Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.

Accredited with A$^+$ by NAAC - IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF BOTANY

SYLLABUS FOR UNDERGRADUATE PROGRAMME

TEACHING PLAN

ODD SEMESTER 2024-2025

Vision

To impart knowledge with professional zeal and devotion for plant science

Mission

Providing student – centered and profession- oriented higher education that bestows academic environment to create intellectuals with scientific temperament, in the context of global issues and environmental challenges.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	Upon completion of B.A/B.Sc. Degree Programme, the graduates will be able to:	Mapping with Mission
PEO 1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.	**M1& M2**
PEO 2	use practical knowledge for developing professional empowerment and entrepreneurship and societal services.	**M2, M3, M4 & M5**
PEO 3	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.	**M3, M4, M5 & M6**

PROGRAMME OUTCOMES (POs)

POs	Upon completion of B.Sc. Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	obtain comprehensive knowledge and skills to pursue higher studies in the relevant field of science.	**PEO1**
PO2	create innovative ideas to enhance entrepreneurial skills for economic independence.	**PEO2**
PO3	reflect upon green initiatives and take responsible steps to build a sustainable environment.	**PEO2**

PO4	enhance leadership qualities, team spirit and communication skills to face challenging competitive examinations for a better developmental career.	**PEO1 &PEO3**
PO5	communicate effectively and collaborate successfully with peers to become competent professionals.	**PEO2&PEO3**
PO6	absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	**PEO2 & PEO3**
PO7	participate in learning activities throughout life, through self-paced and self-directed learning to improve knowledge and skills.	**PEO1&PEO3**

PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of the B.Sc. Botany program, the students are expected to:		**Mapping with POs**
PSO1	implement the concept of science and technology to foster the traditional and modern techniques for solving the complex problems in Plant Biology.	**PO4**
PSO2	ensure the use of contemporary tools and techniques in understanding the scope and significance of Botany	**PO1& PO3**
PSO3	develop the scientific problem solving skills during experimentation, research projects, analysis and interpretation of data	**PO4 & PO7**
PSO4	design scientific experiments independently and to generate useful information to address various issues in Botany.	**PO6 & PO7**
PSO5	enhanced capacity to think critically; ability to design and execute experiments independently and/or team under multidisciplinary settings	**PO2 & PO5**
PSO6	design and standardize protocols for public health and safety, and cultural, societal, and environmental considerations	**PO6 & PO3**
PSO7	apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.	**PO2 & PO7**
PSO8	demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.	**PO6**
PSO9	follow the concept of professional ethics and bioethics norms for practicing the value of plant kingdom.	**PO6**
PSO10	communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively	**PO4 & PO6**

Teaching Plan

Department : Botany

Class : I B.Sc., Botany

Title of the Course : Core I PLANT DIVERSITY I - ALGAE

Semester : I

Course Code : BU231CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231CC1	3	2	-	-	5	5	75	25	75	100

Learning Objectives

1. To provide a comprehensive knowledge on the biology of algae and to understand the evolution higher of plants.

2. To understand the role of algae in ecosystems as primary producers of nutrition and also the importance of algae to animals and humans.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	Relate to the structural organization, reproduction and significance of algae.	**K2 &K5**
2.	Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth	**K3 &K1**
3.	Explain the benefits of various algal technologies on the ecosystem.	**K1**
4.	Compare and contrast the thallus organization and modes of reproduction in algae.	**K4 & K5**
5.	Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.	**K5 & K6**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	1.	General characters of Algae	**3**	K2(U)	Lecture using Chalk and talk, PPT	MCQ, Definition, Short summary, Slip test
	2.	Classification of algae (Fritsch-1935-1945).	5	K1(R)	Lecture using Chalk and talk, hands on activities, Group Discussion, Mind mapping, Field Trips	Role play, True/False, Short essays, Concept explanations, summary overview, field visit report, peer assessment, CIA, Assignment
	3.	Criteria for classification.	4	K2(U)	Lecture using Chalk and talk, Peer tutoring, PPT	Oral presentation, Short essay, Quiz, CIA
	4.	Algal distribution	3	K2(U)	Field Study, and outdoor activities, Lecture	Group Discussion, Definitions, Short summary presentation, field visit
II	1.	Thallus organization - unicellular-	3	K2(U)	Group Discussion, Visual aids and multimedia.	Seminar, CIA, True/False, Short essays, MCQ,

		Chlorella, Diatoms.				
	2.	Thallus organization - colonial- *Volvox*.	3	K2(U)	Mind mapping, Peer tutoring. Visual aids and multimedia	Seminar, CIA, True/False, Short essays, MCQ
	3.	Thallus organization- filamentous- *Anabaena*, *Oedogonium*.	3	K2(U)	PPT, Lecture, Slides, Chart	Seminar, CIA, True/False, Short essays, MCQ, Drawing
	4.	Thallus organization - siphonous- *Caulerpa*.	3	K2(U)	Live Specimen, field trips, Map mapping	CIA, True/False, Short essays, MCQ,
	5.	Thallus organization - parenchymatous- *Sargassum, Gracilaria*.	3	K2(U)	PPT, Live Specimen, Field trips, Lecture with live specimen	Seminar, CIA, True/False, Short essays, MCQ, Drawing
III	1	Reproduction- Vegetative, asexual, sexual reproduction and life histories haplontic- *Oedogonium* and *Chara*.	4	K4 (AN)	Lecture using Chalk and talk, Peer tutoring, PPT	Seminar, CIA, True/False, Short essays, MCQ, essay Questions
	2	Reproduction- Vegetative,	4	K4 (AN)	Lecture using Chalk and talk,	Seminar, CIA, True/False, Short

		asexual, sexual reproduction and life histories diplontic-Diatoms and *Sargassum*.			Group Discussion, Peer tutoring, Lecture using videos, PPT, Field Visit	essays, MCQ, Longer essay, Group Discussion, Field Report
	3	Reproduction-Vegetative, asexual, sexual reproduction and life histories diplohaplontic-*Ulva*.	4	K4 (AN)	Lecture using Chalk and talk, Chart, Group Discussion, Peer tutoring, Lecture using live specimen, Field Visit	Seminar, CIA, True/False, Short essays, MCQ, Graphical representation, peer Assessment, Field Report
	4	Reproduction-Vegetative, asexual, sexual reproduction and life histories diplobiontic-*Gracilaria.*	3	K4 (AN)	Lecture using Chalk and talk, Group Discussion, Peer tutoring, Lecture using live specimen, PPT, Field Visit	Seminar, Longer essay Quiz, Self-Assessment, Field Report, Diagrammatic representation,
1V	1.	Algal cultivation methods	5	K2(U)	Lecture using Chalk and talk, Group Discussion, Peer tutoring, Lecture using videos, PPT	Evaluation through short test, MCQ, True/False, Short essays
	2.	Algal production	5	K3(Ap)	Lecture using Chalk and talk,	Simple definitions, MCQ,

		systems; indoor cultivation methods			Lecture using videos, PPT, Flow Chart,	Recall steps, Flow chart, seminar
	3.	Large-scale cultivation of algae, harvesting of algae.	5	K4(An)	Lecture using Chalk and talk, Lecture using videos, PPT, Group Discussion	Suggest idea/field work
V	1	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite.	4	K3(An)	Lecture using Chalk and talk, Group Discussion, Peer tutoring, Lecture using videos, PPT	Short test, MCQ, True/False, Short essays, Concept explanations
	2	Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical.	4	K3(Ap)	Lecture using Chalk and talk, Lecture using videos, PPT	Short test, MCQ, True/False, essays, summary overview
	3	Phytoremediation. Role of algae in CO_2 sequestration,	3	K3(Ap)	Lecture using Chalk and talk, Lecture using videos, PPT, Group Discussion, Demonstration	Suggest idea, Assignment, Seminar, concept explanations

		Algae as indicator of water pollution	2	K2(U)	Lecture, Chalk & talk, PPT	CIA, MCQ, True/False, Memory test,
		Algal bioinoculants, Bioluminescence.	2	K4(An)	Lecture using Chalk & talk PPT and Group Discussion	short test, MCQ, True/False, Short essays, oral presentation

Course Focussing on Employability/ Entrepreneurship/ Skill Development:

Activities (Em/ En/SD): Skill Development / Entrepreneurship

Employability: Algae Identification

Entrepreneurship: Algae Cultivation, Algal Cuisine

Skill Development: Algae Data Collection and Analysis, Water Quality Analysis, Laboratory algal culture

Course Focussing on Cross Cutting Issues - Environment Sustainability, Water Quality management, Nutrient management

Activities related to Cross Cutting Issues: Role play, Water Quality Management, Algae Cuisine, Biodiversity Conservation Research

Assignment: General characters of algae: Classification of Algae by Fritsch, Algal Distribution, Thallus Organization, Vegetative and Asexual Reproduction of Algae, Sexual Reproduction of Algae, Life cycle of *Oedogonium*, Life cycle of Chara, Life cycle of *Diatoms*, Life cycle of *Sargassum*, Life cycle of *Ulva*, Life cycle of *Gracilaria*, Algal cultivation methods, Algal production systems, Indoor cultivation methods, Large-scale cultivation of algae, Harvesting of algae. Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite, Agar-agar, Alginic acid and Carrageenan; Diatomite, Application of algae as fuel,

agriculture and pharmaceutical. Phytoremediation, Role of algae in CO2 sequestration, Algae as indicator of water pollution, Algal bioinoculants, Bioluminescence.

