Experiment (1952): Confirmed that DNA, not protein, is the material responsible for inheritance by using bacteriophages (viruses that infect bacteria).

2. Topic Introduction:

Structure of DNA

- **Double Helix:** DNA is composed of two strands that coil around each other to form a double helix.
  - **Nucleotides:** The basic building blocks of DNA, consisting of a phosphate group, a deoxyribose sugar, and a nitrogenous base (adenine, thymine, cytosine, or guanine).
  - **Base Pairing:** The strands are held together by base pairs: adenine (A) pairs with thymine (T), and cytosine (C) pairs with guanine (G).

2.1. General Objective:

Enables the students to understand DNA acts as a genetic material

2.2. Specific Objectives:

Enables the students to:

1. Understanding the Role of DNA in Inheritance
2. Storing Genetic Information
3. Transmission of Genetic Information
4. Mutability and Variation

2.3 Expression of Genetic Information

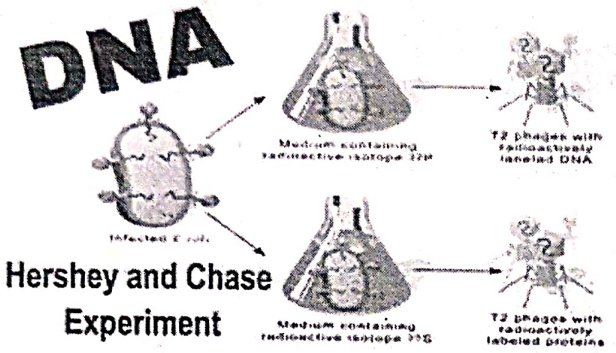
2.4: Taxonomy of objectives:

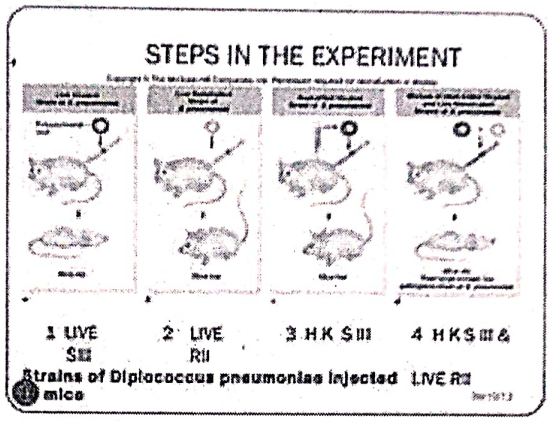
Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	**1**			**1,2,3**	**4**	
B. Conceptual Knowledge		**1, 2,3,4**	**3,4**		**2,3,4**	
C. Procedural Knowledge				**4**		
D. Meta Cognitive Knowledge					**5**	

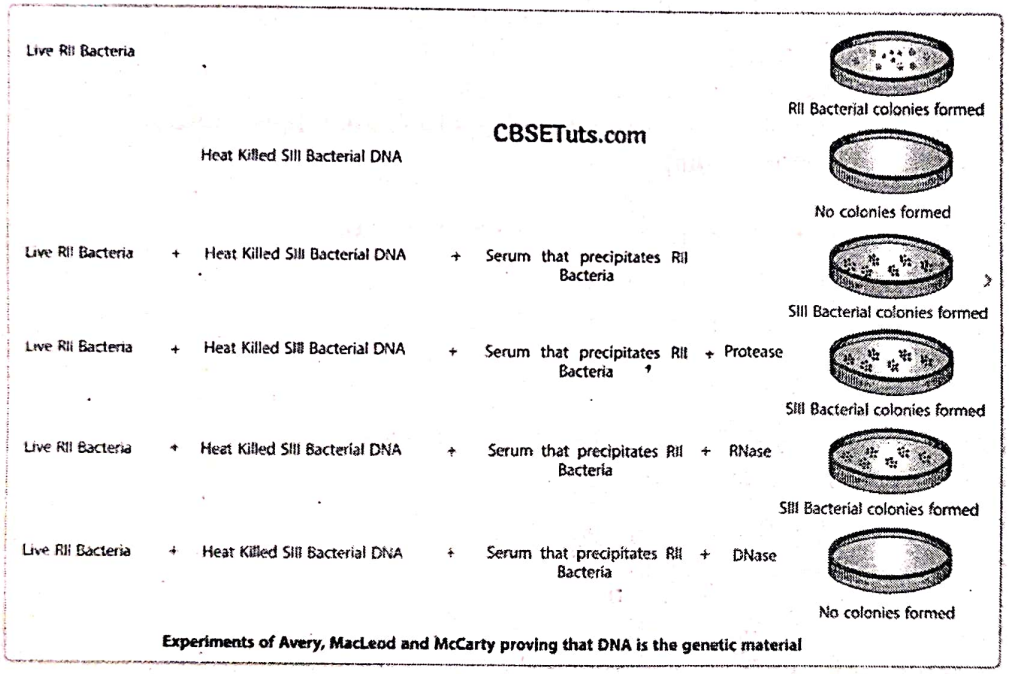
2.5: Key words:

- Genetic Information
- Replication
- Hereditary
- Mutations
- Inheritance

2.6: Key diagrams (if any):



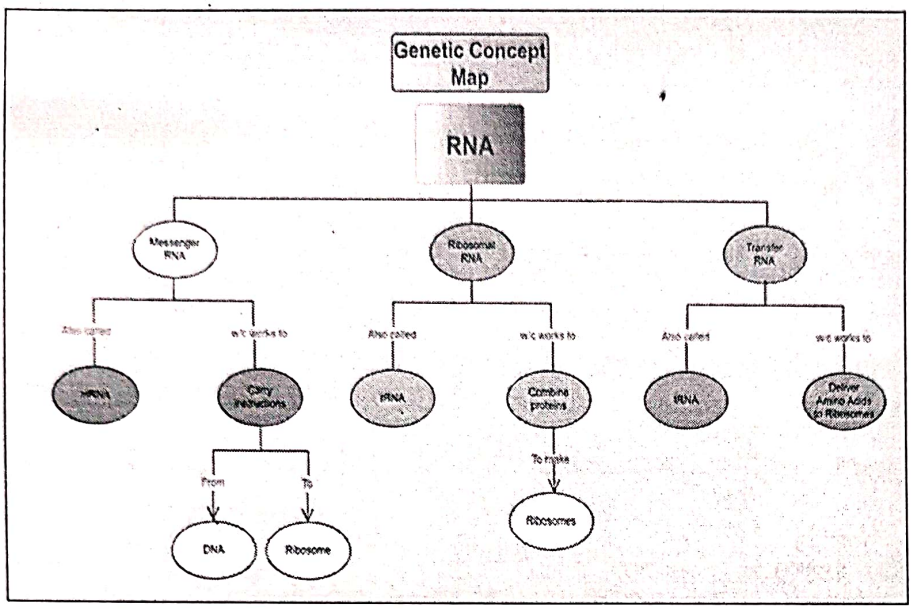




3. Discussion:

The students will be asked to retrieve the scientific terms, facts, and concepts mentioned in the content analysis. One member will be called from each group to present the outcome of the group. The students who have not taken part will be noted, and they will be kindly asked to check on their weight and height and that of their friends.

4. Mind Map:



5. Summary: NA, or deoxyribonucleic acid, is the genetic material that carries the instructions for the growth, development, and functioning of living organisms. It stores genetic information in sequences of nucleotides, which are used to synthesize proteins that determine the structure and function of cells.
DNA is capable of replicating itself during cell division, ensuring that genetic information is passed accurately to daughter cells. It is also responsible for transmitting genetic traits from parents to offspring, either through sexual or asexual reproduction.

6. Assessment through Stimulating questions/Analogy/New ideas and Concepts:

- Generating mental ideas about creating an e-content on the genetic material
- Producing the e-content.

7. FAQ's:

1. Who first demonstrated that DNA is the genetic material responsible for inheritance?
A) Gregor Mendel
B) Watson and Crick
C) Avery, MacLeod, and McCarty
D) Charles Darwin
Answer: C) Avery, MacLeod, and McCarty

2. What is the basic structure of a DNA molecule?
A) Single-stranded helix
B) Double-stranded helix
C) Triple-stranded helix
D) Circular loop
Answer: B) Double-stranded helix

3. **Which of the following is NOT a nitrogenous base found in DNA?**
A) Adenine
B) Uracil
C) Thymine
D) Cytosine
Answer: B) Uracil

4. **What type of bond holds the two strands of DNA together?**

A) Ionic bonds
B) Covalent bonds
C) Hydrogen bonds
D) Disulfide bonds

Answer: C) Hydrogen bonds

5. **Which of the following is a function of DNA?**

A) Protein synthesis
B) Storing genetic information
C) Cellular respiration
D) Energy production

Answer: B) Storing genetic information

8. References: (Books/Periodicals/Journals)

- Dubey R.C., and Maheshwari, S. *A Text Book of Microbiology,* NewDelhi: S.Chand & Co, 2003.
- Jayanthi G.P. *Molecular biology,* Chennai: MJP publishers, 2008.
- Freifelder D., *Molecular Biology*, New Delhi: Narosa publishing house, 1991.

9. Verified by Subject Expert
Dr. C.Siluvai Kirubagari Aneeshia

Approved by HOD

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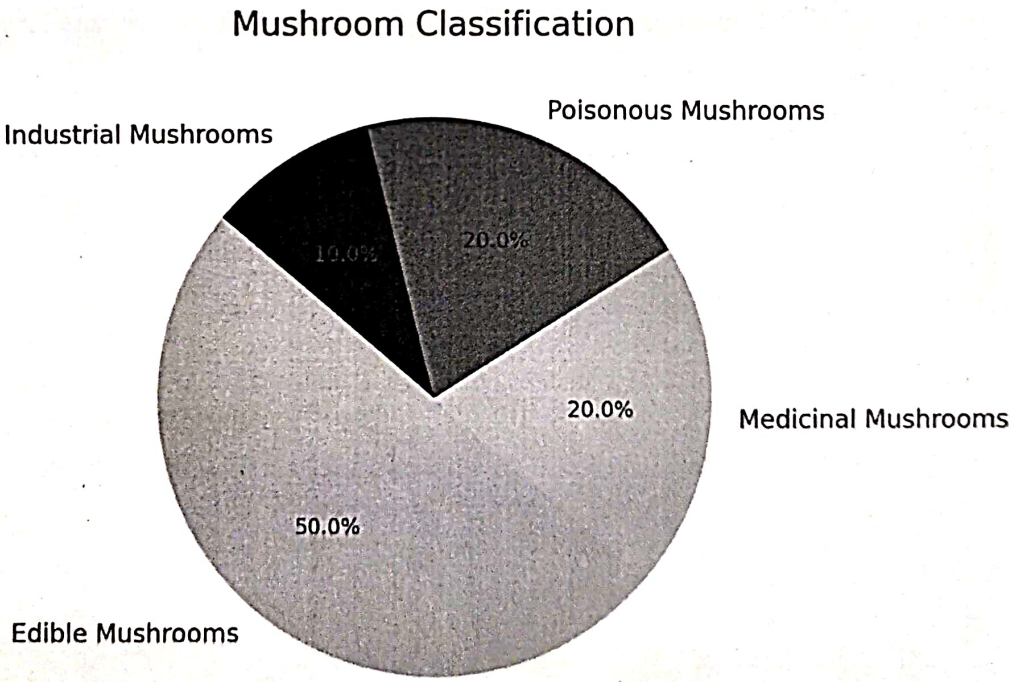
Objective Oriented Learning Process RBT

Programme	B.Sc.Microbiology
Semester	IV
SubjectTitle	Allied – IV – Mushroom Technology
Code	21UMIA41
Hours	4
Total Hours	60
Credits	3
MaxMarks	75
Unit & Title	UnitI:Mushroom
Nameof the Faculty	T.P. Kumari Puspha Rani
T-Ltools	Lecture method, **Audio Visual aid: Lecture Method:** Start by explaining the importance of mushrooms as fungi that play ecological and economic roles.**Audio-Visual Aid:** Show a short video introducing mushrooms (e.g., time-lapse of their growth).

Prerequisite Knowledge:

Students should have basic knowledge Basics of fungi as a kingdom.The difference between autotrophic and heterotrophic organisms.

Microplanning



1. Topic for Learning through evocation

Define infection: A mushroom (also called a toadstool) is the part of a fungus that is comparable to the fruit of a plant. Unlike plants, mushrooms do not use sunlight to generate energy for themselves. Some mushrooms are edible, and are used for cooking in many countries, such as China, Korea and Europe. Other mushrooms, however, are poisonous, and can cause severe illness or death if eaten. People who search for edible mushrooms are called *mycophagists*, meaning "mushroom eater", while the act itself is called "mushrooming". Mushrooms have been known to support bone health and to regulate blood sugar in diabetics. It is available in different colours and shapes.Mushrooms are fungi, a unique group of organisms that differ from plants and animals. They play a crucial role in ecosystems as decomposers, breaking down organic matter and recycling nutrients. Mushrooms have been used for food, medicine, and industry for centuries, with their diverse species ranging from edible to highly poisonous varieties.

Mushrooms are not only valued for their nutritional benefits, being rich in proteins, vitamins, and minerals, but also for their medicinal properties, with certain species used in traditional medicine for their healing effects. Additionally, mushrooms contribute to scientific advancements, including biotechnology and environmental sustainability, such as in bioremediation and packaging alternatives.

Understanding mushrooms involves exploring their classification, cultivation, ecological importance, and safety considerations. This topic will help us appreciate their significance in nature and their various applications in human life.

Topic Introduction:

Explain morphology of mushroom

Discuss the role of mushroom and its types.

1.1. General Objective:

Enable students to understand the nature mushroom morphology structure and parts of mushroom.

1.2. Specific Objectives:

Enables the students to:

1. Define mushroom and identify its types.
2. Explain the structure of mushroom.
3. Recognize the types of mushroom.

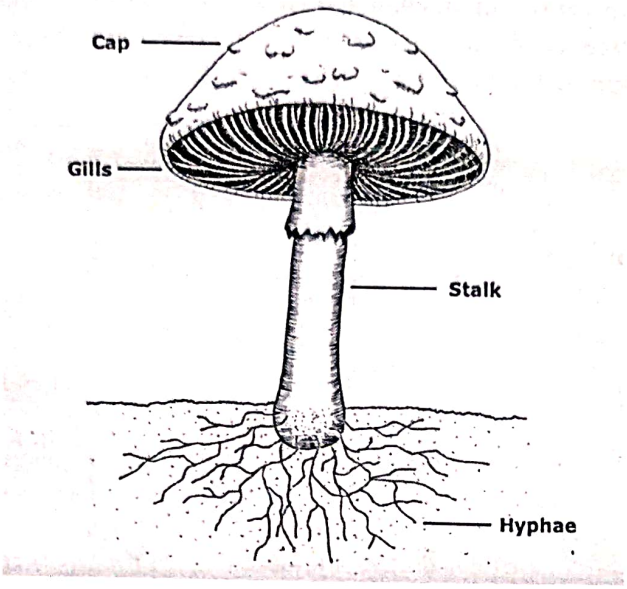
2.3:Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The C ognitive Process Dimension					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1			1,2,3	4	
B. Conceptual Knowledge		1, 2,3,4	3,4		2,3,4	
C. Procedural Knowledge				4		
D.MetaCognitive Knowledge					5	

2.4:Key words:

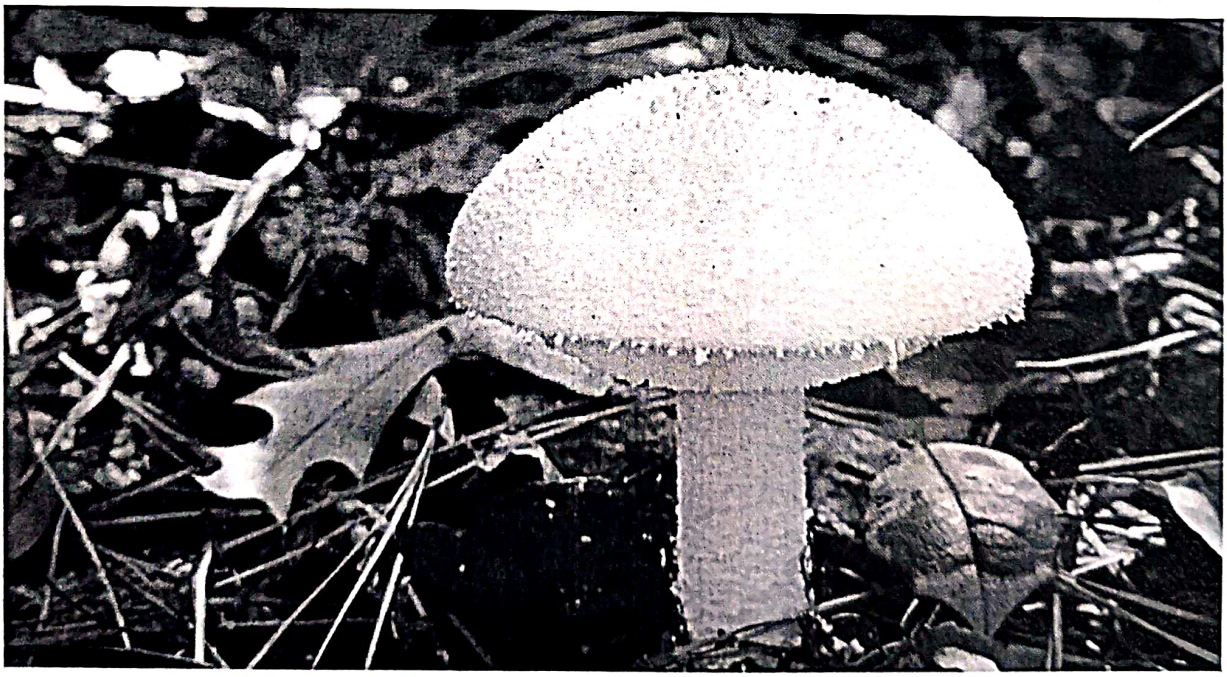
Mycology, Fungal spores, Mushroom cultivation, Mycelium, Edible mushrooms

2.5:Key diagrams(if any):



Mushroom, the conspicuous umbrella-shaped fruiting body (sporophore) of certain fungi, typically of the order Agaricales in the phylum Basidiomycota but also of some other groups. Popularly, the term *mushroom* is used to identify the edible sporophores; the term *toadstool* is often reserved for inedible or poisonous sporophores. There is, however, no scientific distinction between the two names, and either can be properly applied to any fleshy fungus fruiting structure.

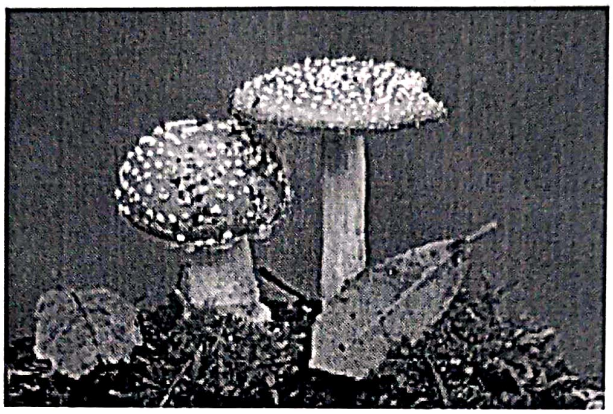
Edible mushrooms



mushroom cultivationCommon white, or button, mushrooms (*Agaricus bisporus*) being cultivated on a mushroom farm in the United Kingdom. They are an immature form of portobello mushroom

Commercially important, edible mushrooms include portobellos (*Agaricus bisporus*), whose forms include button mushrooms, cremini, and baby bellas, and shiitake (*Lentinula edodes*). The morels (*Morchella*, *Verpa*) and false morels or lorchels (*Gyromitra*, *Helvella*) are popularly included with the true mushrooms because of their shape and fleshy

structure; they resemble a deeply folded or pitted conelike sponge at the top of a hollow stem. Some are among the most highly prized edible fungi (e.g., *Morchella esculenta*). Edible truffles (various *Tuber* species), which hardly resemble mushrooms, are also popularly labeled as such. These and other edible mushrooms and fungi are free of cholesterol and contain small amounts of essential amino acids and B vitamins. However, their chief worth is as a specialty food of delicate, subtle flavour and agreeable texture. By fresh weight, the common commercially grown mushroom is more than 90 percent water, less than 3 percent protein, less than 5 percent carbohydrate, less than 1 percent fat, and about 1 percent mineral salts and vitamins.

