

**TEACHING PLANS**  
**BOTANY GENERIC ELECTIVE COURSES**

**Under CBCS syllabus**

**(Year 2020-21 onwards)**

**Semester-I**

**Paper Code: BOT-HG-1016**

**Paper Title: Biodiversity (Microbes, Algae, Fungi and Archegoniate)**

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

**Course Objectives:**

1. Elaborate on structure and reproduction of viruses and bacteria, and their economic importance.
2. Explain the general characteristics, morphological diversity, thallus organization, life cycles, ecological and economic importance of algae, fungi.
3. To highlight general characteristics, classification, morphology of bryophytes, pteridophytes and gymnosperms.
4. Provide practical knowledge on staining and slide preparation to study bacteria, algae and fungi under the microscope.

5. Provide practical knowledge on vegetative and reproductive structures of some representative bryophytes, pteridophytes and gymnosperms.

**Course Outcomes:**

1. Understand the fundamental concepts related to microbes, algae, fungi and bryophytes.
2. Analyse the discovery and general structure of viruses.
3. Examine the morphology and life-cycles of *Trentepohlia*, *Ulva*, *Kappaphycus*, *Sargassum*, *Turbinaria*, *Gracilaria*, *Porphyra*.
4. Evaluate the significance of fungi and its different types.
5. Analyse the anatomy and reproduction of *Cycas* and *Pinus* along with their ecological and economic importance.

<b>Unit 1: Microbes (10 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Viruses: Discovery, general structure	1	Have knowledge on the discovery and general structure of viruses.	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
2.	General account of replication of virus	1	Have knowledge of the replication of virus.		
3.	DNA virus (T-phages) and RNA-virus (TMV)	1	Have knowledge of DNA and RNA viruses and also their difference.		
4.	Lytic and lysogenic cycle	1	Understand the terms and methods of reproduction in virus.		
5.	Economic importance of virus	1	Analyze the importance of viruses.		
6.	Discovery and general characteristics of bacteria	1	Have knowledge of the discovery and characteristic features of bacteria.		

7.	Structure of bacterial cell	1	Analyze the structure bacterial cell.		
8.	Reproduction:Vegetative and asexual	1	Understand how bacteria reproduce vegetatively and asexually.		
9.	Bacterial recombination (conjugation,transformation and transduction)	1	Have knowledge of the different methods of recombination in bacteria.		
10.	Economic importance of bacteria	1	Analyze the importance of bacteria.		

<b>Unit 2: Algae (12 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy: Lecture/Discussion/P PT/Demonstration/P ractical</i>	<i>Assessment/Evaluation: Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
1.	General characteristics of algae	1	Students learn characteristics of algae.	<i>Lecture/Discussion/P PT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
2.	Ecology and distribution of algae	1	Students know Ecology and distribution of algae.		
3.	Range of thallus organization in Algae	1	Have knowledge of the different types of thallus found in algae.		
4.	Reproduction in algae	1	Have knowledge of the different types of reproduction found in algae.		
5.	Classification of algae	1	Have basic idea of how to classify algae.		
6.	Morphology and life cycle of <i>Nostoc</i> .	1	Understand the morphology and life cycle of <i>Nostoc</i> .		
7.	Morphology and life cycle of <i>Chlamydomonas</i> .	1	Understand the morphology and life cycle of <i>Chlamydomonas</i> .		

8.	Morphology and life cycle of <i>Oedogonium</i> .	1	Understand the morphology and life cycle of <i>Oedogonium</i> .		
9.	Morphology and life cycle of <i>Vaucheria</i> .	1	Understand the morphology and life cycle of <i>Vaucheria</i> .		
10.	Morphology and life cycle of <i>Fucus</i> .	1	Understand the morphology and life cycle of <i>Fucus</i> .		
11.	Morphology and life cycle of <i>Polysiphonia</i> .	1	Understand the morphology and life cycle of <i>Polysiphonia</i> .		
12.	Economic importance of algae.	1	Have knowledge of the beneficial and harmful aspects of algae.		