SAMPLE QUESTIONS

Part A

1. Who is known as the "father of Indian phycology"?
   a) Carl Linnaeus
   b) William Henry Harvey
   c) M.O.P. Iyengar
   d) Felix Eugen Fritsch
2. Which statement correctly describes the thallus organization of Oedogonium?
   a) Oedogonium forms dense mats or filamentous growths in marine habitats.
   b) Oedogonium exhibits branched filaments composed of cells arranged end to end.
   c) Growth in Oedogonium primarily occurs at the basal regions of the filaments.
   d) Oedogonium has a filamentous structure consisting of long, unbranched chains of cells.

3. A stem node of *Chara* bears ----------.

4. Write any two examples for large scale cultivation of Algae.

5. Assertion and Reasoning:

Assertion: Algal bioinoculants are environmentally sustainable alternatives to chemical fertilizers and pesticides.

Reasoning: They help plants withstand environmental stresses such as drought, salinity, and heavy metal contamination.

Options:

a) Both assertion and reasoning are true, and the reasoning is the correct explanation of the assertion.

b) Both assertion and reasoning are true, but the reasoning is not the correct explanation of the assertion.

c) Assertion is true, but the reasoning is false.

d) Assertion is false, but the reasoning is true.

Part B

1. Write short notes on algal distribution.
2. Give a short account of *Oedogonium* thallus organization.
3. Describe the vegetative reproduction of *Chara.*
4. Enumerate the indoor cultivation methods of algae?
5. Algae as food- Explain.

Part C

1. List out the general characters of algae.
2. Summarise the thallus organisation of *Chlorella*.
3. Explain the graphical representation of life cycle of *Gracillaria*.
4. Describe the harvesting methods of algae.
5. Algae as bioluminescence – Explain.

Head of the Department | **Course Instructor**

Dr. A. Anami Augustus Arul | **Dr. A.R. Florence**

Dr. A. Anami Augustus Arul

Teaching Plan

Department : Botany

Class : I B.Sc., Botany

Title of the Course : Foundation Course - Basics of Botany

Semester : I

Course Code : BU231FC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
BU231FC1	2	-	-	2	2	30	25	75	100

Objectives:

- To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.
- To understand the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	Increase the awareness and appreciation of human friendly algae and their economic importance	PSO - 5	Ap
CO – 2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies	PSO - 5	Ap
CO – 3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms	PSO - 7	U
CO – 4	Compare the structure and function of cells and explain the development of cells.	PSO - 3	U
CO – 5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	PSO - 5	U

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1.	Systematics: Two Kingdom and Five Kingdom systems	2	K2(U)	Lecture using videos	Evaluation through short test, Short summary
	2.	Salient features of various Plant Groups: Algae, Fungi	2	K1(R)	PPT, Chart, Live specimen	Simple definitions, MCQ,
	3.	Salient features of various Plant Groups :Bryophytes, Pteridophytes and Gymnosperms	1	K2(U)	PPT, Chart, Live specimen	Chart preparation, Slip test
	4.	Salient features of various Plant Groups :Viruses - Bacteria	1	K1 (R)	PPT, Chart, Live specimen	Quiz
II						
	1	Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell)	2	K2(U)	Lecture using videos, Models	Evaluation through short test, Short summary
	2	Light Microscope and Electron Microscope	2	K1(R)	PPT, Demonstration in laboratory	Simple definitions, MCQ

	3	Ultra Structure of Prokaryotic and Eukaryotic Cells	2	K2(U)	PPT, Chart	Chart preparation, Slip test
III						
	1	Structure and Modification of Root, Stem and Leaf	2	K2(U)	Lecture using videos	Evaluation through short test, Short summary
	2	Structure and Types of Inflorescences	2	K1(R)	Video clipping	Simple definitions, MCQ
	3	Structure and Types of Flowers, Fruits and Seeds.	2	K2(U)	PPT, Chart	Chart preparation, Slip test
IV						
	1	Concept of Heredity	2	K2(U)	PPT	Evaluation through short test, Group discussion
	2	Concept of Variation	2	K1(R)	PPT, Group discussion	Simple definitions
	3	Mendel's Laws of Inheritance	2	K2(U)	PPT, Chart	Group discussion
V						
	1	Water relations - Absorption and movement	1	K1(R)	PPT, Demonstration with Experiments	Concept description, Evaluation through short test, short summary
	2	Diffusion, Osmosis, Plasmolysis	1	K2(U)	PPT, Demonstration with Experiments	Simple definitions, MCQ

	3	Imbibition - Permeability, Water Potential	2	K1(R)	PPT, Demonstration with Experiments	Experiments, Slip test
	4	Transpiration - Movement - Mineral Nutrition	2	K2(U)	Lecture using Chalk and talk, Group Discussion	Flow chart, Open book test

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability**/ Skill **Development**

Activities (Em/ En/SD): **Bridge Course to learn basics of botany, Role play**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): **Environment Sustainability**

Activities related to Cross Cutting Issues: **NIL**

Assignment : **Unit IV: Mendel's Laws of Inheritance – Monohybrid and Dihybrid cross**

Seminar Topic: **Unit III:** Structure and Types of Flowers, Fruits and Seeds

SAMPLE QUESTIONS

Part A

1. Flagella of bacteria is used for ----------purpose.
2. The site for protein synthesis is ----------.
   a. Ribosomes b. Mitochondria c. Chloroplast d. Golgi bodies
3. ----------is the process of formation of fruit without fertilization.
4. The ratio of dihybrid cross is 9:3:3:1 – State True or Fase.
5. Why viruses are considered as obligate parasites - State True or Fase.

Part B

1. List out the important characters of bacteria.
2. State the role of ribosomes in prokaryotic and eukaryotic cells.
3. Point out the types of Inflorescences with neat diagram.

4. Comment on the concept of variation.
5. Write the experimental setup to prove the concept of diffusion in plants.

Part C

1. Outline Whittaker's five kingdom concept in systematic and elaborate it.
2. Discuss the principle, working condition and uses of light microscope.
3. Describe the structure and types of flowers with a neat sketch.
4. Summarize the Mendel's law of inheritance with suitable example.
5. Explain Osmosis with experimental proof and diagrammatic representation.

Head of the Department **Course Instructor**

Dr. A. Anami Augustus Arul **Dr. J. Albino Wins**

SEMESTER --I

NON-MAJOR ELECTIVE-I: NURSERY AND LANDSCAPING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231NM1	2	-	-	-	2	30	75	25	75	100

Pre-requisites:

Students should know about the fundamental concepts of nursery and landscaping.

