ORIENTAL COLLEGE (AUTONOMOUS) TAKYEL, IMPHAL
DEPARTMENT OF BOTANY
TEACHING PLAN

B. Sc. Botany (Honours)
Four years Undergraduate Programme (Eight semester course) under LOCF
(Effective from 2022-2023)

Programme Outcome (POS)

PO No.	Programme Outcomes (Upon completion of B.Sc., Botany Programme, the graduates will be able to)
PO1	Acquire academic competence in the subject of Botany and its subfields and able to apply the acquired knowledge in catering the needs of society, employer and institution.
PO2	Develop analytical, innovative and critical thinking skills and practical skill of traditional and emerging field of Botany and able to handle advance tools and techniques used study of plant science.
PO3	Carry out activities effectively as an individual and as a team member take active role in team works and give cooperation to other team members. a member of a team or a leader of a group to fulfil the responsibilities related to group activities.
PO4	Gain awareness of decision-making process and develop basic skill of management to become an effective leader.
PO5	Enhance digital literacy to achieve their core competency through use of new technologies in learning process.
PO6	Emerge as responsible citizen of India and be aware of moral and ethical baseline of the country and the world.
PO7	Able to effectively communicate their idea/findings/concepts to audience.
PO8	Able to take logical approach in solving problems.

Programme Specific Outcome (PSOS)

PO No.	Programme Specific Outcomes (Upon completion of B.Sc., Botany Programme, the graduates will be able to)
PSO1	Gain basic knowledge of diverse forms of plants consisting of microbes, algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms. In addition, students know their ecological significance and economic importance in industry, agriculture and medicines.
PSO2	Develop understanding of how to identify, classify and name plants and evolution of different groups of plants.
PSO3	Understand plant ecology and phytogeography, aware of the current environmental issues such as pollution, climate change, global warming and its associated factor like high ecological footprint.
PSO4	Appreciate biodiversity and various services provided by biodiversity, aware of various approaches to conserve biodiversity and ways to manage bio-resources for sustainable development.
PSO5	Understand organization of cell in prokaryotes and eukaryotes and structure and function of cell organelles. Also, students acquire knowledge of major biomolecules such carbohydrate, lipids, proteins and nucleic acids, their roles in cell functioning and inheritance.
PSO6	Understand morphology of different groups of plants and their anatomy, growth in plants and various processes and structures involved in plant reproduction.
PSO7	Learn various metabolic activities of plants in detail, various factors that caused stress to plants and mechanisms to overcome stresses.
PSO8	Develop understanding of structure and functions of genetic materials of plants, storage of the genetic materials and various processes involved in expression of genes into proteins and modifications of RNAs and proteins to attain their desired functions.
PSO9	Develop understanding of laws related to inheritance, interactions of genes and their effects on phenotypes, linkage, mutation and population genetics.
PSO9	Learn various tools and techniques involved in recombination DNA technology and tissue culture. Also, understand the many benefits derived from recombinant DNA technology and tissue culture.

PSO10	Develop practical skills to effectively handle tools employed in analytical techniques in plant science research. Learn to use biostatistics in interpretation of scientific results and utilize bioinformatics to query informations of nucleic acids and proteins.
PSO11	Develop skill to perform basic scientific experiments, record data, analyse data and produce results.
PSO12	Aware of ethics in scientific experiments and writing.
PSO13	Gain basic knowledge of diverse forms of plants consisting of microbes, algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms. In addition, students know their ecological significance and economic importance in industry, agriculture and medicines.

Teaching plan under LOCF/NEP-2020 Syllabus

(Year 2022-2023 onwards)

Semester- I)

Paper Code: BOT-HC-501

Paper Title: Introduction to Microbial World, Virus, Bacteria, Fungi and Phytopathology

No. of Hours per week	Credit	Total No. of Hours	Marks
6 (Theory)	4 (Theory)	60	75
4 (Practical)	2 (Practical)	30	25

Course Objectives:

1. To impart knowledge of diversity, life forms, life cycles, morphology and importance of viruses, bacteria and fungi.
2. To introduce students about the concepts and principles of plant pathology, causal organisms of plant diseases and their control.
3.

Course Outcomes:

1. Know characteristics, diversity, nutrition and importance of microbes.
2. Classify viruses, bacteria, fungi and lichens based on their characteristics and structures.
3. Describe replication of viruses, bacterial reproduction and genetic recombination, reproduction and life cycle of representative species of different groups of fungi.
4. Develop critical understanding of plant diseases and their remediation.

Unit 1: Introduction to Microbial World (3 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	History of microbiology; Scope and relevance of microbes in industry and environment	1	Know the inception of microbiology and its progression. And, also know the role of microbes in industry and environment.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar / Group Discussion/Q & A Session/Assignment*
2.	Microbial nutrition, growth and metabolism	1	Learn nutrients and nutrition of microbes. Also learn growth and metabolism of microbes.		
3.	Major groups of the microbial world	1	Learn the major groups of microbes.		

Unit 2: Virus (10 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Discovery of virus	1	Learn how tobacco mosaic virus is discovered.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Physiochemical and biological characteristics of virus	1	Know the characteristics of virus.		
3.	Classification of virus – Baltimore	1	Able to classify virus according to Baltimore.		
4.	General structure with special reference to viroids and prions	1	Learn the structure of viroids and prions.		
5.	General account of replication of virus.	1	Learn the replication of virus.		
6.	DNA virus (T-phage)	1	Learn different types of T-phages.		
7.	Lytic cycle	1	Learn lytic cycle and its effect to host.		
8.	Lysogenic cycle	1	Understand lysogenic cycle and how it differs from lytic cycle.		

9.	RNA virus (TMV)	1	Understand the structure of TMV.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
10.	Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostic	1	Gain knowledge of the uses of virus in vaccine, medicine and diagnostic.		
11.	Viruses as causal organisms of plant diseases	1	Understand that viruses that caused diseases in many plants.		
12.	….. contd.	1			

Unit 3: Bacteria (10 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Discovery of bacteria &General characteristics of bacteria	1	Have Knowledge about the discovery of bacteria and the general characteristics of bacteria.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Types- archaebacteria, eubacteria,	1	Develop critical understanding of the type of bacteria and archaebacteria.		
3.	Actinomycetes, mycoplasma	1	Develop understanding of actinomycetes and mycoplasma.		
4.	Rickettsia, chlamydiae, sphaeroplast	1	Develop understanding of rickettsia, chlamydiae and sphaeroplast		
5.	Cell structure	1	Have critical knowledge of bacterial cell.		
6.	Nutritional types	1	Understand nutritional types of bacteria.		
7.	Reproduction-vegetative and asexual	1	Students have clear idea of vegetative and asexual reproduction in bacteria.		
8.	Recombination (conjugation, transformation and transduction)	1	Develop critical idea of recombination in bacteria.		

9.	Economic importance of bacteria with reference to role in agriculture	1	Students became aware of economic importance of bacteria in agriculture.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
10.	Economic importance of bacteria with reference to role in industry (alcohol and antibiotic production)	1	Students became aware of the roles of bacteria in alcohol and antibiotic production.		