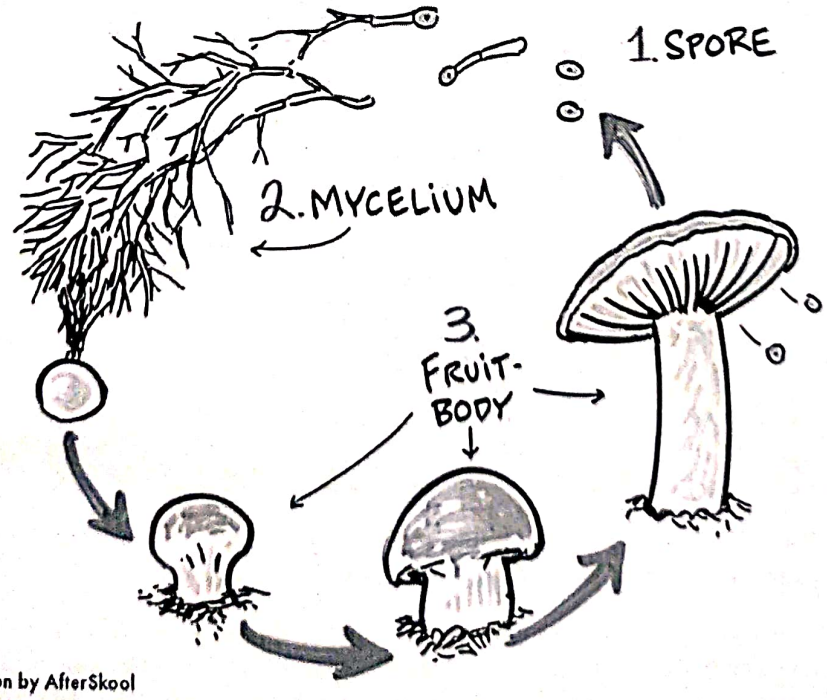


panther cap mushroomPanther cap mushrooms (*Amanita pantherina*). Closely related to the death cap mushroom (*Amanita phalloides*), the panther cap is highly poisonous.(more)

Poisoning by wild mushrooms is common and may be fatal or produce merely mild gastrointestinal disturbance or slight allergic reaction. It is important that every mushroom intended for eating be accurately identified (*see also* mushroom poisoning and death cap mushroom).

Discussion:
Begin by asking students if they know someone who has experienced a mushroom. Facilitate a conversation about how they think morphology spread and their basic understanding of lifecycle.

MindMap:



2. Summary:

- Review key points: Types of mushroom modes, lifecycle
- Encourage critical thinking with questions like, mushroom Different parts of a typical mushroom variations in mushroom morphology.

3. AssessmentthroughStimulatingquestions/Analogy/NewideasandConcepts:

- Multiple-choice quizzes on different parts of a typical mushroom
- Group presentations on a mushroom morphology
- Assign a task to design a mushroom types

4. FAQ's:

1. _____is known as temperature tolerant white button mushroom.

a. Agaricus b. Pleurotus c. Voveriella d. Agaricus bitorquis

2. Agaricus bisporus belongs to family_____.

a. Agaricaceae b. Malvaceae c. Rubiaceae d. Solanaceae

Basidiospores are_____spores.

a. exogenous b. endogenous c. Both a and b d. None of these

4. _____toxin is present in Amanita muscaria.

a. Ibotenic acid b. Lactic acid c. Acidic acid d. All of the above

5. _____ is known as 'king oyster mushroom'.

a. Pleurotus eryngii b. Volveriella c. Agaricus d. None of the above

5. References: (Books/Periodicals/Journals)

1. Biswas S., Datta M. and Ngachan S.V. Mushrooms: A Manual for Cultivation, PHI. 2012.
2. Zadrazil F. and Grabbe K. Edible Mushroom, Biotechnology Vol. 3, Berlin: Weinheim: Verlag Chemie, 1983.
3. Changs T. and Hayanes W.A. (Ed.) Biology and Cultivation of Edible Mushrooms. New York: Academic Press. 1978.
4. Tewari, Pankaj Kapoor, S.C., Mushroom cultivation, Delhi: Mittal Publications, 1988
5. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R, OysterMushrooms, Department of Plant Pathology, Coimbatore: Tamil Nadu AgriculturalUniversity, 1991.
6. Nita Bahl, Hand book of Mushrooms, II Edition, Vol. I & Vol. II: 1988.

Verified by Subject Expert
T.P. Kumari Puspha Rani

Approved by HOD

Dr. Joys Selva Mary Albert
Head
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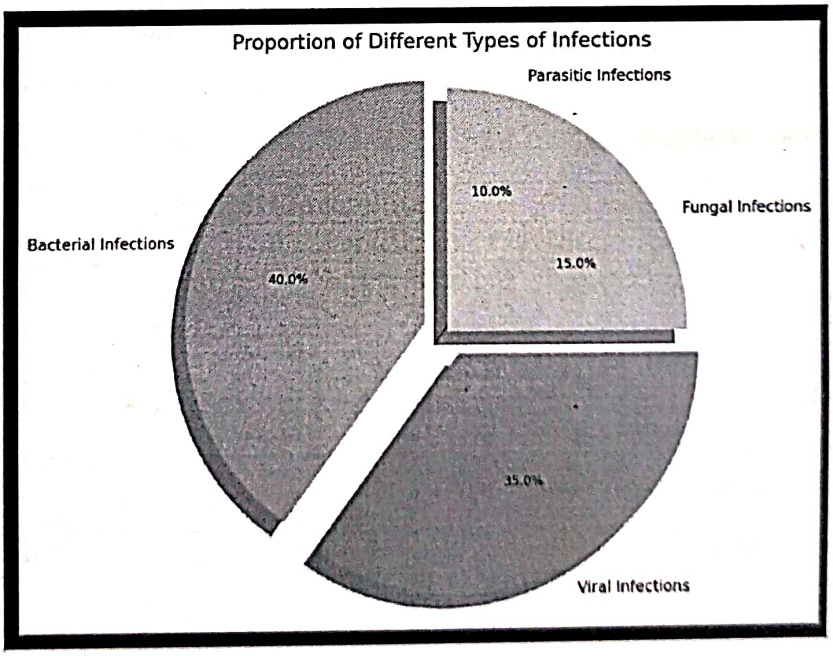
Objective Oriented Learning Process RBT

Programme	B.Sc.Microbiology
Semester	IV
SubjectTitle	NME II : Clinical microbiology
Code	21UMIN41
Hours	2
Total Hours	30
Credits	2
MaxMarks	50
Unit & Title	Unit I:Infection
Nameof the Faculty	T.P.KUMARI PUSHPA RANI
T-Ltools	Lecture method, **Audio Visual aid:** video explaining the life cycle of a pathogen. Real-life examples of disease outbreaks and control measures.A step-by-step guide to proper handwashing techniques. Use of diagnostic methods like blood tests or culturing in a la evaluated by oral questioning,presenting the report of group discussion and checking the observation note.

Prerequisite Knowledge:
Students should have basic knowledge of the human immune system and microorganisms.

Micro-planning



1. Topic for Learning through evocation

An **infection** occurs when harmful microorganisms, such as bacteria, viruses, fungi, or parasites, invade the body, multiply, and cause illness or tissue damage.

Types of Infections

A. Based on the Causative Agent

- **Bacterial Infections** – Caused by bacteria (e.g., Tuberculosis, Strep throat, Pneumonia).
- **Viral Infections** – Caused by viruses (e.g., Influenza, COVID-19, Measles).
- **Fungal Infections** – Caused by fungi (e.g., Ringworm, Candidiasis).
- **Parasitic Infections** – Caused by parasites (e.g., Malaria, Tapeworm infection).

Topic Introduction:

Explain how infections spread (contact, airborne, vector-borne).

Discuss the role of immune responses in combating infections.

1.1. GeneralObjective:

Enable students to understand infections' nature, causes, symptoms, prevention, and treatment.

1.2. SpecificObjectives:

Enablesthestudentsto:

1. Define infection and identify its types.
2. Explain the transmission of infectious diseases.
3. Recognize symptoms and examples of common infections.
4. Discuss methods to prevent and treat infections.

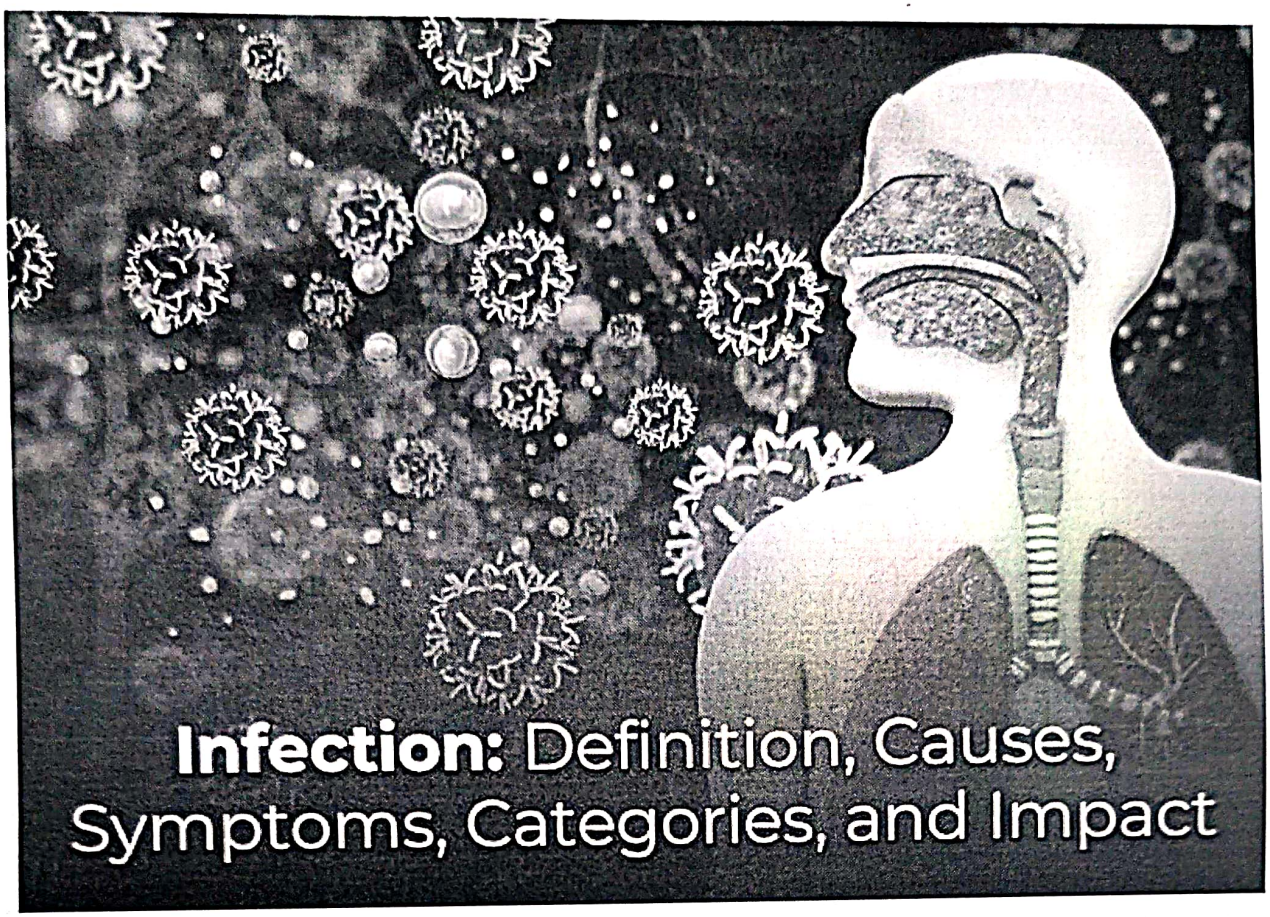
2.3:Taxonomy of objectives:

Taxonomyof Objectives						
Knowledge Dimension	TheCognitiveProcessDimension					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	**1**			**1,2,3**	**4**	
B. Conceptual Knowledge		**1, 2,3,4**	**3,4**		**2,3,4**	
C. Procedural Knowledge				**4**		
D.MetaCognitive Knowledge					**5**	

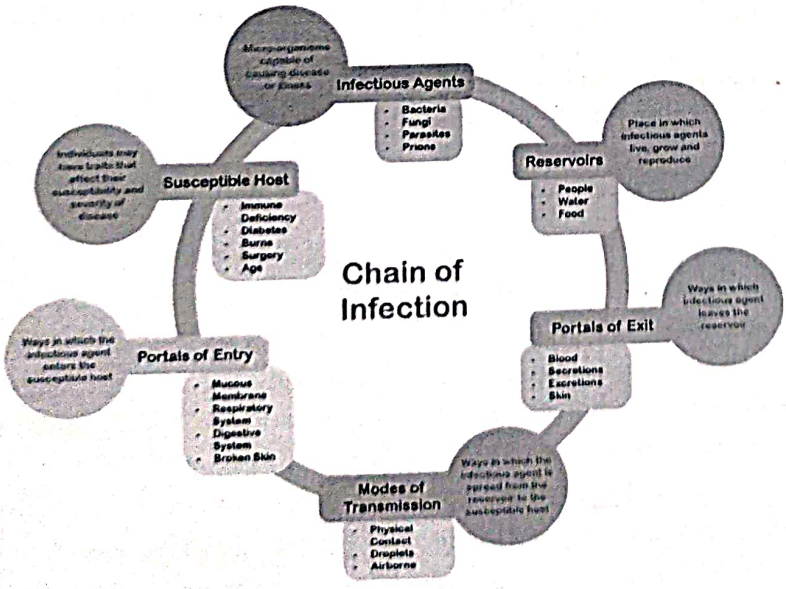
2.4:Key words:

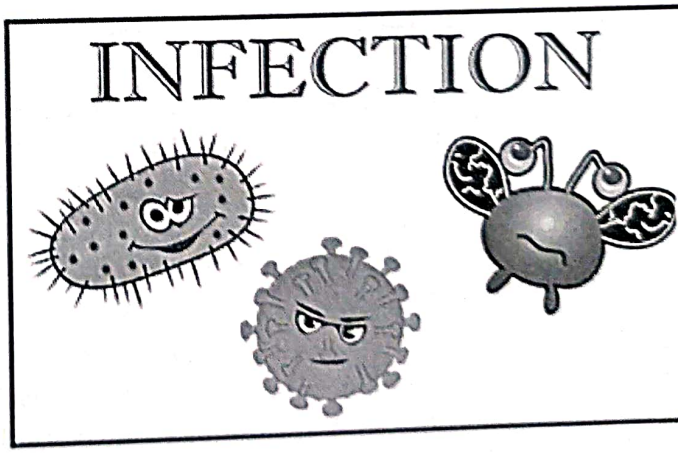
Infection, Pathogen, Transmission, Antibiotics, Vaccination, Hygiene.

2.5:Key diagrams(if any):

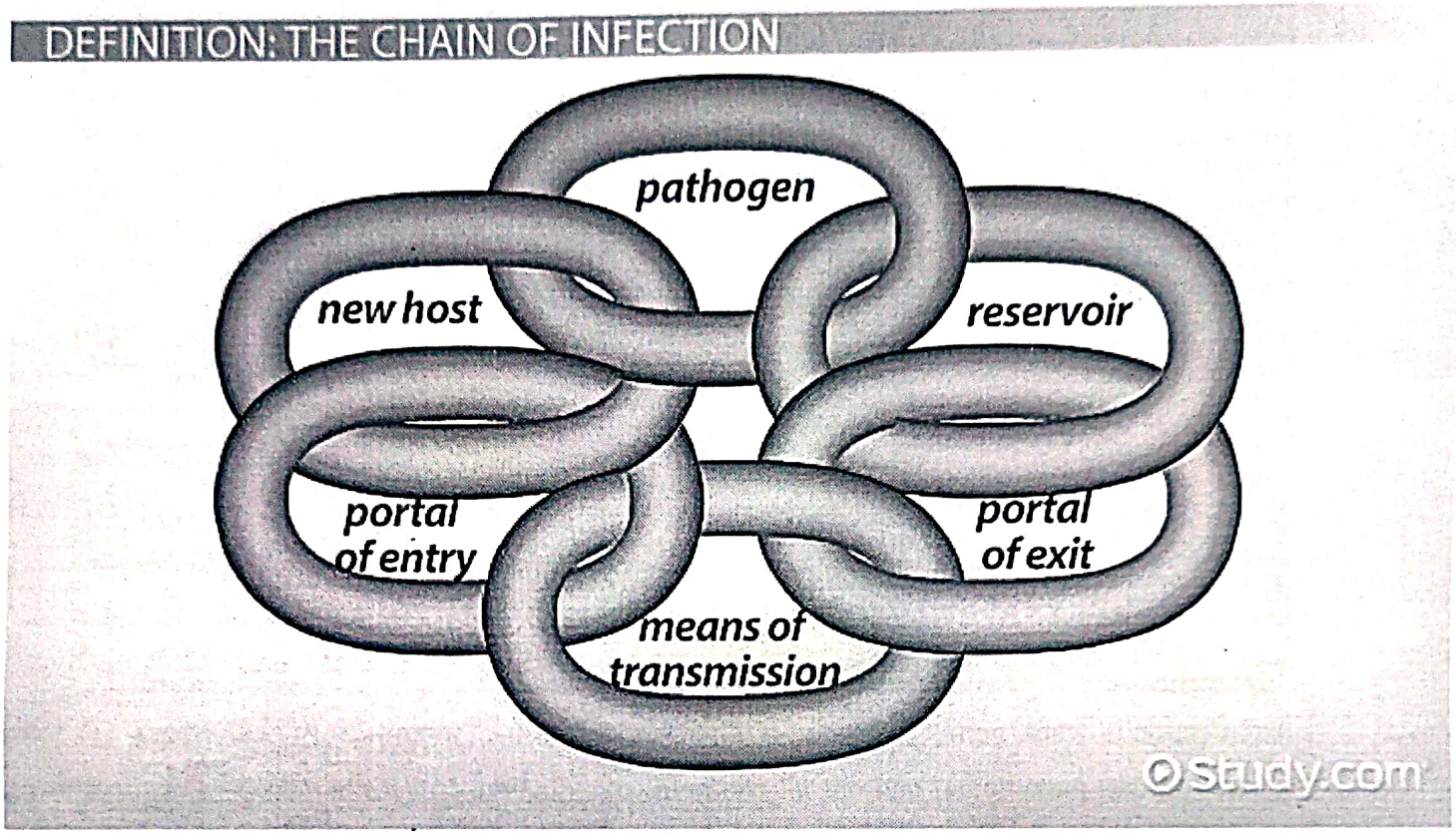


An infection is when germs, bacteria, or microorganisms invade and grow in the body. The common cold, flu, strep throat, pneumonia, and are all examples of infection. Infections can be categorized into four groups: viral, bacterial, parasitic, and fungal. A viral infection is caused by a virus that harms or kills cells in the body. They are often fought with antiviral medications or vaccinations. A bacterial infection is caused by bacteria infiltrating the body through scrapes, wounds, the nose, or the mouth. Antibiotics are often used to treat this type of infection.





There is a wide range of symptoms caused by infection. It can range from no signs at all, all the way to death, and everything in between. The most common signs of infections are fevers, headaches, chills, sore throats, congestion, shortness of breath, and a stiff neck.



