

**SYLLABUS**  
**DIBRUGARH UNIVERSITY**  
**FYUGP**



**B.Sc. IN BOTANY (NEP)**

**Approved in the BOS, Life Sciences held on 23-11-2022**

# **FOUR YEAR UNDER-GRADUATE PROGRAMME (FYUGP) IN BOTANY, DIBRUGARH UNIVERSITY**

## **1. The Preamble:**

Present day plant science is a fusion of the traditional components with the modern aspects of biochemistry, molecular biology and biotechnology. Over the years, plant science (Botany) has shown enormous gain in information and applications owing to tremendous inputs from research in all its aspects. With the global need for conservation, field plant biologists have contributed significantly in assessing and exploring newer dimensions for plant diversity. New insights have been gained in functional and structural aspects of plant development by utilizing modern tools and techniques for botanical research. Challenging areas of teaching and research have emerged in ecology and reproductive biology. Concern for ever increasing pollution and climate change is at its highest than ever before. Keeping the above mentioned advancements and rich plant resources in North East India in view, a revised curriculum is offered by Dibrugarh University at the undergraduate level as per the National Education Policy-2020 so that the undergraduate Botany students of Dibrugarh University shall have the benefit of a balanced, carefully-crafted course structure taking care of different aspects of plant science, namely plant diversity, physiology, biochemistry, molecular biology, reproduction, anatomy, taxonomy, ecology, economic botany and the impact of environment on the growth and development of plants. All these aspects have been given due weightage over the eight semesters. It is essential for the undergraduate students to acquaint themselves with various tools and techniques for exploring the world of plants up to the sub- cellular level. Keeping view of employment entrepreneurship, applied courses have also been introduced. These courses shall provide the botany students hands on experience and professional inputs. On the whole, the curriculum is a source of lot of information and is supported by rich resource materials. It is hoped that a student graduating in Botany with the new curriculum will be able to explore the rich plant diversity of North East India.

## **2. Introduction:**

Dibrugarh University UG syllabus of Botany is designed as per the guidelines of National Education Policy-2020. This Four Year Under Graduate Programme (FYUGP) in Botany consists of Major (Core) disciplines, Minor disciplines, Multi Disciplinary Generic Elective Courses (GE), Ability Enhancement Courses (AEC), Value Added Courses (VAC), Skill Enhancement Courses (SEC), Environmental Education (EE), YOGA, Community Engagement like NCC/NSS, Digital and Technological solutions, Internship, Field Studies, Research Ethics, Research Projects and Discipline Specific electives (DSE) to acquaint the students with balanced knowledge on the plant resources, environment, contemporary issues and entrepreneurship.

The Bachelor of Science in Botany of Dibrugarh University under NEP-2020 is a programme with multiple exit options. UG certificate, UG Diploma, UG Degree and UG Degree (Honours with Research) in Botany will be awarded to students after successful completion of one, two, three and four years respectively. It is expected that, on successful completion of this four year programme students will be skilled in multidisciplinary aspects for exploration and sustainable utilization of plant/natural resources of NE region of India.

### **3. Aims of Four Year Under-Graduate Programme (FYUGP) in Botany:**

1. To introduce the students with the rich biodiversity of North east India.
2. To enable the students to explore the potential of plant resources for human welfare and their use in a sustainable way.
3. To develop capabilities of students for critical evaluation of contemporary issues related to environment and nature.
4. To generate skilled human resource for biological entrepreneurship.

### **4. Graduate Attributes of the FYUGP in Botany:**

#### ***Disciplinary Knowledge***

The graduates should have the ability to demonstrate comprehensive knowledge and understanding of both the theoretical and applied components of plant science and allied areas of study in a multidisciplinary context.

Students should have the ability to connect relevant disciplines, and recent trends in biological and contemporary issues.

#### ***Communication Skills***

The graduates in Botany should have the ability to present and express information, thoughts, experiments and results clearly and concisely for effective communication of any issues related to plant and nature.

#### ***Moral and Ethical Awareness/Reasoning***

Ability to recognise ethical issues that are pertinent to one's work and pledge not to engage in unethical behaviour such as plagiarism, copyright and infringement of intellectual property rights; ability to appreciate recent developments in various fields and one's research with honesty and integrity in all aspects.

#### ***Multicultural Competence***

Ability to correlate and compare recent developments in various branches of plant science worldwide; ability to collaborate research in various fields of biology with other researchers from allied organisations; acquisition of knowledge on traditional practices of different ethnic communities.

#### ***Information/Digital Literacy***

The graduates of Botany should have the ability to utilize Information and Communications Technology (ICT) tools, biological databases and computer and softwares in solving biological problems.

#### ***Reflective Thinking and Problem Solving:***

After completion of graduation in Botany the students will be able to understand the value of plant resources, need for conservation of plant resources, bio-prospecting and sustainable utilization of plant resources for human welfare.

### ***Critical Thinking***

The graduates of Botany should be competent for critical analysis of problems related to plant and nature, sustainable uses of biological resources and their conservation strategies.

### **5. Programme Learning Outcome**

**P.O. 1:** Knowledge on diversity of plant resources, their importance and strategies for conservation.

**P.O. 2.** Scientific approach to address problems in plant science and use of plant based products for human welfare.

**P.O. 3.** Application of knowledge and skills in entrepreneurship.

**P.O. 4.** Develop new techniques/methods for solving the problems of the allied disciplines.

### **6. Teaching Learning Process**

The programme allows to use varied pedagogical methods and techniques both within classroom and beyond.

1. Lecture
2. Practical
3. Tutorial
4. Documentary on related topic
5. Project Work/Dissertation
6. Group Discussion
7. Seminars/workshops/conferences
8. Field visits and Report/Excursions
9. Mentor/Mentee

### **7. Assessment**

1. Home assignment
2. Project Report
3. Class Presentation: Oral/Poster/Power point
4. Group Discussions
5. In semester examinations
6. End Semester examinations

.....