Unit 4: Fungi (12 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	General characteristics of fungi & Status of fungi in living system	1	Have knowledge of the characteristics of fungi and the status of fungi in living world.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Thallus organization and modification of hyphae in fungi	1	Have knowledge of the different forms of fungal thallus and their modifications.		
3.	Homothallism and heterothallism & Reproduction in fungi	1	Have basic concept of different types of thallus involved in sexual reproduction. Also have knowledge of the different types of reproduction found in fungi.		
4.	Classification of fungi (Ainsworth, 1973), up to sub-division with diagnostic character and examples	1	Learn to classify fungi.		
5.	General characteristics of *Chytridiomycota* – S*ynchytrium, Allomyces*	1	Have knowledge of the general characteristics of *Chytridiomycota – Synchytrium, Allomyces.*		
6.	General characteristics of *Oomycota - Albugo*	1	Have knowledge of the general characteristics of *Oomycota – Phytophthora*, *Albugo.*		
7.	General characteristics of *Zygomycota - Rhizopus*	1	Have knowledge of the general characteristics of *Zygomycota – Rhizopus, Mucor*		

8.	General characteristics of *Ascomycota - Aspergillus*	1	Have knowledge of the general characteristics of *Ascomycota – Saccharomyces*, *Aspergillus.*	*Lecture/Discussion PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
9.	General characteristics of *Basidiomycota – Puccinia, Agaricus*	1	Have knowledge of the general characteristics of *Basidiomycota - Puccinia, Agaricus*		
10.	General characteristics of *Deuteromycota - Alternaria*	1	Have knowledge of the general characteristics of *Deuteromycota – Fusarium*, *Alternaria.*		
11.	Myxomycota: General characteristics, Occurrence, Status of slime molds & Classification of slime molds	1	Have knowledge of the general characteristics, occurrence, and status of slime molds. Also, understand how to classify slime molds.		
12.	Reproduction in lichens & economic importance of lichens	1	Learn different methods of reproduction in lichens. Also, have knowledge of the importance of lichens.		
13.	Mycorrhiza: Endomycorrhiza, ectomycorrhiza, and their significance	1	Learn mycorrhiza and its types and their importance.		

Unit 5: Plant Pathology (10 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	History of plant pathology terms and concepts of plant pathology	1	Have knowledge of the history of plant pathology. Also have clear concept of plant pathology.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Plant disease symptoms	1	Understand different plant disease symptoms in plants.		

3.	Host -pathogen relationships		Understand the interaction between host and the pathogen, leading to the development of disease in their host.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
4.	Disease cycle and environmental relation	1	Understand the continuous sequence of interactions among host, pathogen and environment.		
5.	Methods of control of plant diseases	1	Develop understanding on the physical, chemical and biological control of plant diseases.		
6.	Plant quarantine	1	Understand the term and the importance of plant quarantine.		
7.	Fungal diseases- late blight of potato; Brown leaf spot of rice	1	Have knowledge of the causal organism, disease symptoms and prevention and control measures of the disease.		
8.	Black rust of wheat; White rust of crucifers	1	Have knowledge of the causal organism, disease symptoms and prevention and control measures of the disease.		
9.	Bacterial diseases- Citrus canker; Bacterial blight of rice	1	Have knowledge of the causal organism, disease symptoms and prevention and control measures of the diseases.		
10.	Viral diseases - Tobacco mosaic virus; Vein clearing	1	Have knowledge of the causal organism, disease symptoms and prevention and control measures of the disease.		

N.B. The contact hours for tutorial classes will be 15 hour

Course teachers:

1. Padmaja S.
2. H.Rajesh Sharma
3. Dr. Chipem Vashi
4. Dr. R.K.Imosana

HoD ……

Semester- I

(Year 2022-2023 onwards)

Paper Code: BOT-HC-502

Paper Title: Algae, Bryophytes, Pteridophytes and Gymnosperms

No. of Hours per week	Credit	Total No. of Hours	Marks
6 (Theory)	4 (Theory)	60	75
4 (Practical)	2 (Practical)	30	25

Course Objective:

1. To render knowledge of diversity, life forms, life cycles, morphology and importance of algae, bryophytes, pteridophytes and gymnosperms along with proficiency in the experimental techniques of analysis of these plant groups.

Course Outcomes:

1. Able to classify and know economic value of lower plants and gymnosperms.
2. Develop critical understanding on morphology, anatomy and reproduction of algae, bryophytes, pteridophytes and gymnosperms.
3. Understand plant evolution and their transition to land habitat.
4. Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of algae, bryophytes, pteridophytes and gymnosperms.

Unit 1: Algae (12 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Characteristics of algae;	1	Have knowledge on the characteristics features of algae.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/ Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Range of thallus organization	1	Have the Knowledge of the different forms of thallus found in algae		
3.	Cell structure and components; Pigment system & Reserve food materials	1	Know the structure of algal cells in detail. Also have knowledge of different reserve foods and pigments found in different groups of algae		
4.	Classification system proposed by Fritsch and Lee	1	Understand Fritsch and Lee system of classification of algae.		
5.	Thallus structure, reproduction and life cycle of Cyanophyta *(Nostoc, Oscillatoria, Spirulina)*	1	Have understanding on the morphology, reproduction and lifecycle pattern in *Nostoc, Oscillatoria, Spirulina.*		
6.	Thallus structure, reproduction and life cycle of Chlorophyta *(Chlamydomonas, Volvox, Oedogonium and Coleochaete)*	1	Have understanding on the morphology, reproduction and lifecycle pattern in *Chlamydomonas, Volvox, Oedogonium and Coleochaete*		
7.	……..contd.	1			
8.	Thallus structure, reproducti-on and life cycle of Charophyta *(Chara)*	1	Have understanding on the morphology, reproduction and lifecycle pattern in *Chara.*		
9.	Thallus structure, reproduction and life cycle of Xanthophyta *(Vaucheria)*	1	Have understanding on the morphology, reproduction and lifecycle pattern in *Vaucheria.*		
10.	Thallus structure, reprodution and life cycle of Phaeophyta *(Ectocarpus)*	1	Have understanding on the morphology, reproduction and lifecycle		

			pattern in *Ectocarpus.*	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/ Seminar/ Group Discussion/Q & A Session/Assignment*
11.	Thallus structure, reproduction and life cycle of Rhodophyta *(Polysiphonia)*	1	Have understanding on the morphology, reproduction and lifecycle pattern in *Polysiphonia.*		
12.	Economic importance of Algae	1	Have knowledge of the economic importance of algae.		

Unit 2: Bryophytes (11 Lec.)					**.**
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Comparatively and evolutionary trends in liverworts and mosses	1	Understand the process of evolution in liverworts and mosses.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Progressive sterilization of the sporophytes	1	Have understanding of the process of sterilization of the sporophytes in bryophytes.		
4.	General characters, Classification of gametophytes and sporophytes bryophytes	1	Understand the characteristics features and Classification of gametophytes and sporophytes in bryophytes.		
5.	Structure of gametophytes and sporophytes bryophytes	1	Have a critical understanding of the structure of gametophytes and sporophytes of bryophytes.		
6.	Methods of reproduction and life cycle of *Riccia*	1	Understand the methods of reproduction and life cycle pattern in *Riccia.*		
7.	Methods of reproduction and life cycle of *Marchantia*	1	Understand the methods of reproduction and life cycle pattern in *Marchantia.*		
8.	Methods of reproduction and life cycle of *Pellia*	1	Understand the methods of reproduction and life cycle pattern in *Pellia.*		

9.	Methods of reproduction and life cycle of *Porella*	1	Understand the methods of reproduction and life cycle pattern in *Porella.*	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
10.	Methods of reproduction and life cycle of *Anthoceros*	1	Understand the methods of reproduction and life cycle pattern in *Anthoceros.*		
11.	Methods of reproduction and life cycle of S*phagnum*	1	Understand the methods of reproduction and life cycle pattern in S*phagnum.*		
12.	Methods of reproduction and life cycle of *Funaria*	1	Understand the methods of reproduction and life cycle pattern in *Funaria.*		