Learning Objectives

1. To recognize the importance of growing plants and practice the knowledge gained by developing kitchen garden and ornamental garden.
2. To be able to design gardens, learn the methods of propagation and become entrepreneur in Horticulture.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	Recognize the basic principles and components of gardening.	K2
2.	Explain about bio-aesthetic planning and conceptualize flower arrangement.	K1
3.	Apply techniques for design various types of gardens according to the culture and art of bonsai.	K3
4.	Compare and contrast different garden styles and landscaping patterns	K3
5.	Establish and maintain special types of gardens for outdoor and indoor landscaping.	K2

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Unit-I: 6 hrs**					
	1.	Introduction, prospects and scope of nursery.	3	K1 (R) K2 (U)	Inquiry based Teaching, Brainstorming	Mind map, Preparation of a nursery bed
	2	Prospects and scope of landscaping.	3	K1 (R) K2 (U)	Brainstorming, KWL	Mind map of landscape
II	**Unit-II: 6 hrs**					
	1.	Methods of Propagation – cutting, layering	2	K1 (R) K2 (U)	Lecture using videos, Demonstration, PPT	Flow chart
	2.	Grafting, budding	2	K2 (U) K3 (Ap)	Lecture using videos, Demonstration, PPT	Hands-on-training.
	3.	Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.	2	K2 (U) K3 (Ap)	Demonstration, Hands-on-training, Videos	Garden Tour – Video making
III	**Unit-III: 6 hrs**					
	1	Gardening – formal garden, informal garden	2	K2 (U) K3 (Ap)	Demonstration, Field visit.	Developing a garden
	2	Vegetable garden	1	K2 (U) K3 (Ap)	Demonstration, Discussion	Video making
	3	Landscaped layout designing	2	K3 (Ap)	Lecture using PPT	Photograph of different lawns
	4	Formation and maintenance of lawn.	1	K3 (Ap) K4 (An)	Lecture, Observation	
IV	**Unit-IV: 6 hrs**					
	1	Nursery structures	2	K1 (R) K2 (U) K3 (Ap)	Brainstorming, Interactive Teaching	Assignment
	2	Green house – Shade house	2	K2 (U) K3 (Ap)	Reflective Thinking, Lecture using videos	Presentation using ppt by students-seminar
	3	Mist chamber – Topiary	1	K2 (U) K3 (Ap)	Lecture – PPT Recall definitions	Oral test
	4	Bonsai culture.	1	K2 (U) K3 (Ap)	Lecture – PPT Experiential learning	Slip test
V	**Unit-V: 6 hrs**					

	1	Manures	2	K1 (R) K2 (U) K3 (Ap)	Experiential Learning, Demonstration	Assignment
	2	Composting	2	K2 (U) K3 (Ap)	Debate Lecture-videos, Demonstration.	Chart preparation
	3	Vermicomposting.	2	K2 (U) K3 (Ap)	Hands-on-training, Experiential Learning	Vermicompost preparation

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill Development**

Activities (**Skill Development**): **Develop a nursery bed**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): **(Environmental sustainability)**

Activities related to Cross Cutting Issues: **Vermicompost preparation**

Assignment: **(Video /photography)**

Sample questions (minimum one question from each unit)

Part A

1. If you are interested in rose plantation, what type of propagation you would adopt?

Part B

1. What steps should be followed during the cultivation of jasmine?

Part C

1. How will you convert your kitchen waste into vermicompost? Explain the steps.

Head of the Department

Dr. A. Anami Augustus Arul

Course Instructors

Dr. J. Anitha
Dr. A. Punitha

Teaching Plan

Department : Botany

Class : I B.Sc., Chemistry

Title of the Course : ELECTIVE ALLIED BOTANY-I

Semester : I

Course Code : BU231EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231EC1	3	1	-	-	3	4	60	25	75	100

Objectives

- To study morphological and anatomical adaptations of plants of various habitats.
- To familiarize with the structure of DNA, RNA, plant tissue culture techniques, and experiments related with plant physiology and biochemistry.

Course outcomes

1	increase the awareness and appreciation of human friendly algae and their economic importance.	K2
2	develop an understanding of microbes and fungi and appreciate their adaptive strategies	K3
3	develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K5
4	compare the structure and function of cells and explain the development of cells.	K5
5	understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K1

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Algae:**					
	1.	General characters of algae	1	K1 (R)	Inquiry based approach, PPT, Videos,	Multiple-Choice,Short-Answer Tests Assignments
	2.	Structure, reproduction and life cycle of – *Anabaena*	2	K2 (U)	Microscope slides, diagrams, interactive discussions	Assignments, MCQ, quizzes, class test, formative assessment, Recall steps
	3.	Structure, reproduction and life cycle of *Sargassum*	2	K2 (U)	Group discussion, diagrams, videos, microscope slides,	Multiple-choice questions, short answer questions, essay questions, Diagrams and Labelling,
	4.	Economic importance of algae	1	K3 (Ap)	Lecture, group discussion, PPT, debates	Class test, MCQ, True/False.
II	**Fungi, Bacteria and Virus:**					
	1.	General characters of fungi	1	K1 (R)	Cooperative learning, Chalk and board, diagrams, PPT	Class tests, Group discussion Formative assessments, Summative assessments,

	2.	Structure, reproduction and life cycle of *Penicillium*	1	K2 (U)	Flipped classroom, Lecture, PPT, diagrams, chalk and board, videos	Formative assessments, MCQs, diagram labelling, short answer questions
	3.	Structure, reproduction and life cycle of *Agaricus*	1	K2 (U)	Lecture, PPT, diagrams, guided group discussion, flowcharts	True/False, fill-in-the-blank, class test, formative assessment, quiz
	4.	economic importance of fungi	1	K1 (Ap)	Inquiry based approach, Lecture, PPT, interactive discussion,	Class test, Diagram labelling, online quizzes Assignments
	5.	Bacteria - general characters, structure and reproduction of *Escherichia coli* and economic importance of bacteria.	1	K2 (U)	Lecture, PPT, diagrams, interactive discussions, cooperative learning	Diagram Labelling, Short Answer Questions, Essay Questions
	6.	Virus - general characters, structure of TMV, structure of bacteriophage.	1	K2 (U)	Inquiry based approach, Lecture, PPT, diagrams, Interactive Discussions	MCQs, Diagram Labelling, Class test, Assignment, Visual Presentations Formative and Summative Assessments
III	**Bryophytes, Pteridophytes and Gymnosperms:**					
	1.	General characters of Bryophytes	1	K1 (R)	Lecture, PPT, illustrations,	Labelling diagrams, Short

					Group discussions	Answer Diagram Construction Formative and Summative Assessments,
	2.	Structure and life cycle of *Funaria*.	1	K2 (U)	Flipped classroom, Lecture, PPT, Charts, diagrams	Class test, Labelling Diagram, formative and summative assessments
	3.	General characters of Pteridophytes	1	K1 (R)	Lecture, PPT, diagrams, Group discussion	MCQs, Diagram labelling, essay question
	4.	Structure and life cycle of *Lycopodium*.	1	K2 (U)	Flipped classroom, Lecture, PPT, flowcharts, diagram	Life Cycle Sequencing, Diagram Labelling, Class test, formative assessment,
	5.	General characters of Gymnosperms	1	K1 (R)	Inquiry based approach, Lecture, PPT, videos, comparing with other groups of plants	Debate, Assignment, Class test, MCQs,
	6.	Structure and life cycle of *Cycas*.	1	K2 (U)	Cooperative learning, Lecture, charts, chalk and board, diagram, lifecycle flowcharts	Life Cycle Sequencing, Class test, Labelling Diagram,

IV	**Cell Biology**					
	1.	Prokaryotic and Eukaryotic cell-structure /organization.	2	K2 (U)	Flipped classroom, Lecture, Chalk and board, PPT	Class test, quizzes Diagram labelling,
	2.	ultra structure and function of chloroplast	1	K2 (U)	Reflective thinking, lecture, PPT, photos, videos	Class test, Assignment MCQs, essay test. Formative assessment,
	3.	ultra structure and function of mitochondria	1	K2 (U)	Lecture, reflective thinking, PPT, videos, photos	Short answer test, MCQs, Assignment Class test,
	4.	ultra structure and function of nucleus.	1	K2 (U)	Brainstorming, lecture, PPT, Chart, videos	Quizzes, formative assessment, class test, Assignment
	5.	Cell division - mitosis and meiosis.	1	K1 (R)	Lecture, diagram, photos, chalk and board, videos.	MCQs, open book test, Short test
V	**Genetics and Plant Biotechnology**					
	1.	Mendelism - Law of dominance, Law of segregation, Incomplete dominance.	2	K2 (U)	Brainstorming, lecture, group discussions, diagrams	MCQs, formative assessment, Class tests
	2.	Law of independent assortment.	1	K2 (U)	Lecture, chalk and board, diagram, videos	Class test, MCQs, formative assessment, quizzes

	3.	Monohybrid and dihybrid cross - Test cross - Back cross.	1	K3 (Ap)	Inquiry based approach, Lecture, Chalk and board, PPT,	essay questions, MCQs, Fill in the blanks.
	4.	Plant tissue culture - *In vitro* culture methods. Plant tissue culture and its application in biotechnology.	2	K2 (U)	Videos, flipped classroom, Lecture, chart, flow chart, PPT	MCQs. True or False online quiz,

Course Focussing on **Employability**

Activities: **Seminar, Assignment**

Course Focussing on Cross Cutting Issues: **Professional Ethics**

Activities related to Cross Cutting Issues: **Assignment and Seminar**

Assignment Topic: **Ultra structure and function of nucleus.**

Seminar Topic: **Plant tissue culture and its application in biotechnology.**

Sample questions

Part A

1. Which of the following best describes the reproduction method in Anabaena?
   a. Binary fission b. Budding c. Conjugation d. Fragmentation
2. The body of a fungus is known as:
   a. Mycelium b. Hypha c. Spore d. Stipe
3. Which of the following statements best describes the life cycle of Funaria, a common moss?
   a. Funaria has a dominant gametophyte generation and a reduced sporophyte generation.
   b. Funaria has a dominant sporophyte generation and a reduced gametophyte generation.
   c. Funaria has equal-sized gametophyte and sporophyte generations.
   d. Funaria reproduces exclusively through vegetative propagation and lacks a life cycle.
4. The inner membrane of a chloroplast is highly folded to form structures known as:
   a. Thylakoids b. Grana c. Stroma d. Cristae

5. The Law of Independent Assortment states that:
   a. Genes on the same chromosome will always be inherited together.
   b. Genes on different chromosomes will segregate independently during gamete formation.
   c. Genes on different chromosomes will always be inherited together.
   d. Genes on the same chromosome will segregate independently during gamete formation.