Year	Semester	Course	Title of the Course	Total Credit	
Year 01	1 <sup>st</sup> Semester	C - 1	Algae, Fungi, Bryophyte & Pteridophyte	4	
		Minor 1	Algae, Fungi, Bryophyte & Pteridophyte	4	
		GEC - 1	Natural resource management	3	
		AEC 1	Modern Indian Language	4	
		VAC 1	Understanding India	2	
		VAC 2	Health and Wellness	2	
		SEC 1	Tea plantation and management/Mushroom Culture technology	3	
	<b>22</b>				
	2 <sup>nd</sup> Semester	C - 2	Morphology and Reproduction of Spermatophytes	4	
		Minor 2	Morphology and Reproduction of Spermatophytes	4	
		GEC 2	Plant Diversity and Human Welfare	3	
		AEC 2	English Language and Communication Skills	4	
		VAC 3	Environmental Science	2	
		VAC 4	Yoga Education	2	
SEC 2		Biofertilizers/Conservation and Cultivation of Orchids	3		
<b>22</b>					
<b>The students on exit shall be awarded Undergraduate Certificate (in the Field of Study/Discipline) after securing the requisite 44 Credits in Semester 1 and 2 provided they secure 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credits from skill based courses earned during 1<sup>st</sup> and 2<sup>nd</sup> Semester</b>					
Year 02	3 <sup>rd</sup> Semester	C - 3	Cell Biology	4	
		C - 4	Plant Biochemistry & Molecular Biology	4	
		Minor 3	Plant Physiology & Metabolism	4	
		GEC - 3	Ethnobotany	3	
		VAC 3	Digital and Technological Solutions / Digital Fluency	2	
		AEC - 3	Communicative English / Mathematical Ability	2	
		SEC - 3	Nursery and Gardening/Medicinal Botany	3	
<b>22</b>					

**Abbreviations Used:**

- **C = Major**
- **GEC = Generic Elective Course / Multi Disciplinary Course**
- **AEC = Ability Enhancement Course**
- **SEC = Skill Enhancement Course**
- **VAC = Value Added Course**

## DETAILED SYLLABUS OF 1<sup>st</sup> SEMESTER

**Title of the Course** : Algae, Fungi, Bryophyte & Pteridophyte  
**Course Code** : BOTC1  
**Nature of the Course** : MAJOR/CORE COURSE I  
**Total Credits** : 04  
**Distribution of Marks** : 80 (End Sem) (60T+20P) + 20 (In-Sem)

**COURSE OBJECTIVES:** The objective of this course is to provide knowledge to the students on various forms of algae, fungi, bryophytes and pteridophytes - their characteristics, mode of reproduction and economic importance.

UNITS	CONTENTS	L	T	P	Total Hours
I 16 marks	<b>Introduction to Algae :</b> Classification system of Fritsch, and Basic concept of evolutionary classification viz. Lee; General characteristics; range of thallus organization; cell structure; pigment system, reserve food, methods of reproduction. Role of algae in the environment, agriculture, biotechnology and industry. <b>Study of major divisions of Algae:</b> Comparative study of Characteristics; Occurrence; Mode of reproduction; Morphology and life cycles of <i>Volvox</i> , <i>Oedogonium</i> , <i>Chara</i> , <i>Ectocarpus</i> , <i>Anabaena</i> and <i>Polysiphonia</i> . Diatoms and its importance.	11	2	-	13
II 16 marks	<b>Introduction to fungi</b> Salient features; Classification; Thallus organization; Cell wall composition; Nutrition; Classification. Mycorrhiza (Ectomycorrhiza, Endomycorrhiza and their significance); Lichen: Classification & Economic Importance. <b>Study of major divisions of fungi:</b> General characteristics of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, Oomycota: asexual and sexual fruiting bodies; Life cycle of <i>Phytophthora</i> , <i>Saccharomyces</i> , <i>Penicillium</i> , <i>Puccinia</i> , <i>Peziza</i> , <i>Agaricus</i> . Economic importance of fungi.	11	2	-	13
III 14 marks	<b>Bryophytes :</b> General features; classification; thallus organization; morphology, anatomy and reproduction of <i>Marchantia</i> , <i>Anthoceros</i> , <i>Sphagnum</i> ; Reproduction and evolutionary trends in bryophytes. Ecological and economic importance of bryophytes.	09	1		10
IV 14 marks	<b>Pteridophytes:</b> Classification, morphology, anatomy and reproduction of <i>Psilotum</i> , <i>Selaginella</i> , <i>Equisetum</i> and <i>Ophioglossum</i> , <i>Marselia</i> . Heterospory, stelar evolution; Ecological and economic importance.	08	1		09
Practical (20 marks)	1. Study of vegetative and reproductive structures of <i>Nostoc</i> , <i>Chlamydomonas</i> (electron micrographs), <i>Volvox</i> , <i>Oedogonium</i> , <i>Coleochaete</i> , <i>Chara</i> , <i>Vaucheria</i> , <i>Ectocarpus</i> , <i>Fucus</i> and <i>Polysiphonia</i> , through electron micrographs, temporary preparations and permanent slides. 2. Study of vegetative and reproductive structures of <i>Phytophthora</i> , <i>Albugo</i> , <i>Saccharomyces</i> , <i>Aspergillus</i> , <i>Penicillium</i> , <i>Alternaria</i> , and <i>Peziza</i> . 3. Study of vegetative and reproductive structures of <i>Riccia</i> , <i>Marchantia</i> , <i>Anthoceros</i> , <i>Sphagnum</i> , <i>Funaria</i> and <i>Polytrichum</i> 4. Study of vegetative and reproductive structures of <i>Selaginella</i> , <i>Equisetum</i> and <i>Ophioglossum</i> , <i>Marselia</i>			30	30
<b>Total</b>		<b>39</b>	<b>06</b>	<b>30</b>	<b>75</b>

Where,

**L: Lectures**

**T: Tutorials**

**P: Practicals**

**MODES OF IN-SEMESTER ASSESSMENT:**

- One Internal Examination -
- Others (Any one) -
  - Sessional Examination

(20 Marks)

**10 Marks**

**10 Marks**

- Assignment

**LEARNING OUTCOMES:**

- (1) Know the classification, morphology, reproduction and economic and ecological importance of cryptogams.
- (2) Handling and observation of algae, fungi, bryophytes and pteridophytes.