Unit 3: Pteridophytes (15 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy:***	***Assessment/Evaluation***
1.	General characteristics of pteridophytes	1	Understand the Characteristics features of pteridophytes.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/ Seminar/ Group Discussion/ Q & A Session/ Assignment*
2.	Classification of pteridophytes; Early land plants *(Cooksonia and Rhynia)*	1	Hacve knowledge of the classification of pteridophytes and the early land plants *(Cooksonia and Rhynia).*		
3.	Reproduction and life cycle of *Psilotum*	1	Understand the methods of reproduction and life cycle pattern in *Psilotum.*		
4.	Reproduction and life cycle of *Lycopodium*	1	Understand the methods of reproduction and life cycle pattern in *Lycopodium.*		
5.	Reproduction and life cycle of *Selaginella*	1	Understand the methods of reproduction and life cycle pattern in *Lycopodium.*		

6.	Reproduction and life cycle of *Equisetum*	1	Understand the methods of reproduction and life cycle pattern in *Equisetum.*	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/ Seminar/ Group Discussion/ Q & A Session/ Assignment*
7.	Reproduction and life cycle of *Pteris*	1	Understand the methods of reproduction and life cycle pattern in *Pteris.*		
8.	Reproduction and life cycle of *Marsilea*	1	Understand the methods of reproduction and life cycle pattern in *Marsilea.*		
9.	Apogamy and Apospory, heterospory and Seed habit	1	Understand the terms and also have knowledge about the seed habit of pteridophyte.		
10.	Telome theory and Stellar evolution	1	Understand the Telome theory and Stellar evolution.		
11.	Ecological and economics importance	1	Have knowledge of the ecological role and the economic importance of pteridophytes.		

Unit 4: Gymnosperm (11 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Characteristics features of Gymnosperms	1	Understand the Characteristics features of Gymnosperms.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Classification of Gymnosperms	1	Understand the classification of Gymnosperms.		
3.	Morphology, reproduction, lifecycle and economic importance of *Cycas.*	1	Have critical understanding on the morphology, reproduction, life cycle pattern and economic importance of *Cycas.*		
4.	Morphology, reproduction, lifecycle and economic importance of *Pinus*	1	Have critical understanding on the morphology, reproduction life cycle pattern and economic importance of *Pinus.*		

5.	Morphology, reproduction, lifecycle and economic importance of *Gnetum*	1	Have critical understanding on the morphology, reproduction life cycle pattern and economic importance of *Gnetum.*	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Classtest/Seminar/ Group Discussion/Q & A Session/Assignment*
6.	Morphology, reproduction, lifecycle and economic importance of *Ephedra*	1	Have critical understanding on the morphology, reproduction life cycle pattern and economic importance of *Ephedra.*		
7.	Morphology, reproduction, lifecycle and economic importance of *Ginkgo*	1	Have critical understanding on the morphology, reproduction life cycle pattern and economic importance of *Ginkgo.*		
8.	Polyembryony and pollination drops with special reference to *Pinus*.	1	Understand the development of embryo and pollination drop in *Pinus.*		
9.	Economic importance of Gymnosperms	1	Have knowledge of the economic importance of Gymnosperms.		
10.	Palaeobotany: Geological time scale; Dominant fossil flora of different ages	1	Have knowledge of the dominant fossil flora of different geological era.		
11.	Fossil formation and types of fossilizations	1	Understand the process of fossil formation and its different types.		

N.B. The contact hours for tutorial classes will be 15 hours

Course teacher

1. L.Degachandra Singh
2. Dr. Y Pramoda Devi
3. N. Nirupama Devi

HoD ……

Semester I

(Year 2022-2023 onwards)

Paper Code: BOT-SE-501
Skill Enhancement Course
Paper Title: Mushroom Cultivation

No. of Hours per week	Credit	Total No. of Hours	Marks
4 (Theory)	3 (Theory)	45	75
2 (Practical)	1 (Practical)	15	75

Course Objectives:

1. To help students in learning mushroom cultivation technique.
2. To enable in distinguishing edible and poisonous mushroom,
3. To make students appreciate medicinal, economic and nutritional values of mushroom.
4. To make student aware of marketing aspects of mushroom cultivation.

Course Outcomes:

1. Identify various types of mushrooms.
2. Demonstrate various types of mushroom cultivation technologies.
3. Value the economic factors associated with mushroom cultivation.
4. Device new methods and strategies to contribute to mushroom production.

Unit 1: Introduction (8 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Introduction: Mushroom cultivation	1	Students are able to understand what mushroom cultivation is, its scope and the importance.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	History of Mushroom cultivation	1	Students have knowledge of the history of Mushroom cultivation.		
3.	Nutritional and medicinal value of edible mushroom	1	Understand the nutritional and the medicinal value of different types of mushrooms.		
4.	Poisonous mushroom	1	Have the idea of the characteristic features of poisonous mushrooms and their effects.		
5.	Types of edible mushrooms available in India (with local emphasis*); Volvariella volvacea,*	1	Know the characteristic features, nutritional as well as the medicinal value.		
6.	*Pleurotus sp. and Agaricus bisporus,*	1	Know their characteristic features, nutritional as well as the medicinal value.		
7.	*Schizophyllum commune and Auricularia sp.,*	1	Know their characteristic features, nutritional as well as the medicinal value.		
8.	*Lentinula edodes and Gonoderma sp.*	1	Know their characteristic features, nutritional as well as the medicinal value.		

Unit 2: Cultivation Technology (8 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Infrastructure: substrates (locally available), polythene bag, vessels. Inoculation hook, inoculation loop, low-cost stove, sieves, culture rack, mushroom unit (thatched house), water sprayer, tray, small polythene bag.	1	Students are familiar with all these materials required for the cultivation of mushroom.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	……..contd.	1			
3.	Pure culture: Media preparation,	1	Understand the term culture media, media used in mushroom cultivation and their preparations.		
4.	Preparation of spawn, multiplication	1	Understand the process of spawn preparation and its multiplication.		
5.	Mushroom bed preparation: Paddy straw, sugarcane trash, maize straw, banana leaf.	1	Understand the process of mushroom bed preparation and also the materials required for it.		
6.	Factors affecting the mushroom bed preparation	1	Have the idea of the different factors which can affect the mushroom bed and also understand how they affect it.		
7.	Low-cost technology	1	Have understanding on the low cost technology of mushroom cultivation its advantages.		
8.	Composting technology in mushroom production.	1	Have idea of the different methods of composting in mushroom production.		

Unit 3: Cultivation Methods (7 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Cultivation method of *Pleurotus* an	1	Understand the cultivation process of *Pleurotus* and *Volvareilla.*	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Cultivation method of *Volvareilla*	1	Understand the cultivation process *Volvareilla.*		
3.	Cultivation method of *Lentinula*	1	Understand the cultivation process of *Lentinula* and *Agaricus.*		
4.	Cultivation method *Agaricus*		Understand the cultivation process *Agaricus.*		
5.	Methods of harvesting, processing, grading and packing	1	Have idea of harvesting, processing, grading and packing of mushroom of marketing.		
6.	Short-term storage (Refrigeration – up to 24 hrs); Long-term storage (canning, pickles, papads), drying, storage in salt solutions	1	Have knowledge of the process of short-term storage; and long-term storage of mushrooms		
7.	Use of spent mushroom in vermicomposting and in organic farming.	1	Understand the process and the advantages of the use of spent mushroom in vermin-composting and in organic farming.		