<b>Unit 3: Fungi (12 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy: Lecture/Discussion/P PT/Demonstration/P ractical</i>	<i>Assessment/Evaluation: Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
1.	Fungi: General characteristics, ecology and distribution	1	Have knowledge of their characteristics and the different habitats where they occur.	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
2.	Range of thallus organization in fungi	1	Have the knowledge of different forms of thallus organization in fungi.		
3.	Cell wall composition and nutrition in fungi	1	Understand the chemical substances present in the cell wall of different groups of fungi and also the types of nutrition in fungi.		

4.	Reproduction in fungi	1	Have the basic knowledge of the different methods of reproduction in fungi	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
5.	Classification of fungi	1	Understand how classification of fungi is done		
6.	True fungi – General characteristics, ecology and significance	1	Have the knowledge of the true fungi, their distribution and the significance		
7.	Life cycle of <i>Rhizopus</i>	1	Understand the life cycle of <i>Rhizopus</i>		
8.	Life cycle of <i>Penicillium</i>	1	Understand the life cycle of <i>Penicillium</i>		
9.	Life cycle of <i>Alternaria</i>	1	Understand the life cycle of <i>Alternaria</i> .		
10.	Life cycle of <i>Puccinia</i>	1	Understand the life cycle of <i>Puccinia</i>		
11.	Life cycle of <i>Agaricus</i>	11	Understand the life cycle of <i>Agaricus</i>		
12.	Lichens – General account, reproduction and significance		Understand the general account, reproduction and significance of lichens		
13.	Mycorrhiza – ectomycorrhiza, endomycorrhiza and significance of mycorrhiza	1	Have a clear concept of mycorrhiza, their types and ecological significance		

<b>Unit 4: Introduction to Archegoniate (2 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Unifying characters of archegoniates and transition to land habit	1	Have knowledge of the unifying characters of archegoniates and transit to land habit.	<i>Lecture/Discussion/P PT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
2.	Alternation of generations	1	Understand the alternation of generations of archegoniates		

<b>Unit 5: Bryophytes (10 Lec.)</b>					
Section	Topic	Lec. Hrs.	Learning Outcome	Pedagogy	Assessment/Evaluation
1.	General characteristics of bryophytes	1	Students learn general characteristics of Bryophytes	Lecture/Discussion/ PPT/Demonstration	Quiz/Class test/Seminar/Group Discussion/Q & A Session/Assignment
2.	Bryophytes first land plants	1	Have the knowledge of first land plants		
3.	Classification of Bryophytes	1	Learn important classification of Bryophytes		
4.	Range of thallus organization in Bryophytes	1	Understand the range of thallus organization in Bryophytes		
5.	Morphology and Anatomy of <i>Marchantia</i>	1	Have the knowledge of Morphology and Anatomy of <i>Marchantia</i>		
6.	Morphology and Anatomy of <i>Funaria</i>	1	Have the knowledge of Morphology and Anatomy of <i>Funaria</i>		
7.	Reproduction in <i>Marchantia</i>	1	Methods of reproduction in <i>Marchantia</i>		
8.	Reproduction in <i>Funaria</i>	1	Methods of reproduction in <i>Funaria</i>		
9.	Ecology of bryophytes	1	Understand the ecology of bryophytes		
10.	Economic importance of bryophytes	1	Understand the economic importance of bryophytes		

<b>Unit 6: Pteridophytes (8 Lec.)</b>					
Section	Topic	Lec. Hrs.	Learning Outcome	Pedagogy	Assessment/Evaluation
1.	General characters & classification	1	The students are able to understand general account and classification of pteridophytes	Lecture/Discussion/ PPT/Demonstration	Quiz/Class test/Seminar/Group Discussion/Q & A Session/Assignment
2.	Early land plants ( <i>Cooksonia</i> , <i>Rhynia</i> )	1	Understand about early land plants		