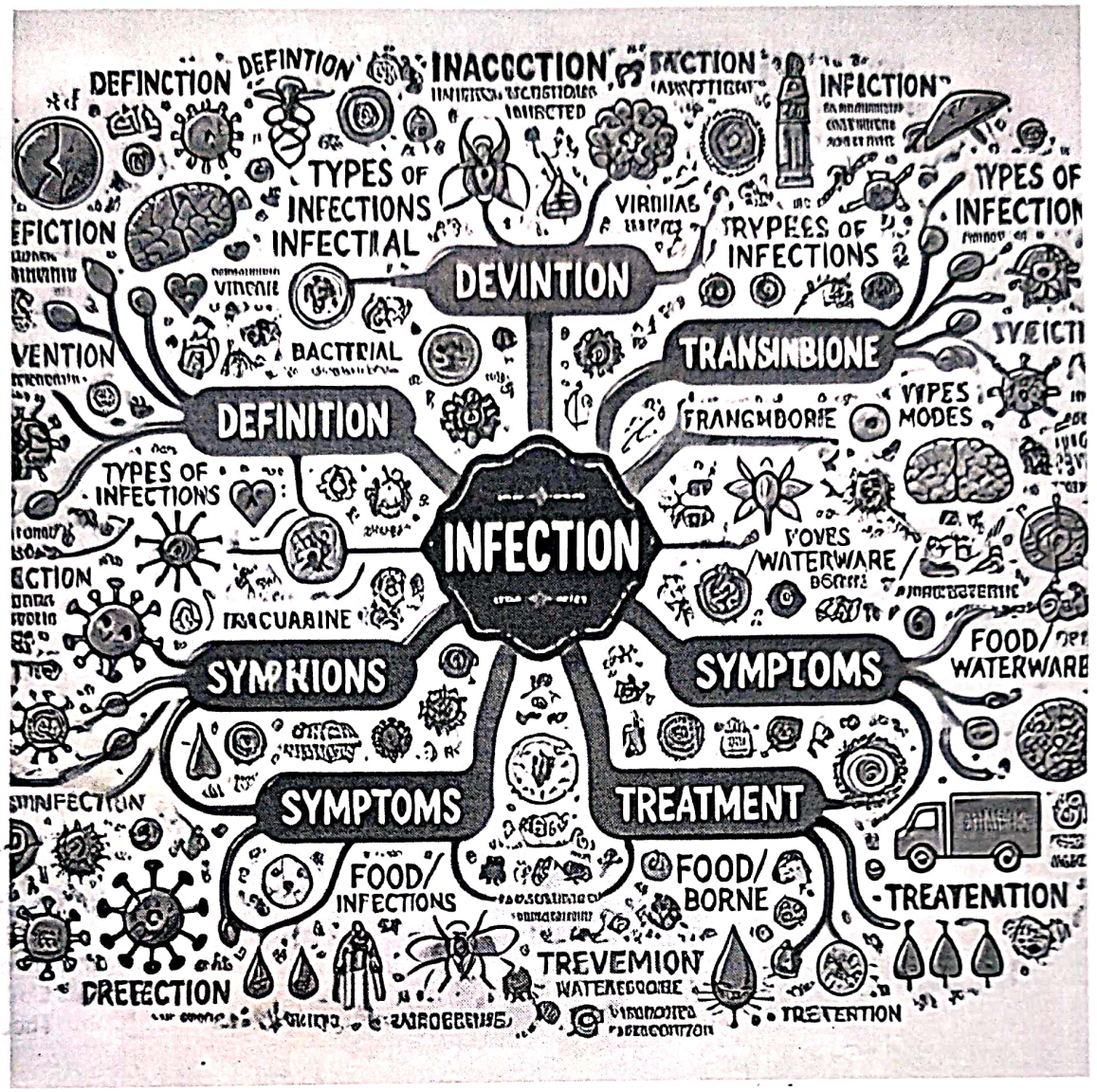
Infections can be caused by a wide range of pathogens, most prominently bacteria and viruses.Hosts can fight infections using their immune systems. Mammalian hosts react to infections with an innate response, often involving inflammation, followed by an adaptive response.

Discussion:

Begin by asking students if they know someone who has experienced a common infection, such as the flu or a skin infection. Facilitate a conversation about how they think infections spread and their basic understanding of symptoms.

- Identify Divide students into small groups and assign each group a type of infection (bacterial, viral, fungal, or parasitic). Ask them examples of infections in their assigned category.
- Discuss how these infections are transmitted.
- Share preventive measures for their type of infection.
  Groups will present their findings to the class.
- How do infections affect individuals differently based on age or immune system status?
- Why are vaccinations important in preventing certain infections?
- Can you think of any recent infectious disease outbreaks and how they were controlled?
  Provide a short case study about an outbreak, such as cholera in a community or an influenza epidemic in a school.
- The cause of the outbreak.
- Measures taken to contain the infection.
- The role of public health authorities.
- Encourage students to check their Body Mass Index (BMI) and discuss its relation to immune health.
- Plan a mock visit to a clinic where students learn about diagnostic methods like blood tests or cultures.

MindMap:



5. **Summary:**
   - Review key points: Types of infections, transmission modes, prevention strategies.
   - Encourage critical thinking with questions like, "How does overuse of antibiotics lead to resistance?"

6. **Assessment through Stimulating questions/Analogy/New ideas and Concepts:**

   - Multiple-choice quizzes on infection types and symptoms.
   - Group presentations on a chosen infection (e.g., causes, prevention, treatment).
   - Assign a task to design a public health campaign for infection prevention.

7. **FAQ's:**

What are the primary modes of infection transmission?

a) Contact b) Airborne c) Vector-borne d) All of the above

Which of the following is an example of a viral infection?

a) Tuberculosis b) Influenza c) Ringworm d) Malaria

Which infectious agent is responsible for causing malaria?

a) Bacteria b) Virus c) Parasite d) Fungi

What is one of the common symptoms of an infection?

a) Fever b) High blood pressure c) Hair loss d) Broken bones

What preventive measure is most effective in reducing airborne transmission?

a) Wearing masks b) Avoiding vaccinations c) Eating healthy d) Drinking bottled water

What does proper hand hygiene help prevent?

a) Contact-based infections b) Airborne infections c) Vector-borne infections

d) None of the above

8. References:(Books/Periodicals/Journals)

1. Frazier, W.C and Westhoff, D.C Food microbiology, 4th edition, New Delhi. Tata Mac Graw Hill,2008.
2. Adams, M.R and Moss M.O Food Microbiology New Age International (p) Limited Publishers1995
3. Banwart, G.J., Basic Food Microbiology, New Delhi. CBS Publishers and Distributors,2nd Edition 1989.
4. Robinson R.K Dairy Microbiology, London. Elsevier Applied science, 1990
5. Edward Arnold, Hobbs BC Roberts D Food Poisoning and Food Hygiene, London.,1993.

Verified by Subject Expert

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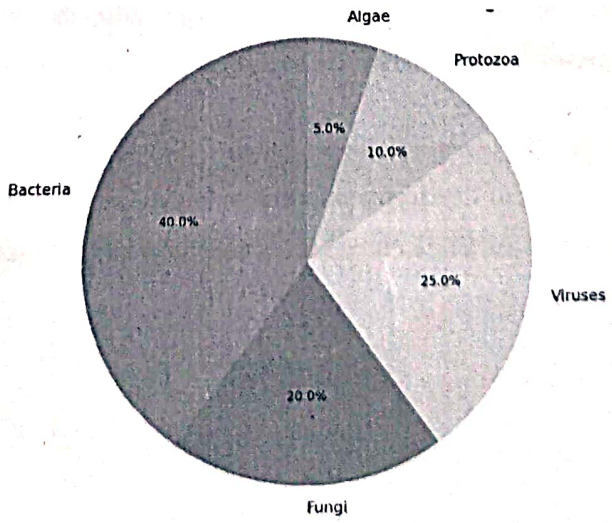
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	V
Subject Title	Common core: Psychology and Microbiology for health care
Code	21UBCS51
Hours	6
Total Hours	90
Credits	3
Max Marks	100
Unit & Title	Unit I : Classification of microorganisms (Bacteria, fungi, virus)
Name of the Faculty	Ms. A. Maria Heartina Adlin Vaz
T-L tools	Lecture method, **Audio Visual aid:** video showing about classification of microorganisms. **Visual aid:** Showing a mind map on classification of microorganisms

Prerequisite Knowledge:

- Understanding the differences between prokaryotic (bacteria, archaea) and eukaryotic cells (fungi, protozoa, algae) is fundamental to classifying microbes.
- Concepts like DNA, RNA, gene expression, mutation, and genetic variation are important because these factors often play a role in microbial classification.
- Familiarizing with the major types of microbes, such as bacteria, fungi, viruses, archaea, and protozoa.
- Recognize how the shape, size, and arrangement of microbes (e.g., cocci, bacilli, spirilla) play a role in classification.

Microplanning:



1. Topic for Learning through evocation

The need for microbial classification arises from the importance of organizing and understanding the immense diversity of microorganisms in nature. Proper classification allows scientists to systematically identify, study, and use microorganisms for various purposes. The key reasons for microbial classification are Understanding Microbial Diversity, Facilitating Identification, Predicting Characteristics and Behavior, Advancing Research and Biotechnology.

2. Topic Introduction:

Microorganisms, commonly referred to as microbes, represent an extraordinary diversity of life forms that are invisible to the naked eye. They include bacteria, archaea, fungi, algae, protozoa, and viruses, each playing crucial roles in ecosystems, health, industry, and biotechnology. Given their abundance, diversity, and significance, the classification of microbes is essential to systematically organize and study these organisms.

Microbial classification involves grouping microorganisms based on shared characteristics such as morphology, physiology, genetic composition, and ecological functions. This process enables scientists to identify, describe, and understand microbial species, facilitating advancements in medicine, agriculture, and environmental science.

Historically, microbial classification relied on observable traits such as size, shape, and staining properties. However, with advances in molecular biology and genomics, modern taxonomy incorporates genetic information, such as 16S rRNA gene sequencing, to reveal evolutionary relationships and refine classification systems.

The study of microbial classification not only deepens our understanding of the microbial world but also supports practical applications, such as diagnosing diseases, discovering antibiotics, and monitoring environmental changes. By organizing the complexity of microbial life, classification provides a foundation for scientific discovery and innovation in various fields.

2.1 General Objective:

To organize and categorize microorganisms into a systematic framework to facilitate their identification, study, and application

2.2 Specific Objectives:

Students will be able to:

- Analyze accurate Identification of Microbes
- Understand Evolutionary Relationships
- Create Standardized Nomenclature
- Compile Research in Microbial Diversity
- Able to facilitate Disease Diagnosis and Control

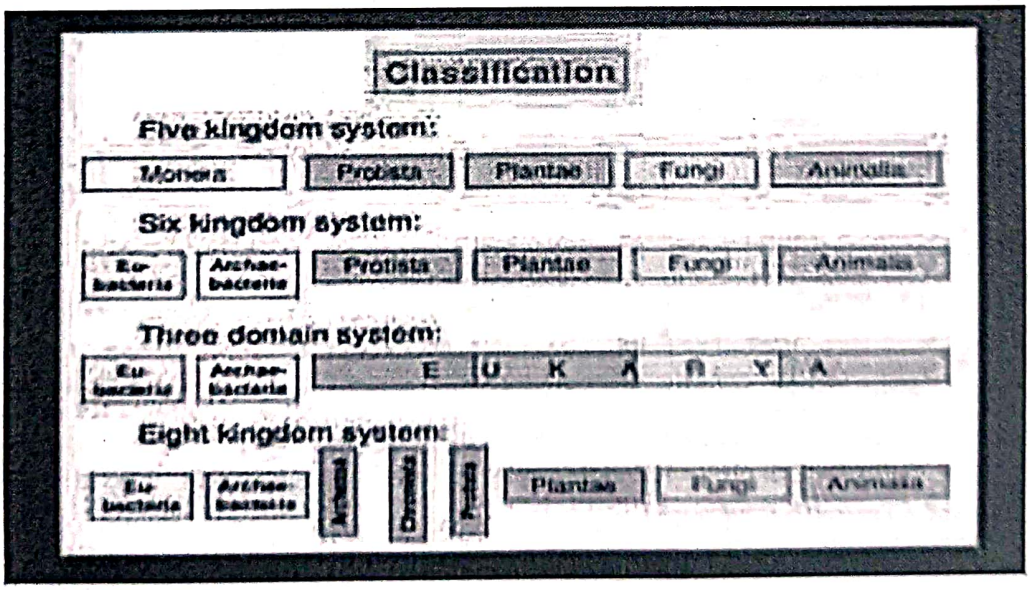
2.3 Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1	2	3	1,2	3,4	
B. Conceptual Knowledge		3	4	2		
C. Procedural Knowledge	2		3	4,5	2	
D. Meta Cognitive Knowledge			5		3	

2.4 Key words:

Taxonomy, identification, nomenclature, Bacteria, Fungi, Algae, Protozoa, Virus

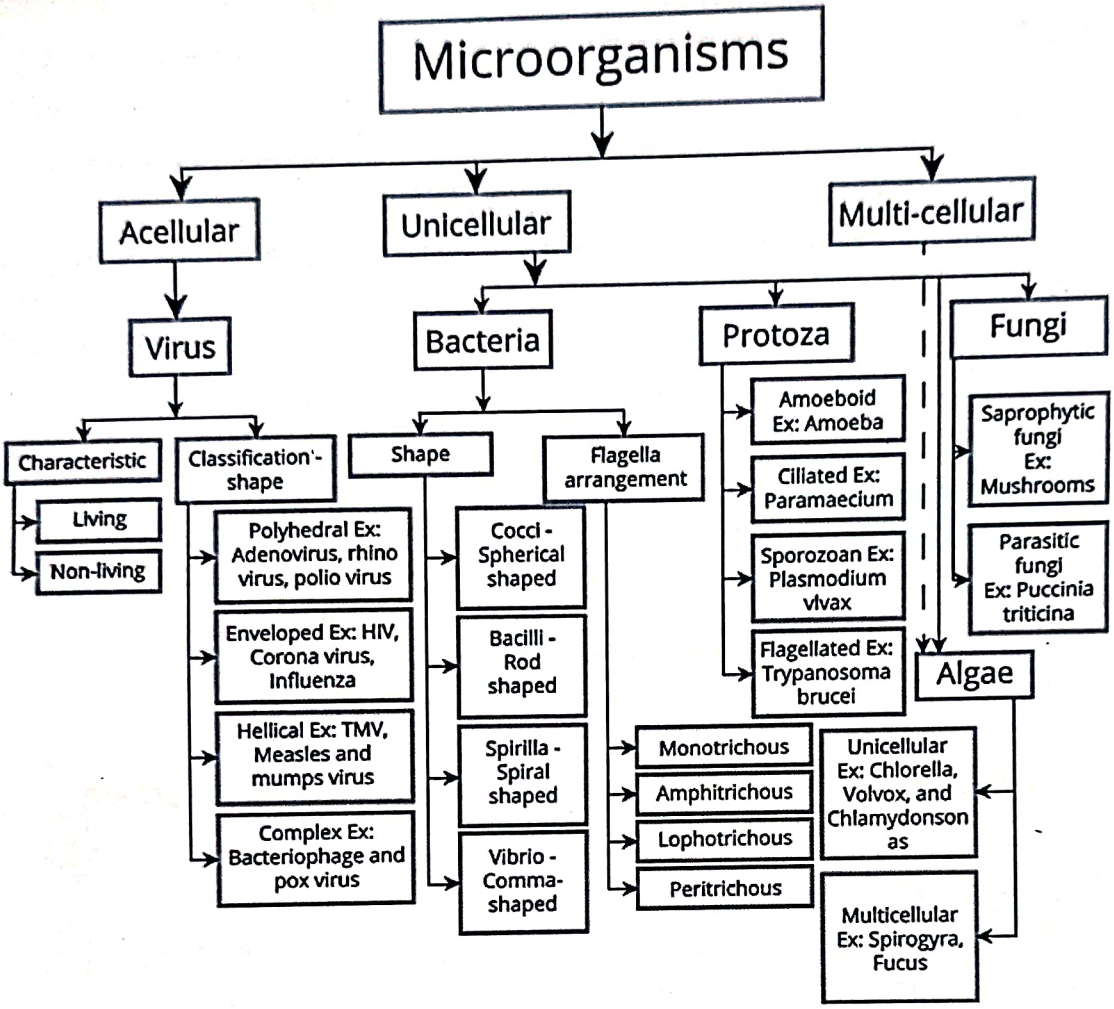
2.5 Key diagrams (if any):



3. Discussion:

Enabling the students to understand the concept of microbial diversity, microbial classification, nomenclature, taxonomy through lecture method. Discussing about various classification systems in microbial world like five kingdom, three domain, six kingdom, eight kingdom classification.

4. Mind map



5. Summary

Recalling all the points discussed in the class regarding microbial classification, microbial diversity, microbial classification, nomenclature, taxonomy. Learning examples of every class of microorganisms. Asking the students to draw the various types of microorganisms.

6. Assessment through Stimulating questions/Analogy/New ideas and Concepts:

Why is it important to classify microorganisms systematically rather than studying them individually? How do traditional and modern approaches to microbial classification differ? What are the major challenges in accurately classifying newly discovered microorganisms? Asking the students to discuss these type of questions.