Unit 4: Disease Control and Pest Management (7 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Introduction: Disease control and pest management in mushroom	1	Students have basic idea about prevention and control of diseases in mushroom.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*

2.	Types of diseases and pest of mushrooms	1	Have knowledge about the fungal, bacterial, viral and nematode diseases in mushroom.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
3.	……..contd.	1			
4.	Diseases and pest control methods in mushrooms	1	Have basic idea about the causal organism, management and control of the diseases in mushroom.		
5.	Mushroom Research centers – National level and Regional level	1	Know where they are located in India and their role in the of mushroom production.		
6.	Marketing and cost economics of mushroom culture – cost benefit ratio	1	Have knowledge of the cost-benefit ratio of mushroom cultivation.		
7.	Marketing in India and aboard; Export value	1	Have knowledge of the processes involved in the marketing of mushrooms in India and aboard and about the export value in comparison with the local or national value.		

N.B. The contact hours for tutorial classes will be 15 hours

Course teachers:

1. L.Degachandra Singh
2. Dr. Y Pramoda Devi
3. N. Nirupama Devi

HoD …….

Semester II

(Year 2022-2023 onwards)

Paper Code: BOT-HC-503

Paper Title - Plant Systematics

No. of Hours per week	Credit	Total No. of Hours	Marks
6 (Theory)	4 (Theory)	60	75
4 (Practical)	2 (Practical)	30	25

Course Objective:

1. To provide knowledge of taxonomy and phylogeny of plants.
2.

Learning Outcomes:

1. Gain basic knowledge of plant identification, classification, nomenclature and numerical taxonomy.
2. Recognize the importance of herbarium and virtual herbarium.
3. Assess terms and concepts related to phylogenetic systematics.
4. Understand the characters of the families according to Bentham and Hooker's system of classification and other system of classification.

Unit 1: Plant Systematics (17 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Introduction to plant systematics	1	Understand What Is systematics and the main aim of the study of systematics.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
2.	Plant identification and Classification	1	Understand basic concept of identification and classification ofplants.		
3.	Nomenclature	1	Understand how to give scientific name to a plant.		
4.	Evidence from Palynology	1	Learn to interpret palynology data in systematics.		
5.	Evidence from Cytology	1	Learn to understand cytological evidences in systematics.		
6.	Evidence from phytochemistry: Alkaloids, phenolics (in brief)	1	Have basic idea of the use of chemical methods in the identification of plants (genera and species).		
7.	Glucosides, Terpenes and Semantides (in brief)	1			
8.	Evidence from Molecular data (cp. DNA, mt.DNA, nuclear DNA, PCR amplification, sequence data analysis)	1	Learn to use molecular data for systematics.		
9.	PCR amplification	1	Learn about PCR amplification.		
10.	Sequence data analysis	1	Learn how to analyse sequence data.		
11.	Field inventory	1	Have basic idea of it and its importance.		
12.	Importance of herbarium, and important herbaria and botanical gardens of the world and India	1	Know the importance of herbarium. And also, have knowledge of the important herbaria and Botanical garden of the world and India		
13.	Virtual herbarium, E-Flora	1	Have basic idea of the digitize herbarium		

			and flora and their advantages.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
14.	Documentation: Flora, Monographs	1	Have basic idea of documentation in plant systematics and how to do documentation of a plant.		
15.	Journals	1	Understand what is journal and its importance.		
16.	Keys: indented (yolk) and bracketed keys	1	Understand taxonomic keys and their uses.		
17.	Phenetics vs. Cladistic classification	1	Understand the terms and the difference between them.		

Unit2: Botanical Nomenclature and System of Classification (15 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Botanical nomenclature	1	Understand binomial nomenclature and rules of giving scientific name to plants.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
2.	Principles and Rules of ICBN	1	Understand the basic rules and guiding Principles of ICBN.		
3.	Rank and Names	1	Know the relative level of a group of organisms.		
4.	Typification	1	Have basic concept of different nomenclatural types.		
5.	…… contd.	1			
6.	Authors citation	1	Know the importance of author's name in scientific naming of plants.		
7.	Valid publication	1	Understand the rules to be fulfilled for valid publication of a scientific name of a plant.		

8.	Rejection of names	1	Understand the rules given by ICBN for rejection of names, while giving scientific names to plants.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
9.	Principles of Priority and its limitation	1	Have idea on the rules of priority and its limitation provided by the ICBN in naming a plant.		
10.	Names of hybrid	1	Have knowledge of the options provided by the International Code of nomenclature for algae, fungi and plants (ICNafp) for naming the hybrid plants.		
11.	Natural system of classification (Bentham & Hooker)	1	Understand Bentham and Hooker's system of classification its merits and demerits.		
12.	……..contd.	1			
13.	Takhtajan Classification of angiosperm	1	Understand Takhtajan's system of classification and its merits and demerits.		
14.	……contd.	1			
15.	Principles of angiosperm Phylogeny (APG IV)	1	Have basic concept of the Principles of angiosperm Phylogeny (APG IV).		

Unit 3: Biometrics, Numerical Taxonomy and Cladistics (10 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Introduction: Characters	1	Learn the basics of numerical taxonomy and characters used in numerical taxonomy	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
2.	Variations	1	Learn about variations in characters between individual organisms or group of organisms.		

3.	OTUs	1	Know the basic unit of numerical taxonomy in detail.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
4.	Character weighing and coding	1	Learn character weighting and different types of character coding		
5.	…….. contd.	1			
6.	Cluster analysis	1	Learn concept of cluster analysis, steps involved in cluster analysis with examples		
7.	…… contd.	1			
8.	…… contd.	1			
9.	Phenograms	1	Learn the concept of phenogram		
10.	Cladograms(definitions and differences)	1	Learn the concept of cladogram and differences from phenograms		

Unit 4: Taxonomic Hierarchy and Phylogenetic Systematics (18 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	**Taxonomic hierarchy**: Concept of taxa (family, genus, species)	1	Have the idea of Taxonomic hierarchy, concept of various taxa.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
2.	Categories	1	Grasp the idea of taxonomic classification.		
3.	Taxonomic hierarchy	1	Grasp the idea of taxonomic classification		
4.	Species concept	1	Understand species concept in general.		
5.	Biological species concept	1	Understand biological species concept.		
6.	Morphological species concept	1	Understand morphological species concept.		
7.	Evolutionary species concept	1	Understand evolutionarily species concept.		

8.	**Phylogenetic Systematics:** Term and concepts of – primitive and advanced,	1	Knowledge of phylogenetic systematics	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
9.	Homology and analogy,	1	Understand the terms and their importance in plant systematics.		
10.	Parallelism and convergence	1	Have concept of parallelism and convergence		
11.	Monophyly, paraphyly,	1	Have concept of monophyly, paraphyly.		
12.	Polyphyly , clades	1	Have concept of polyphyly and clades.		
13.	Synapomorphy , symplesiomorphy, apomorphy	1	Understand the terms Synapomorphy , symplesiomorphy, and apomorphy.		
14.	Origin of angiosperms	1	Have the idea of the Origin of angiosperms.		
15.	Evolution of angiosperms	1	Have the idea of the evolution of angiosperms.		
16.	Co-evolution of angiosperms and animals	1	Understand how angiosperms and animals Co-evolved.		
17.	Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram)	1	Have the idea of various Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).		
18.	…… contd.	1			

N.B. The contact hours for tutorial classes will be 15 hours

Course teachers:

1. Padmaja S.
2. H.Rajesh Sharma
3. Dr. R.K. Imosana
4. Dr. Chipem Vashi

HoD ……

Semester II

(Year 2022-2023 onwards)

Paper Code: BOT-HC-504

Paper Title: Biomolecules and Cell Biology

No. of Hours per week	Credit	Total No. of Hours	Marks
6 (Theory)	4 (Theory)	60	75
4 (Practical)	2 (Practical)	30	25

Course Objectives:

1. To discuss the significance of chemical bonds in biological systems, thermodynamics, enzyme structure and action.
2. To highlight major biomolecules of cells, their structure and function in living organisms.
3. To provide insights of structure and function of cell organelles.
4. Describe cell division.