3.	Morphology, anatomy & reproduction of <i>Selaginella</i>	1	Have knowledge of morphology, anatomy & reproduction of <i>Selaginella</i>	Lecture/Discussion/ PPT/Demonstration	Quiz/Class test/Seminar/Group Discussion/Q & A Session/Assignment
4.	Morphology, anatomy & reproduction of <i>Equisetum</i>	1	Have knowledge of morphology, anatomy & reproduction of <i>Equisetum</i>		
5.	<i>Pteris</i>	1	Understand morphology, anatomy & reproduction of <i>Pteris</i>		
6.	Heterospory and seed habit	1	Have knowledge of Heterospory and seed habit of pteridophytes		
7.	Stelar evolution	1	Understand stelar evolution in pteridophytes		
8.	Ecological and economic importance of pteridophytes	1	Importance of pteridophytes on ecological and economic point of view		

<b>Unit 7: Gymnosperms (6 Lec.)</b>					
Section	Topic	Lec. Hrs.	Learning Outcome	Pedagogy	Assessment/Evaluation
1.	Introduction and general characteristics	1	Students have clear idea about gymnosperm and their characteristics features	Lecture/Discussion/ PPT/Demonstration	Quiz/Class test/Seminar/Group Discussion/Q & A Session/Assignment
2.	Classification	1	Understand how to classify gymnosperms		
3.	Morphology, anatomy and reproduction in <i>Cycas</i>		Have knowledge of morphology, anatomy and reproduction in <i>Cycas</i>		
4.	Morphology, anatomy and reproduction in <i>Pinus</i>	1	Have knowledge of morphology, anatomy and reproduction in <i>Pinus</i>		
5.	Ecological importance of gymnosperm	1	Understand the ecological importance of gymnosperm		

6.	Economical importance of gymnosperm	1	Have knowledge of the economic importance of gymnosperm	<i>Lecture/Discussion/PPT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
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N.B. The contact hours for tutorial classes is 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-II

Paper Code: BOT-HG-2016

Paper Title: Plant Ecology and Taxonomy

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. Provide knowledge on soil, water, light and temperature as ecological factors.
2. Highlight on plant community types and their succession.
3. Throw light on ecosystem, trophic levels and energy flow in the ecosystems.
4. Provide knowledge on plant taxonomy, principles, ICN rules, ranks and hierarchy.
5. Discuss on different systems of plant classification and cluster analysis.
6. Knowledge on Quadrature size determination for herbaceous plant studies in ecology.
7. Provide practical knowledge on plant identification up to the family level and preparation of herbarium specimens.

### Course Outcomes:

1. Comprehend the basic concepts of plant ecology and taxonomy, and botanical nomenclature.
2. Analyse the characteristics of different plant communities.
3. Examine the structure and functions of eco-system.
4. Evaluate the significance of herbarium.
5. Analyse the implications of biometrics, numerical taxonomy and cladistics.

<b>Unit 1: Introduction to Plant ecology (2 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Introduction to plant ecology	1	Know its definition, term coinage, branches, scope, three main ecological categories and importance	<i>Lecture/Discussion/PPT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
2.	Types of ecology	1	Know about organismal, population community and ecosystem ecology		

<b>Unit 2: Ecological factors (10 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Introduction – soil	1	Know about soil and its importance	<i>Lecture/Discussion/PPT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
2.	Origin and formation of soil	1	Understand the process of soil formation and the primary factors involved in the formation of soil		
3.	Soil composition and soil profile	1	Know the different layers of soil and their physical, chemical and biological characteristics		
4.	States of water in the environment	1	Know about the different forms of water in our environment		
5.	Precipitation types	1	Know the definition, types and their formation		
6.	Light: variation, optimal and limiting factors	1	Understand the role of light in ecosystem		
7.	Temperature: variation, optimal and limiting factors	1	Understand the role of temperature in ecosystem		