Part B

1. What role does algae play in the food industry from an economic perspective?
2. What is the reproductive process of Agaricus?
3. In pteridophytes, where are male gametes formed and how do they achieve mobility?
4. Can you explain what thylakoids are?
5. What does the Law of Independent Assortment state?

Part C

1. How does algae contribute economically to the food industry?
2. How does Agaricus reproduce?
3. Where are male gametes produced in pteridophytes, and how do they move?
4. What are thylakoids and what is their function?
5. What is the Law of Independent Assortment and what does it explain?

Head of the Department:

Dr. A. Anami Augustus Arul

Course Instructors:

1. Dr. Sr. P. Leema Rose

2. Dr. Bojaxa A. Rosy

Department : Botany

Class : II B.Sc., Botany

Title of the Course : Core Course III: Plant Diversity – III – Bryophytes and Pteridophytes

Semester : III

Course Code : BU233CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233CC1	3	2	-	-	4	5	75	25	75	100

Pre-requisite: Students should be familiar with the basics of Bryophytes and Pteridophytes.

Learning Objectives:

1. To enable the students to have an overview of non-vascular and vascular cryptogams.
2. To know the evolution, morphological diversity, structure, reproduction and economic importance of Bryophytes and Pteridophytes.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recognize morphological variations of Bryophytes and Pteridophytes	**K2 & K4**
2.	explain the anatomy and reproduction of Bryophytes and Pteridophytes.	**K2 & K4**
3.	compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and Pteridophytes.	**K4**
4.	decipher the stages of plant evolution and their transition to land habitat.	**K1& K2**
5.	access the useful role of Bryophytes and Pteridophytes.	**K4**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching	Cognitive level	Pedagogy	Assessment/ Evaluation

			Hours			
I	1.	General characters of bryophytes, Evolution of bryophytes	5	K1(R)	Lecture using Chalk and talk, Group Discussion, Mind mapping, Power point Presentation, Field Trips	True/False, Short essays, Concept explanations, Short summary, field work report, peer assessment, CIA, Assignment
	2.	Classification (Watson, 1971, up to family level).	3	K2(U)	Lecture using Chalk and talk, Peer tutoring, PPT	Critique or justify with pros and cons, short essay, Quiz, CIA
	3.	Economic importance of Bryophytes; Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture and industrial uses.	7	K2(U)	Field Study, Lecture	Group Discussion, Concept explanations, short summary presentation, field work report
II	1.	Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (*Marchantia*)	5	K2 (An)	Group Discussion, Visual aids and multimedia.	Seminar, CIA, True/False, Short essays, MCQ, Longer essay
	2.	Structure, reproduction and life histories of the following classes each with a suitable example:	5	K2 (An)	Mind mapping, Peer tutoring, Visual aids and multimedia	Seminar, CIA, True/False, Short essays, MCQ, Longer essay

		Anthocerotopsida (*Anthoceros*)				
	3	Structure, reproduction and life histories of the following classes each with a suitable example: Bryopsida (*Polytrichum*)	5	K4 (An)	Lecture using Chalk and talk,Peer tutoring, Lecture using videos	Group Discussion, Concept explanations, short summary presentation, field work report
III	1	General Characters of Pteridophytes, Classification (Reimer, 1954),	5	K4 (U)	Lecture using Chalk and talk, PPT, Flow Chart,	Summary overview, CIA, True/False, Short essays, MCQ, Longer essay, Flow Chart Evaluation, Field visit
	2	Origin and evolution of Pteridophytes. Stelar Evolution; Types of steles.	6	K4 (An)	Lecture using Chalk and talk, Group Discussion, Peer tutoring, Lecture using videos, PPT, Field Visit	Album preparation, Group Discussion, Concept explanations
	3	Economic and Ecological importance of Pteridophytes.	4	K4 (U)	Lecture using Chalk and talk, Group Discussion, Peer tutoring, Lecture using videos, PPT, Field Visit	Seminar, Assignment Short essays, longer essay, Peer Assessment, Field Report
1V	1.	Morphology, anatomy and reproduction of the taxa belonging to each	6	K2(An)	Lecture using Chalk and talk, Group Discussion, Peer tutoring,	Evaluation through short test, MCQ, True/False, Seminar, PPT

		of the following classes: Psilotopsida (*Psilotum)*			Lecture using videos, PPT	
	2.	Morphology, anatomy and reproduction of the taxa belonging to each of the following classes: Lycopsida (*Selaginella*),	7	K3(An)	Lecture using Chalk and talk, Lecture using videos, PPT, Flow Chart,	Simple definitions, MCQ, recall steps, Slip test, Seminar with PPT
	3.	Heterospory and Seed habit.	2	K4(An)	Lecture using Chalk and talk, Lecture using videos, PPT, Group Discussion	Definitions, Suggest idea, Short essay
V	1	Morphology, anatomy and reproduction of the taxa belonging to each of the following classes: Sphenopsida (*Equisetum)*	6	K3(An)	Lecture using Chalk and talk, Group Discussion, Peer tutoring, Lecture using videos, PPT	Short test, MCQ, True/False, Seminar with PPT
	2	Morphology, anatomy and reproduction of the taxa belonging to each of the following classes: Pteropsida (*Marsilea*).	7	K3(An)	Lecture using Chalk and talk, Lecture using videos, PPT	Short test, MCQ, True/False, Short essays, Flannel Card Preparation
	3	Apogamy, apospory, homospory	2	K3(Ap)	Lecture using Chalk and talk, Lecture using videos, PPT, Group Discussion, Demonstration	Suggest idea, Summary overview, Concept explanations

SAMPLE QUESTIONS

Part A

1. Who is the Father of Indian Bryology?
2. Write the common name of *Anthoceros*.
3. ----------is a fundamental type of stele of vascular plants.
4. *Psilotum* is commonly called 'whisk fern'. True or False
5. Which type of stele is present in the *Marsilea* stem?.

a. Amphipholic siphonostele b. Ectopholic siphonostele

c. Actinostelic siphonostele d. None of these

Part B

1. Point out some ecological importance of Bryophytes.
2. Explain the sporophyte of *Marchantia* with neat labeled diagrams.
3. Enumerate the general characters of Pteridophytes.
4. Describe the heterospory and seed habitat of *Selaginella*.
5. Explain the external features of *Equisetum* sporophyte.

Part C

1. Classify the Bryophytes according to Watson classification (1971).
2. Describe the reproductive strategies of Polytrichum with respective diagram.
3. Classify Pteridophytes according to Reimer (1954), with flowchart and examples.
4. Describe the asexual reproduction of *Selaginella* with sketches.
5. Describe the reproduction methods of *Equisetum* and draw neat labeled sketches.

Head of the Department **Course Instructor**

Dr. A. Anami Augustus Arul **Dr. A.R. Florence**

Dr. J. Albino Wins

Teaching Plan

Department : Botany

Class : II B.Sc., Botany

Title of the Course : Entrepreneurial Opportunities in Botany

Semester : III

Course Code : BU233SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231CC1	2	-	-	-	1	2	30	25	75	100

Pre-requisite: Students should be familiar with various fields of Botany.