Learning Outcomes:

On completion of this course, students will be able to:

1. Develop understanding of chemical bonding among molecules.
2. Describe biomolecules of cells and their specific role in cell functioning.
3. Classify enzymes and explain structure and mechanism of action.
4. Understand structure and function of various cell organelles in a cell.

Unit 1: Bioenergitics and Enzymes (15 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Laws of thermodynamics	1	Understand the laws of thermodynamics	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Concept of free energy Endergonic and exergonic reactions	1	Knowledge of free energy endergonic and exergonic reactions		
3.	Coupled reactions and redox reactions	1	Understand the concept of coupled reactions and redox reactions		
4.	ATP structure and its role as an energy currency molecule	1	Understand ATP structure and its role as an energy currency molecule.		
5.	……contd.	1			
6.	Structure of enzyme, holoenzyme, apoenzyme , cofactors , coenzymes and prosthetic groups	1	Understand the different structures of enzymes as mentioned with their roles.		
7.	……..contd.	1			
8.	Classification of enzymes	1	Knowledge of types of enzymes.		
9.	Features of active site , substrate specificity	1	Idea of active site , substrate specificity		
10.	……contd.	1			
11.	Mechanism of enzyme action(activation energy, lock and Key hypothesis, Induced fit theory)	1	Understand the different mechanisms of enzyme action.		
12.	……..Contd.	1			

13.	Michaelis-Menten Equation, Lineweaver-Burk equation	1	Knowledge of Michaelisn-Menten Equation, lineweaver-Burk equation	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
14.	…….. contd.	1			
15.	Factors affecting enzyme activity	1	Idea of Factors affecting enzyme activity.		

Unit 2: Biomolecules (15 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Types and significance of chemical bonds	1	Understand types and significance of chemical bonds.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q &A Session/Assignment*
2.	Structure and properties of water; pH and buffer	1	Knowledge of structure and properties of water; pH and buffer		
3.	Carbohydrates: Nomenclature and classification; Role of monosaccharides (glucose fructose, sugar, alcohol – manitol and sorbitol)	1	Nomenclature and classification of carbohydrates and role of monosaccharides.		
4.	……..contd.	1			
5.	Disaccharides(sucrose, maltose, lactose); Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, chitin, mucilage; storage – starch, insulin	1	Understand role of Disaccharides (sucrose, maltose, lactose); Oligosaccharides and polysaccharides.		
6.	……..contd.	1			

7.	Lipid: definition and major classes of storage and structural lipids; Fatty acids-structure and functions	1	Idea of Lipid and major classes of storage and structural lipids; Fatty acids-structure and functions.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
8.	……..contd.	1			
9.	Structural lipids: Triacylglycerols structure, function and properties	1	Knowledge of Structural of lipids-triacylglycerols structure, function and properties		
10.	Phosphoglycerides	1	Knowledge of Phosphoglycerides		
11.	Protein: Structure of amino acids, levels of protein structures – primary, secondary and quaternary	1	Understand the structures of protein and amino acids.		
12.	Protein denaturation and biological roles of proteins	1	Idea of protein denaturation and biological roles of protein		
13.	Nucleic acids: Structure of nitrogenous bases; Structure and function of nuleotides	1	Understand Nucleic acids-structure of nitrogenous bases; Structure and function of nuleotides.		
14.	……..contd.	1			
15.	Types of Nucleic acids: Structure of A, B, Z types of DNA, Types of RNA; Structure of tRNA	1	Understand the different types of Nucleic acids, DNA (A,B,Z), RNA; and structure of tRNA		

Unit 3: Cell Biology-I (15 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Structure and function of cell; Characteristics of prokaryotic and eukaryotic cells; Plant and animal cells	1	Knowledge of structure and function of cell; characteristics of prokaryote and eukaryote; plant and animal cell and their difference.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	……..contd.	1			
3.	Origin of eukaryotic cell (Endosymbiotic theory)	1	Idea of origin of eukaryotic cell		
4.	Chemistry structure and function of plant cell wall	1	Concept of chemistry and structure of cell wall.		
5.	Overview of membrane function; fluid mosaic model; Chemical composition of membranes	1	Function, fluid mosaic model; chemical composition of plant membranes		
6.	……..contd.	1			
7.	Membrane transport – Passive, active and facilitated transport	1	Knowledge of passive, active and facilitated transport.		
8.	Endocytosis and exocytosis	1	Difference between endocytosis and exocytosis		
9.	Nucleus: Structure – nuclear envelope, nuclear pore complex, nuclear lamina	1	Understand structure- nuclear envelope, nuclear pore complex, nuclear lamina.		
10.	……..contd.	1			
11.	Molecular organisation of chromatin and nucleolus	1	Knowledge of molecular organisation of chromatin and nucleolus.		

12.	Phases of eukaryotic cell cycle, Mitosis and Meiosis	1	Clear idea of Mitosis and Meiosis and their difference.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q &A Session/Assignment*
13.	……..contd.	1			
14.	Regulation of Cell Cycle – checkpoints and regulation	1	Clear concept of regulation of Cell Cycle- Checkpoints and Regulation		
15.	Role Protein Kinases	1	Understand the Role Protein Kinases and its importance		

Unit 4: Cell Biology-II (15 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Cytoskelon: General description, types	1	Have knowledge on cytoskeleton.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Role and structure of microtubules	1	Learn about the structure and role of microtubules.		
3.	Role and structure of microfilaments	1	Understand the roles and structure of microfilaments.		
4.	Role and structure of intermediary filaments	1	Understand the roles and structure of intermediary filaments.		
5.	Intracellular trafficking	1	Have idea of intracellular trafficking		
6.	Structural organisation and functions of chloroplast	1	Clear concept of structural organisation and functions of chloroplast		
7.	Structural organisation and functions of mitochondria	1	Clear concept of structural organisation and functions of chloroplast		
8.	Structural organisation and functions of peroxisomes	1	Clear concept of structural organisation and functions of peroxisomes.		
9.	Semiautonomous nature of mitochondria and chloroplast	1	Clear concept and idea semiautonomous nature of mitochondria and chloroplast		

10.	Lysosomes and vacuoles	1	Understand lysosomes and vacuoles	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
11.	Endomembrane system: General account	1	General account endomembrane system.		
12.	Types and structure of: Endoplasmic reticulum-	1	Understand different types of Endoplasmic reticulum and structure		
13.	Golgi apparatus: Organisation, protein glocosylation protein sorting and export from Golgi apparatus	1	Golgi apparatus-organisation, protein glocosylation protein sorting and export from Golgi apparatus		
14.	Signal transduction	1	Idea of Signal transduction		
15.	Receptor and primary and secondary signal transduction	1	Knowledge of receptor and primary and secondary signal transduction		

N. B. The contact hours for tutorial classes will be 15 hours

Course teachers

1. Dr. Y Pramoda Devi
2. N. Nirupama Devi
3. L.Degachandra Singh

HoD ……

Semester II

(Year 2022-2023 onwards)

Paper Code: BOT-SE-502

Paper Title: Skill Enhancement Course - Nursery and Gardening

No. of Hours per week	Credit	Total No. of Hours	Marks
4 (Theory)	3 (Theory)	45	75
2 (Practical)	1 (Practical)	15	25

Course Objective:

1. To provide knowledge of gardening, cultivation, multiplication, raising of seedlings of ornamental plants.

Learning Outcomes:

On completion of this course, students will be able to:

1. Understand the process of sowing seeds in nursery.
2. List the various resources required for the development of nursery.
3. Distinguish among the different forms of sowing and growing plants.
4. Utilize vegetative propagation.
5. Appreciate the diversity of plants and selection of gardening.
6. Examine the cultivation of different vegetables and growth of plants in nursery and gardening.