8.	Shelford's law of tolerance	1	Understand the law and the minimum, maximum and optimum ecological factors for the survival and existence of a species	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
9.	Adaptation of hydrophytes	1	Understand the term hydrophytes and the various features of hydrophytes		
10.	Adaptation of xerophytes	1	Understand the term xerophytes and the various features of xerophytes		

<b>Unit 3: Plant communities (6 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Plant communities	1	Understand the term and the important factors for determining plant community distribution of an area	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
2.	Characters of plant communities	1	Understand the basic characteristics of plant communities		
3.	Ecotone and edge effect	1	Know about the changes in population or community structure that occur at the boundary of two habitats		
4.	Succession	1	Understand the term and the change in community structure over time		

5.	Process of succession	1	Know the process of succession	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
6.	Types of succession	1	Know the types of succession with example		

**Unit 4: Ecosystem (8 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Introduction – Ecosystem, structure of ecosystem	1	Understand the term, and biotic and abiotic components of an ecosystem	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
2.	Energy flow and trophic level organization	1	Understand the energy flow taking place via the food chain and food web		
3.	Food chains and food webs	1	Know the different types of food chain and the food web, and their differences		
4.	Ecological pyramid	1	Understand the term, its types and the importance		
5.	Production and productivity	1	Understand the terms, types of productivity, and their differences		
6.	Biogeochemical cycling: Carbon cycle	1	Understand nature's way of reusing carbon atoms		
7.	Nitrogen cycle	1	Understand the N <sup>2</sup> cycle in nature		
8.	Phosphorus cycle	1	Understand phosphorous cycle in nature		

**Unit 5: Phytogeography (4 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Phytogeography	1	Have the basic concept of the distribution of plants in different regions of the world	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>

2.	Principles of phytogeography	1	Developed the knowledge of the role of environment, routes of migration, etc. in the distribution of plants	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
3.	Bio-geographical zones	1	Knows about different bio-geographical zones of the world and their characteristics		
4.	Endemism	1	Developed the basic concept of restriction of some species to a particular small regions only		

**Unit 6: Introduction to plant taxonomy (2 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Introduction	1	Understand plant taxonomy, its objectives and importance	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
2.	Identification, classification and nomenclature	1	Have basic idea of – identification, classification and nomenclature		

**Unit 7: Identification (4 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Function of herbarium	1	Understanding the role of herbarium in the identification of a plant	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
2.	Important herbaria and botanical garden of world and India	1	Have knowledge of some famous ones and their significance		

3.	Documentation: Flora	1	Understand how to do documentation of plants	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
4.	Key: single access and multi-access	1	Understand how to prepare keys and also know the significance of keys		

<b>Unit 8: Taxonomic evidence from palynology, cytology, phytochemistry and molecular data (6 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Taxonomic evidence from palynology	.1	Have knowledge of the use of spores and pollen grains to classify plant	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
2.	Evidence from cytology	1	Have knowledge of the use of characteristics of cellular structures to classify plants		
3.	Evidence from phyto-chemistry	1	Have knowledge of the uses of certain chemical compounds found in plants to classify them		
4.	..... contd.	1			
5.	Evidence from molecular data	1	Have knowledge of the use of spores and pollen grains in identification of a plant		
6.	..... contd.	1			

<b>Unit 9: Taxonomic Hierarchy (2 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Taxonomic ranks and categories	1	Know the relative level of a group of organisms.	<i>Lecture/Discussion/P PT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
2.	Taxonomic groups	1	Know about the taxon with all its subordinate taxa.		