Learning Objectives

1. To foster students comprehension of entrepreneurial opportunities within Botany, including ventures utilizing medicinal plants, biotechniques, and marketing bioproducts.
2. To cultivate a mindset among students to initiate their own ventures as a means of income generation and professional empowerment.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	relate to how various fields of botany could be understood with an entrepreneurial approach.	**K2**
2	explain the concept of entrepreneurial opportunities in Botany.	**K2**
3	make use of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations	**K3**
4	decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas, etc.	**K4**
5	develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.	**K5 & K6**

Teaching plan

Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	1.	Introduction to entrepreneurship	1	K2(U)	Lecture	Group Discussion, Definitions
	2.	Scope and identification of new ventures using plant resources	1	K2(U)	Lecture, PPT	Mind mapping, Concept explanations
	3.	General concept about the Govt. formalities, rules & regulation	2	K3(Ap)	Lecture, Peer tutoring	Oral presentation, Quiz
	4.	Role of funding agencies – NABARD, Rural Banking and DIC	2	K4(An)	Field Study, Lecture	Short summary presentation, field report
II	1.	Production of Coconut	1	K2(U)	Visual aids and multimedia, PPT	True/False, Short essays, MCQ
	2.	Value addition in Coconut: Coconut honey	1	K3(Ap)	PPT, Lecture, Field Visit, Hands on training	Skill assessment, CIA, Quiz, Short essays,

		and White meat				
	3.	Desiccated coconut and Coconut flour	1	K3(Ap)	PPT, Lecture, Field Visit, Hands on training	Skill assessment, CIA, Quiz, Short essays
	4.	Coconut milk and Coconut chips.	1	K3(Ap)	PPT, Lecture, Field Visit, Hands on training	Skill assessment, CIA, Quiz, Short essays
	5.	Value added products from Coconut Shell	2	K6(Cr)	PPT, Lecture, Field Visit, Hands on training	Skill assessment, CIA, Quiz, Short essays
III	1	Production of Banana	2	K4 (AN)	Visual aids and multimedia, PPT	True/False, Short essays, MCQ
	2	Value addition in Banana: Banana flour and Banana puree.	1	K4 (AN)	PPT, Lecture, Field Visit, Hands on training	Skill assessment, CIA, Quiz, Short essays
	3	Banana RTS Juice and Banana Wine	1	K4 (AN)	PPT, Lecture, Field Visit, Hands on training	Skill assessment, CIA, Quiz, Short essays
	4	Banana biscuits and Banana fibre.	2	K4 (AN)	PPT, Lecture, Field Visit, Hands on training	Skill assessment, CIA, Quiz, Short essays
1V	1.	Production of Jack fruit	2	K2(U)	Visual aids and multimedia, PPT	True/False, Short essays, MCQ
	2.	Value addition of Jack fruit: Dried jack,	2	K3(Ap)	PPT, Lecture, Field Visit, Hands on training	Skill assessment, CIA, Quiz, Short essays

		Jack rind and pickle				
	3.	Jack fruit halwa, Jack fruit toffee, and Jack chips	2	K3(Ap)	PPT, Lecture, Field Visit, Hands on training	Skill assessment, CIA, Quiz, Short essays
V	1	*Spirulina* cultivation.	1	K3(Ap)	Peer tutoring, Lecture using videos, PPT	Short test, MCQ, Concept explanations
	2	*Azolla* cultivation.	1	K3(Ap)	Lecture using videos, PPT	Short test, summary overview
	3	Elite and ornamental Plants in vitro propagation	2	K2(U)	Lecture using videos, PPT, Group Discussion, Demonstration	Assignment, Seminar, concept explanations
	4	Selection of superior biotypes of *Orchids*	1	K3(Ap)	Lecture, Chalk & talk, PPT	CIA, MCQ, Memory test, Concept explanation
	5	Selection of superior biotypes of *Syngonium.*	1	K3(Ap)	Chalk & talk, PPT, Group Discussion	Short essays, oral presentation

Course Focussing on Employability/ Entrepreneurship/ Skill Development:

Activities (Em/ En/SD):

Employability: Elite and ornamental Plants in vitro propagation

Entrepreneurship: Value addition in Jack fruit, Coconut and Banana

Skill Development: Value addition in Jack fruit, Coconut and Banana and Elite and ornamental Plants in vitro propagation like Orchid and Syngonium.

Course Focussing on Cross Cutting Issues -

Activities related to Cross Cutting Issues: Entrepreneurial Economics

Assignment: Skill Assessment in Jack fruit, Coconut and Banana value added products.

SAMPLE QUESTIONS

Part A

1. Bring out the functions of NABARD?
2. Define Coconut chips.
3. Explain two methods for improving banana yield.

Part B

4. Explain the various harvesting and processing techniques used in *Spirulina* cultivation.
5. Discuss the methods of cultivating *Azolla* and the best practices for maintaining its growth.
6. Discuss the criteria used in the selection of superior biotypes of orchids.

Part C

7. What are the key legal requirements and compliance measures that entrepreneurs must adhere to?
8. Discuss the entire process of coconut production, from cultivation to harvesting. What are the key factors that influence coconut yield and quality?
9. Examine the various value-added products that can be made from coconut shells. How do these products contribute to waste reduction and sustainability in the coconut industry?

Head of the Department **Course Instructor**

Dr. A. Anami Augustus Arul

Dr. A. Anami Augustus Arul

Teaching Plan

Department : Botany

Class : II B.Sc., Zoology

Title of the Course : ALLIED BOTANY-III

Semester : III

Course Code : BU233EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231EC1	3	1	-	-	3	4	60	25	75	100

Pre-requisite: To study the basics of botany.

Learning Objectives

1.To study morphological and anatomical adaptations of plants of various habitats.

2. To demonstrate techniques and experiments in plant tissue culture, plant physiology and biochemistry.

Course outcomes

On the successful completion of the course, student will be able to:		
1.	increase the awareness and appreciation of human friendly algae and their economic importance.	**K3**
2.	develop an understanding of microbes and fungi and appreciate their adaptive strategies	**K2**
3.	develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	**K2**
4.	compare the structure and function of cells and explain the development of cells.	**K4**

5.	understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	**K2**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I	**Algae:**					
	1.	General characters of algae	2	K1 (R)	Inquiry based approach, PPT, Videos	MC, Short-Answer Tests Assignments
	2.	Structure, reproduction and life cycle of – *Anabaena*	4	K2 (U)	Lecture, Microscope slides, interactive discussions	Assignments, MCQ, quizzes, class test, formative assessment
	3.	Structure, reproduction and life cycle of *Sargassum*	4	K2 (U)	Group discussion, Live specimen, videos, microscope slides	Multiple-choice questions, mind map, Diagrams and Labelling,
	4.	Economic importance of algae	2	K3 (Ap)	Lecture, group discussion, PPT	Class test, MCQ, True/False.
II	**Fungi, Bacteria and Virus:**					
	7.	General characters of fungi	1	K1 (R)	Cooperative learning, Chalk and board, diagrams, PPT	Class tests, Group discussion, CIA, Debate
	8.	Structure, reproduction and life cycle of *Penicillium*	2	K2 (U)	Flipped classroom, Lecture, PPT, Microslide	Formative assessments, MCQs, diagram labelling, short

						answer questions
	9.	Structure, reproduction and life cycle of *Agaricus*	3	K2 (U)	Lecture, PPT, diagrams, group discussion, flowcharts	True/False, fill-in-the-blank, class test, formative assessment, quiz
	10.	Economic importance of fungi	1	K1 (Ap)	Inquiry based approach, Lecture, PPT,	Class test, Quizzes Assignments
	11.	Bacteria - general characters, structure and reproduction of *Escherichia coli* and economic importance of bacteria.	3	K2 (U)	Lecture, PPT, interactive discussions,	Diagram Labelling, Short Answer Questions, Essay Questions
	12.	Virus - general characters, structure of TMV, structure of bacteriophage.	2	K2 (U)	Lecture, PPT, diagrams, Interactive Discussions	MCQs, Diagram Labelling, Class test, Assignment, Formative and Summative Assessments
III	**Bryophytes, Pteridophytes and Gymnosperms:**					
	7.	General characters of Bryophytes	2	K1 (R)	Lecture, PPT, illustrations, Group discussions	Short Answer Diagram Formative and Summative Assessments,

	8.	Structure and life cycle of *Funaria*.	2	K2 (U)	Lecture, PPT, Charts, diagrams	Labelling Diagram, formative and summative assessments
	9.	General characters of Pteridophytes	2	K1 (R)	Lecture, PPT, diagrams, Group discussion	MCQs, Diagram labelling, essay question
	10.	Structure and life cycle of *Lycopodium*.	2	K2 (U)	Flipped classroom, Lecture, PPT, flowcharts, diagram	Life Cycle Sequencing, Diagram Labelling, Class test, formative assessment
	11.	General characters of Gymnosperms	2	K1 (R)	Inquiry based approach, Lecture, PPT, videos,	Debate, Assignment, Class test, MCQs,
	12.	Structure and life cycle of *Cycas*.	2	K2 (U)	Lecture, charts, chalk and board, diagram, life cycle flowcharts	Life Cycle Mind mapping, Class test, Quizzes, MCQQ
IV	**Cell Biology**					
	6.	Prokaryotic and Eukaryotic cell-structure /organization.	2	K2 (U)	Flipped classroom, Lecture, Chalk and board, PPT	Class test, quizzes Diagram
	7.	Ultra structure and function of chloroplast	2	K2 (U)	Lecture, PPT,	Class test, Assignment