7. FAQ's:

Which of the following is the primary criterion for classifying bacteria in the Gram-positive or Gram-negative groups?

a) Shape of the bacteria
b) Cell wall composition
c) Ability to form spores
d) Genetic sequence analysis

Answer: b) Cell wall composition

2. Which taxonomic rank comes immediately after the "Class" in the hierarchical classification of organisms?

a) Order
b) Family
c) Phylum
d) Genus

Answer: a) Order

3. Which of the following is NOT a characteristic used to classify fungi?

a) Morphological characteristics
b) Mode of reproduction
c) Cell wall composition
d) Genetic sequencing

Answer: d) Genetic sequencing

4. Which of the following methods is most commonly used to classify bacteria based on their genetic material?

a) Gram staining
b) PCR and DNA sequencing
c) Catalase test
d) Oxidase test

Answer: b) PCR and DNA sequencing

5. Which of the following is considered a prokaryotic microorganism?

a) Yeast
b) Paramecium
c) Bacterium
d) Protozoan

Answer: c) Bacterium

6. In the binomial nomenclature system, which of the following is the correct format for the name of a species?

a) Genus and species in all capital letters
b) Genus in italics, species in regular font
c) Genus in regular font, species in italics
d) Both genus and species in regular font

Answer: c) Genus in regular font, species in italics

7. Which of the following organisms is classified as an archaeon?

a) Escherichia coli
b) Saccharomyces cerevisiae
c) Methanobacterium
d) Plasmodium falciparum

Answer: c) Methanobacterium

8. What is the primary distinguishing feature between the two domains of prokaryotes: Bacteria and Archaea?

a) Ability to cause disease
b) Presence of a nucleus
c) Cell wall composition and membrane lipids
d) Size of the cell

Answer: c) Cell wall composition and membrane lipids

9. Which of the following is a common feature of all viruses?

a) They have a cellular structure
b) They contain both DNA and RNA

c) They require a host cell to replicate
d) They can be classified as Gram-positive or Gram-negative
Answer: c) They require a host cell to replicate
10. Which of the following bacterial shapes is characterized by a spherical structure?
a) Bacillus
b) Spirillum
c) Coccus
d) Vibrio
Answer: c) Coccus

8. References: (Books/Periodicals/Journals)

1. Wiley,Sherwood,Woolverton. Prescott'sMicrobiol gy. McGraw Hill International XIX Edition. 2014.

9. Verified by Subject Expert

(A. MARIA HEARTINA ADLIN VAZ)

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LESSON PLAN

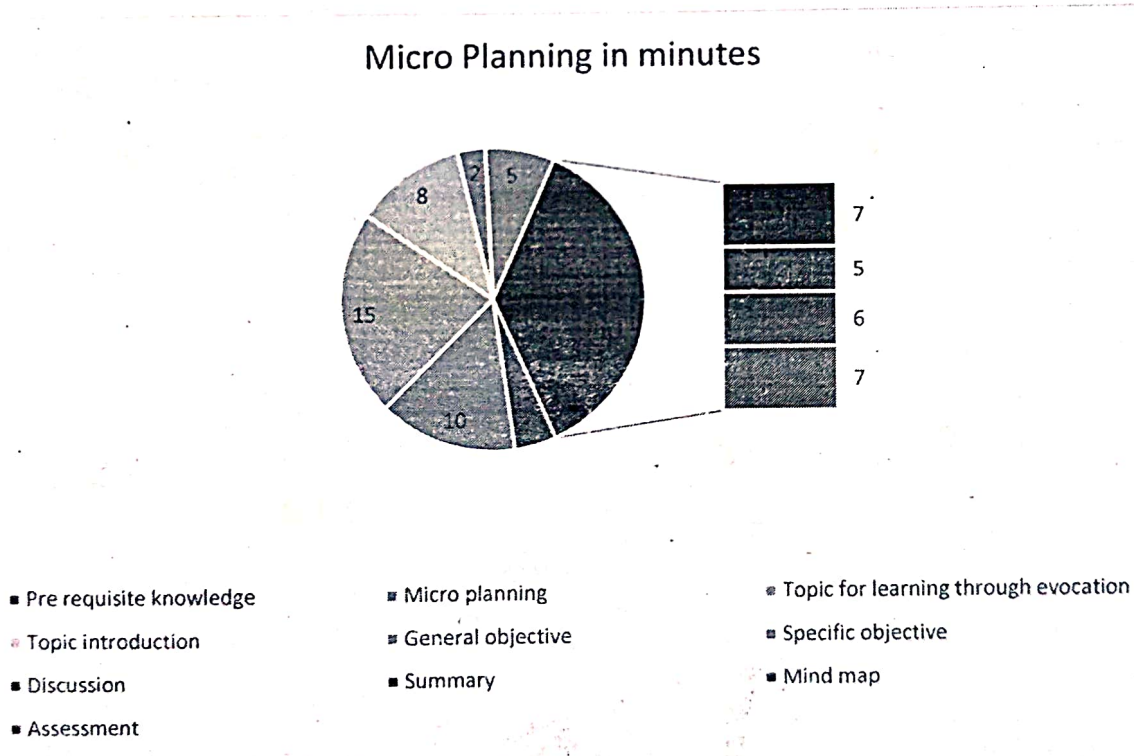
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	V
Subject Title	Major Core: Immunology
Code	21UMIC51
Hours	6
Total Hours	90
Credits	6
Max Marks	100
Unit & Title	Unit: IV – ELISA
Name of the Faculty	Mr.EDWARD C
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the principle and steps of ELISA

Prerequisite Knowledge:

Understanding their structure, function, and interactions of antigen and antibodies, Familiarity with spectrophotometry or fluorescence detection.

Micro -planning



1. Topic for Learning through evocation

Evoking Curiosity: Introducing ELISA

Step-by-Step Exploration of ELISA Mechanism

(Use interactive discussions, diagrams, or videos to make each step engaging)

Application and Real wide significance

Evocation Question: How would a false positive or negative affect medical diagnosis?

Discuss the clinical, diagnostic, and research applications of ELISA, such as in detecting diseases (e.g., HIV, COVID-19, pregnancy tests) and monitoring immune responses in vaccine development.

Testing understanding

Reflect and connect

Encourage learners to reflect on:

How ELISA has revolutionized diagnostic testing.

The role of specificity and sensitivity in ensuring reliable test results.

2.Topic Introduction:

ELISA (Enzyme-Linked Immunosorbent Assay) is a laboratory technique used to detect and quantify substances such as proteins, antibodies, antigens, or hormones in a liquid sample. It is widely used in clinical diagnostics, research, and the detection of diseases. The primary advantage of ELISA is its high sensitivity and specificity, making it an invaluable tool in various fields such as immunology, biotechnology, and medical diagnostics. ELISA operates based on the interaction between an antigen (the target molecule) and its specific antibody. The method involves using an enzyme conjugated to an antibody or antigen, which produces a detectable signal, usually a color change, upon reaction with a substrate.

2.1General Objective:

The general objective of **ELISA** is to provide a reliable, sensitive, and specific method for detecting and quantifying **target molecules** (such as proteins, antibodies, antigens, and other analytes) in a sample.

2.2 Specific Objectives:

Enables the students to:

1. List the types of ELISA (e.g., direct, indirect, sandwich, and competitive ELISA).
2. Identify the components involved in an ELISA test (e.g., antigen, antibody, enzyme, (substrate).
3. Explain the purpose and applications of ELISA in diagnostics and research.
4. Demonstrate how to perform a basic ELISA experiment in the laboratory.
5. Evaluate the advantages and limitations of ELISA in diagnostic and research settings.
6. Design ELISA experiment to identify particular molecular in the sample

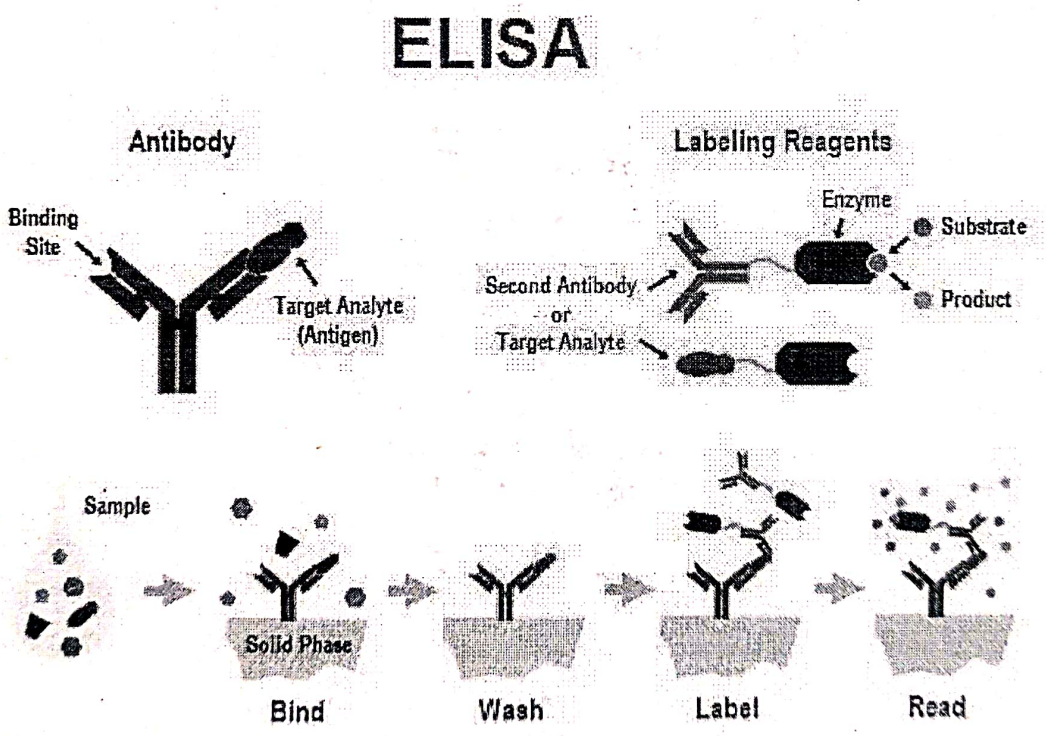
2.3 Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1			1,2	4	
B. Conceptual Knowledge		1, 2,3,4			2,3	
C. Procedural Knowledge			3,4	3, 4	4	6
D. Meta Cognitive Knowledge					5	

2.4 : Key words:

Antigen, Analyte , Binding site , Secondary antibody

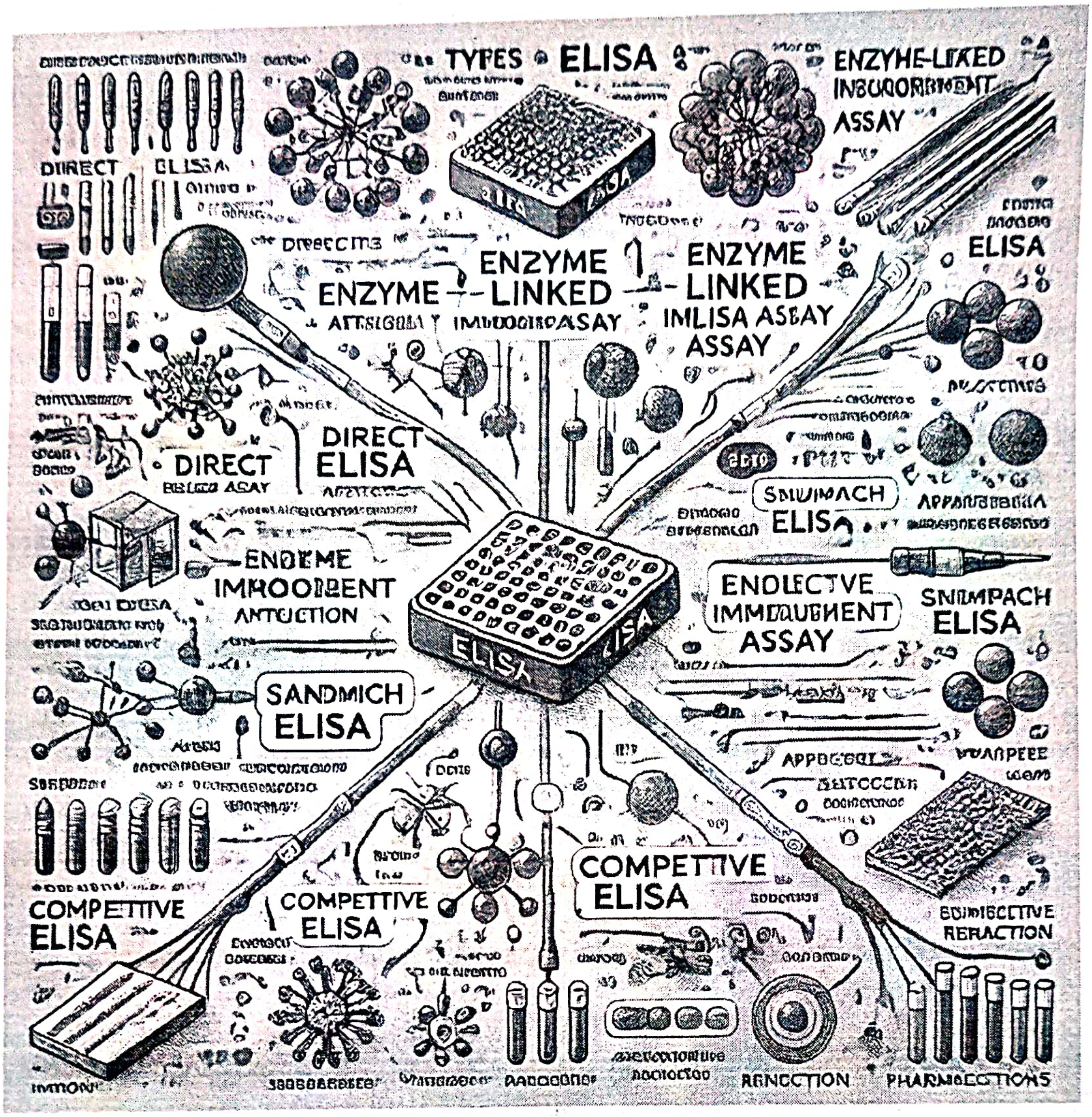
2.5: Key diagrams (if any):



3 Discussion:

The students will be discussed about binding nature of antigen and antibody and immunologic reaction One of the students will be asked to explain the steps involved in the ELISA test and interpretation of the result

4Mind Map:


TYPES
ELISA
DIRECT
ENZYME
LINKED
ENZYME
LINKED
ASSAY
DIRECT
ELISA
DIRECT
SANDMICH
ELISA
ELISA
COMPETTIVE
ELISA
COMPETTIVE
ELISA
COMPETTIVE
ELISA

5 Summary:

Students will be asked to identify the fundamental principle of antigen – antibody reactions. applications of ELISA in medical diagnostics like detecting diseases or measuring hormone levels, and considerations for proper technique and data analysis.

6 Assessment through Stimulating questions/Analogy/New ideas and Concepts:

Generating mental idea about creating an e-content of ELISA test

Producing the e-content and demonstrating the technical procedure

Provided with antigen and antibody and asked to identify unknown molecules present in the sample

7 FAQ's:

1. In an indirect ELISA, the enzyme is linked to:
a) Antigen b) Primary antibody c) Secondary antibody d) Substrate
2 The substrate used in ELISA is responsible for:
a) Binding to the antigen b) Producing a color change c) Neutralizing the antigen d) Binding to the enzyme
3 The sensitivity of an ELISA test depends on:
a) The quality of antibodies used b) The incubation time and temperature c) The enzyme-substrate reaction d) All of the above
4 In a competitive ELISA, the signal intensity is:
a) Directly proportional to the antigen concentration b) Inversely proportional to the antigen concentration c) Unaffected by antigen concentration d) Always constant
5. Which enzyme is commonly used in ELISA for generating a colorimetric signal?
a)) DNA polymerase b) Alkaline phosphatase c) Restriction endonuclease d) RNA helicase

8 References

1. Kannan. *Immunology*. Chennai: MJP Publisher, 2007.

2 Donald.M.Weirand john Steward. *Immunology*. London:(7th Education).ELBS, 1993.

3 Ivan M.Roit. *Essential Immunology*. Oxford: Blackwell Scientific Publications. 1998.

4 Ananthanrayanan,R. ,and Panicker.J. *TextBook of Microbiology*.NewDelhi: Orientlongmans. 2000.

EDWARD C
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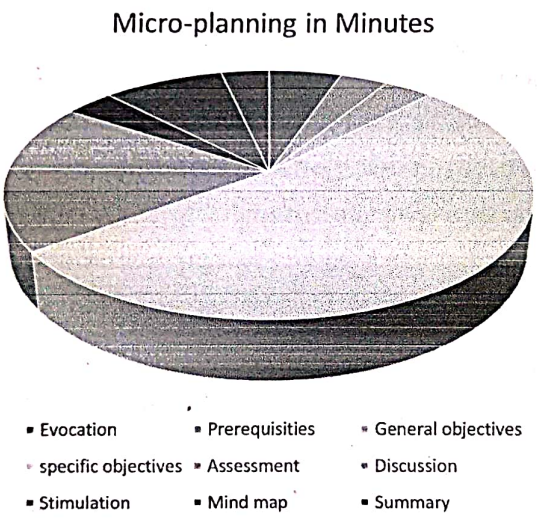
LESSON PLAN

Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	V
Subject Title	Core: Clinical Microbiology
Code	21UMIC52
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit: I – Modes of transmission of infection
Name of the Faculty	Ms. R. Shynisha Begam
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the different spread of infectious organism

Prerequisite Knowledge:
Knowledge of different modes of pathogen transmission and the source of infection

Micro -planning



1. Topic for Learning through evocation

When an infected person comes in contact with or exchanges body fluids with a non-infe mother can transmit infections to the unborn child via the placenta. A sexually transmitted disease s gonorrhoea can be transmitted by direct transmission.

The droplets spread during sneezing, speaking, and coughing by an infected person can infections. The infections can also spread by touching the nose and mouth with the hands contamin infectious droplets. There are a few infections such as chickenpox, conjunctivitis, head lice, ringwo spread when the skin of an infected person comes in contact with the skin of the other person.

Some infectious agents are transmitted by the blood-sucking insects. The insects feed birds, animals, and humans and carry infectious agents from them. These infections are transmitted host. Malaria and Lyme disease are the two vector-borne diseases.

2. Topic Introduction:

- The mode of transmission of infection is how germs are spread from one person to another. T different modes of transmission, including direct contact and indirect contact.
- Direct Transmission– This occurs when the pathogen is transmitted directly from an infected
- Indirect Transmission- When the pathogens are not transmitted directly from the infected per

2.1.General Objective:

Enables the students to understand the different methods of transmission of infection

2.2.Specific Objectives:

Enables the students to:

1. Compare the direct and indirect modes of disease transmission
2. Show the role of vectors in disease transmission
3. List out the transmission methods
4. Describe the mode of spread of pathogen from one host to another
5. Distinguish between the horizontal and vertical transmission

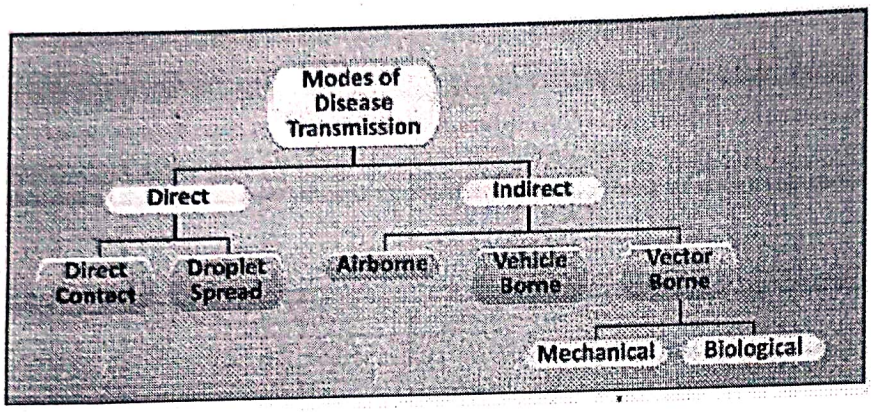
2.3 : Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1			1,2,3	4	
B. Conceptual Knowledge		1, 2,3	3,4		2,3,4	
C. Procedural Knowledge	1,2	4		4		
D. Meta Cognitive Knowledge					5	

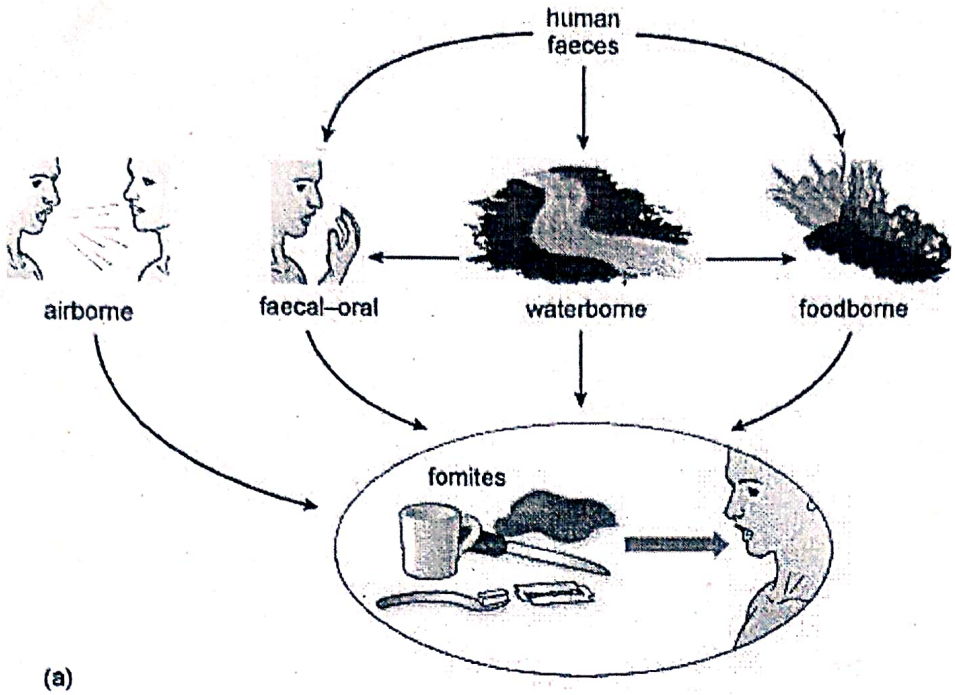
2.4: Key words:

Direct, indirect, vertical, fomites, vector, Droplet nuclei, waterborne, foodborne, transmission

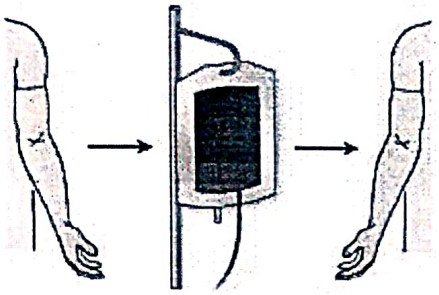
2.5: Key diagrams (if any):



The infectious agents are present in soil, water and plants as well. These agents can be transmitted to people and may cause diseases. For e.g., Hookworm is transmitted through contaminated soil. Legionnaires disease is spread by water supplied to condensers and cooling towers



(a)



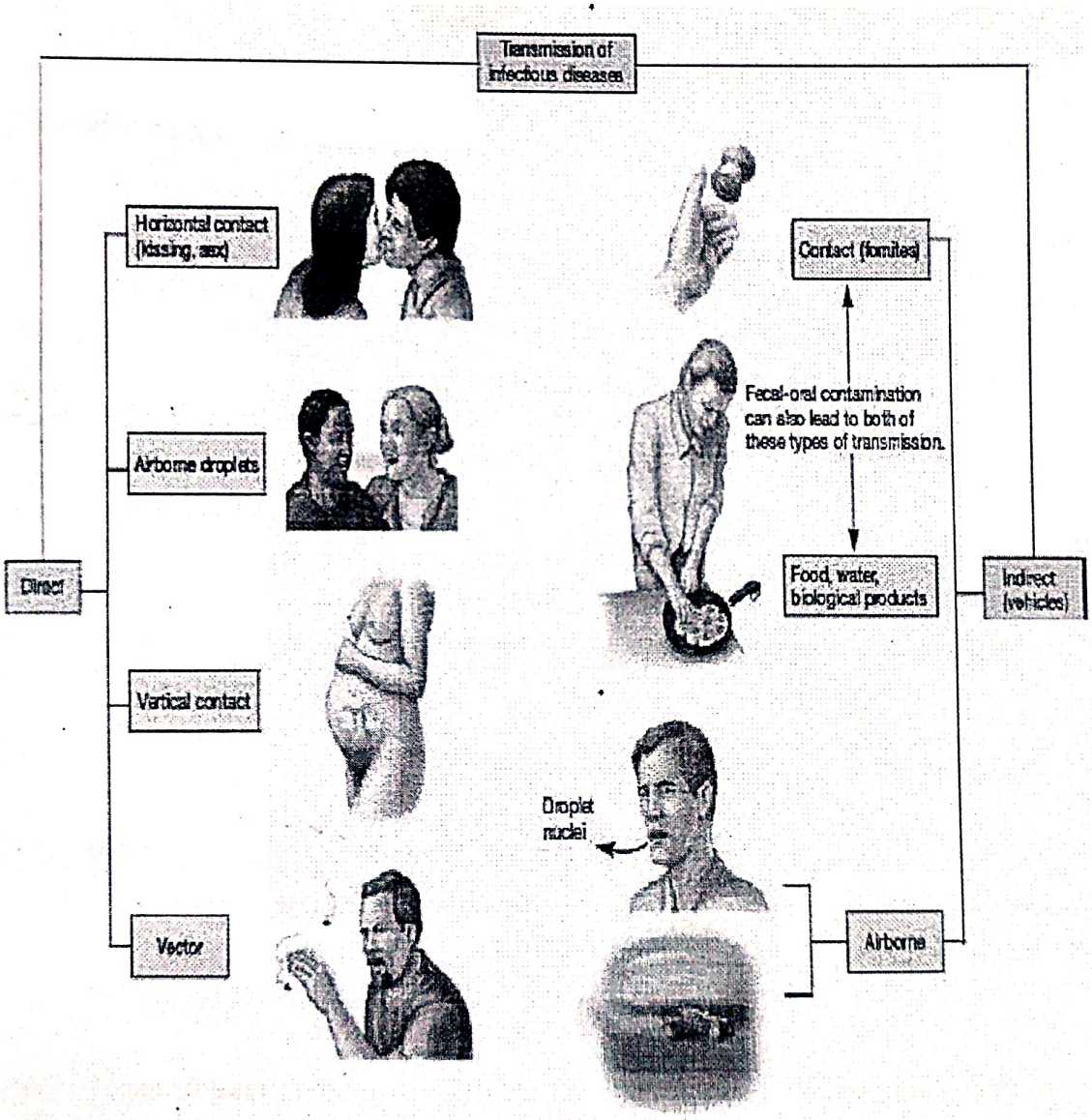
(b) bloodborne

Improperly canned and undercooked food is the main source of infections. Water also carries various pathogens from rivers and lakes. It should be boiled or filtered before use.

3. Discussion:

The students will be asked questions regarding the direct and indirect method in transmission of infection. One of the students will be asked to draw the flow chart in mode of transmission studied during the class. Students will be asked how the recent epidemic diseases are transmitted

4. Mind Map:


Transmission of infectious diseases
Horizontal contact (kissing, sex)
Airborne droplets
Vertical contact
Vector
Direct
Contact (fomites)
Fecal-oral contamination can also lead to both of these types of transmission.
Food, water, biological products
Indirect (vehicles)
Droplet nuclei
Airborne

5. **Summary:**

The student will be asked questions on source of infection and to recall the transmission modes by using the mind map.

6. **Assessment through Stimulating questions/Analogy/New ideas and Concepts:**

- Generating mental idea about creating an e-content on the transmission of infection
- Producing the e-content.
- Differentiating the direct and indirect mode of transmission.
- Prepare a chart on various infection and how it is transmitted

7. **FAQ's:**

1.The transmission of infection from mother to child through placenta is
a. Vertical b. horizontal c. indirect d. mechanical

2. Which of the following is not a direct transmission
a. vertical b. contact c. vector d. droplet

3. The infection which are transmitted by insects is termed as _____ borne
a. reservoir b. vector c. zoonotic d. vertical

4. The size of the droplet nuclei measures _____ micron
a. 10-20 b. 20-30 c. 25- 40 d. 1-10

5. Which of the following disease is transmitted through air
a. Cholera b. Rabies c. Gonorrhoea d. flu

8. **References**

1. Anathanarayanan, R., and Panicker, J. *Textbook of microbiology.* Hyderabad: Orier Longmans. 2000.
2. S., Rajan. *Medical microbiology.* Chennai: MJP publisher, 2007.
3. . L. M., Prescott J.P., Harley and D.A., Klein. Microbiology. New York: 7th editior McGraw-Hill Inc, 2008.
4. J. R Pelczar., M.J. Chan E. C. S., and Kreig N. R. Microbiology. New York: McGraw- Hill Inc,1993.

Verified by Subject Expert

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LESSON PLAN

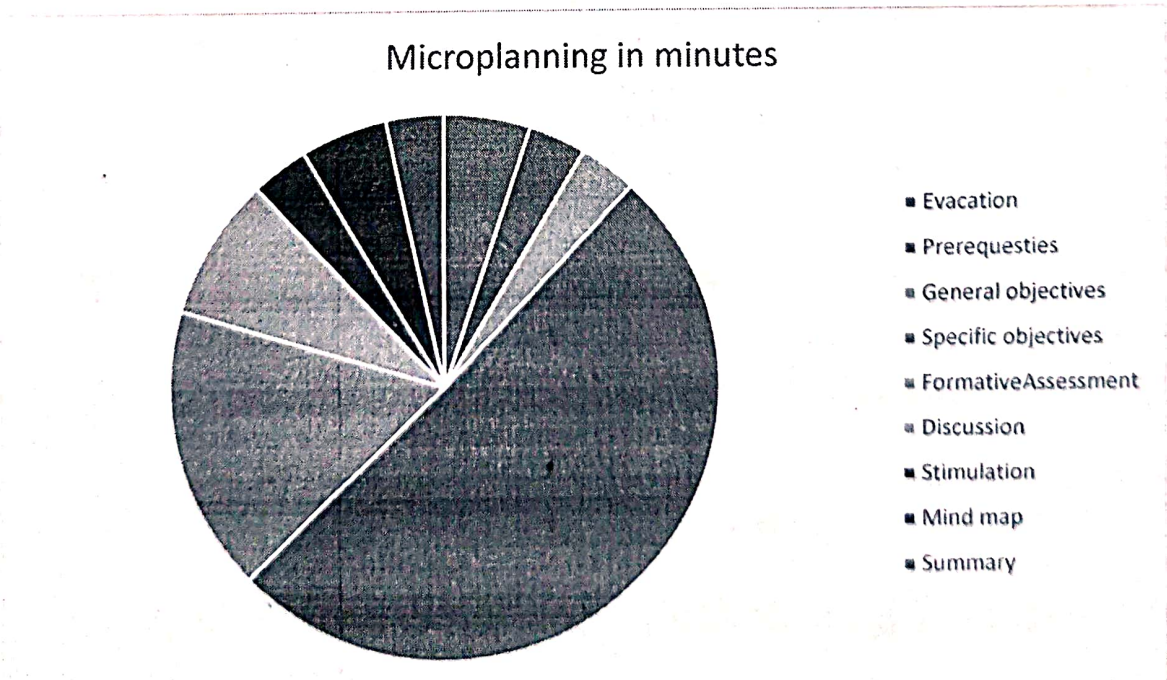
Objective Oriented Learning Process RBT

Programme	B.Sc Microbiology
Semester	V
Subject Title	Core VII Bio statistical and Bioinformatics
Code	21UMIC53
Hours	4
Total Hours	60
Credits	4
Max.Marks	100
Unit & Title	Unit I Introduction of Biostatistics
Name of the Faculty	Dr. T. P. Kumari Pushpa Rani
TL Tools	Lecture method Audio visual aid : Video Showily about Collective of data Types of data a evaluated by oral questions. Presenting the report of group discussion and checking the observations note

Prerequisite Knowledge :-

Knowledge about data collective and its importance

Micro Planning:



nitrogenous bases facing each other on the inside of the ladder. In DNA, there are four different types of nitrogenous bases : adenine (A), Cuaxide (a), Thymine (T) and cytosine (C).

DNA bases can pair according to specific rules, where adenine (A) binds to thymine (T), While guanine (G) birds to cytosine (C). These rules of complementary base – painting are critical for DNA replications and transcription.

2. Topic Introduction :

The structure of DNA is a double helix, which is a twisted ladder made up of two strands of nucleotides. The basic building blocks of DNA made up of a sugar, a phosphate group and a nitrogen base. The sugar in DNA is called deoxyribose.

2.1 General objective:

Enables the students to understands the structure of DNA.

2.2 Specific objectives:

Enables the students to

1. Identifying the components of nucleotide.
2. Summarize the components of nucleotide.
3. Describe the double helix structure of DNA.
4. Give an outline of the structure of DNA to its function is storing genetic information.
5. Taxonomic of objectives.

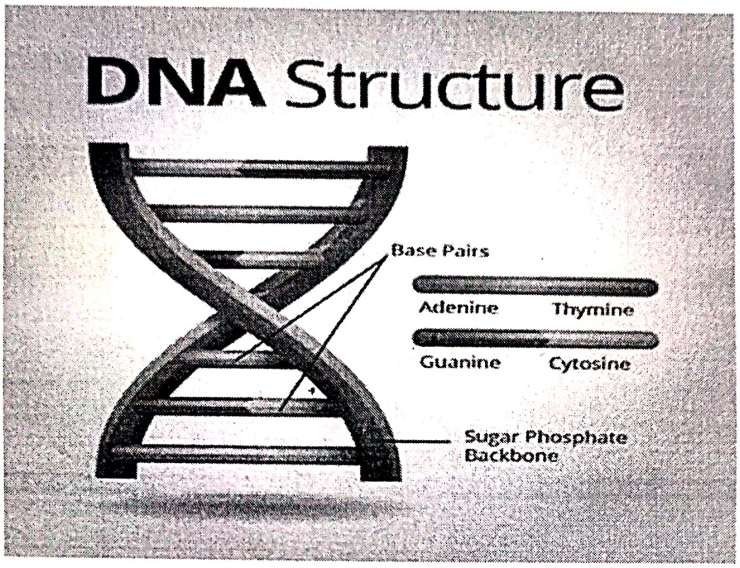
2.3 Taxonomic of objectives:

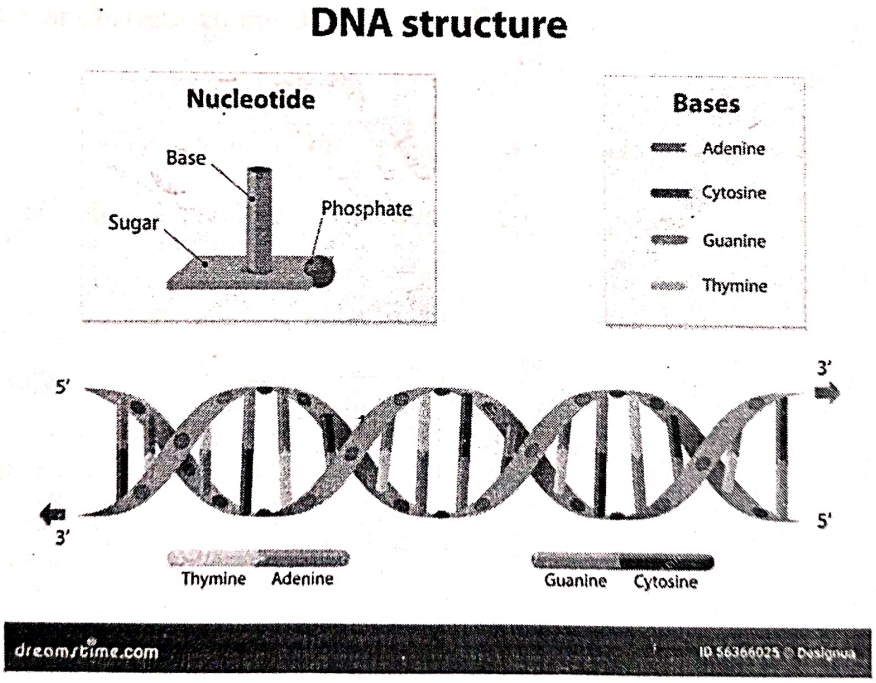
Taxonomy of objectives						
Knowledge Dimension	**The Cognitive process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1			2.3,4		
B. Conceptual Knowledge		3,4				
C.Procedural Knowledge					4,5	
D. Meta Cognitive Knowledge				3		

2.4 Key words:

Genetic material, Polynucleotide, DNA strands, Purine, Pyrimidine, Nucleotide, Nucleoside Base bairs.

2.5 Key diagrams (If any):

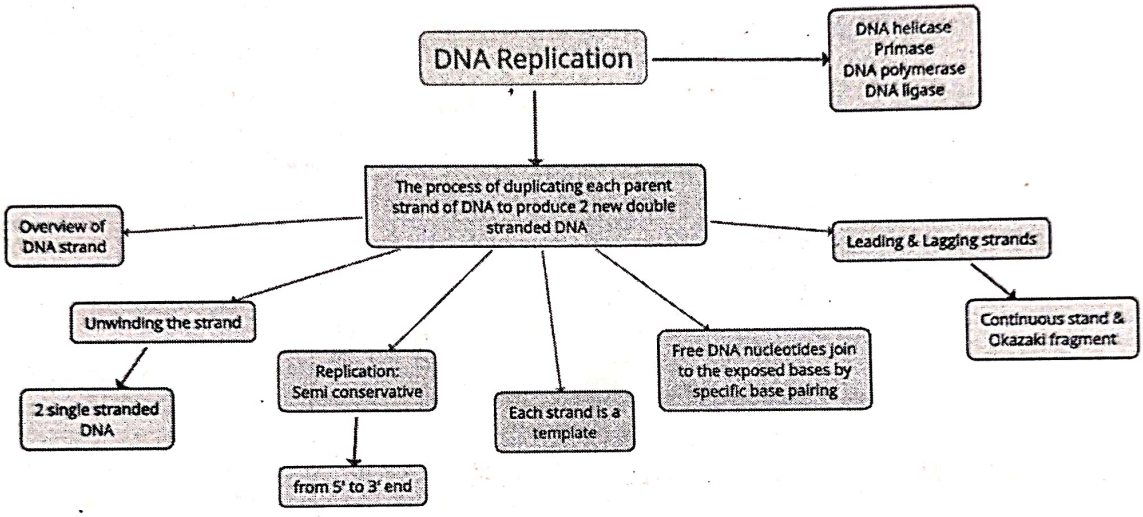




Discussion

The Students will be asked to the concepts of basis pairs and importance of the nucleotide and nucleoside one of the students to draw the structure of DNA during the class.

5. Mind Map :



DNA Structure

5. Summary

Students will be asked to how genetical information process carried and in DNA studied by using the mind map.

6. Assessment through stimulating question / New Ideas and concepts :-

- Generating mental idea about creating and e-content of working of structure of DNA.
- Producing the e-content.

7. FAQ's

1. _____was discovered Gram's staining method
a) Peter Mitchell b) Andre Jegendrot c) Ernest Uribe d) Watson and crick
2. _____ Form and DNA is described by Watson – Crick Model.
a) B – DNA b) I – DNA c) Qudraplex DNA
3. _____ based pairs are there is every helical turn of double helix model
a) 32.3 b) 11.6 c) 20 d) 10.4

4. The type of coiling in DNA is _____
a) Zig – Zag b) Left handed c) Opposite d) Right Handed
5. In DNA, the enzyme which break the H2, bodn is
a) Ligase b) Helicase c) Topoisomerase d) Polymerase

References : (Books / Periodicals / Journals

1. David Freifelder, George.M. Malacinski. Molecular Biology, Narosa Publishing House 1993.
2. Avinash., Kakoli upadhyay MolBio – Fundamentals of Molecular Biology Himalaya Publishing House 2005.
3. Sambamurthy A.V.S.S Molecular Biology, Narosa Publishing House 2011.
4. Jeyanthi, G.P. Molecular Biology. Chennai : MJP Publisher, 2009.
5. Raja Pandian.K, Shanthi.S.Molecular Biology and Microbial Genetics. PBS Book Enterprises. 2011.