<b>Unit 10: Botanical Nomenclature (6 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Botanical nomenclature	1	Know the scientific naming of plants	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
2.	Principles and rules of ICBN	1	Understand the rules and the guiding Principles of ICBN for naming of plants		
3.	..... contd.	1			
4.	Rank and names	1	Know the relative level of a group of organisms		
5.	Typification	1	Have the basic concept of several nomenclatural types		
6.	Author citation, valid publication & rejection of names.	1	Understand the importance of authors name in naming a plant and the conditions to fulfill for valid publication, priority and rejection of a name		

<b>Unit 11: Classification (6 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Types of classification – artificial system of classification	1	Understand how artificial classification is done	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
2.	Natural system of classification (up to series)	1	Understand how natural system of classification is done		

3.	Phylogenetic system of classification (up to series)	1	Understand how phylogenetic system of classification is done	<i>Lecture/Discussion/PPT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
4.	Bentham and Hooker's classification (up to series)	1	Know how Bentham and Hooker classified the angiospermic plants		
5.	..... contd.	1			
6.	Engler and Prantl's classification (up to series)	1	Know how artificial classification is done		

<b>Unit 12: Biometrics, numerical taxonomy and cladistics (4 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Characters, variation	1	Understand the characters and variations which are used in numerical taxonomy	<i>Lecture/Discussion/PPT/Demonstration</i>	<i>Quiz/Class test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
2.	OTUs, character weighing and coding	1	Know about OTUs as a basic unit for numerical taxonomy and also know character weighing and coding		

3.	Cluster analysis	1	Understand how to perform cluster analysis	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class test/Seminar /Group Discussion/Q &amp; A Session/Assignment</i>
4.	Phenograms, cladograms (definitions and differences)	1	Understand the terms phenograms and cladograms and their difference		

**N.B. The contact hours for tutorial classes is 15 hours**

**Course teachers:**

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2. L. Degachandra Singh
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6. Dr. Chipem Vashi

**HoD .....**

## Semester-III

Paper Code: BOT-HG-3016

Generic Elective Course

Paper Title: Plant Physiology and 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 Objectives:

1. Provide knowledge on plant-water relations and various factors affecting transpiration.
2. Highlight on the role of micro- and macro-elements in plants.
3. Discuss on photosynthesis and carbon fixation pathways.
4. Provide knowledge on enzyme properties, actions and inhibitions.
5. Highlight on biological nitrogen fixation.
6. Discuss on plant hormones, and plant responses to light and temperature.
7. Demonstrate the effect of pH and concentrations in catalase activity.

### Course Outcomes:

1. Comprehend the basic concepts of plant-water relations understanding transpiration and its significance.
2. Elaborate on the role of essential elements and mechanism of ion transport across cell membrane. Understand the concept of photosynthesis, Electron transport, mechanism of ATP synthesis and Photorespiration.
3. Imbibe the concepts of Glycolysis, anaerobic respiration, TCA cycle and Oxidative phosphorylation.
4. Examine the structure and properties of enzymes.
5. Analyse the implications of biometrics, numerical taxonomy and cladistics.

**Unit 1: Plant Water relations (8 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>	<i>Classes taken on</i>	<i>Signature of teacher</i>
11.	Importance of water	1	Have knowledge of the importance of water in plants				
12.	Water potential and its components	1	Understand the term water potential and its role on the absorption of water				
13.	Transpiration and its significance	1	Know what transpiration is, its types mechanism and significance				
14.	..... contd.	1					
15.	Factors affecting transpiration	1	Understand how different external and internal factors affect transpiration				
16.	..... contd.	1					
17.	Root pressure	1	Have basic concept of them, their mechanism and importance in the upward movement of water				
18.	Guttation	1	Know the process and its significance				

**Unit 2: Mineral Nutriton (8 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>	<i>Classes taken on</i>	<i>Signature of teacher</i>
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13.	Essential elements	1	Have basic concept of these elements				
14.	Macro-nutrients	1	Know the function and deficiency symptoms of these elements in plants				
15.	Micro-nutrients	1	Know the function and deficiency symptoms of these essential elements in plants				
16.	Criteria of essentiality of elements	1	Have understand the criteria for the essentiality of these elements				
17.	Role of essential elements	1	Know the specific functions of essential elements in plants				
18.	Transport of ions across cell membrane	1	Understand the different methods of transport of ions across cell membrane				
19.	Active and passive transport	1	Understand the difference between active and passive transport				
20.	Carriers channels and pumps	1	Able to understand the difference between a carriers channels and a pump				