						MCQs, Formative assessment,
	8.	Ultra structure and function of mitochondria	2	K2 (U)	Lecture, PPT,	Short answer test, MCQs, Assignment Class test,
	9.	Ultra structure and function of nucleus.	2	K2 (U)	Brainstorming, lecture, PPT, Chart	Quizzes, formative assessment, class test, Assignment
	10.	Cell division - mitosis and meiosis.	4	K1 (R)	Lecture, chalk and talk, videos.	MCQs, open book test, Short test
V	**Genetics and Plant Biotechnology**					
	5.	Mendelism - Law of dominance, Law of segregation, Incomplete dominance.	4	K2 (U)	Brainstorming, lecture, group discussions, PPT	MCQs, formative assessment, Class tests
	6.	Law of independent assortment.	2	K2 (U)	Lecture	Class test, MCQs, formative assessment, quizzes
	7.	Monohybrid and dihybrid cross - Test cross - Back cross.	2	K3 (Ap)	Practical work, Lecture, PPT	Essay questions, MCQs, Fill in the blanks.

	8.	Plant tissue culture - *In vitro* culture methods. Plant tissue culture and its application in biotechnology.	4	K2 (U)	Videos, flipped classroom, Lecture, PPT, Hands on practice	MCQs. True or False, Quizzes, Mind map

Course Focussing on **Employability**

Activities: **Role Play, Model making**

Course Focussing on Cross Cutting Issues: **Biotechnology and Genetic Engineering**

Activities related to Cross Cutting Issues: **Hands on training in tissue culture and genetics**

Assignment Topic: **Basic knowledge in Botany – Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms**

Seminar Topic: **Cell organelles and cell division**

Sample questions

Part A

1. Identify the amphibian of the plant kingdom.
   a. Pteridophytes b. Bryophytes
   c. Gymnosperms d. Angiosperms
2. The term 'Vascular Cryptogams' is used for pteridophytes – True or False.
3. The inner membrane of a chloroplast is highly folded to form structures known as:
   a. Thylakoids b. Grana c. Stroma d. Cristae
4. Totipotency is the ability of a cell to produce a new organism. State True/False.
5. Ratio for monohybrid test cross _____

Part B

1. Draw and analyse the internal structure of *Sargassum* leaf.
2. List out the economic importance of Bryophytes.
3. Comment on the economic importance of Pteridophytes
4. Explain the internal structure of Mitochondria?
5. Analyse incomplete dominance.

Part C

1. Interpret the sexual reproduction in *Cycas.*
2. Explain the general characters of Virus, and specify the structure of TMV
3. Write an essay on test cross and back cross.
4. Explain the steps involved in plant tissue culture and its application in biotechnology.
5. What is the Law of Independent Assortment and what does it explain?

Head of the Department:
Dr. A. Anami Augustus Arul

Course Instructors:
1. Dr. A. Anami Augustus Arul
2. Dr. J. Albino Wins

Teaching Plan

Department : Botany
Class : III B.Sc., Botany
Title of the Course : Major Core-V Taxonomy of Angiosperms and Economic Botany
Semester : V
Course Code : BC2051

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
CC2041	6	-	-	6	6	90	25	75	100

Objectives

- To know the principles of classification of taxa and to evaluate the medicinal importance of selected angiosperms.
- To acquire knowledge on the botanical vocabulary and taxonomical terminology to identify plants.

Course outcomes

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	relate the modifications in plant parts.	PSO–1	K2 (U)
CO - 2	differentiate the artificial, natural and phylogenetic classification and learn about ICN rules.	PSO–2	K4 (An)
CO - 3	evaluate the taxonomists of India.	PSO–1	K5 (E)
CO - 4	recall the characters of some important families.	PSO–1	K1 (R)
CO - 5	understand the economically important products of plants and their use at various levels.	PSO - 2	K2 (U)
CO - 6	construct digital herbarium and learn about Herbarium techniques.	PSO - 5	K6 (C)

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1.	Botanical nomenclature: Principles and rules of International Code of Nomenclature (ICN);	2	K2 (U)	Group discussion, Lecture using Chalk and board, PPT	Class test, MCQ, True/False, essay test
	2.	Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations.	2	K3 (Ap)	Brainstorming, Lecture, PPT, chalk and board	Simple definitions, MCQ, Recall steps, Concept definitions
	3.	Morphology – root, stem – their modifications.	2	K2 (U)	Inquiry based approach, Lecture, PPT, photos, diagram,	Short question test, essay question test, quizzes, formative assessment
	4.	Morphology of leaf and inflorescence – their modifications.	3	K2 (U)	Inquiry based approach, Lecture, PPT, diagram, chalk and board, live speciments	Formative assessment, true/false, fill in the blanks

	5.	Morphology of flower, and fruit – their modifications.	3	K2 (U)	Flipped classroom, Lecture, PPT, chalk and board, diagram, live specimens	Class test, Essay test, MCQs, formative assessment
II						
	1.	Detailed study on Sexual system-Carolus Linnaeus,	2	K1 (R)	Reflective thinking, Lecture, PPT, diagram, flowchart. photos	Class test, formative assessment,
	2.	Natural System – Bentham and Hooker,	3	K1 (R)	Brainstorming, Lecture, PPT, flowchart, group discussion, Photos, diagram,	MCQs, short test, essay test, fill in the blanks
	3.	Phylogenetic System - APG Classification (2016).	1	K1 (R)	Lecture method, PPT, interactive discussion, flowchart. Photos, diagram,	Quizzes, formative assessment, essay test
	4.	Field inventory: Functions of Herbarium; Virtual herbarium; E-flora; Herbarium techniques.	3	K2 (U)	Lecture, Video, teaching using website, debate, group discussion	quizzes, class test, formative and summative assessment, field visit.

	5.	Contribution to systematic botany by Indian Taxonomists: K.M. Mathew and Hermenegild Santapau.	3	K1(R)	Lecture method, chalk and board, PPT, photos	Essay test, class test, quizzes
III						
	1.	Detailed study of the following families with their economic importance: Annonaceae, Rutaceae,	3	K2 (U)	Inquiry based approach, lecture, PPT, diagram, photos, interactive discussion	Class test, formative and summative assessment, quizzes, essay test, field visit
	2.	Detailed study of the following families with their economic importance: Meliaceae, Caesalpiniaceae	3	K1 (R)	lecture, PPT, diagram, photos, debate, context based learning	Short answer test, essay test, true/false, fill in the blanks
	3.	Anacardiaceae, Cucurbitaceae	3	K1 (R)	Lecture, PPT, diagram, debate, photos, context based learning	Class test, Quizzes, formative and summative assemssment.
	4.	Detailed study of the following families with their economic importance: Rubiaceae and Sapotaceae.	3	K2 (U)	Flipped classroom, lecture, photos, illustration, PPT,	MCQs, true/false, fill in the blanks, class test, field visit
IV						

	1.	Apocynaceae, Asclepiadaceae,	3	K1 (R)	Inquiry based approach, lecture, PPT, diagram, live specimens, photos	Class test, true/false, fill in the blanks, formative and summative assessment
	2.	Lamiaceae, Euphorbiaceae	3	K2 (U)	Brain storming, Lecture, PPT, live specimens, demonstration, photos, video, diagram	Short answer question, essay question, True/False, fill in the blanks
	3.	Amaranthaceae, Cannaceae	3	K2 (U)	Lecture, diagram, chalk and board, photos, live specimens	Formative and summative assessment, Class test, quizzes
	4.	Orchidaceae and Poaceae.	3	K1 (R)	Lecture, PPT, context based learning, illustration, interactive discussion	Class test, Short test, oral questioning, formative assessment
V						

