SYLLABUS OF FYUGP IN BOTANY

Approve in the BOS held on 06th May 2025

DEPARTMENT OF BOTANY

DIGBOI COLLEGE (AUTONOMOUS)

Digboi-786171

FOUR YEAR UNDER-GRADUATE PROGRAMME (FYUGP) IN BOTANY

The Preamble

Contemporary plant science represents a blend of traditional elements and advanced fields like biochemistry, molecular biology, and biotechnology. Throughout the years, plant science (Botany) has experienced substantial growth in knowledge and practical applications due to significant contributions from research across all its fields. In light of the global emphasis on conservation, field plant biologists have played a crucial role in evaluating and uncovering new aspects of plant diversity. By employing modern tools and techniques for botanical research, new understandings have emerged regarding the functional and structural components of plant development. There are now challenging opportunities in teaching and research within the realms of ecology and reproductive biology. Concern over the rising levels of pollution and climate change has reached unprecedented heights. Considering the previously mentioned advancements and the abundant plant resources found in North East India, has introduced a revised curriculum at the undergraduate level in accordance with the National Education Policy-2020.

This new curriculum aims to provide undergraduate Botany students with a well-balanced and thoughtfully designed course structure that addresses various aspects of plant science, including plant diversity, physiology, biochemistry, molecular biology, reproduction, anatomy, taxonomy, ecology, economic botany, and the influence of the environment on plant growth and development. Each of these themes has been appropriately emphasized throughout the eight semesters. It is crucial for undergraduate students to familiarize themselves with various tools and techniques for studying plants down to the sub-cellular level. In light of employment and entrepreneurship, applied courses have been implemented. These courses will give botany students practical experience and professional insights. Overall, the curriculum is a valuable source of information and is supported by extensive resource materials. It is anticipated that a student graduating in Botany with this updated curriculum will be equipped to investigate the abundant plant diversity.

Introduction

The UG syllabus for Botany has been crafted in accordance with the National Education Policy-2020. This Four-Year Undergraduate Program (FYUGP) in Botany includes Major (Core) subjects, Minor subjects, Multi Disciplinary Multi Disciplinary Courses (MDC), Ability Enhancement Courses (AEC), Value Added Courses (VAC), Skill Enhancement Courses (SEC), Environmental Education (EE), YOGA, Community Engagement through initiatives like NCC/NSS, Digital and Technological solutions, Internship experiences, Field Studies, Research Ethics, Research Projects, and Discipline Specific Electives (DSE) to provide students with a well-rounded understanding of plant resources, the environment, current issues, and entrepreneurship.

The Bachelor of Science in Botany offered by Digboi College (Autonomous) under NEP-2020 is designed with various exit points. Students will receive a UG certificate, UG Diploma, UG Degree, or UG Degree (Honors with Research) in Botany upon completing one, two, three, or four years of study, respectively. It is anticipated that graduates of this FYUGP will possess skills in diverse areas related to the exploration and sustainable use of plants and natural resources in the northeastern region of India.

Aims of Four Year Under-Graduate Programme (FYUGP) in Botany:

1. To familiarize students with Plant diversity with Special emphasis to Northeast India's abundant biodiversity.

2. To give the students the opportunity to investigate the potential of plant resources for human well-being and their sustainable usage.

3. To build students' capacity for critical analysis of current environmental and natural challenges.

4. To produce human resources with the necessary skills for biological entrepreneurship.

Graduate Attributes of the FYUGP in Botany:

Disciplinary Knowledge

In a multidisciplinary setting, the graduates should be able to exhibit thorough knowledge and comprehension of the theoretical and applied aspects of plant science and related fields of study.
Students should be able to make connections between current issues, biological trends, and related fields.

Communication Skills
To effectively communicate any topic and pertaining to plants and nature, botany graduates should be able to explain and express information, thoughts, experiments, and results in a clear and succinct manner.

Moral and Ethical Awareness/Reasoning

Ability to recognize ethical issues that are pertinent to one's work and pledge not to engage in un ethical behavior 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.

Multi cultural Competence

Ability to correlate and compare recent developments in various branches of plant science worldwide; ability to collaborate research in various fields of Plant Science 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 CommunicationsTechnology(ICT)tools,biologicaldatabasesandcomputerandsoftwaresin 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.

Programme Educational Objectives (PEOs)

1. To create plans for using biological resources to attain sustainable development.
2. To assess environmental issues and create awareness.
3. To exhibit a willingness to use interdisciplinary methods to solve problems.