Unit 1: Nursery (7 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Nursery: Introduction and Definition	1	Understand what is nursery and its importance.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
2.	Objectives and scope	1	Have knowledge on the objectives and scope of nursery.		
3.	Building up of infrastructures for nursery	1	Have knowledge of building up of infrastructures for nursery.		
4.	……..Contd.	1			
5.	Planning and seasonal activities	1	Have idea of how to do planning and seasonal activities of nursery.		
6.	……..Contd.	1			
7.	Planting: direct seeding & transplants	1	Have knowledge of the direct seedling and transplanting of nursery plants.		

Unit 2: Seed (7 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Structure and types of seeds	1	Know the structure of dicot and monocot seeds, and the different types of seeds.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Seed dormancy and causes; method of breaking of seed dormancy	1	Understand the term seed dormancy; causes of seed dormancy and the method of breaking dormancy in different seeds.		
3.	……..Contd.	1			
4.	Seed storage: seed banks	1	Know what is seed bank and how seeds are stored in seed banks.		
5.	Factors affecting seed viability,	1	Know the different factors which affect viability of seed and how they affect viability of seed.		

6.	genetic erosion- seed production technology,	1	Developed basic knowledge of seed production technology.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
7.	Seed testing and seed certification	1	Developed the knowledge of seed testing and seed certification.		

Unit 3: Vegetative Propagation (7 lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Vegetative propagation: air layering and cutting	1	Know the different methods of vegetative propagation in plants and how they are to be done.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Selection of cutting, Collecting season, treatment of cutting	1	Have knowledge on how cutting is to be done, best season to perform cutting, treatment with chemical for quick rooting and prevent infection.		
3.	Contd.	1			
4.	Rooting medium and planting of cuttings	1	Have knowledge of some rooting medium and planting of cuttings		
5.	Hardening of plants; green house, mist chamber	1	Have basic knowledge on hardening of plants, green house and mist chamber.		
6.	Shed roof, shade house	1	Have concept of Shed roof, shade house.		
7.	Glass house	1	Have knowledge of glass house and its types.		

Unit 4: Gardening (7 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Definition objective and scope, different types of gardening	1	Have knowledge of gardening, it's objective and scope, and the different types of gardening.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar / Group Discussion/Q & A Session/Assignment*
2.	……..Contd.	1			

3.	Landscape and home gardening	1	Have idea about landscape and home gardening.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar / Group Discussion/Q & A Session/Assignment*
4.	Parks and its components: Plant material and design- computer application in landscaping.	1	Have knowledge of Parks and its components such as plant material and design- computer application in landscaping.		
5.	Gardening operations: soil laying, manuring, watering, management of pest and diseases and harvesting	1	Have idea of garden operation such as soil laying, manuring, watering, management of pest and diseases and harvesting		
6.	Transplanting of seedlings- study of cultivation of different vegetables, (cabbage, brinjals, lady's finger, onion garlic, tomato, carrot	1	Have idea of transplanting of seedlings- study of cultivation of different vegetables		
7.	Storage and marketing procedures	1	Knowledge and techniques of storage and marketing procedures		

N.B. The contact hours for tutorial classes will be 15 hours

Course teachers:

1. Padmaja S.
2. L.Degachandra Singh
3. Dr. Y Pramoda Devi
4. N. Nirupama Devi
5. H.Rajesh Sharma
6. Dr. Chipem Vashi

HoD ……

Semester III

(Year 2022-2023 onwards)

Paper Code: BOT-HC-601

Paper Title: Plant Metabolism

No. of Hours per week	Credit	Total No. of Hours	Marks
6 (Theory)	4 (Theory)	60	75
4 (Practical)	2 (Practical)	30	25

Course Objective:

1. To provide insight of physiological and biochemical processes in the plant systems with emphasis on different pathways, regulation and integration of metabolic processes with their role in crop productivity.

Learning Outcomes:

On completion of this course, students will be able to:

1. Differentiate anabolic and catabolic pathways of metabolism.
2. Learn the similarity and differences in metabolic pathways in animals and plants.
3. Recognize the importance of carbon fixation and assimilation in plants.
4. Explain the ATP-Synthesis.
5. Interpret the biological nitrogen fixation in metabolism.
6. Grasp the concept of signal reception and transduction in a cell.

Unit 1: Concept of Metabolism and Photosynthetic Pigments (8 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Introduction – anabolic and catabolic pathways	1	Understand the terms and process of anabolism and catabolism.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Regulation of metabolism	1	Have the knowledge of regulation of different metabolic processes,		
3.	Enzyme: Enzyme inhibition (competitive, non-competitive and uncompetitive)	1	Have a clear knowledge of enzymes and different mechanism of enzyme inhibition.		
4.	Role of regulatory enzymes (allosteric regulation and covalent modulation, isoenzyme and alloenzymes)	1	Understand the role of these different types of enzymes.		
5.	Photosynthesis – Historical background	1	Understand how photosynthesis was discovered.		
6.	Role of photosynthetic pigments (chlorophyll and accessory pigments – no structural details)	1	Recognize the importance of photosynthetic in photosynthesis.		
7.	……contd.	1			
8.	Antenna molecules and reaction centers	1	Understand the role of different pigment molecules and reaction center.		

Unit 2: Assimilation, metabolism and Oxidation (16 Lec.)					
Section	*Topic*	*Lec. Hrs.*	*Learning Outcome*	*Pedagogy*	*Assessment/Evaluation*
1.	Photochemical reactions; PS-I, & PS-II	1	Understand how light energy is converted into chemical energy. Also, the two light absorbing system of photosynthesis and their differences.		

2.	Photosynthetic electron transport, photophosphorylation, Q-cycle	1	Understand how ATP and NADPH are synthesis during light reaction of photosynthesis.	*Lecture/Discussion/PPT/Demonstration*	*Quiz/Class test/Semina/ Group Discussion/Q & A Session/Assignment*
3.	CO_2 Reduction/Carbon Assimilation	1	Understand the importance of carbon fixation and assimilation in plants.		
4.	C_3-Cycle	1	Understand the pathway of the conversion of inorganic carbon (CO_2) into carbohydrate in C_3 plants.		
5.	C_4 and CAM pathways	1	Understand the pathway of the conversion of inorganic carbon (CO_2) into carbohydrate in C_4 and CAM plants.		
6.	Photorespiration	1	Understand the term, how it occurs and its advantage and disadvantage.		
7.	Factors affecting CO_2 reduction	1	Have knowledge of the various factors affecting photosynthesis.		
8.	Synthesis and catabolism of sucrose and starch	1	Understand how sucrose and starch are synthesis and their breakdown processes.		
9.	Carbon oxidation: Glycolysis and its regulation	1	Have knowledge of the different steps of carbon- oxidation and its regulation.		
10.	Fate of pyruvate – aerobic and anaerobic respiration and fermentation	1	How pyruvate enters different routes of metabolism after glycolysis.		
11.	Oxidative decarboxylation of pyruvate, TCA cycle	1	Understand about tri-carboxylic cycle that occurs in mitochondrial matrix.		
12.	Oxidative pentose-phosphate pathway	1	Have knowledge of PPP (pentose phosphate pathways) pathways.		
13.	Amphibolic role and anaplerotic reaction	1	Have knowledge of amphibolic and anaplerotic reactions.		