	1.	Study of the following plants with special reference to their botanical name, family, morphology of useful part, economic products and uses: Cereals - Paddy, Wheat; Pulses - Green gram, Bengal gram	3	K1 (R)	Flipped classroom, lecture, diagrams, PPT, live plant products	formative assessments, diagram labelling short answer questions, MCQs,
	2.	Tuber crops -Tapioca, Potato; Spices - Pepper, Cardamom;	2	K2 (U)	Inquiry based approach, lecture, PPT, diagrams, chalk and board, live specimens	true/false statements, or fill-in-the-blank questions, class test, formative assessment, quiz with multiple-choice questions,
	3.	Beverages - Tea, Coffee; Oil yielding plants - Coconut, Groundnut	3	K1 (R)	Brainstorming, PPT, diagrams, guided discussion, flowcharts	group discussion Assignments, class tests, formative assessments, summative assessments,
	4.	Fibre yielding plants - Cotton, Coir; Timber yielding plants - Teak, Rose wood	2	K3 (Ap)	Group discussion, PPT, interactive	Labeling, Short Answer Questions,

					discussion, live plant products	Diagram Essay Questions
	5.	Latex yielding plants - Para rubber, Sapota; Ornamental plants - Rose, Orchids.	2	K3 (Ap)	Cooperative learning, PPT, diagrams, interactive discussions, live plant parts	Formative and Summative Assessments MCQs, Diagram Labeling, Class test, Visual Presentations

Course Focussing on: **Employability**

Activities (Em/ En/SD): **Assignment and Seminar**

Course Focussing on Cross Cutting Issues: **Professional Ethics**

Activities related to Cross Cutting Issues: **Seminar and Assignment**

Assignment: **Virtual herbarium**

Seminar Topic: **Ornamental plant - Orchids.**

Sample questions

Part A

1. The flat, expanded part of a leaf is known as the:

a. Petiole b. Blade c. Midrib d. Vein

2. Which of the following is a commonly used method for drying plant specimens in a herbarium?

a. Pressing between heavy books
b. Hanging the specimen upside down
c. Placing in a microwave oven
d. Immersing in water

3. Which of the following plants belongs to the Anacardiaceae family?

a. Sunflower b. Rose c. Mango d. Lavender

4. The Amaranthaceae family is characterized by the presence of edible seeds known as:

a. Nuts b. Grains c. Legumes d. Drupes

5. What is the structure in orchids that is modified into a highly specialized lip?

a. Sepal b. Petal c. Column d. Stamen

Part B

1. What is the correct format for writing scientific plant names according to the ICN?
2. What is the purpose of e-flora?
3. What is the distinctive characteristic of the leaves in the Rutaceae family?
4. What is the distinctive feature of the flowers in the Lamiaceae family?
5. What is the process involved in the extraction of latex from latex-yielding plants?

Part C

1. Explain the characteristics and examples of racemose inflorescence.
2. Explain the functions of herbarium specimens in documenting plant diversity and distribution.
3. Provide an overview of the Meliaceae family, including its botanical characteristics, distribution, and economic importance.
4. Discuss the taxonomic characteristics and diversity of the Amaranthaceae family.
5. Describe the botanical name, family, morphology of useful part, economic products and uses of Paddy and Wheat.

Head of the Department:

Dr. Anami Augustus Arul

Course In-charges: Dr. Bojaxa A. Rosy

Dr. A. R. Florence

Teaching Plan

Department : Botany
Class : III B.Sc
Title of the Course : Biochemistry and Biophysics
Semester : V
Course Code : BC2052

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
BC2052	**6**	**-**	**-**	**6**	**6**	**90**	**25**	**75**	**100**

Objectives:

1. To understand the structure and properties of bio-molecules.

2.To learn the emerging field of biophysics and principles of bioenergetics.

CO	Upon completion of this course the students will be able to:	PSO addressed	Cognitive Level
1	apply the usage of pH and buffers in biological experiments.	PSO–3	K (4)
2	understand the importance of Bio-molecules	PSO–. 1	K(2)
3	describe its biological roles and significance of lipids.	PSO– 1	K(2)
4	analyse enzyme activity.	PSO–2	K (3)
5	demonstrate thermodynamic principles in biological energy conversion	PSO-7	K (5)

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topics	Teaching hours	Cognitive level	Pedagogy	Assessment

						/Evaluation
	1	Types Chemical bonds –co-ordinate, covalent, hydrogen	2	K3(An)	Lecture, Chalk, ppt, video	Oral presentation, Written explanation
	2	Acids and Bases	2	K4(Ap)	Interactive demonstration, pH testing, group discussion	Written Assessment, Practical skills
	3	pH and Buffer system.	3	K4(Ap)	Interactive demonstration, Buffer experiment	Written Assessment, Group discussion
	4	Classification of carbohydrates; Monosaccharides: Structure of glucose (linear, open chain, ring form)	4	K6(C)	Hands on activities, Interactive demonstration	Model building, structural diagrams, Group discussion
	5	Fructose, properties of monosaccharides	2	K1(R)	Lecture, Chalk, ppt, video	Conceptual question, Group discussion
	6	Disaccharides: Structure and properties of maltose, sucrose and lactose	2	K2(U)	Lecture, PPT, diagrams, chalk and board, videos	formative assessments

	7	Polysaccharides: Structure and properties of starch and cellulose.	3	K3(An)	Lecture, PPT, diagrams, guided discussion,	quiz with multiple-choice questions, true/false statements, or fill-in-the-blank questions, class test, formative assessment
II	1	Amino acids - classification, structure and properties	2	K2(U)	Lecture, PPT, interactive discussion,	Assignments, class tests, group discussion
	2	Protein – primary, secondary, tertiary (myoglobin) and quaternary (haemoglobin).	4	K2(U)	Lecture, PPT, diagrams, interactive discussions	Answer Questions, Essay Questions
	3	Protein denaturation and biological roles of proteins	4	K1(R)	Lecture, PPT, Structure,	Class test, Visual Presentations
	4	Water-soluble vitamins e.g., Thiamine, Riboflavin and Niacin;	4	K4(Ap)	Lecture, PPT, Group discussions	Short Answer Questions,
	5	Fat-soluble vitamins e.g., vitamin A-retinol, Vitamin D – Ergosterol.	4	K4(Ap)	Lecture, PPT,	Class test, formative and summative assessments

III	1	Introduction to Lipids: saturated and unsaturated fatty acids	4	K2(U)	Lecture, PPT, interactive discussion	MCQs, essay question
	2	Simple lipids (waxes and triglycerides).	4	K3(An)	Lecture, PPT, flowcharts,	Class test, formative assessment, Sequencing
	3	Compound lipids (phospholipid and glycolipid)	5	K2(U)	Lecture, PPT, videos,	Assignment, Class test
	4	Derived lipids (cholesterol, carotenoids and terpenes).	5	K3(An)	Lecture, chalk and board,	Class test
IV `	1	Enzymes: Classification, nomenclature based on IUB	5	K2(U)	Lecture, Chalk and board, PPT	class test, quizzes
	2	Activation energy, active site, cofactors, coenzymes (NAD, CoA),isoenzyme;	4	K3(An)	Lecture, PPT, photos, videos	MCQs, essay test. Formative assessment, class test
	3	Mechanism of enzyme action (lock and key model, induced - fit theory),	3	K4(Ap)	Lecture, PPT, videos, photos	Class test, Short answer test, MCQs,
	4	Enzyme inhibition	3	K4(Ap)	Lecture, PPT, Chart, videos	Quizzes, formative assessment, class test

	5	Factors affecting enzyme activity.	3	K2 (U)	Lecture, chalk and board,	Short test, MCQs, open book test.
V	1	Photobiology- Dual nature of light and its characteristics	3	K2(U)	Lecture using chalk and board, group discussions, diagrams	Class tests, MCQs, formative assessement
	2	Electromagnetic Spectrum, Action and Absorption spectrum,	3	K1(R)	Lecture, chalk and board,	Class test, formative assessment, quizzes
	3	Emission spectrum – excitation and de-excitation.	3	K4(Ap)	Lecture, Chalk and board, PPT,	online quiz, essay questions
	4	Phosphorescence, fluorescence and bio-luminescence.	3	K2 (U)	Lecture, chart, flow chart, PPT	Fill in the blanks. True or False
	5	Bioenergetics: Laws of thermodynamics, coupled reactions, redox reactions	3	K4(Ap)	Lecture using chalk and board, group discussions,	Class tests, MCQs, formative assessement
	6	Concept of free energy, endergonic and exergonic reactions,	2	K4(Ap)	Interactive demonstration, group discussion	Written Assessment, Practical skills
	7	ATP: structure, its role as an energy currency molecule	1	K2(U)	Interactive demonstration,	Written Assessment,

						Group discussion

Course Focussing on Employability/ Entrepreneurship/Skill development : **Employability**

Activities: **Simple experiments, Assignments**

Course Focussing on Cross Cutting Issues: **NIL**

Activities related to Cross Cutting Issues: **NIL**

Assignment Topics: **Unit V: ATP: Structure, its role as an energy currency molecule**

Seminar Topics: **Unit II: Water-soluble vitamins and Fat soluble vitamins**

Sample questions

Part A

1. A buffer is a solution that can resist ----------change upon the addition of acidic and basic components.
2. Is Inulin a carbohydrate or protein?
3. Amino acids that possess sulphur component is----------.
   a) Cystein b) Alanine c) Methionine d) Phenylalanine
4. Which of the following is a fat-soluble vitamin?
   (a) Vitamin B (b) Vitamin K (c) Vitamin B_{12} (d) Vitamin C
5. Out of the four statements one is fit to Soap making
   a) Emulsification b) Saponification c) Rancidification d) Insulation

PART B

1. List out the importance of oligosaccharides.
2. Schematically represent the secondary and tertiary structure of proteins.
3. State the difference between fats and oils.
4. Discuss the mechanism of enzyme action with suitable examples.
5. Write the principle of phosphorescence with example.