**Unit 3: Translocation in Phloem (6 lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy:</i>	<i>Assessment/Evaluation</i>	<i>Classes taken on</i>	<i>Signature of teacher</i>
14.	Composition of Phloem sap	1	Have knowledge of the chemical composition of phloem sap				

15.	Girdling experiment	1	Can identify and understand the tissue through which the food is transported				
16.	Pressure flow model	1	Could analyze the model concerned				
17.	..... contd.	1					
18.	Phloem loading	1	Understand the mechanism involved in water and minerals translocation.				
19.	Phloem unloading	1	Understand the mechanism of the transfer of sugar from sieve tube elements to roots or other storage cells (sink)				

**Unit 4: Photosynthesis (12 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>	<i>Classes taken on</i>	<i>Signature of teacher</i>
3.	Photosynthetic pigments (Chlorophyll – a, b, xanthophylls and carotenes)	1	Recognize the importance of pigment molecules in photosynthesis				
4.	..... contd.	1					
5.	Photosystem – I and II	1	Understand the two light absorbing system of photo-synthesis and their differences				

6.	Reaction center	1	Understand the role of reaction center in photosynthesis				
7.	Antenna molecules	1	Understand the role of different pigment molecules in photosynthesis				
8.	Electron transport and mechanism of ATP synthesis	1	Understand electron transport chain and the mechanism of ATP synthesis				
9.	C3 pathways of carbon fixation	1	Understand the pathway of the conversion of inorganic carbon (CO <sub>2</sub> ) into carbohydrate in C <sub>3</sub> plants				
10.	..... Contd.	1					
11.	C4 pathways of carbon fixation	1	Understand the pathway of the conversion of inorganic carbon (CO <sub>2</sub> ) into carbohydrate in C <sub>4</sub>				
12.	.....contd.	1					
13.	CAM pathways of carbon fixation	1	Understand the pathway of the conversion of inorganic carbon (CO <sub>2</sub> ) into carbohydrate in CAM plants.				
14.	Photorespiration	1	Understand the term, how it occurs and its advantage and disadvantage				

**Unit 5: Respiration (6 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>	<i>Classes taken on</i>	<i>Signature of teacher</i>
7.	Glycolysis	1	Students will have the knowledge of different steps				

			of glycolysis.				
8.	Anaerobic respiration	1	Understand the process, its types and its importance				
9.	TCA-Cycle	1	Have the knowledge of the different steps of tri-carboxylic acid cycle				
10.	Oxidative phosphorylation	1	Have a clear idea of oxidative phosphorylation				
11.	Glyoxylate pathway	1	Understand the process and its importance in a cell				
12.	Oxidative pentose phosphate pathway	1	Will introduce different steps of oxidative pentose phosphate pathway				

**Unit 6: Enzymes (4 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>	<i>Classes taken on</i>	<i>Signature of teacher</i>
9.	Structure and properties of enzymes	1	Understand the different structures of enzymes and their properties				
10.	Mechanism of enzyme catalysis	1	Understand the different mechanisms of enzyme catalysis				
11.	..... contd.	1	Will introduce different steps of oxidative pentose phosphate pathway				
12.	Enzyme inhibition	1	Understand the term and its types				

<b>Unit 7: Nitrogen metabolism (4 Lec.)</b>							
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>	<i>Classes taken on</i>	<i>Signature of teacher</i>
13.	Biological nitrogen fixation	1	Recognize the importance and the process of N <sub>2</sub> fixation by living organisms				
14.	..... contd.	1					
15.	Nitrate assimilation	1	Know the process of converting inorganic N <sub>2</sub> into organic nitrogen				
16.	Ammonia assimilation	1	Have a clear concept on ammonia assimilation				