**SUGGESTED READINGS:**

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4<sup>th</sup> edition.
  2. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
  3. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
  4. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8<sup>th</sup> edition.
  5. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4<sup>th</sup> edition.
  6. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3<sup>rd</sup> edition
  7. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
  8. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
  9. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
  10. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press
  11. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
- .....

**Title of the Course : Algae, Fungi, Bryophyte & Pteridophyte**  
**Course Code : MINBOT1**  
**Nature of the Course : MINOR COURSE I**  
**Total Credits : 04**  
**Distribution of Marks : 80 (End Sem) (60T+20P) + 20 (In-Sem)**

**COURSE OBJECTIVES:** The objective of this course is to provide knowledge to the students on various forms of algae, fungi, bryophytes and pteridophytes - their characteristics, mode of reproduction and economic importance.

UNITS	CONTENTS	L	T	P	Total Hours
I 16 marks	<b>Introduction to Algae :</b> Classification system of Fritsch, and Basic concept of evolutionary classification viz. Lee; General characteristics; range of thallus organization; cell structure; pigment system, reserve food, methods of reproduction. Role of algae in the environment, agriculture, biotechnology and industry. <b>Study of major divisions of Algae:</b> Comparative study of Characteristics; Occurrence; Mode of reproduction; Morphology and life cycles of <i>Volvox</i> , <i>Oedogonium</i> , <i>Chara</i> , <i>Ectocarpus</i> , <i>Anabaena</i> and <i>Polysiphonia</i> . Diatoms and its importance.	11	2	-	13
II 16 marks	<b>Introduction to fungi</b> Salient features; Classification; Thallus organization; Cell wall composition; Nutrition; Classification. Mycorrhiza (Ectomycorrhiza, Endomycorrhiza and their significance); Lichen: Classification & Economic Importance. <b>Study of major divisions of fungi:</b> General characteristics of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, Oomycota: asexual and sexual fruiting bodies; Life cycle of <i>Phytophthora</i> , <i>Saccharomyces</i> , <i>Penicillium</i> , <i>Puccinia</i> , <i>Peziza</i> , <i>Agaricus</i> . Economic importance of fungi.	11	2	-	13
III 14 marks	<b>Bryophytes :</b> General features; classification; thallus organization; morphology, anatomy and reproduction of <i>Marchantia</i> , <i>Anthoceros</i> , <i>Sphagnum</i> ; Reproduction and evolutionary trends in bryophytes. Ecological and economic importance of bryophytes.	09	1		10
IV 14 marks	<b>Pteridophytes:</b> Classification, morphology, anatomy and reproduction of <i>Psilotum</i> , <i>Selaginella</i> , <i>Equisetum</i> and <i>Ophioglossum</i> , <i>Marselia</i> . Heterospory, stelar evolution; Ecological and economic importance.	08	1		09
<b>Practical (20 marks)</b>	1. Study of vegetative and reproductive structures of <i>Nostoc</i> , <i>Chlamydomonas</i> (electron micrographs), <i>Volvox</i> , <i>Oedogonium</i> , <i>Coleochaete</i> , <i>Chara</i> , <i>Vaucheria</i> , <i>Ectocarpus</i> , <i>Fucus</i> and <i>Polysiphonia</i> , through electron micrographs, temporary preparations and permanent slides. 2. Study of vegetative and reproductive structures of <i>Phytophthora</i> , <i>Albugo</i> , <i>Saccharomyces</i> , <i>Aspergillus</i> , <i>Penicillium</i> , <i>Alternaria</i> , and <i>Peziza</i> . 3. Study of vegetative and reproductive structures of <i>Riccia</i> , <i>Marchantia</i> , <i>Anthoceros</i> , <i>Sphagnum</i> , <i>Funaria</i> and <i>Polytrichum</i> 4. . Study of vegetative and reproductive structures of <i>Selaginella</i> , <i>Equisetum</i> and <i>Ophioglossium</i> , <i>Marselia</i>			30	30
	<b>Total</b>	<b>39</b>	<b>06</b>	<b>30</b>	<b>75</b>

**Where,**  
**MODES OF IN-SEMESTER ASSESSMENT:**  
 • One Internal Examination -  
 • Others (Any one) -  
   ○ Sessional Examination  
   ○ Assignment  
**LEARNING OUTCOMES:**



1. Know the classification, morphology, reproduction and economic and ecological importance of cryptogams.
2. Handling and observation of algae, fungi, bryophytes and pteridophytes.

**SUGGESTED READINGS:**

12. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4<sup>th</sup> edition.
13. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
14. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
15. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8<sup>th</sup> edition.
16. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4<sup>th</sup> edition.
17. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3<sup>rd</sup> edition
18. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
19. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
20. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
21. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.
22. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.

**Title of the Course : Natural resource management**  
**Course Code : GECBOT 1**  
**Nature of the Course : Generic Elective Course-I**  
**Total Credits : 03**  
**Distribution of Marks : 80 (End Sem) + 20 (In-Sem)**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on importance, sustainable utilization, conservation and management of natural resources.*

UNITS	CONTENTS	L	T	P	Total Hours
I 15 MARKS	Natural resources: Definition and types. Natural resources of NE India.	8	01	-	09
II 25 MARKS	Sustainable utilization of land and water resources; Soil degradation and management; water resources and their management. Renewable and non-renewable sources of energy.	12	01	-	13
III 15 MARKS	Forests: Definition, Significance; Types of vegetation in India; NTFC Depletion and Management, JFM.	08	02	-	10
IV 25 MARKS	Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management. National and international efforts in resource management and conservation	10	03	-	13
<b>Total</b>		<b>38</b>	<b>07</b>	<b>-</b>	<b>45</b>

*Where, L: Lectures T: Tutorials P: Practicals*

**MODES OF IN-SEMESTER ASSESSMENT:** (20 Marks)

- One Internal Examination - **10 Marks**
- Others (Any one) - **10 Marks**
  - Sessional Examinations
  - Assignment