9. Verified by Subject Expert

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LESSON PLAN

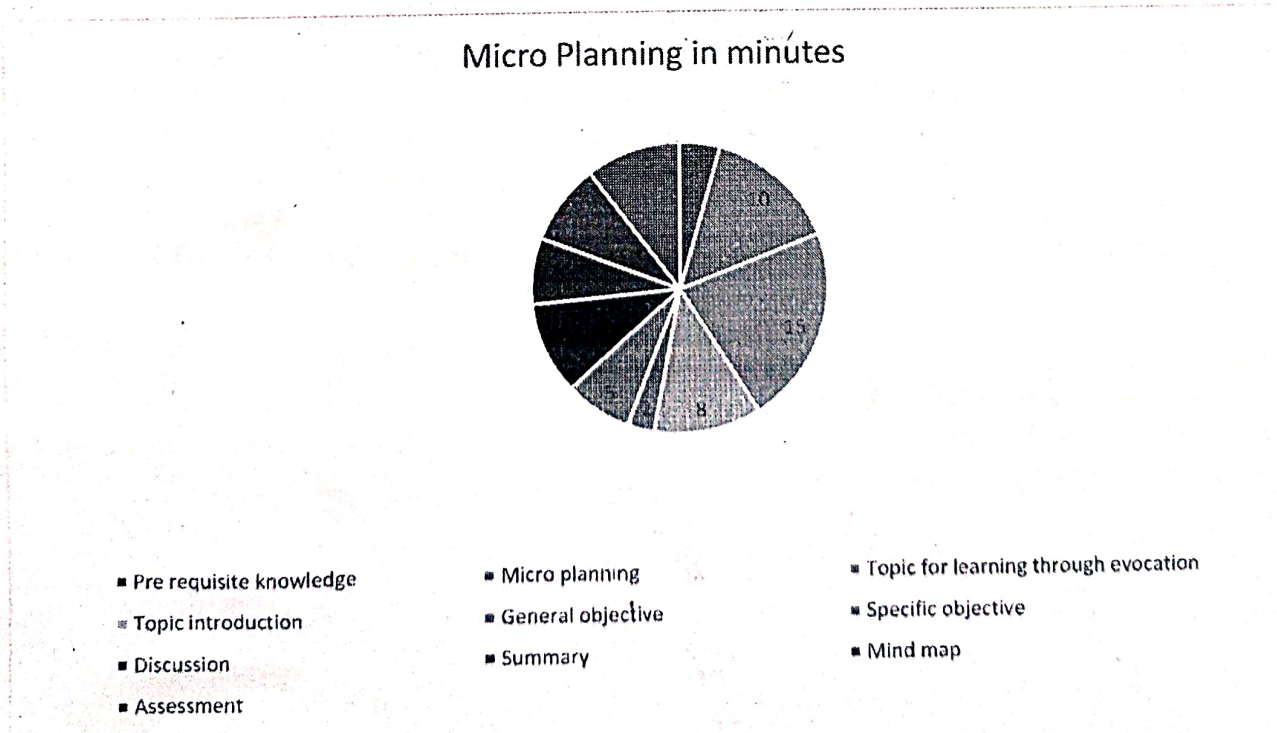
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	V
Subject Title	Major Elective: Microbial Nanotechnology
Code	21UMIE51
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit: II Nanoparticle synthesis by Plant
Name of the Faculty	Mr.EDWARD C
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the principle and steps of Nanoparticle synthesis by plant

Prerequisite Knowledge:

Familiarity with types of nanoparticles (e.g., silver, gold, zinc oxide), metal oxides, and quantum dots.
Knowledge of primary and secondary metabolites in plants (e.g., phenolics, flavonoids, terpenoids) that play a role in nanoparticle synthesis.

Micro -planning



1.Topic for Learning through evocation

Stimulating Curiosity:

How can plants act as "mini-chemical factories" to synthesize nanoparticles?

Why is plant-mediated nanoparticle synthesis considered eco-friendly compared to chemical methods?

Use Analogies for Engagement:

"Just as chefs use natural ingredients to create gourmet dishes, plants use their metabolites to craft nanoparticles with unique properties."

"Plants are like alchemists, turning metal salts into valuable nanoparticles using their bioactive compounds."

Thought Provoking Questions:

What role do plant metabolites (like flavonoids and terpenoids) play in reducing and stabilizing nanoparticles?

Can different parts of the plant (leaves, roots, stems) influence the properties of synthesized nanoparticles?

How does green synthesis compare with chemical and physical methods in terms of cost, safety, and environmental impact?

Real-Life Connections:

How are plant-synthesized nanoparticles being used in real-world applications like medicine, agriculture, and environmental cleanup?

Could this method help in addressing global challenges such as sustainable agriculture or clean water technology?

Visual Aids and Demonstrations:

Explore colorful reactions where plant extracts reduce metal ions to nanoparticles (e.g., a color change during silver nanoparticle synthesis).

Use microscopy images of plant-synthesized nanoparticles to demonstrate their unique shapes and sizes.

2.Topic Introduction:

Nanotechnology has revolutionized science and technology by enabling the manipulation of materials at the nanoscale, where particles exhibit unique physical, chemical, and biological properties. Among various methods of synthesizing nanoparticles, **plant-mediated synthesis** has emerged as a sustainable, cost-effective, and eco-friendly alternative to conventional chemical and physical approaches. Plants are rich in bioactive compounds such as phenolics, flavonoids, terpenoids, alkaloids, and proteins, which act as natural reducing and stabilizing agents during nanoparticle synthesis. This green synthesis process leverages the inherent metabolic capabilities of plants to reduce metal salts (like silver nitrate or gold chloride) into nanoparticles while capping them with plant-derived molecules for stability.

2.1General Objective:

To understand the principles, methods, and mechanisms of nanoparticle synthesis, including plant-mediated approaches, and to explore their unique properties, ecological advantages, and diverse applications in medicine, agriculture, industry, and environmental science.

2.2 Specific Objectives:

Enables the students to:

1. Define nanoparticle synthesis and list its basic types (chemical, physical, biological)
2. Explain the process of nanoparticle synthesis using plant extracts
3. Apply this method to synthesize nanoparticles for specific applications like antimicrobial activity
4. Analyze the effect of different plant extracts on the size, shape, and stability of nanoparticles.
5. Assess the advantages and limitations of plant-mediated nanoparticle synthesis.
6. Design a troubleshooting guide for common errors in the nanoparticle synthesis

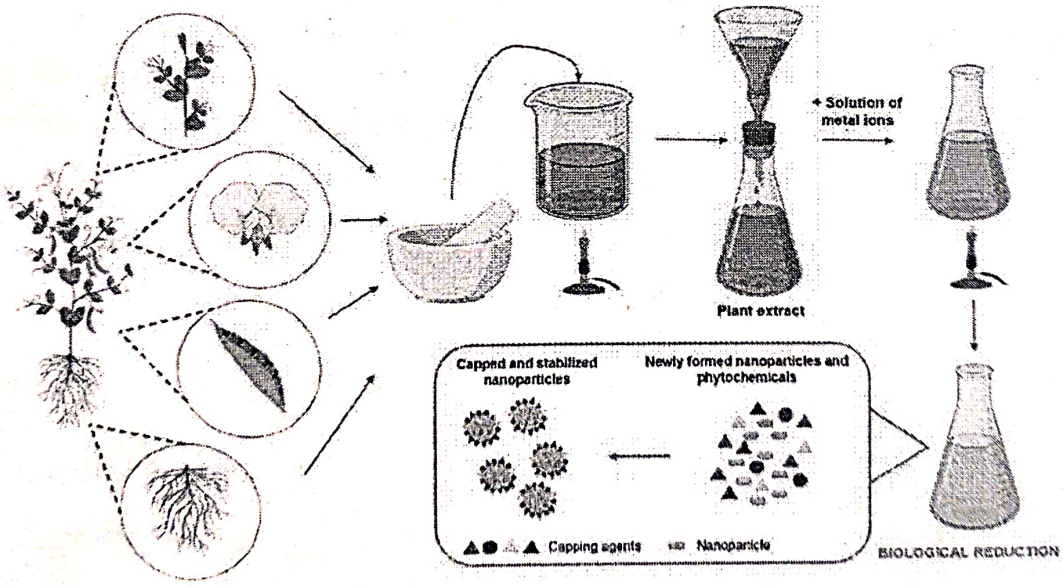
2.3: Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1			1,2	4	
B. Conceptual Knowledge		1, 2,3,4			2,3	
C. Procedural Knowledge			3,4	3, 4	4	6
D. Meta Cognitive Knowledge					5	

2.4: Key words:

Nanoparticles, Green synthesis, Plant extracts, Bioactive compounds and Phenolics

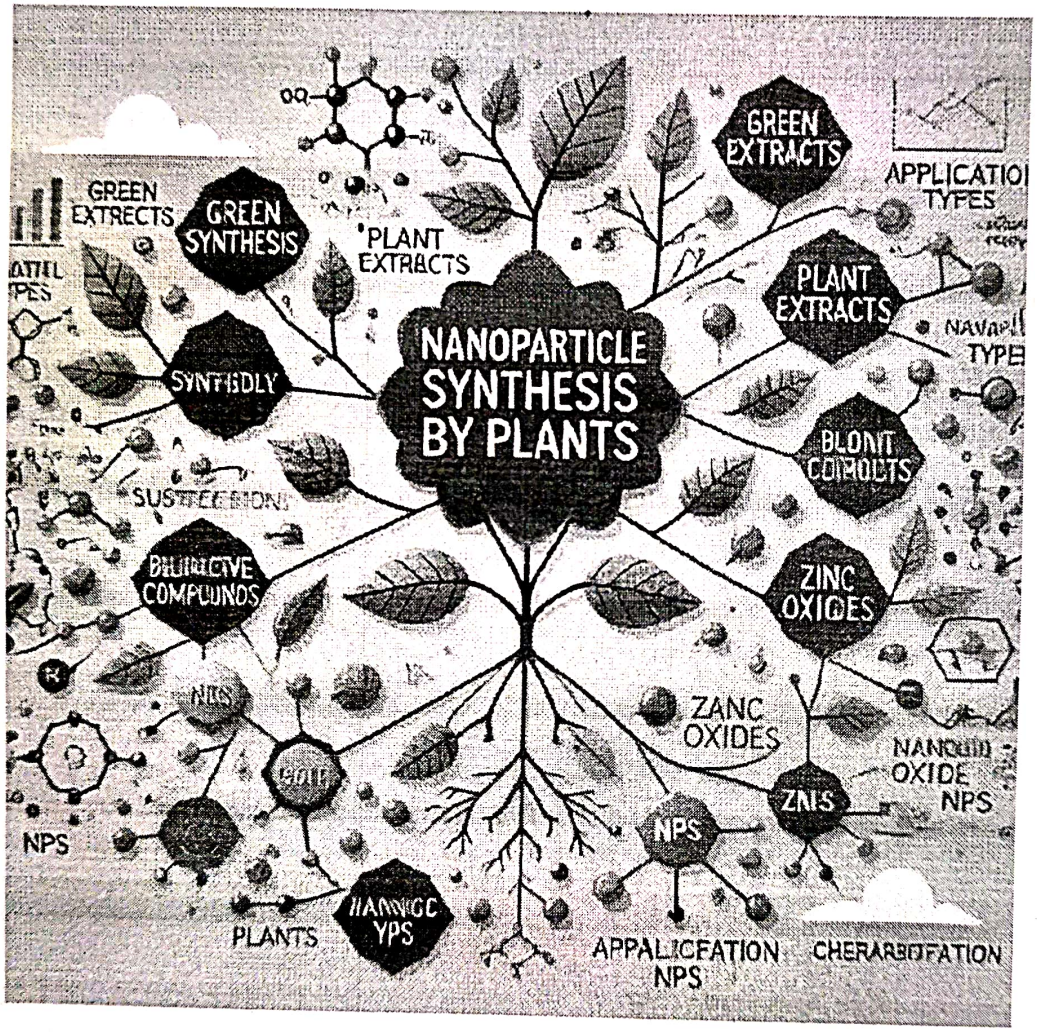
2.5: Key diagrams (if any):



3 Discussion:

The students will be asked questions regarding the nature of nanoparticles and its importance. One of the students will be asked to explain the steps involved in the method and interpretation of the result

4 Mind Map:



5 Summary:

Students will be asked to prepare plant extracts from various parts of the plants and set up nanoparticle synthesis

6 Assessment through Stimulating questions/Analogy/New ideas and Concepts:

Generating mental idea about creating an e-content of nanoparticle and its type

Producing the e-content and demonstrating the technical procedure

Provided with plant extracts and various nanomaterials and asked to synthesis various particles using novel method

7 FAQ's:

1What is the primary role of plant extracts in nanoparticle synthesis?
a) Heating the metal ions b) Acting as reducing and stabilizing agents c) Breaking down the nanoparticles d) Coloring the solution
2 Which part of the plant can be used for nanoparticle synthesis?
a) Leaves b) Roots c) Flowers d) All of the above
3 Which characterization technique is used to determine the size and morphology of synthesized nanoparticles?
a) UV-Vis spectroscopy b) Scanning Electron Microscopy (SEM) c) X-Ray Diffraction (XRD) d) Fourier Transform Infrared Spectroscopy (FTIR).
4 What is one of the major applications of plant-synthesized nanoparticles?
a) Genetic engineering b) Water purification c) Traditional medicine d) Soil erosion prevention
5. What is typically used as the metal precursor in plant-mediated nanoparticle synthesis?
a) Plant pigments b) Metal salts (e.g., silver nitrate) c) Crude oil d) Mineral ores

8 References

1. David.S.Goodsell.Jhonwiley.*Bionanotechnology*. NewDelhi: Lessons from Nature. 2006.
2. R.K.Rathi. *Nanotechnology* . NewDehli:1stEdition.S.Chand&CompanyLtd, 2009
3. Bernd Rehm, *Microbial Bio nano technology: Biological Self-assembly Systems* and *Biopolymer-based Nano structures*. London: Horizon Scientific Press. 2006.
4. Fulekar M.H., *Nanotechnology: Importance and Applications*. New Delhi: I K international Pvt Ltd, 2010.

EDWARD C

Verified by Subject Expert

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LESSON PLAN FOR MICROBIOLOGY

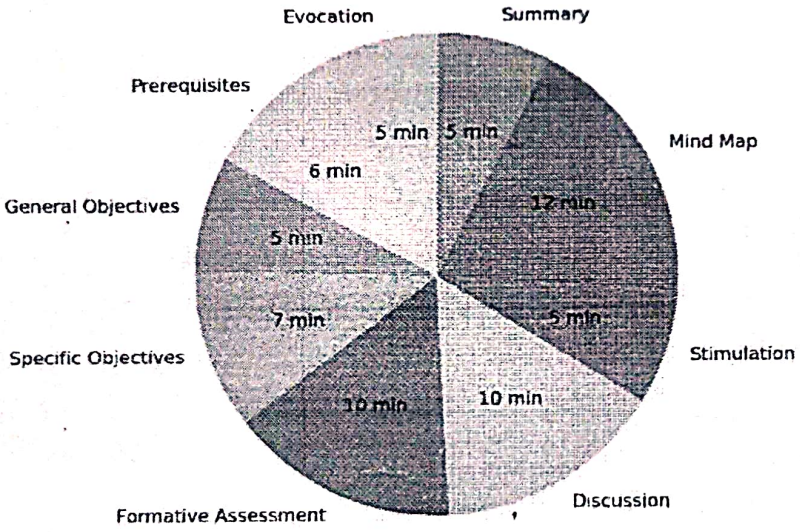
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	VI
Subject Title	Major Core: Food Microbiology
Code	21UMIC61
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit V : HACCP
Name of the Faculty	Dr. Joys Selva Mary Albert
T-L tools	Lecture method, **Visual aid:** Picture of HACCP

Prerequisite Knowledge: Knowledge about quality assurance in food industry is necessary

Micro-planning

MICRO PLANNING



1. Topic for Learning through evocation

Due to poor hygiene and the unclean food preparation process, foodborne illness and allergic issues can make people suffer. Bacteria and other microorganisms can easily infect food and multiply rapidly. If this diseased germ gets into the human body, it can create a life-threatening illness. The main work of the HACCP plan is to make our foods healthy and contamination-free as much as possible. In order to ensure the food that we consume is made with care and is pathogen-free, the food industry should abide by the 7 principles of HACCP.

2. Topic Introduction: The full form of HACCP is Hazard Analysis and Critical Control Points. It is an international management system to identify food hazards and ensure food safety. HACCP is a preventive approach to food safety. Therefore, it considers all the food safety issues that occur due to biological, chemical, physical hazards, and radiological hazards during food production. It is done by following the 7 principles of HACCP.

2.1. General Objective:

Enables the students to understand HACCP implemented in food industries.

2.2. Specific Objectives:

Enables the students to:

1. Outline the principles of HACCP
2. Describe the HACCP concept
3. Summarize the functions of HACCP

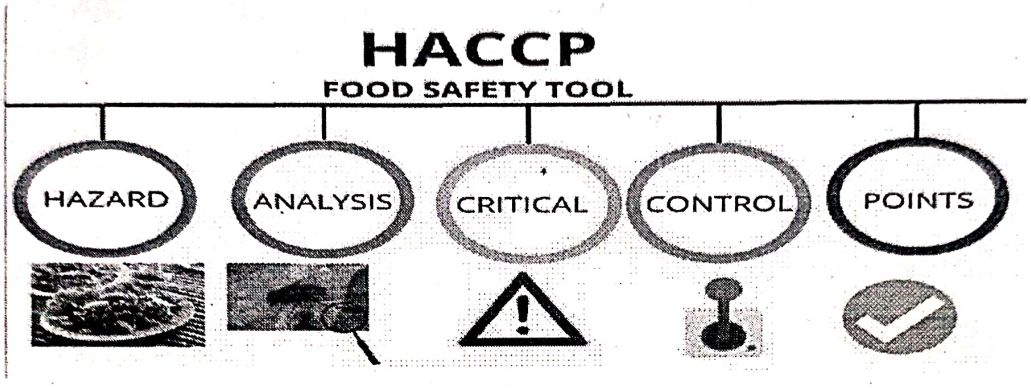
2.3. Taxonomy of objectives:

Taxonomy of objectives						
Knowledge Dimension	**The Cognitive Process Dimension**					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	1			1,2,3	4	
B. Conceptual Knowledge		1,2,3	3,4		2,3,4	
C. Procedural Knowledge				4		
D.MetaCognitive Knowledge					5	

2.4. Key words:

Hazard, CCPs, Critical limits, Monitoring, Corrective action, Verification, Documentation

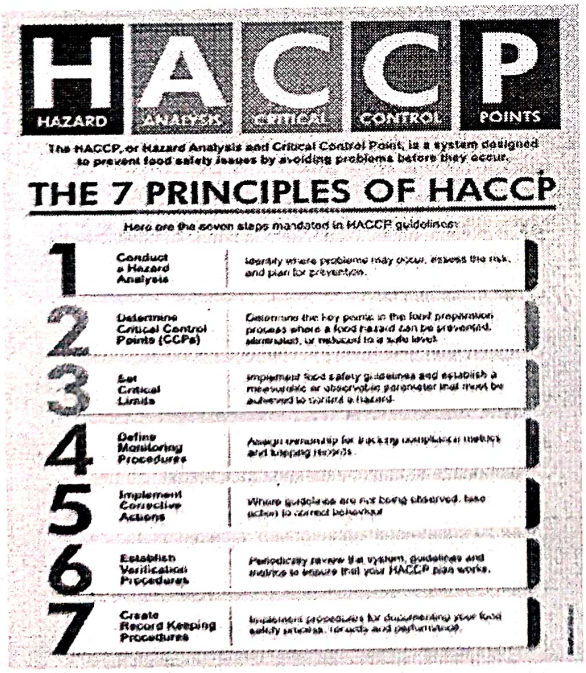
2.5. Key diagrams (if any):



3. Discussion:

The students will be asked to retrieve the principles of HACCP mentioned in the content analysis. One member will be called from each group to present the CCPs. Arrange the class to explain the functions of HACCP in industries.

4. Mind Map:



Explanation of Each Step:

1. **Hazard Analysis:**
   - Identify and evaluate potential hazards (biological, chemical, physical) at each step of the food process.
2. **Identify Critical Control Points (CCPs):**
   - Identify points in the process where you can control hazards to prevent, eliminate, or reduce them.
3. **Establish Critical Limits for Each CCP:**
   - Set thresholds like temperature, time, pH, etc., that ensure food safety.
4. **Monitor Critical Control Points:**
   - Continuously check the CCPs to ensure critical limits are met.
5. **Establish Corrective Actions:**
   - Define actions if a critical limit is violated, like adjusting the process or discarding unsafe products.
6. **Verification:**
   - Perform regular checks (e.g., audits or testing) to ensure the HACCP system is working.
7. **Record Keeping:**
   - Maintain logs and documentation to track the entire HACCP process for compliance and future reference.

5. Summary: Executing the acquired knowledge by asking questions like ' Definition for HACCP. Discuss critical control point. What are the principle of HACCP?

6. Assessment through Stimulating questions/Analogy/New ideas/and Concepts:

- Generating mental ideas about creating an e-content on HACCP in a sea food industry.
- Identifying different critical control points for different product in food industries.