<b>Unit 8: Plant growth Regulator (6 Lec.)</b>							
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>	<i>Classes taken on</i>	<i>Signature of teacher</i>
1.	Discovery and physiological roles of auxins	1	Know its role in cell elongation, apical dominance parthenocarpy, flowering etc.				
2.	..... contd.	1					
3.	Discovery and physiological roles of gibberellins	1	Know its role in stem and leaf growth, bolting, flowering see d germination, sex determination etc.				
4.	Discovery and physiological roles of cytokinins	1	Know its role in cell division, cell elongation, seed				

			dormancy, senescence, etc.				
5.	Discovery and physiological roles of ABA	1	Know its role in bud dormancy, seed dormancy, parthenocarpy , etc.				
6.	Discovery and physiological roles of ethylene	1	Know its role in fruit ripening, breaking dormancy, root initiation, etc.				

**Unit 9 : Plant response to Light and Temperature (6 Lec.)**

<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>	<i>Classes taken on</i>	<i>Signature of teacher</i>
1.	Photoperiodism	1	Know about the developmental responses of plants to the relative lengths of light and dark period				
2.	SDP and LDP Day neutral plants	1	Have knowledge about SDP, LDP and day neutral plants				
3.	.....contd.	1					
4.	Phytochrome (discovery & structure)	1	Have knowledge of the discovery of phytochrome				
5.	Red and far-red light responses on photomorphogenesis	1	Have clear idea of the role of red and far-red light on photo-morphogenesis				

6.	Vernalization	1	Know the process of flowering in plants				
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N.B. The contact hours for tutorial classes is 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-IV

Paper Code: BOT-HG-4016

Paper Title: Plant Anatomy, Embryology, Economic Botany and Biotechnology

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. Provide knowledge on plant cell, tissues, type of tissues, organization of tissues in organ, primary growth and secondary growth in angiosperms.
2. Impart knowledge of reproduction in angiosperms including structures and function of reproductive organs, their specific functions, various processes involved reproduction such as sporogenesis, gametogenesis, pollination, fertilization and development of endosperms and embryos.
3. Highlight origin of crop plants, some main crop plants used as oil, fibres, sugars, legumes, beverages, rubber and medicines and their uses and processing.
4. Explain the basic concept of tissue culture, genetic engineering and its application for human welfare.

### Course Outcomes:

1. Comprehend cell, tissues, organization of tissues in parts of plants and growth in plants.
2. Learn structures of reproductive organs and the various processes involved of reproduction in angiosperms.
3. Understand origin of crop plants and study some main crop plants used as oil, fibres, sugars, legumes, beverages, rubber and medicines.
4. Learn basic concept of tissue culture, genetic engineering and its application for human welfare.

**4<sup>th</sup> Semester**  
**Paper Code: BOT-HG – 4016**  
**Title of Paper: Plant Anatomy, Embryology, Economic Botany and Biotechnology**

<b>Unit 1: Plant Anatomy (15 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Cell structure	1	Understand the fundamentals of cell structure	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class/test/Seminar/ Group Discussion/Q &amp; A Session/Assignment</i>
2.	Cell wall	1	Understand structure of cell wall		
3.	Cell inclusion	1	Learn about various cell inclusions		
4.	Organization of apical meristem	1	Gain substantial knowledge of apical meristem of root and shoot		
5.	Theories of organization of shoot apex	1	Understand different theories of shoot apex organization		
6.	Theories of organization of root apex	1	Understand different theories of shoot apex organization		
7.	Tissues-introduction and types	1	Learn about tissue, tissue system and types		
8.	Simple tissues-structure and distribution	1	Learn about simple tissues, their structure and distribution in plant organs		
9.	..... contd.	1			
10.	Complex tissues-structure and distribution	1	Learn about complex tissues, their structure and distribution in plant organs		
11.	..... contd.	1			

12.	Primary growth in plants	1	Understand primary growth in plants.	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class/test/Seminar/ Group Discussion/Q &amp; A Session/Assignment</i>
13.	Secondary growth in plants	1	Understand secondary growth in plants.		
14.	Vascular cambium-structure and function	1	Learn the structure of different cambium initials and their function.		
15.	.....contd.	1			