**LEARNING OUTCOMES:**

1. Know about the natural resources, its types, sustainable utilization and management practices.

**SUGGESTED READINGS:**

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

**Title of the Course: TEA PLANTATION AND MANAGEMENT**  
**Course Code : SEC118**  
**Nature of the Course: Skill Enhancement Course-I**  
**Total Credits: 03**  
**Distribution of Marks: 80 (End Sem) (60T+20P) + 20 (In-Sem)**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on tea plant, its history, tea cultivation practices, tea production and processing.*

UNITS	CONTENTS	L	T	P	Total Hours
I (20 marks)	History of tea cultivation, classification; Botany of tea plant, morphology and anatomy of tea plants; Climate and tea production, temperature, rainfall, humidity, sunshine, shade trees, soil characteristics, organic matter, soil nutrients, nutrients application.	10	1	-	11
II (20 marks)	Cultivation Practices: Tea culture and Propagation techniques, seed propagation, vegetative propagation, grafting, nursery management; Selection of planting sites, land preparation, plant spacing and staking, irrigation, organic Tea cultivation. Manuring, pruning, tipping and plucking, shade tree.	10	2	-	12
III (20 marks)	Production and processing: Black tea, Green tea and Oolong tea. Tea grades; storing of tea; Organic tea preparation, instant tea, herbal tea health benefits of tea, employment generation, revenue earner.	10	1	-	11
<b>Practical (20 marks)</b>	Demonstration of tea nursery, cutting and vegetative propagation, pruning and skiffing, tea processing industries and packaging of tea.		01	25	26
<b>Total</b>		<b>30</b>	<b>05</b>	<b>25</b>	<b>60</b>

*Where,*

*L: Lectures*

*T: Tutorials*

*P: Practicals*

**MODES OF IN-SEMESTER ASSESSMENT:**

- One Internal Examination -
- Others (Any one) -
  - Sessional Examination
  - Assignment

**(20 Marks)**

**10 Marks**

**10 Marks**

**LEARNING OUTCOMES:**

1. Know the tea cultivation, production and processing techniques.
2. Learn the techniques of vegetative propagation of tea and development of tea nursery.

**SUGGESTED READINGS:**

1. Tea Cultivation in the Plains of North East India by A. P. Das, S. E. Kabir  
Regency Publications
2. Global Advance in Tea Science Paperback – June 1, 2002 by N. K. Jain
3. James Norwood Pratt's Tea Dictionary by James Norwood Pratt and Devan Shah
4. Global tea science Current Status and Future Needs Editors

**Title of the Course: Mushroom Culture technology****Course Code: SEC119****Nature of the Course: Skill Enhancement Course-I****Total Credits: 03****Distribution of Marks: 80 (End Sem) (60T+20P) + 20 (In-Sem)**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on Mushroomcultivation, production and processing techniques.*

UNITS	CONTENTS	L	T	P	Total Hours
I (20 marks)	Introduction, Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.Types of edible mushrooms available in India – <i>Volvariellavolvacea</i> , <i>Pleurotuscitrinopileatus</i> , <i>Agaricusbisporus</i> .	10	1	-	11
II (25 marks)	Cultivation Technology : 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. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, composting technology in mushroom production.	10	2	-	12
III (15 marks)	Storage: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions.	10	1	-	11
<b>Practical (20 marks)</b>	Identification of edible mushroom, Demonstration of spawn preparation, Demonstration of culture & packaging technique of mushroom.		01	25	26
<b>Total</b>		<b>30</b>	<b>05</b>	<b>25</b>	<b>60</b>

*Where,**L: Lectures**T: Tutorials**P: Practicals***MODES OF IN-SEMESTER ASSESSMENT:****(20 Marks)**

- One Internal Examination -
- Others (Any one) -
  - Sessional Examination
  - Assignment

**10 Marks****10 Marks****LEARNING OUTCOMES:**

1. Know the Mushroom cultivation, production and processing techniques.
2. Learn the techniques of identification of edible and non-edible mushrooms.

**SUGGESTED READINGS:**

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (199 Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II

## DETAILED SYLLABUS OF 2<sup>nd</sup> SEMESTER

**Title of the Course** : Morphology and Reproduction of Spermatophytes  
**Course Code** : BOTC2  
**Nature of the Course** : MAJOR/CORE COURSE II  
**Total Credits** : 04  
**Distribution of Marks** : 80 (End Sem) (60T+20P) + 20 (In-Sem)

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on Gymnosperms and Angiosperms with their morphology, mode of reproduction, patterns of embryo development and economic and ecological importance.*

UNITS	CONTENTS	L	T	P	Total Hours
I 16 MARKS	<b>Gymnosperms</b> General characteristics, classification, morphology, anatomy and reproduction of Cycas, Pinus, Ginkgo and Gnetum; Patterns of embryo development in gymnosperms. Ecological and economic importance. <b>Fossil plants:</b> Process of fossilization; early land plants; <i>Rhynia</i> , <i>Cycadeoidea</i> , <i>Sphenophyllum</i> ; Geological time scale; importance of fossil study.	10	02		14
II 12 MARKS	<b>Morphology of Angiosperms:</b> Morphology and types of root, stem, and leaves; phyllotaxy and venation, hairs and trichomes, inflorescence and its types; aestivation. Arrangement and types of reproductive parts of flower, placentation and its types.	09	01		11
III 16 MARKS	<b>Anther and pollen biology:</b> Anther wall: structure and functions, microsporogenesis, callose deposition and its significance; microgametogenesis; pollen wall structure, MGU (male germ unit) structure, NPC system; palynology and scope (a brief account); pollen wall proteins; pollen viability, storage and germination. <b>Ovule:</b> Structure and types of ovule; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis.	10	02	-	07
IV 16 MARKS	<b>Pollination, fertilization and post fertilization developments:</b> Pollination types and significance; adaptations for pollination; Double fertilization; Structure and types; general pattern of development of dicot and monocot embryo and endosperm; suspensor: structure and functions; embryo-endosperm relationship; nutrition of embryo; polyembryony, apomixes and parthenocarpy self, incompatibility.	10	01		15