PART C

1. Describe the structure and properties of Polysaccharides.
2. Explain the structure, importance, sources and deficiency symptoms of water soluble vitamins.
3. Comprehend the classification of lipids based on their hydrolysis.
4. Explain in detail about the Laws of thermodynamics with suitable example.
5. With relevant diagrammatic representation, describe the electromagnetic spectrum.

Head of the Department **Course Instructor**

A. Anami Augustus Arul

Dr. Sr. P. Leema Rose

Dr. J.Abino Wins

Department : Botany
Class : III B.Sc., Botany
Title of the Course : Major Core – VII – Microbiology and Plant Pathology
Semester : V
Course Code : BC2053

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
BC2053	6	-	-	5	6	90	25	75	100

Objectives

- To provide the students with the comprehensive understanding and appreciation for the diversity and significance of microbes on planet earth.
- To study the interaction between plant and pathogen and to develop method of disease management.

Course Outcomes

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO – 1	get an insight on the structure and reproduction of bacteria and viruses.	PSO - 1	U
CO – 2	explore the role and relevance of bacteria and viruses in the field of microbiology.	PSO - 1	An
CO–3	learn the sterilization techniques and preparation of culture media.	PSO–2	Ap
CO– 4	become an expert in operating microbiological instruments thereby undertaking careers in that field.	PSO - 5	Ap
CO -5	understand the economic and pathological importance of bacteria, viruses and fungi.	PSO - 1	U

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Cognitive level	Pedagogy	Assessment/ Evaluation
I						
	1.	Introduction to microbial world: Bacteria: General characteristics; Archaebacteria, Eubacteria, wall-less forms (mycoplasmas).	4	K2(U)	Lecture using videos, Group discussion	Evaluation through short test, Short summary
	2.	Ultrastructure; Nutritional types of bacteria - autotrophs and heterotrophs	4	K1(R)	Brainstorming, Lecture using chart	Simple definitions, MCQ, Diagrammatic representation
	3.	Reproduction and recombination (conjugation, transformation and transduction).	4	K2(U)	Lecture using models, Brainstorming	Chart preparation, Flow charts, Slip test
	4.	Binary fission and endospore formation	2	K1(R)	Inquiry Based Approach, PPT	Flow chart, Open book test
	5.	Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).	4	K3(Ap)	Lecture using Chalk and talk, Group Discussion	Chart preparation, Quiz,

II						
	1	General characteristics; classification (Baltimore),	4	K2(U)	Lecture method, PPT	Evaluation through short test, Short summary
	2	Structure and replication of DNA virus(T4)	4	K1(R)	Flipped classroom, Videos	Simple definitions, MCQ, Recall steps
	3	Lytic and lysogenic cycle	4	K2(U)	Lecture method, Video	Chart preparation, Cycle representation, Slip test
	4	RNA virus (TMV, Corona Virus), viroids and prions.	3	K1(R)	Inquiry based approach, PPT	Flow chart, Open book test
	5	Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of Plant diseases.	3	K3(Ap)	Lecture using Chalk and talk, Group Discussion	Chart preparation, Quiz,
III						
	1	Sterilization of glassware	3	K2(U)	Inquiry based approach. Lecture using videos	Evaluation through short test, Short summary
	2	Preparation of agar medium.	2	K1(R)	Demonstrative learning, PPT	Practical representation
	3	Bacterial growth- growth curve - pure culture, batch culture And continuous	3	K2(U)	PPT, Laboratory test	Graphical representation,

		culture.				Problem solving, Slip test
	4	Physical and chemical agents for controlling microorganisms. Dry and Wet sterilization	3	K1(R)	Brainstorming, PPT, Instrumentation Demonstration	Open book test
	5	Working principles of Autoclave, Laminar Air Flow and Incubator.	3	K3 (Ap)	Lecture method, Instrumentation Demonstration	Chart preparation, Quiz, Schematic representation
	6	Contributions to Microbiology: Anton Van Leeuwenhoek, Louis Pasteur and Robert Koch.	4	K1 (R)	Lecture method, Mind map	Online quiz, Group Discussions
IV						
	1	Food Microbiology: General account of food spoilage through microbes.	3	K2(U)	Brainstorming, PPT, Chart	Evaluation through short test, Short summary
	2	Food borne infections and preventions– Botulism and Salmonellosis	4	K1(R)	PPT, Mind map Flipped classroom	Simple definitions, MCQ, Recall the name of microbes
	3	Dairy microbiology –Sources of milk contamination, Pasteurization technique, Test for grading milk quality	3	K2(U)	PPT, Group Discussion,	Laboratory tests Chart preparation, Slip test,
	4	Potable and non-potable water	3	K1(R)	Lecture method, Group Discussion	Quiz, Open book test, MCQs

	5	Municipal sewage treatment process : Primary, Secondary,(aerobic and anaerobic process), chemical treatment: chlorination. Disposal of treated sewage. (sludge as fertilizer; irrigation and dilution)	3	K3 (Ap)	Lecture using PPT, reflective thinking	Slip test, Chart preparation, Quiz,
	6	Test for detection of coliform bacteria	2	K1 (R)	Video, Laboratory test	Quiz, Flow chart, Laboratory test
V						
	1	Terms and concepts; General symptoms; Etiology;Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine.	5	K1(R)	PPT, Plant specimen, context-based learning	Concept description, short test, Assignment,
	2	Bacterial diseases – Citrus canker and angular leaf spot of Cotton.	4	K2(U)	Inquiry based approach, PPT, Plant specimen	class test, MCQ, Recall names of plant with reference to disease,
	3	Viral diseases – Bunchy Top of Banana, Veinclearing in lady's finger.	4	K1(R)	Inquiry based approach, PPT, Plant specimen	Recall names of plant with reference to disease, quiz
	4	Fungal diseases – Late blight of Potato and	5	K2(U)	Flipped classroom, Lecture method,	Recall names of plant with reference to

		Tikka Disease of Groundnut			Plant specimen	disease, MCQ, slip test

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability**

Activities (Em/ En/SD): **Microbiology Lab Visit**

Course Focussing on Cross Cutting Issues (Professional Ethics / Human Values /Environment Sustainability / Gender Equity): **Environment Sustainability**

Activities related to Cross Cutting Issues: **NIL**

Assignment: **Unit III: Working principles of Autoclave, Laminar Air Flow and Incubator**.

Contributions to Microbiology: Anton Van Leeuwenhoek, Louis Pasteur and Robert Koch.

Sample questions

Part A

1. True or False: Bacillus is a Gram-positive bacterium.
2. Viruses are _____ parasites.
   a. obligate b. intracellular c. facultative d. non-cellular
3. The hot air oven operates on the principle of _____ sterilization.
   a. moist heat b. dry heat c. water d. chemical
4. The bacterium _____ causes botulism.
5. Tikka disease of groundnut is caused by a fungus. State True or False.

Part B

1. What are the general characteristics of Mycoplasma?
2. Create a schematic representation of the lytic cycle.
3. Draw a bacterial growth curve and explain its phases.
4. How can the quality of milk be tested in a laboratory?
5. Describe the symptoms of citrus canker and angular leaf spot of cotton.

Part C

1. Describe the ultrastructure of bacteria and include a detailed sketch.
2. Provide an overview of the coronavirus, accompanied by a detailed sketch.

3. Summarize the various physical agents used to control microorganisms.

4. Explain the municipal sewage treatment process with a diagrammatic representation.

5. Write an essay on the host-pathogen relationships in plants.

Head of the Department

B. Anami Augustus Arul

Course in-charges:

Dr. Sr. P. Leema Rose

Dr. Bojaxa A. Rosy