14.	Mitochondrial electron transport and oxidative phosphorylation	1	Understand how electron transport takes place in inner membrane of mitochondria associated with oxidative phosphorylation.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Semina/ Group Discussion/Q & A Session/Assignment*
15.	Cyanide-resistant respiration	1	Understand how cyanide block the electron transport chain during respiration.		
16.	Factors affecting respiration	1	Know the different factors which affect respiration and how they affect respiration.		

Unit 3: ATP Synthesis (8 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Mechanism of ATP synthesis	1	Understand the mechanism ATP synthesis.	*Lecture/Discussion/PPT/Demonstration*	*Quiz/Class test/Semina/ Group Discussion/Q & A Session/Assignment*
2.	Substrate level phosphorylation	1	Understand substrate level phosphorylation.		
3.	Chemiosmotic mechanism (oxidative and phosphorylation)	1	Students have the idea how to differentiate the types of phosphorylation.		
4.	ATP synthatase	1	Have a clear knowledge on the enzyme.		
5.	Boyers conformational model	1	Have a clear idea on the model of the enzyme		
6.	Racker’s experiment	1	Have a clear knowledge on the different experiments of different researches.		
7.	Jagendorf’s experiment	1			

8.	Role of uncoplers	1	Understand the term encoplers and their role.		

Unit 4: Lipid and Nitrogen Metabolism, Mechanism of Signaling Transduction (13 Lec.)					
Section	*Topic*	*Lec. Hrs.*	*Learning Outcome*	*Pedagogy: Lecture/Discussion/PPT/Demonstration/Practical*	*Assessment/Evaluation: Quiz/Classtest/Seminar/Group Discussion/Q & A Session/Assignment*
1.	Synthesis of triglycerides	1	Understand the process of triglycerides synthesis.	*Lecture/Discussion/PPT/Demonstration*	*Quiz/Class test/Semina/ Group Discussion/Q & A Session/Assignment*
2.	Breakdown of triglycerides	1	Know how triglycerides are brokendown.		
3.	β-Oxidation	1	Have idea on the types of pathway of lipid breakdown.		
4.	Gluconeogenesis	1	Understand the term, and the process how glucose is formed by glucogenesis.		
5.	Role in mobilization of lipids during seed germination	1	Know the importance of glucogenesis in seed germination.		
6.	α-oxidation	1	Have knowledge on α-oxidation.		
7.	Nitrate assimilation	1	Know the process of converting inorganic N_2 into organic nitrogen.		
8.	Biological N_2-fixation (examples of legumes and non-legumes)	1	Recognize the importance and the process of N_2 fixation by living organisms.		
9.	Physiology and biochemistry of N_2-fixation	1	Students can interpret nitrogen fixation in metabolism.		
10.	Ammonia assimilation (GS-GOGAT)	1	A clear concept on (GS-GOGAT) with relation to ammonia assimilation.		

11.	Reductive amination and transamination	1	Recognize the importance of amination.	*Lecture/Discussion/PPT/Demonstration*	*Quiz/Class test/Semina/ Group Discussion/Q & A Session/Assignment*
12.	Receptor-ligand interactions: Secondary messenger concept Secondary messenger concept	1	Have a clear idea on the receptor-ligand interaction.		
13.	Calcium-calmodulin MAP kinase cascade	1	Have a clear idea on the receptor-ligand interaction.		

N.B. The contact hours of tutorial classes will be 15 hours

Course teachers

1. Dr. Y Pramoda Devi
2. N. Nirupama Devi
3. H.Rajesh Sharma

HoD ……

Semester III

(Year 2022-2023 onwards)

Paper Code: BOT-HC-602
Paper Title: Ecology and Phytogeography

No. of Hours per week	Credit	Total No. of Hours	Marks
6 (Theory)	4 (Theory)	60	75
4 (Practical)	2 (Practical)	30	25

Course Objectives:

1. To gain knowledge on ecology and basic ecological concepts, inter-relation between the living world and environment.
2. To make students aware of phytogeographical regions.

Learning Outcomes:

On completion of this course, students will be able to:

1. Understand the complex interrelationship between organisms and environment.
2. Acquire knowledges on different methods for vegetation analysis.
3. Evaluate community patterns and processes including ecosystem functions.
4. Attain knowledge on principles of phytogeography and plant endemism.
5. Gain practical knowledge on different instruments used for analyzing soil and climate variables
6. Conduct qualitative and quantitative analysis for different parameters of both soil and water.

Unit 1: Introduction (9 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Brief history of ecology	1	Understand the history of ecology.	*Lecture/Discussion /PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Levels of organisaton	1	Have knowledge of the different levels of organization.		
3.	Inter-relationship between the living world and the environment	1	Understand the relationship between living world and the environment.		
4.	Ecosystem dynamics and homeostasis	1	Acquire knowledge of the ecosystem dynamics and homeostasis.		
5.	Soil formation	1	Understand the process of soil formation.		
6.	Types of soil	1	Have knowledge of the different types of soil.		
7.	Soil profile development	1	Have knowledge of the different layers of soil.		
8.	Physical properties of soil	1	Understand the different physical properties.		
9.	Chemical properties of soil	1	Understand the different chemical properties of soil.		

Unit 2: Population Ecology and Plant Adaptation (12 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Distribution and characteristics of populations	1	Understand the term population, its distribution and characteristics distri-bution (size, density, dispersion, etc.)	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Population growth and dynamics	1	Grasp the idea of various theories to explain the population growth and dynamics.		

3.	Ecological speciation	1	Understand the various factors involved in the process of speciation.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
4.	Ecads ,ecotypes, ecospecies, etc.	1	Have the idea of ecological concept of species and individuals. Understand the influence of different habitats on a species.		
5.	Mortality, natality	1	Understand the terms and have the idea of population growth and the factors that influence the population growth.		
6.	r and k selection	1	Understand the theory of Mac Arthur and Wilson (1967) regarding the population ecology and evolution of species.		
7.	Types of biotic interaction	1	Have idea about different types of interactions.		
8.	…… contd.	1			
9.	Inter- and intra-specific competition	1	Understand the terms and their differences.		
10.	Adaptations of plants to environmental factors – water	1	Understand the morphological and anatomical adaptive characters found in plants due to environmental factors such as water.		
11.	Adaptations of plants to environmental factors – light,	1	Understand the morphological and anatomical adaptive characters found in plants due to environmental factors such as light.		

12.	Adaptations of plants to environmental factors – Others	1	Understand the morphological and anatomical adaptive characters found in plants due to environmental factors. such as temperature, etc.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*

Unit 3: Ecosystem and Plant Communities (16 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Structures, types & processes	1	Have idea about structure and types of ecosystem	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
2.	Trophic organization	1	Understand the concept of Trophic organization of ecosystem.		
3.	Food chains and food webs	1	Understand the terms, types and their differences.		
4.	Ecological pyramids	1	Have knowledge of the different types of ecological pyramids.		
5.	Principles and modes of energy flow	1	Have basic concepts of the principles of modes of energy flow of an ecosystem.		
6.	Production and productivity	1	Have idea of the production and productivity in an ecosystem.		
7.	Biogeochemical cycling	1	Understand the different types of biogeochemical cycling – sulphur, phosphorous, etc. in nature.		
8.	…… contd.	1			
9.	Concept of ecological amplitude	1	Understand the concept of ecological amplitude.		
10.	Habitat and ecological Niche	1	Have a clear concept of habitat and ecological niche and their difference.		