<b>Practicals 20 marks</b>	<b>1.</b> Study of morphology and reproductive parts of <i>Cycas, Pinus, Ginkgo &amp; Gnetum</i> . <b>2.</b> Study of Fossil plants (Photographs/specimen). <b>3.</b> Study of different types of roots (Morphology only). <b>4.</b> Types of leaves, venation, hairs and trichomes, phyllotaxy, inflorescence and aestivation. <b>5.</b> Types of placentation and ovule (Preparation of temporary slides) <b>6.</b> Study of pollen morphology and pollen tube formation. <b>7.</b> Study of types of embryos and endosperms (Permanent slides/ photographs)			30	
	<b>Total</b>	<b>39</b>	<b>06</b>	<b>30</b>	<b>75</b>

<i>Where,</i>	<i>L: Lectures</i>	<i>T: Tutorials</i>	<i>P: Practicals</i>
<b>MODES OF IN-SEMESTER ASSESSMENT:</b>			<b>(20 Marks)</b>
• One Internal Examination	-		<b>10 Marks</b>
• Others (Any one)	-		<b>10 Marks</b>
○ Sessional Examinations			
○ Assignment			

**LEARNING OUTCOMES:**

1. Know the classification, morphology, reproduction and economic and ecological importance of Spermatophytes
2. Handling and observation of Spermatophytes

**SUGGESTED READINGS:**

1. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
2. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5<sup>th</sup> edition.
3. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
4. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
5. Johri, B.M. (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.

**Title of the Course** : Morphology and Reproduction of Spermatopythes  
**Course Code** : MINBOT2  
**Nature of the Course** : Minor course-II  
**Total Credits** : 04  
**Distribution of Marks** : 80 (End Sem) (60T+20P) + 20 (In-Sem)

**COURSE OBJECTIVES:** The objective of this course is to provide knowledge to the students on Gymnosperms and Angiosperms with their morphology, mode of reproduction, patterns of embryo development and economic and ecological importance.

UNITS	CONTENTS	L	T	P	Total Hours
I 16 MARKS	<b>Gymnosperms</b> General characteristics, classification, morphology, anatomy and reproduction of Cycas, Pinus, Ginkgo and Gnetum; Patterns of embryo development in gymnosperms. Ecological and economic importance. <b>Fossil plants:</b> Process of fossilization; early land plants; <i>Rhynia</i> , <i>Cycadeoidea</i> , <i>Sphenophyllum</i> ; Geological time scale; importance of fossil study.	10	02		14
II 12 MARKS	<b>Morphology of Angiosperms:</b> Morphology and types of root, stem, and leaves; phyllotaxy and venation, hairs and trichomes, inflorescence and its types; aestivation. Arrangement and types of reproductive parts of flower, placentation and its types.	09	01		11
III 16 MARKS	<b>Anther and pollen biology:</b> Anther wall: structure and functions, microsporogenesis, callose deposition and its significance; microgametogenesis; pollen wall structure, MGU (male germ unit) structure, NPC system; palynology and scope (a brief account); pollen wall proteins; pollen viability, storage and germination. <b>Ovule:</b> Structure and types of ovule; female gametophyte–megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis.	10	02	-	07
IV 16 MARKS	<b>Pollination, fertilization and post fertilization developments:</b> Pollination types and significance; adaptations for pollination; Double fertilization; Structure and types; general pattern of development of dicot and monocot embryo and endosperm; suspensor: structure and functions; embryo-endosperm relationship; nutrition of embryo; polyembryony, apomixes and parthenocarpy self, incompatibility.	10	01		15
<b>Practicals 20 marks</b>	1. Study of morphology and reproductive parts of <i>Cycas</i> , <i>Pinus</i> , <i>Ginkgo</i> & <i>Gnetum</i> . 2. Study of Fossil plants (Photographs/specimen). 3. Study of different types of roots (Morphology only). 4. Types of leaves, venation, hairs and trichomes, phyllotaxy, inflorescence and aestivation. 5. Types of placentation and ovule (Preparation of temporary slides) 6. Study of pollen morphology and pollen tube formation. 7. Study of types of embryos and endosperms (Permanent slides/ photographs)			30	
<b>Total</b>		<b>39</b>	<b>06</b>	<b>30</b>	<b>75</b>

<i>Where,</i>	<i>L: Lectures</i>	<i>T: Tutorials</i>	<i>P: Practicals</i>
<b>MODES OF IN-SEMESTER ASSESSMENT:</b>			<b>(20 Marks)</b>
• One Internal Examination	-		<b>10 Marks</b>
• Others (Any one)	-		<b>10 Marks</b>
○ Sessional Examinations			
○ Assignment			

**LEARNING OUTCOMES:**

1. Know the classification, morphology, reproduction and economic and ecological importance of Spermatophytes
2. Handling and observation of Spermatophytes

**SUGGESTED READINGS:**

3. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
4. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5<sup>th</sup> edition.
5. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
6. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
7. Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.



**Title of the Course** : Plant Diversity and Human Welfare  
**Course Code** : GECBOT2  
**Nature of the Course** : Generic Elective Course-II  
**Total Credits** : 03  
**Distribution of Marks** : 80 (End Sem) + 20 (In-Sem)

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on biodiversity and its importance for human welfare.*

UNITS	CONTENTS	L	T	P	Total Hours
I 20 MARKS	Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.	10	1	-	11
II 20 MARKS	Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, Management of Plant Biodiversity: Organizations associated with biodiversity management- Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.	10	2	-	12
III 20 MARKS	Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.	10	1	-	11
IV 20 MARKS	Role of plants in relation to Human Welfare; a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.	10	01	-	11
<b>Total</b>		<b>45</b>	<b>05</b>	<b>-</b>	<b>45</b>

*Where,*

*L: Lectures*

*T: Tutorials*

*P: Practicals*

**MODES OF IN-SEMESTER ASSESSMENT:**

**(20 Marks)**

- One Internal Examination -
- Others (Any one) -
  - Sessional Examinations
  - Assignment

**10 Marks**

**10 Marks**

**LEARNING OUTCOMES:**

1. Know the scope, dimension and importance and threats to plant diversity.
2. Conservation ways of biodiversity and its Sustainable utilization.
3. Acquire knowledge of biodiversity for human welfare.