<b>Unit 2: Embryology (15 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Structural organization of flowers	1	Learn how different floral organs are organised in a flower	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class/test/Seminar/ Group Discussion/Q &amp; A Session/Assignment</i>
2.	Structure of anther and pollen	1	Understand structure of anther and pollen		
3.	.....contd.	1			
4.	.....contd.	1			
5.	Structure and types of ovules	1	Learn structure and various types of ovules		
6.	Types of embryo sac	1	Understand various types of embryo sac		
7.	.....contd.	1			
8.	Organization and ultra-structure of mature embryo sac	1	Understand how cells are organized in an Embryo-sac		
9.	.....contd.	1			

10.	Fertilization	1	Understand fertilization	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class/test/Seminar/ Group Discussion/Q &amp; A Session/Assignment</i>
11.	..... contd.	1			
12.	Embryo development	1	Understand various types of embryo development		
13.	..... contd.	1			
14.	Endosperm development	1	Understand the main three types of endosperm development		
15.	..... contd.	1			

<b>Unit 3: Economic Botany (15 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Origin of cultivated plants	1	Learn about origin of cultivated plants	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class/test/Seminar/ Group Discussion/Q &amp; A Session/Assignment</i>
2.	Vavilov's centre of origin	1	Understand the concept of Vavilov's centre of origin and the various centres		
3.	..... contd.	1			
4.	Origin, cultivation and improvement of rice and potato	1	Learn about origin, cultivation and improvement of rice and potato		
5.	..... contd.	1			
6.	..... contd.	1			
7.	Tea- history, cultivation and processing	1	Gain knowledge of history, cultivation and processing of tea		
8.	..... contd.	1			

9.	Oils- general description with special reference to mustard oil	1	Know general description of mustard	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class/test/Seminar/ Group Discussion/Q &amp; A Session/Assignment</i>
10.	Legumes: General account with special reference to pea and soy bean	1	Learn general account of legumes with special reference to pea and soy bean.		
11.	..... contd.	1			
12.	..... contd.	1			
13.	Medicinal Plants: <i>Cinchona</i> , <i>Rauwolfia</i> and <i>Adhatota</i>	1	Learn some medicinal plants		
14.	..... contd.	1			
15.	..... contd.	1			

<b>Unit 4: Biotechnology (16 Lec.)</b>					
<i>Section</i>	<i>Topic</i>	<i>Lec. Hrs.</i>	<i>Learning Outcome</i>	<i>Pedagogy</i>	<i>Assessment/Evaluation</i>
1.	Introduction to biotechnology	1	Have clear concept of biotechnology.	<i>Lecture/Discussion/ PPT/Demonstration</i>	<i>Quiz/Class/test/Seminar/ Group Discussion/Q &amp; A Session/Assignment</i>
2.	Basic aspect of plant tissue culture	1	Understand the basic aspect of plant tissue culture.		
3.	..... contd.	1			
4.	Cellular totipotency	1	Know cellular to totipotency and its use in tissue culture.		
5.	Differentiation	1	Learn the concept of differentiation.		
6.	Morphogenesis	1	Learn the concept of morphogenesis.		

7.	Genetic engineering in plant improvement	1	Understand genetic engineering in plant improvement	<i>Lecture/Discussion/PPT/Demonstration</i>	<i>Quiz/Class/test/Seminar/Group Discussion/Q &amp; A Session/Assignment</i>
8.	..... contd.	1			
9.	Application of genetic engineering in plant improvement	1	Learn application of genetic engineering in plant improvement with examples		
10.	..... contd.	1			
11.	Application of biotechnology in medicines	1	Learn some applications of biotechnology in medicines		
12.	..... contd.	1			
13.	Application of biotechnology in human welfare	1	Learn some applications of biotechnology in human welfare		
14.	..... contd.	1			
15.	Application of biotechnology in agriculture	1	Learn some application of biotechnology in agriculture		
16.	..... contd.	1			

N.B. The contact hours for tutorial classes is 15 hours

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