11.	Community characters	1	Understand the structure of a community.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
12.	Ecotone and edge effects		Understand the terms and their effects in an ecosystem.		
13.	Methods of studying vegetation	1	Understand the different methods of studying vegetation.		
14.	Concepts of plant succession and climax,	1	Understand the succession of plant communities in an area.		
15.	Hydrosere	1	Understand the succession of plant communities in water.		
16.	Xerosere	1	Understand the succession of plant communities in dry areas.		

Unit 4: Phytogeography (8 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Phytogeography: Phytogeographic regions of the world,	1	Understand the term and also the different phytogeographical regions of the world.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar /Group Discussion/Q & A Session/Assignment*
2.	Phytogeographic regions of the India	1	Have knowledge of the different phytogeographical regions of India.		
3.	Static and dynamic phytogeography	1	Understand the concept of static and dynamic phytogeography.		
4.	Continental drift	1	Have knowledge of how the continents are formed.		
5.	Theory of tolerance	1	Have knowledge of how species are able to occupy a particular area.		

6.	Endemism	1	Have knowledge why some species are restricted only to a particular small region.		
7.	Major terrestrial biomes	1	Understand the characteristic features of the major terrestrial biomes of the world.		
8.	Vegetation of NE India with special reference to Manipur	1	Analyze the different types of forest found in Manipur.		

N.B. the contact hours for tutorial classes will be 15 hours

Course teachers:

1. Padmaja S.
2. L.Degachandra Singh
3. H.Rajesh Sharma
4. Dr.R.K. Imosana

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Semester III

(Year 2022-2023 onwards)

Paper Code: BOT-HC-603
Paper Title: Genetics and Cytogenetics

No. of Hours per week	Credit	Total No. of Hours	Marks
6 (Theory)	4 (Theory)	60	75
4 (Practical)	2 (Practical)	30	25

Course Objectives

1. To highlight the principles of inheritance and types of expressions resulting from the interaction of genes.
2. To discuss on how mutation occurs at the genetic level and agents that cause mutation.
3. To highlight on the importance of theories of genetics in relation with genetic variation and speciation.
4. To provide knowledge on Mendelian concepts in genetics.
5. To render knowledge of structure, functions and properties of chromosome and chromosomal aberration.
6. To provide practical knowledge on mendelian inheritance, chromosomal mapping and gene interactions.

Learning Outcomes

On completion of this course, students will be able to:

1. Possess conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
2. Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.
3. Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.
4. Analyse the effect of mutations on gene functions.

Unit 1: Mendelian Genetics and Its Extension (12 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Mendelian: History of inheritance	1	Learn about Mendelian history	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Principles of inheritance	1	Understand principles of inheritance		
3.	Chromosome theory of inheritance	1	Understand the concept of Chromosome theory of inheritance		
4.	Autosomes and sex chromosomes	1	Idea about autosomes and sex chromosomes		
5.	Probability and pedigree analysis	1	Concept of Probability and pedigree analysis with diagram.		
6.	Incomplete dominance and codominance	1	Clear concept of Incomplete dominance and codominance		
7.	Multiple alleles and Lethal alleles	1	Idea about types of alleles like Multiple alleles and Lethal alleles		
8.	Epistasis	1	Knowledge of Epistasis		
9.	Pleiotropy	1	Can understand about Pleiotropy		
10.	Recessive and Dominant traits	1	Clear concept[of Recessive and Dominant traits		
11.	Penetrance and Expressivity	1	Understand the idea of Penetrance and Expressivity		
12.	Polygenic inheritance	1	Idea of inheritance by Polygenic		

Unit 2: Extrachromosomal Inheritance (5 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Inrtoduction: Extra-chromosomal Inheritance		Learn about Inrtoductiory concept of Extra-chromosomal Inheritance.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Chloroplast inheritance: variegation in Four o'clock plant	1	Understand the mode of chloroplast inheritance in variegation Four o'clock plant.		
3.	Mitochondrial inheritance in yeast	1	Have the clear concept of mitochondrial inheritance in yeast.		
4.	Maternal effect of coiling in snail	1	Understand the Maternal effect of coiling in snail.		
5.	Kappa particles in Paramecium	1	Understand the role of Kappa particles in Paramecium.		

Unit 3: Linkage, Crossing Over and Chromosome Mapping (8 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Linkage and crossing over	1	Learn about Linkage and crossing over.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Cytological basis of crossing over	1	Understand cytological basis of crossing over.		
3.	……..contd.	1			
4.	Recombination frequency	1	Knowledge of recombination frequency.		
5.	Two factor and three factor crosses	1	Idea about two factor and three factor crosses.		

6.	Inheritance and coincidence	1	Knowledge about the terms	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
7.	Numerical based on gene mapping	1	Knowledge about numerical based on gene mapping in picturisation.		
8.	Sex linkage		Have idea about sex linkage.		

Unit 4: Variation In Chromosome Number and Structure (5 Lec.)					
Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Introduction: Variation in chromosome number and structure	1	Have understanding of the different types of chromosome mutation.	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/Group Discussion/Q & A Session/Assignment*
2.	Deletion and Duplication; Position effect	1	Students have basic concept of the genetic effects of the loss or addition of part of chromosome.		
3.	Inversion and Translocation	1	Students have knowledge of the genetic effect of the rotation or shifting of a part of chromosome.		
4.	Aneuploidy	1	Have clear of the genetic effect of the loss or addition of one or more chromosome to a complete diploid set of chromosome.		
5.	Euploidy	1	Have the concept of monoploidy, diploidy and polyploidy and their genetic significance.		

Unit 5: Fine Structure of Gene and Gene Mutations (10 Lec.)

Section	***Topic***	***Lec. Hrs.***	***Learning Outcome***	***Pedagogy***	***Assessment/Evaluation***
1.	Fine structure of gene	1	Have knowledge of Fine structure of gene	*Lecture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*
2.	Gene mutation	1	Understand gene mutation		
3.	Classical vs. molecular concepts of gene	1	Difference between classical and molecular concepts of gene		
4.	Cistron, Muton and rII locus	1	Have clear idea of Cistron, Muton and rII locus		
5.	Types of mutation	1	Understand different types of mutations.		
6.	Molecular basis of mutaton	1	Learn major molecular basis of mutation.		
7.	Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents)	1	Know radiations that are agents of mutations and different types of chemical mutagens.		
8.	Detection of mutations: ClB method	1	Understand the use of ClB in detection of mutations.		
9.	Role of transposons in mutation	1	Understand the role of transposons in mutations of plants.		
10.	DNA repair mechanisms	1	Learn different mechanisms of DNA repair.		

Unit 6: Population and Evolutionary genetics (5 Lec.)					
Section	*Topic*	*Lec. Hrs.*	*Learning Outcome*	*Pedagogy*	*Assessment/Evaluation*
1.	Allele frequency	1	Idea about allele frequency		*Quiz/Class test/Seminar/*
2.	Genotypes frequencies	1	Idea about Genotypes frequencies and difference between allele frequency and Genotypic frequency		

3.	Hardy-Weinberg Law	1	Understand Hardy-Weinberg Law and application.	*Leture/Discussion/ PPT/Demonstration*	*Group Discussion/Q & A Session/Assignment*
4.	Role of natural selection; and Genetic drift	1	Knowledge and Ro1le of natural selection; and Genetic drift		
5.	Genetic variation and Speciation	1	Understand the concept of Genetic variation and Speciation	*Leture/Discussion/ PPT/Demonstration*	*Quiz/Class test/Seminar/ Group Discussion/Q & A Session/Assignment*

N.B. the contact hours for tutorial classes will be 15 hours

Course teachers:

1. Padmaja S.
2. L.Degachandra Singh
3. Dr. Y Pramoda Devi
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