**SUGGESTED READINGS:**

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.

**Title of the Course** : Biofertilizers  
**Course Code** : SEC218  
**Nature of the Course** :Skill Enhancement Course-II  
**Total Credits** : 03  
**Distribution of Marks** : 80 (End Sem) (60T+20P) + 20 (In-Sem)

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on biofertilizers, its importance and its production from different biological sources..*

UNITS	CONTENTS	L	T	P	Total Hours
I 15 marks	Factors affecting plant growth; essential nutrients; microbes used as biofertilizer (nitrogen fixers, phosphate solubilizers, PGPR) biocontrol agents.	08	-	-	08
II 15 marks	Cyanobacteria (blue green algae), <i>Azolla</i> and <i>Anabaena azollae</i> association, process of nitrogen fixation, blue green algae and <i>Azollain</i> rice cultivation.	08	-	-	08
III 15 marks	Mycorrhizal association, types of mycorrhizal association; colonization of AM – isolation and inoculum production of AM, and its influence on growth and yield of crop plants.	08	1	-	09
IV 15 marks	Organic farming – Green manuring and organic fertilizers, Recycling of bio-degradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.	12	1	-	13
<b>Practical</b> (20 MARKS)	Demonstration/field visit to biofertilizer producing units, identification of some common biofertilizers.			22	22
	<b>Total</b>	<b>36</b>	<b>02</b>	<b>22</b>	<b>60</b>

*Where,*

*L: Lectures*

*T: Tutorials*

*P: Practicals*

**MODES OF IN-SEMESTER ASSESSMENT:**

- One Internal Examination -
- Others (Any one) -
  - Sessional Examinations
  - Assignment

**(20 Marks)**

**10 Marks**

**10 Marks**

**LEARNING OUTCOMES:**

After the completion of this course, the learner will be able to:

1. Learn about the biofertilizers, its manufacturing processes.
2. Know about the role different organisms and bioresources in production of biofertilizers.
3. Able to identify the common biofertilizers.

**SUGGESTED READINGS:**

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand& Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming AktaPrakashan, Nadiad

**Title of the Course** : Conservation and Cultivation of Orchids  
**Course Code** : SEC219  
**Nature of the Course** :Skill Enhancement Course-II  
**Total Credits** : 03  
**Distribution of Marks** : 80 (End Sem) (60T+20P) + 20 (In-Sem)

**COURSE OBJECTIVES:**The objective of this course is to provide knowledge to the students on Orchid diversity with special reference to NE India, Cultivation, Propagation and conservation techniques..

UNITS	CONTENTS	L	T	P	Total Hours
I 13 MARKS	<b>Introduction to Orchids:</b> Salient features, habitat, origin and diversity, morphology and classification of orchids, Economic importance of Orchids.	06		-	06
II 17 MARKS	Common and endemic Orchids of North East India: status and distribution; RET species of Orchids of India with special reference to NE India	10		-	10
III 18 MARKS	Propagation of Orchids: Different methods of propagation of orchids (cutting and hybridization), Substratum/soil preparation of orchids, nutritional and environmental requirement maintenance of orchidarium, <i>In-vitro</i> propagation of orchids.	12	1	-	13
IV 12 MARKS	Conservation of Orchids: <i>in-situ</i> and <i>ex-situ</i> conservation, Conservation of habitats and host plants.	8	1	-	09
<b>Practical</b> 20 MARKS	Identification of orchids, Demonstration of vegetative propagation of orchids, preparation of substrata for economically importance orchids, exposure visit to Orchidarium.	-	-	22	22
<b>Total</b>		<b>36</b>	<b>2</b>	<b>22</b>	<b>60</b>

*Where,*                      *L: Lectures*                      *T: Tutorials*                      *P: Practicals*

**MODES OF IN-SEMESTER ASSESSMENT:** (20 Marks)

- One Internal Examination - **10 Marks**
- Others (Any one) - **10 Marks**
  - Sessional Examinations
  - Assignment

**LEARNING OUTCOMES:**

4. Learn about the diversity of orchids with special reference to NE India.
5. Learn about the propagation techniques for orchid cultivation.
6. Know about the in-situ and ex-situ conservation ways for orchid conservation.

**SUGGESTED READINGS:**

1. Gogoi, K. 2017. Wild Orchids of Assam: A Pictorial guide. Assam State Biodiversity Board.

## DETAILED SYLLABUS OF 3<sup>rd</sup> SEMESTER

<b>Title of the Course</b>	<b>: Cell Biology</b>
<b>Course Code</b>	<b>: BOTC3</b>
<b>Nature of the Course</b>	<b>: MAJOR/CORE COURSE III</b>
<b>Total Credits</b>	<b>: 04</b>
<b>Distribution of Marks</b>	<b>: 80 (End Sem) (60T+20P) + 20 (In-Sem)</b>

**COURSE OBJECTIVES:** *The objective of this course is to provide students the concept of cell as functional unit of life, structure of plant cell and functions of cellular components.*

UNITS	CONTENTS	L	T	P	Total Hours
I 12 MARKS	<b>The cell</b> Cell as a unit of structure and function; cell theory, Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).	8			19
II 18 MARKS	<b>Cell wall and plasma membrane</b> Chemistry, structure and function of Plant cell wall; Overview of fluid mosaic model; Chemical composition of membranes; membrane function. <b>Cell organelles</b> Nucleus; Structure-nuclear envelope, nuclear pore complex, nuclear lamina, organization of chromatin; nucleolus. Microtubules, microfilaments and intermediary filament. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast; Ribosomes- types, components and function; Lysosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, Golgi Apparatus.	12	02		12
III 18 MARKS	<b>Membrane transport and Protein sorting &amp; targeting</b> Membrane transport – Passive, active and facilitated transport, membrane channels, gates and pores; endocytosis and exocytosis; protein glycosylation, protein sorting and export from Golgi apparatus; protein folding & processing; Smooth endoplasmic reticulum and lipid synthesis, export of proteins and lipids.	12	02		15
IV 12 MARKS	<b>Cell division</b> Types of cell division, stages of mitosis and meiosis; Phases of eukaryotic cell cycle, Regulation of cell cycle-checkpoints, role of protein kinases, significance.	07	02		12