7. FAQ's:

1. What does HACCP stand for?
a) Hazard Analysis and Critical Control Points b) Health and Control of Critical Points c) Hazard Assessment of Critical Control Points d) Health and Safety Analysis of Critical Control Points
2. Which of the following is the main purpose of a HACCP system?
a) To ensure the production of safe food b) To reduce the cost of food production c) To manage employee safety d) To track food sales data
3. In HACCP, which of the following is defined as a point where control can be applied to prevent, eliminate, or reduce a food safety hazard?
a) Hazard b) Critical Control Point (CCP) c) Control Measure d) Monitoring Point
4. What is the first step in the HACCP process?
a) Identifying Critical Control Points b) Determining hazards and assessing risks c) Establishing monitoring procedures d) Conducting verification activities
5. Which of the following is a potential hazard in a HACCP plan?
a) Chemical b) Biological c) Physical d) All of the above

8. References: (Books/Periodicals/Journals)

1. Jones, F. R., & Richardson, C. M. (2000). *HACCP: A systematic approach to food safety.* CRC Press.

2. Sofos, J. N. (2008). *HACCP: A practical approach* (2nd ed.). Springer Science & Business Media.

3. Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). *Modern food microbiology* (7th ed.). Springer Science & Business Media.

9. Verified by Subject Expert

Dr. Joys Selva Mary Albert

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LESSON PLAN

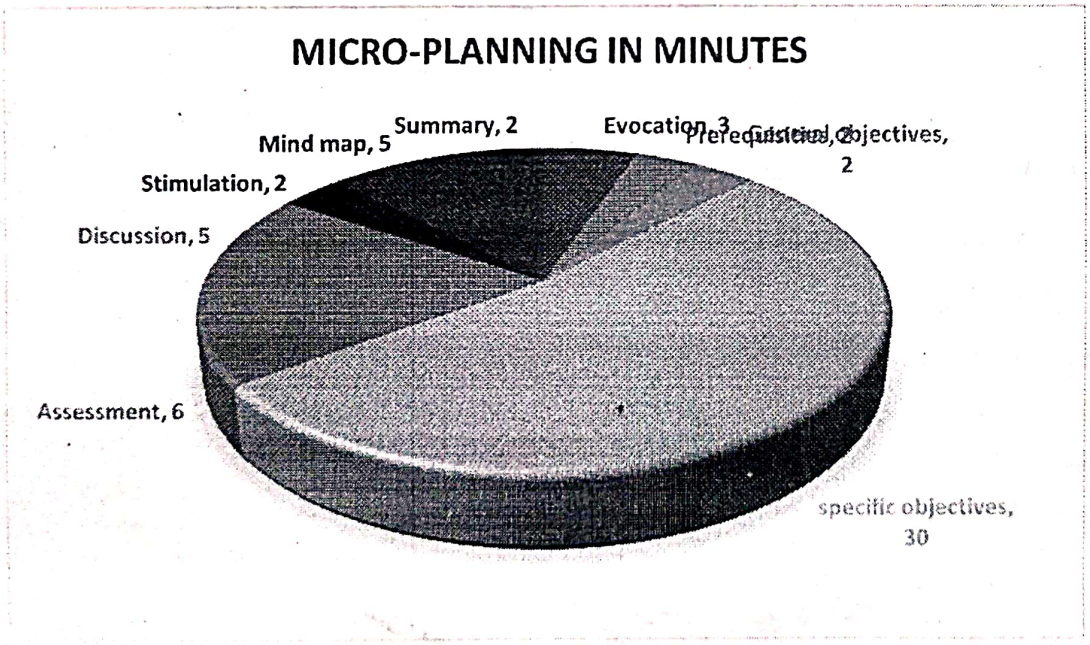
Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	VI
Subject Title	Core: Industrial Microbiology
Code	21UMIC62
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit: 1I – Production of recombinant proteins, applications: Insulin
Name of the Faculty	Ms. R. Shynisha Begam
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the structure of insulin and production and purification of insulin

Prerequisite Knowledge:

Knowledge of application and production of recombinant protein.

Micro -planning



1. Topic for Learning through evocation

Recombinant protein production is a biotechnological process that involves inserting a gene into a host organism to produce a specific protein. The process is used to produce large quantities of proteins for a variety of applications. They are used in research, diagnostics, and therapeutics.

The production of recombinant insulin includes, Gene isolation, Plasmid selection, Gene insertion, Transformation, Fermentation, Protein purification and folding and processing. Insulin derived from animal sources show allergic reactions but no allergy with recombinant insulin. Insulin is composed of two protein chains, with 21 amino acids in the A chain and 30 amino acids in the B chain, linked by disulfide bridges.

The healthy adult pancreas contains approximately 200 units of insulin, and the amount of daily insulin secretion into the circulatory system in healthy individuals ranges from 30 to 50 units. Proinsulin secreted by the beta cells is relatively inactive under biological conditions, but after cleavage in two places yields the two chains (B and A) of the active hormone insulin,

2. Topic Introduction:

Recombinant protein insulin is produced through genetic engineering techniques, where the human insulin gene is inserted into a suitable host organism like bacteria allowing the microorganism to produce large quantities of human insulin protein, which can then be harvested and purified for medical use.

Human insulin is a peptide hormone with a molecular mass of 5808 Da produced by the beta cells of the islets of Langerhans of the pancreas, and it is responsible for regulating the metabolism of glucose

2.1. General Objective:

Enables the students to understand the processes of preparation of recombinant protein

2.2.Specific Objectives:

Enables the students to:

1. Give an outline on the production and recovery of Insulin
2. Show the advantage of recombinant protein production.
3. Summarize the recombinant protein produced in large scale
4. Identifies the application of recombinant technology
5. Describe the structure of insulin.

2.3: Taxonomy of objectives:

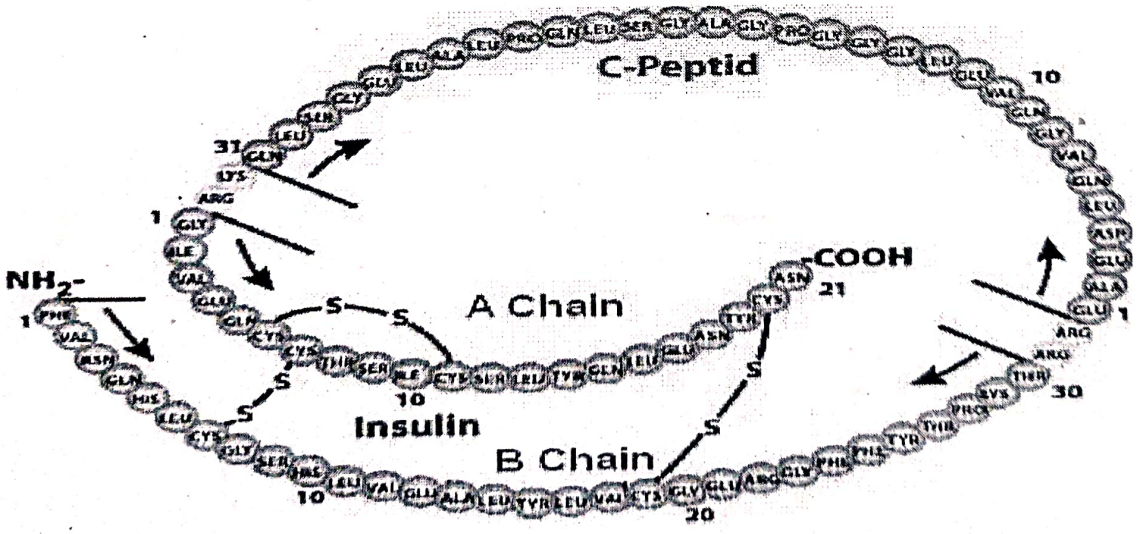
Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1			1,2	4	
B. Conceptual Knowledge		1, 2,3,4			2,3	
C. Procedural Knowledge			3,4	3, 4	4	
D. Meta Cognitive Knowledge					5	

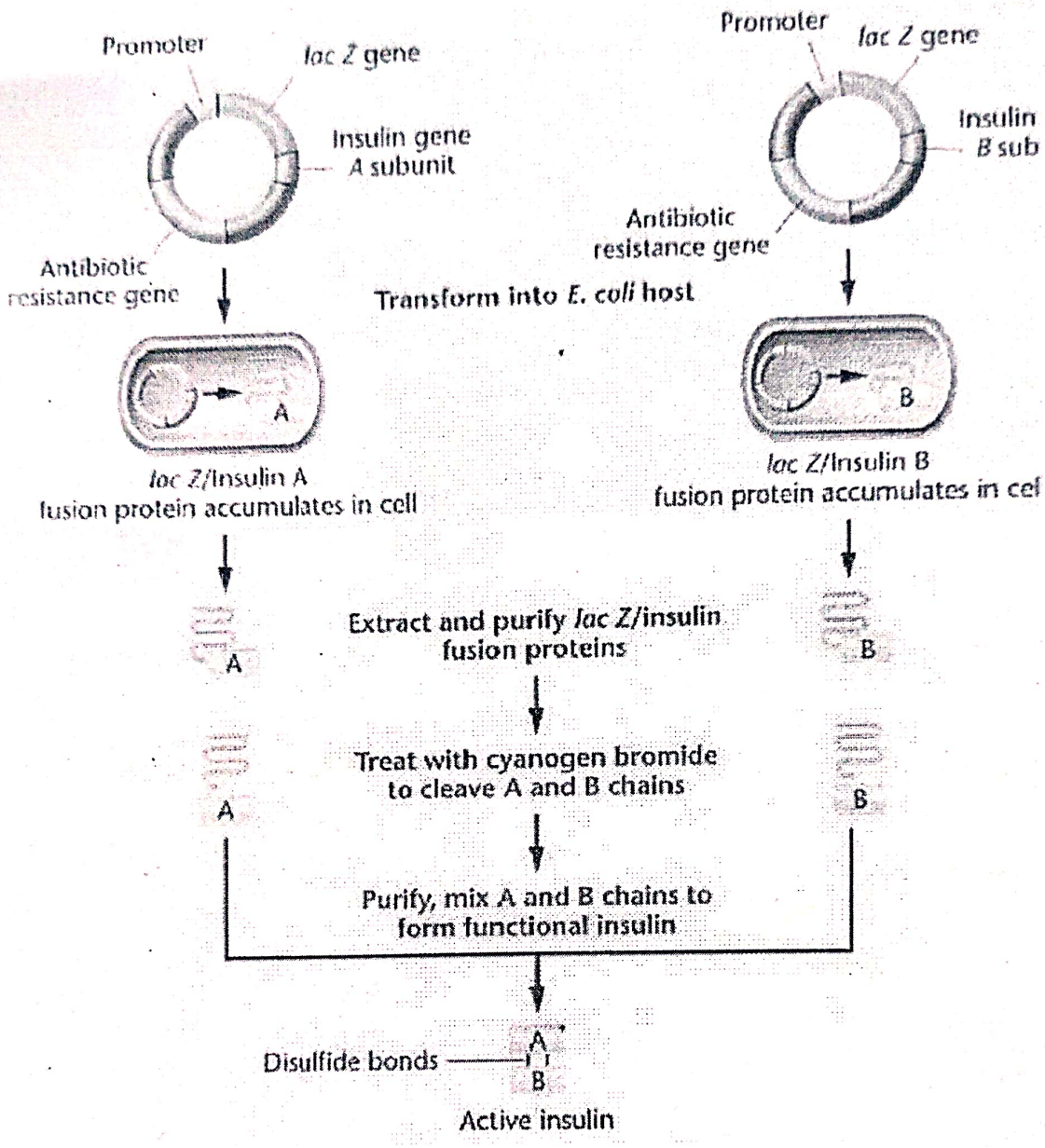
2.4: Key words:

Insulin, recombinant protein, vector, host, transformation, large scale production, purification, pancreas, diabetes

2.5: Key diagrams (if any):

Structure of insulin



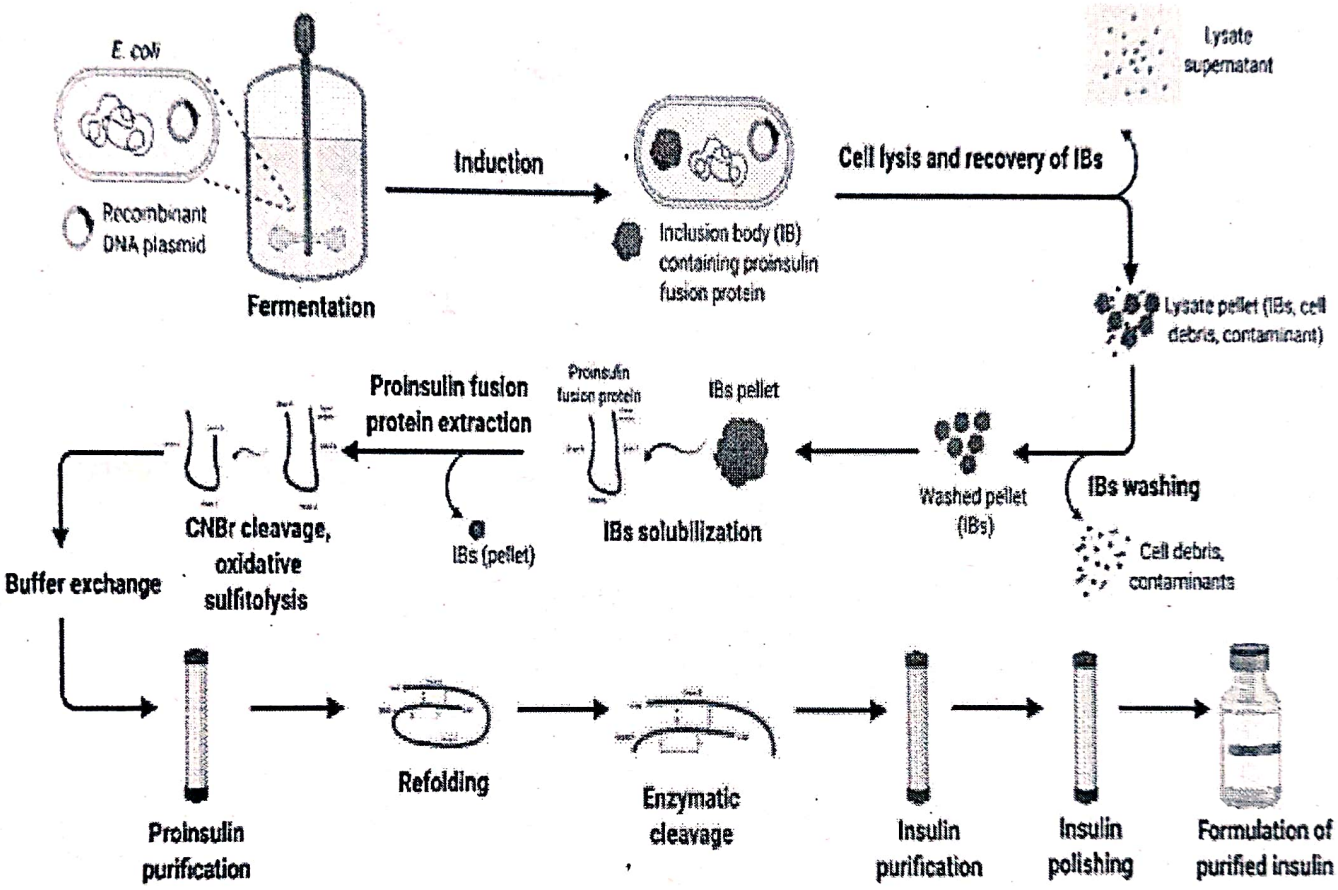


Steps in the production of recombinant Insulin

3. Discussion:

The students will be asked questions regarding the structure and function of Insulin. One of the students will be asked to draw the steps in the production of recombinant Insulin.

4. Mind Map:



5. Summary:

Executing the acquired knowledge by asking questions like 'beneficial aspect of recombinant protein' How the insulin produced in large scale in the industry?

6. Assessment through Stimulating questions/Analogy/New ideas and Concepts:

- Generating mental idea about creating an e-content of production of insulin
- Producing the e-content.
- Methods involved in the recovery of insulin
- Structure of insulin

7. FAQ's:

1. The role of plasmid in recombinant insulin production
   a) host b) vector c) donor c) recipient
2. The commonly used host for recombinant insulin production
   a) E. coli b) B. subtilis c) P. notatum d) S. typhi
3. The enzyme used to cut the plasmid DNA and insert the insulin gene is
   a) Ligase b) Restriction enzyme c) polymerase enzyme d) lysozyme
4. What is the commercial name for recombinant insulin
   a) Novolin b) Pegintron c) Humulin d) Intron
5. The process of introducing recombinant plasmid into bacterial cell is called
   a) Replication b) conjugation c) Transduction d) Transformation

8. References

1. Satyanarayana. U. *Biotechnology*. Kolkata: Book sand Allied (P) Ltd, 2013.
2. Purohit, S. S., Kakrani, H. N., Saluja, A. K. *Pharmaceutical Biotechnology*. Jodhpur: Student edition, 2006
3. Dubey, R.C. *A Textbook of Biotechnol*ogy. New Delhi: S Chand and Company Limited. 4th Rev. Edition 2006.
4. Gupta, P.K. *Elements of Biotechnology*. Meerut: Rastogi Publications, 2005.
5. Jogdand, S. N. *Gene Biotechnology*. New Delhi: Himalaya publishing house. 4th Edition, 2016.
6. Reed, G Prescott and Dunn. *Industrial Microbiology*. US: Macmillan Publication. 1982.

Verified by Subject Expert

Ms. R. Shynisha Begam

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LESSON PLAN

Objective Oriented Learning Process RBT

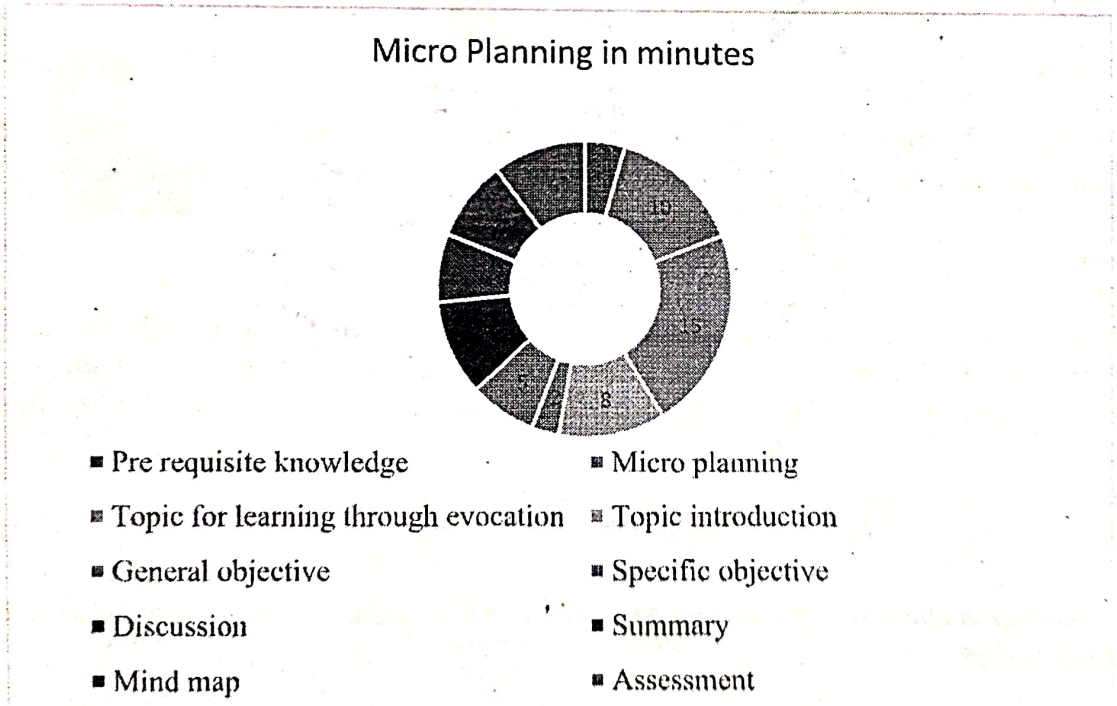
Programme	B.Sc. Microbiology
Semester	VI
Subject Title	Major Core : Environmental and Agriculture Microbiology
Code	21UMIC63
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit: II Root nodule formation
Name of the Faculty	Mr.EDWARD C
T-L tools	Lecture method, **Visual aid**: PPT, Picture showing the principle and steps of root nodule formation

Prerequisite Knowledge:

Knowledge of root hair cells and their role in nutrient absorption.

Characteristics of *Rhizobium* bacteria and its role as a nitrogen-fixing microorganism.

Micro -planning



1. Topic for Learning through evocation

Stimulating Curiosity:

Why do some plants grow better in poor soils than others?

Have you ever heard of plants "teaming up" with bacteria to create their own nutrients?

Use Analogies for Engagement:

Show an image of a legume root with visible nodules and ask: "What do you think these small bumps are doing on the root?"

Thought Provoking Questions:

"Imagine having a tiny team of workers underground helping you gather essential nutrients. How do you think they communicate and work together?"

Real-Life Connections:

"If nitrogen is abundant in the atmosphere, why can't plants just use it directly? What might they need to make it usable?"

Visual Aids and Demonstrations:

Demonstrate plant root of peas and chick pea with nodules

2.Topic Introduction:

Root nodule formation is a fascinating biological process in which certain plants, primarily legumes, form a symbiotic relationship with nitrogen-fixing bacteria, such as *Rhizobium*. This process allows plants to overcome nitrogen deficiency in the soil by converting atmospheric nitrogen (N_2), which is unavailable to most plants, into ammonia (NH_3), a usable form of nitrogen.

The interaction begins when the plant roots secrete chemical signals to attract the bacteria. In response, the bacteria produce signaling molecules called nod factors, which initiate a series of changes in the plant root cells. This leads to the formation of nodules—specialized structures on the roots where nitrogen fixation occurs

2.1General Objective:

The general objective of root nodule formation is to establish a symbiotic relationship between leguminous plants and nitrogen-fixing bacteria, specifically *Rhizobium* species. This process allows the plant to obtain essential nitrogen compounds, which are vital for growth, from the soil.

2.2 Specific Objectives:

Enables the students to:

1. Recall the process of root nodule formation and the role of *Rhizobium* bacteria in nitrogen fixation.
2. Describe how nitrogen fixation occurs within the root nodules and its significance for plant growth.
3. Demonstrate the steps involved in inoculating leguminous seeds with *Rhizobium* for efficient nodule formation.
4. Compare the differences in root nodule formation between various legume species.
5. Assess the effectiveness of root nodule formation in improving soil fertility and plant growth in different agricultural settings.
6. Develop a strategy to optimize root nodule formation in a specific region or soil type for sustainable agricultural practices.

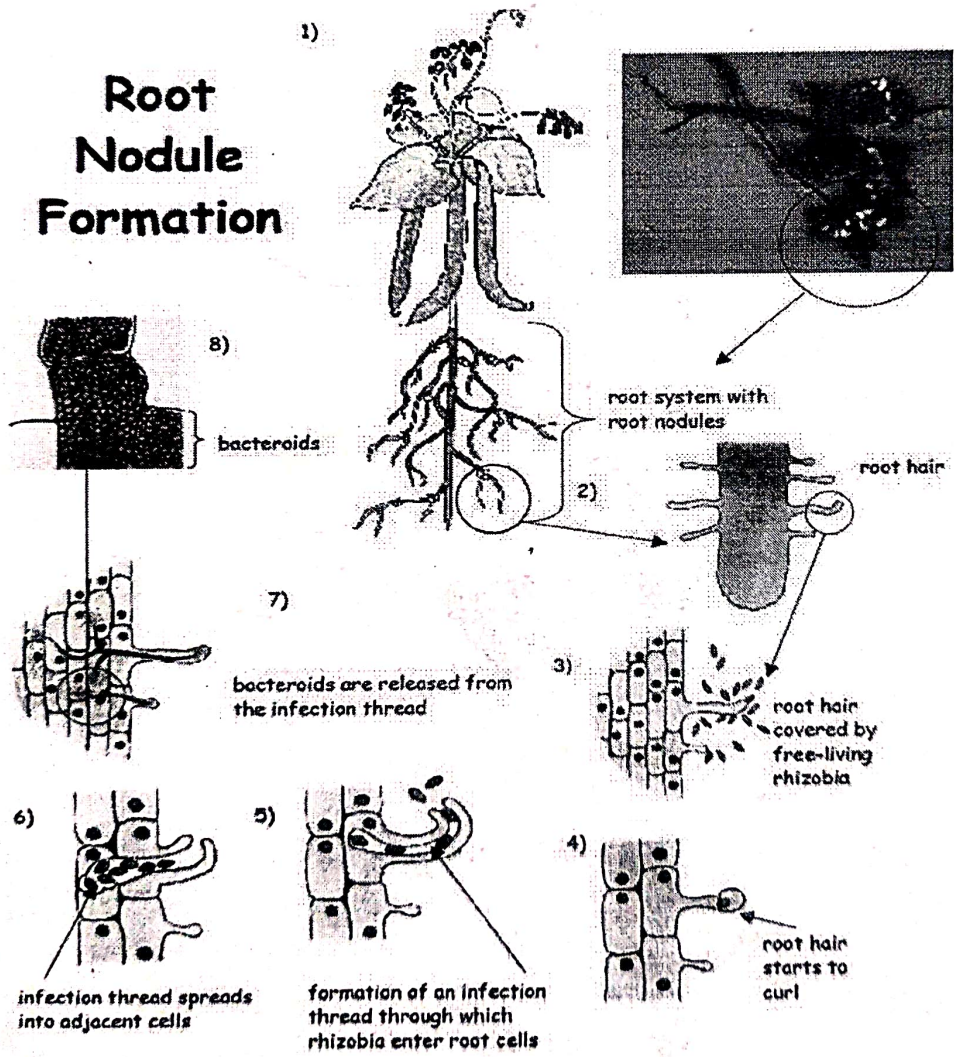
2.3: Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
A. Factual Knowledge	1			1,2	4	
B. Conceptual Knowledge		1, 2,3,4			2,3	
C. Procedural Knowledge			3,4	3, 4	4	6
D. Meta Cognitive Knowledge					5	

2.4: Key words:

Nodule, Rhizobium, Nitrogen fixation , Flavonoids and Nitrogenase

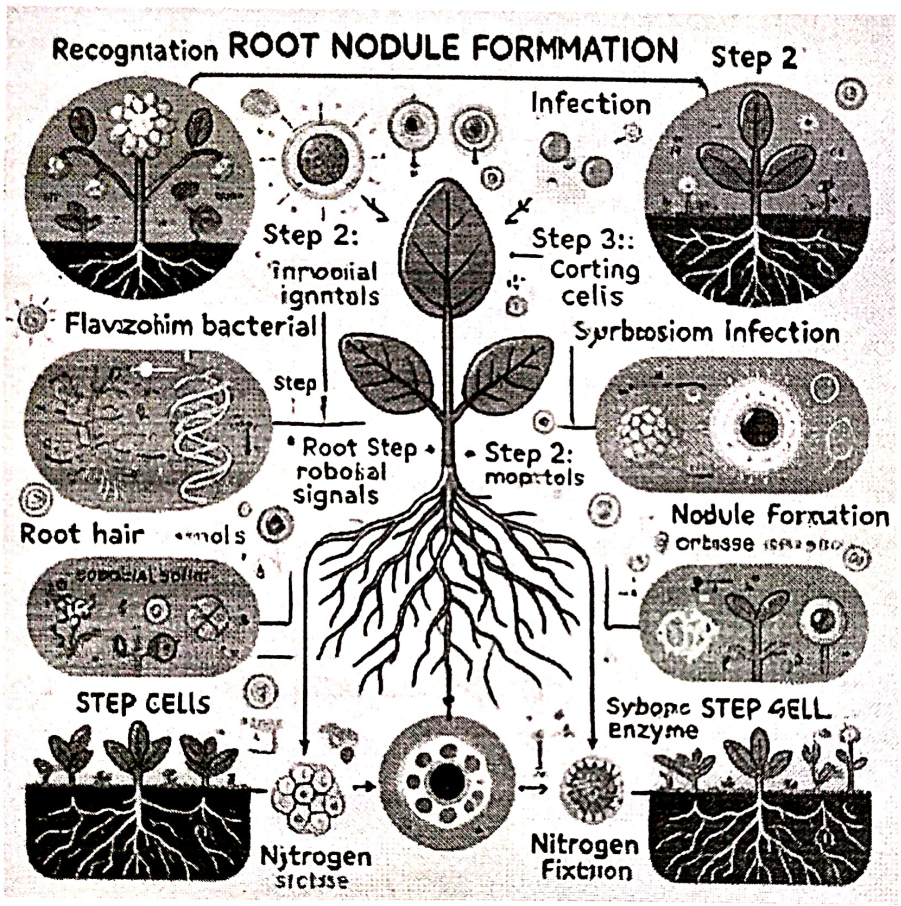
2.5: Key diagrams (if any):



3 Discussion:

The students will be asked questions regarding the nature of nodule formation and its importance. One of the students will be asked to explain about interaction of nitrogen fixing organism and root cells

4 Mind Map:



5 Summary:

Students will be asked to collect roots with nodule and will demonstrate steps involved in the nodule formation

6 Assessment through Stimulating questions/Analogy/New ideas and Concepts:

Generating mental idea about creating an e-content of root nodule formation and type

Producing the e-content and demonstrating the technical procedure

7 FAQ's:

1 Which structure is formed during the infection process in root nodule formation?
a) Symbiosome b) Infection thread c) Root hairs d) Plasmodesmata
2 Which bacteria are involved in root nodule formation in legumes? a) Pseudomonas b) Rhizobium c) Escherichia d) Bacillus
3 What are *Nod factors*?
a) Hormones produced by plants b) Signals produced by Rhizobium c) Antibiotics produced by bacteria d) Enzymes for nitrogen fixation
4 what is the primary enzyme involved in nitrogen fixation
a) Nitrogenase b) Amylase c) Urease d) Hydrolase
5. Root nodule formation is an example of
a) Mutualism b) Commensalism c) Parasitism d) Predation

8 References

1 Dubey R.C. *A Text Book of Biotechnology.* New Delhi: Fifth revised Edition. S Chand & Co. 2014.

2 Shiva Aithal. C. *Modern approaches in Soil, Agricultural and Environmental Microbiology.* New Delhi: Himalaya Publishers, 2010.

3 K. VIjaya Ramesh. *Environmental Microbiology.* Chennai: MJP Publishers, 2005

4 Subbarao. N.S. *Soil Microorganisms and Plant growth.* New Delhi: Ed, Oxford and IBH Publishing Co, Pvt. Ltd, 1995.

EDWARD C

Verified by Subject Expert

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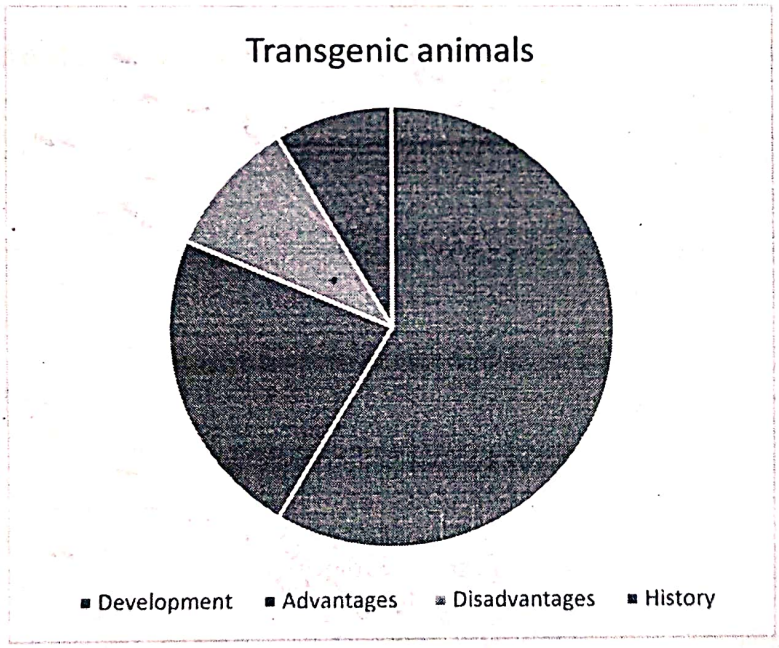
LESSON PLAN SAMPLE FOR SCIENCE

Objective Oriented Learning Process RBT

Programme	B.Sc. Microbiology
Semester	VI
Subject Title	Major Core: Microbial Biotechnology
Code	21UMIC64
Hours	4
Total Hours	60
Credits	4
Max Marks	100
Unit & Title	Unit II: Transgenic animals (Dolly)
Name of the Faculty	Dr.C.Siluvai Kirubagari Aneeshia
T-L tools	Lecture method, **Audio Visual aid:** video showing about Dolly development **Visual aid:** Picture of transgenic animals and evaluated by oral questioning, presenting the report of group discussion and checking the observation note.

Prerequisite Knowledge:
Knowledge about transgenic animals

Micro -planning



1. Topic for Learning through evocation

Transgenic Animals are animals that have been genetically modified by inserting genes from other species into their DNA. This modification can be done for various purposes, such as research, improving agriculture, or producing pharmaceuticals.

2. Topic Introduction:

Transgenic animals are organisms whose genetic material has been altered through biotechnology to contain genes from other species. This process involves introducing foreign DNA into an animal's genome, often to produce desirable traits that would not naturally occur. The creation of transgenic animals has opened up new possibilities in medicine, agriculture, and environmental conservation, offering solutions for improving human health, enhancing food production, and addressing environmental issues.

2.1. General Objective:

Enables the students to understand transgenic animals.

2.2. Specific Objectives:

Enables the students to:

1. Understand the Concept of Transgenic Animals
2. Identify the Methods Used in Creating Transgenic Animals
3. Explore the Applications of Transgenic Animals
4. Examine Ethical, Legal, and Environmental Concerns

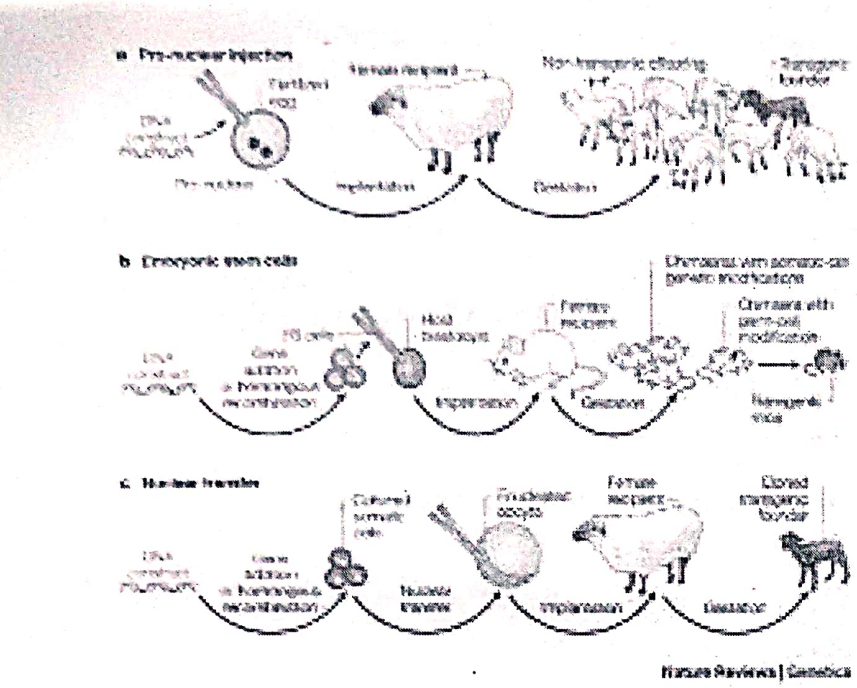
2.3: Taxonomy of objectives:

Taxonomy of Objectives						
Knowledge Dimension	The Cognitive Process Dimension					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A. Factual Knowledge	**1**			**1,2,3**	**4**	
B. Conceptual Knowledge		**1, 2,3,4**	**3,4**		**2,3,4**	
C. Procedural Knowledge				**4**		
D. Meta Cognitive Knowledge					**5**	

2.4: Key words:

- Transgenic Animals
- Genetic Engineering
- Gene Insertion
- Dolly

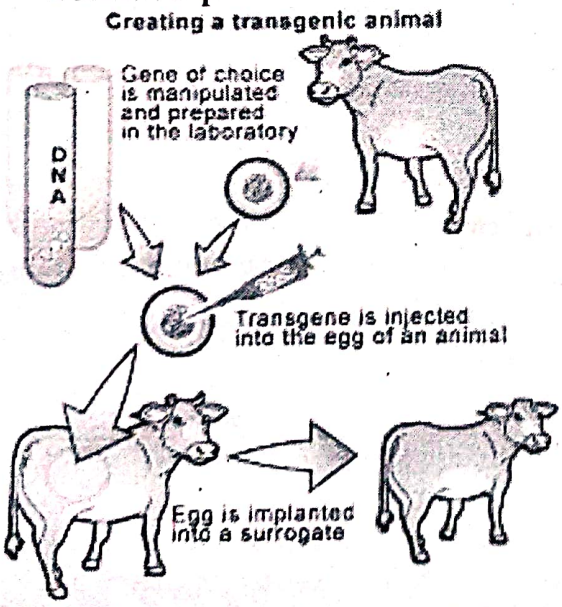
2.5: Key diagrams (if any):



3. Discussion:

The students will be asked to retrieve the scientific terms, facts, and concepts mentioned in the content analysis. One member will be called from each group to present the outcome of the group. The students who have not taken part will be noted.

4. Mind Map:



5. Summary: Transgenic animals are animals that have been genetically modified to carry genes from other species, often through genetic engineering techniques. These modifications can be done for various purposes, including research, medicine, and agriculture. The most common examples of transgenic animals are those that have been altered to produce proteins, study diseases, or improve food production.

6. Assessment through Stimulating questions/Analogy/New ideas and Concepts:

- Generating mental ideas about creating an e-content on the Dolly
- Producing the e-content.

7. FAQ's:

What is a transgenic animal?
a) An animal that has undergone natural mutation
b) An animal that has been genetically modified to carry a gene from another species
c) An animal with a naturally occurring genetic mutation
d) An animal that has been cloned using somatic cells
Answer: b) An animal that has been genetically modified to carry a gene from another species

Which of the following is NOT a typical use of transgenic animals?
a) Production of therapeutic proteins
b) Testing for drug safety
c) Cloning animals for reproduction
d) Studying genetic diseases
Answer: c) Cloning animals for reproduction

Which method is commonly used for introducing foreign genes into animals?
a) In vitro fertilization
b) Gene gun
c) Electroporation
d) All of the above
Answer: d) All of the above

Which of these animals is genetically modified to produce a therapeutic protein in their milk?
a) Sheep
b) Cows
c) Goats
d) Pigs
Answer: c) Goats

What is the primary purpose of creating transgenic animals in research?
a) To improve food production
b) To create pets with desirable traits
c) To study genetic diseases and develop therapies
d) To improve animal resistance to diseases
Answer: c) To study genetic diseases and develop therapies

8. References: (Books/Periodicals/Journals)

1. *Text book of Biotechnology*. R.C.Dubey Chand and company (P)Ltd. (2006).
2. Glick. B, R and Pasternak J. J *Molecular biotechnology*. ASM press,Washington. (2001)
3. Kumaresan . V *Biotechnology*. Saras Publication. (2009)
4. Singh B. D *Biotechnology*.KalyaniPublication. (2006).

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