<b>Practicals 20 marks</b>	1. Study of plant cell structure with the help of epidermal peel mount of Onion/Crinum/Rheo.			30	30
	2. Demonstration of the phenomenon of protoplasmic streaming in <i>Hydrilla</i> leaf, vallisnaria.				
	3. Measurement of cell size by of micrometric method.				
	4. Cell counting using haemocytometer. (Yeast/pollen grains).				
	5. Study the phenomenon of plasmolysis and deplasmolysis.				
	6. Study of cell and its organelles with the help of electron micrographs (Demonstration).				
	7. Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.				
	8. Study different stages of mitosis and meiosis.				
	<b>Total</b>	<b>39</b>	<b>06</b>	<b>30</b>	<b>75</b>

<i>Where,</i>	<i>L: Lectures</i>	<i>T: Tutorials</i>	<i>P: Practicals</i>
<b>MODES OF IN-SEMESTER ASSESSMENT:</b>			<b>(20 Marks)</b>
• One Internal Examination	-		<b>10 Marks</b>
• Others (Any one)	-		<b>10 Marks</b>
○ Sessional examination			
○ Assignment			

**LEARNING OUTCOMES:**

- (1) Know the types of biomolecules present on plant body and their functions.
- (2) Isolation and estimation of biomolecules

**SUGGESTED READINGS:**

1. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
2. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
3. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

**Title of the Course : Plant Biochemistry & Molecular Biology**

**Course Code : BOTC4**

**Nature of the Course : MAJOR/CORE COURSE III**

**Total Credits : 04**

**Distribution of Marks : 80 (End Sem) (60T+20P) + 20 (In-Sem)**

**COURSE OBJECTIVES:***The objective of this course is to provide knowledge to the students on Biomolecules and their functions*

UNITS	CONTENTS	L	T	P	Total Hours
I 16 MARKS	<b>Biomolecules:</b> Types and significance of chemical bonds; Structure and properties of water; pH and buffers. Carbohydrates: Nomenclature and classification; <b>Monosaccharides;</b> Disaccharides; Oligosaccharides and polysaccharides. <b>Lipids:</b> Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties; Phosphoglycerides. <b>Proteins:</b> Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins. <b>Nucleic acids:</b> Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.	10	01		11
II 16 MARKS	<b>Bioenergetics:</b> Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule. <b>Enzymes</b> Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.	10	02		12
III 16 MARKS	<b>Genetic material and its organization :</b> DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty experiment); denaturation and renaturation of DNA,; Organization of DNA- Prokaryotes, Viruses, Eukaryotes. RNA Structure; Organelle DNA- mitochondria and chloroplast DNA. <b>Replication and Transcription of DNA</b> General principles – bidirectional, semi-conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, replication of linear ds-DNA. Transcription in prokaryotes and eukaryotes; PostTranscriptional modification of RNA Operon concept: Lac operon and its regulation.	12	02		14

IV 12 MARKS	<b>Genetic codes &amp; Translation</b> Genetic codes: salient features; Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, factors involve in initiation, elongation and termination of polypeptides; Post-translational modifications of proteins.	07	01		08
<b>Practicals</b> <b>20 marks</b>	<ol style="list-style-type: none"> <li>1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.</li> <li>2. Cytochemical staining of : DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.</li> <li>3. Estimation of plant proteins by Biuret/Lowry method.</li> <li>4. Estimation of reducing and non-reducing sugars in plant samples.</li> <li>5. DNA estimation by diphenylamine reagent/UV Spectrophotometry.</li> <li>6. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).</li> <li>7. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.</li> <li>8. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey &amp; Chase's and Fraenkel &amp; Conrat's experiments)</li> </ol>			30	30
	<b>Total</b>	<b>39</b>	<b>06</b>	<b>30</b>	<b>75</b>

<i>Where,</i>	<i>L: Lectures</i>	<i>T: Tutorials</i>	<i>P: Practicals</i>
<b>MODES OF IN-SEMESTER ASSESSMENT:</b>			<b>(20 Marks)</b>
• One Internal Examination	-		<b>10 Marks</b>
• Others (Any one)	-		<b>10 Marks</b>
○ Sessional examination			
○ Assignment			

#### LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

1. Know the types of biomolecules present on plant body and their structure and functions.
2. Isolation and estimation of biomolecules

#### SUGGESTED READINGS:

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

**Title of the Course : Plant Physiology & Metabolism**  
**Course Code : MINBOT3**  
**Nature of the Course : Minor course-III**  
**Total Credits : 04**  
**Distribution of Marks : 80 (End Sem) (60T+20P) + 20 (In-Sem)**

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on plant physiological processes.*

UNITS	CONTENTS	L	T	P	Total Hours
I 14 MARKS	<b>Plant-water relations:</b> Importance of water, water potential and its components; Ascent of sap, Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. <b>Translocation in phloem:</b> Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.	10	02	-	12
II 12 MARKS	<b>Mineral nutrition:</b> Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Biological nitrogen fixation; Nitrate and ammonia assimilation.	07	01	-	08
III 22 MARKS	<b>Photosynthesis:</b> Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C <sub>3</sub> , C <sub>4</sub> and CAM pathways of carbon fixation; Photorespiration. <b>Respiration:</b> Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.	15	02	-	17
IV 12 MARKS	<b>Plant growth regulators &amp; plant responses:</b> Physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. Plant response to light and temperature; photoperiodism and its importance.	07	1	-	08
<b>Practicals 20 marks</b>	1. Determination of osmotic potential of plant cell sap by plasmolytic and weight method. 2. To study the effect of environmental factors (light and wind) on transpiration by excised twig. 3. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration. 4. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte. 5. Demonstration of Hill reaction. 6. To study the effect of light intensity and bicarbonate concentration on O <sub>2</sub> evolution in photosynthesis. 7. Determination of rate of transpiration.		30		30
<b>Total</b>		<b>39</b>	<b>06</b>	<b>30</b>	<b>75</b>

*Where, L: Lectures T: Tutorials P: Practicals*

**MODES OF IN-SEMESTER ASSESSMENT:**

- One Internal Examination - **10 Marks**
- Others (Any one) - **10 Marks**
  - Sessional examination
  - Assignment

**LEARNING OUTCOMES:**



After the completion of this course, the learner will be able to:

1. Know the role of minerals as plant nutrition, plant water relationship and its mechanisms.
2. Production of sugar through photosynthesis, its mechanism and importance
3. Respiratory pathways, metabolic processes and role of different growth promoters and inhibitors in plant growth and development.

**SUGGESTED READINGS:**

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

**Title of the Course** : Ethnobotany  
**Course Code** : GECBOT3  
**Nature of the Course** : Generic Elective Course-II  
**Total Credits** : 03  
**Distribution of Marks** : 80 (End Sem) + 20 (In-Sem)

**COURSE OBJECTIVES:** The objective of this course is to provide knowledge to the students on use of plant resources in traditional practices of the ethnic communities of NE India.

UNITS	CONTENTS	L	T	P	Total Hours
I 25 MARKS	<b>Ethnobotany</b> Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.	10	1	-	11
II 15 MARKS	<b>Methodology of Ethnobotanical studies</b> a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.	10	2	-	12
III 25 MARKS	Medico-ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology) a) <i>Azadiractha indica</i> b) <i>Ocimum sanctum</i> c) <i>Vitex negundo</i> . d) <i>Gloriosa superba</i> e) <i>Tribulus terrestris</i> f) <i>Pongamia pinnata</i> g) <i>Cassia auriculata</i> h) <i>Indigofera tinctoria</i> . Role of ethnobotany in modern medicine with special example <i>Rauvolfia serpentina</i> , <i>Trichopus zeylanicus</i> , <i>Artemisia</i> , <i>Withania</i> . Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).	10	1	-	11
IV 15 MARKS	<b>Ethnobotany and legal aspects</b> Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.	10	01	-	11
<b>Total</b>		<b>45</b>	<b>05</b>	<b>-</b>	<b>45</b>

**MODES OF IN-SEMESTER ASSESSMENT:**

- One Internal Examination -
- Others (Any one) -
  - Sessional Examinations
  - Assignment

**(20 Marks)**

**10 Marks**

**10 Marks**

**LEARNING OUTCOMES:**

4. Know the scope, dimension and importance of ethnobotany.
5. Conservation ways of biodiversity and its Sustainable utilization in traditional practices.
6. Acquire knowledge of bioactive compounds available in plant resources of NE India.

**Title of the Course** : Nursery and Gardening  
**Course Code** : SEC318  
**Nature of the Course** : Skill Enhancement course-III  
**Total Credits** : 03  
**Distribution of Marks** : 80 (End Sem) (60T+20P) + 20 (In-Sem)

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on setting up of nursery and gardens and its management.*

UNITS	CONTENTS	L	T	P	Total Hours
I 20 MARKS	<b>Nursery:</b> definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. <b>Seed storage:</b> Seed banks, factors affecting seed viability, genetic erosion- Seed production technology. Seed testing and certification; Greenhouse - mist chamber, shed root, shade house and glass house.	10		-	10
II 20MARKS	<b>Vegetative propagation:</b> air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glass house.	10		-	10
III 20 MARKS	Gardening: Different types of gardening - landscape and home gardening - parks and its components - plant materials and design. <b>Gardening operations:</b> soil preparation, manuring, watering, management of pests and diseases and harvesting. Sowing/raising of seeds and seedlings - Transplanting of seedlings.	10		-	10
Practicals 20 marks	Preparation of cuttings/seedlings of some important horticultural crops. Exposure visit to established nurseries, farms, gardens etc.,			30	30
<b>Total</b>		<b>30</b>		<b>30</b>	<b>60</b>

Where,

*L: Lectures*

*T: Tutorials*

*P: Practicals*

**MODES OF IN-SEMESTER ASSESSMENT:**

- One Internal Examination - **10 Marks**
- Others (Any one) - **10 Marks**
  - Sessional examination
  - Assignment

**LEARNING OUTCOMES:**

1. Learn about the nursery development processes, requirements and, management techniques.
2. Learn about the garden development processes, requirements and, management techniques.

**SUGGESTED READINGS:**

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.

3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

**Title of the Course** : Medicinal Botany  
**Course Code** : SEC319  
**Nature of the Course** : Skill Enhancement course-III  
**Total Credits** : 03  
**Distribution of Marks** : 80 (End Sem) (60T+20P) + 20 (In-Sem)

**COURSE OBJECTIVES:** *The objective of this course is to provide knowledge to the students on traditional herbal medicinal practices, its importance and plants used as herbal medicine and its propagation.*

UNITS	CONTENTS	L	T	P	Total Hours
I 12 marks	History, Scope and Importance of Medicinal Plants. Conservation of endangered and endemic medicinal plants.	05		-	05
II 16 marks	Ayurveda: History, origin, Panchamahabhutas, Saptadhatu and Tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine.	06		-	06
III 20 marks	Definition: endemic and endangered medicinal plants, red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; <i>Ex-situ</i> conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.	12			12
IV 12 marks	Unani: History, concept: Umoor-e- tabiya, tumor treatments/ therapy, polyherbal formulations.	07			07
Practicals 20 marks	Identification, collection and conservation (Propagation and Plantation) of local medicinal plants.			30	30
<b>Total</b>		<b>30</b>		<b>30</b>	<b>60</b>

*Where, L: Lectures T: Tutorials P: Practicals*

**MODES OF IN-SEMESTER ASSESSMENT:** (20 Marks)

- One Internal Examination - **10 Marks**
- Others (Any one) - **10 Marks**
  - Sessional examination
  - Assignment

**LEARNING OUTCOMES:**

1. Learn about the various traditional medicinal systems with special reference to NE India.
2. Know about importance of medicinal plants, their status and conservational strategies.
3. Identification, propagation and conservation the medicinal plants.

**SUGGESTED READINGS:**

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2<sup>nd</sup> edn. Agrobios, India.

\*\*\*\*\*