Programme Outcomes (POs)

After completion of the programme a student will be able

1. To develop ideas to assess and inventorize existing Plant resources of this region.
2. To formulate innovative strategies for conservation of biogenetic resources for human welfare.
3. To explore and validate ethnobiological knowledge of Northeast India.
4. To provide solutions for existing societal problems using Plant science knowledge.
5. To develop research skills to solve complex biological issues.

6. To execute good communication skills for disseminating knowledge of Plant sciences.

7.To promote the attitude to work as a team appreciating ethical values.

Programme Specific Outcomes(PSOs)

1. Evaluate the diversity and evolution of Plants.
2. Analyze the fundamentals of life-sustaining processes.
3. Design strategies for issues concerning public health and human welfare.
4. Critically analyze the environmental issues and develop strategies to address them.
5. Formulate measures to mitigate climate change effects.

COURSE STRUCTURE

Year	Sem.	Code	Nature of course	Titleofthecourse	Credit
I	I	BOTC-101T	Core-I	Cryptogams	3
		BOTC-101P	Core-I	Cryptogams	1
		BOTM-101T	Minor-I	Cryptogams	3
		BOTM-101P	Minor-I	Cryptogams	1
		BOTMDC-101	MDC-I	Natural resource management	3
			AEC-I	Modern Indian Language	4
		BOTSEC-101T	SEC-I	Mushroom Culture technology	2
		BOTSEC-101P	SEC-I	Mushroom Culture technology	1
			VAC-I	Understanding India	2
		Totalcredit			**20**
	II	BOTC-201T	Core-II	Spermatophytes	3
		BOTC-201P	Core-II	Spermatophytes	1
		BOTM-202T	Minor-II	Spermatophytes	3
		BOTM-201P	Core-II	Spermatophytes	1
		BOTMDC-201	MDC-II	Phytodiversity and Human Welfare	3
			AEC-II	English Language and Communication Skills	4
		BOTSEC-201T	SEC-II	Biofertilizers	2
		BOTSEC-201P	SEC-II	Biofertilizers	1
			VAC-II	Environmental Science	2
		Totalcredit			**20**
		UG CERTIFICATE			
		BOTC-301T	Core-III	Cell biology and immunology	3
		BOTC-301P	Core-III	Cell biology and immunology	1
		BOTC-302T	Core-IV	Plant Biochemistry & Molecular Biology	3
		BOTC-302P	Core-IV	Plant Biochemistry & Molecular Biology	1
		BOTM-301T	Minor-III	Angiosperm systematics	3

II	III	BOTM-301T	Minor-III	Angiosperm systematics	1
		BOTMDC-301	MDC-III	Plants and Traditional Knowledge	3
		BOTSEC-301T	SEC-III	Horticulture	2
		BOTSEC-301P	SEC-III	Horticulture	1
			VAC-III	Digital and Technological Solutions/ Digital Fluency	2
				Totalcredit	**20**
	IV	BOTC-401T	Core-V	Plant Ecology & Phytogeography	3
		BOTC-401P	Core-V	Plant Ecology & Phytogeography	1
		BOTC-402T	Core-VI	Angiosperm systematics	3
		BOTC-402T	Core-VI	Angiosperm systematics	1
		BOTC-403T	Core-VII	Plant anatomy & Embryology	3
		BOTC-403P	Core-VII	Plant anatomy & Embryology	1
		BOTC-404T	Core-VIII	Genetics & Evolution	3
		-BOTC-404P	Core-VIII	Genetics & Evolution	1
		BOTM-401T	Minor-IV	Plant physiology and metabolism	3
		BOTM-401P	Minor-IV	Plant physiology and metabolism	1
		TotalCredit			**20**
		UG DIPLOMA			
		BOTC-501T	Core-IX	Plant physiology & Metabolism	3
		BOTC-501P	Core-IX	Plant physiology &Metabolism	1
		BOTC-502T	Core-X	Plant breeding & Biostatistics	3
		BOTC-502P	Core-X	Plant breeding & Biostatistics	1
III	V	BOTC-503T	Core-XI	Microbiology	3
		BOTC-503P	Core-XI	Microbiology	1
		BOTC-504PR	Int./Comm./p r oject	Field study/project	4
		BOTM-501T	Minor-V	Plant Resources and Economicbotany	3
		BOTM-501P	Minor-V	Plant Resources and Economic botany	1
		Totalcredit			**20**
	VI	BOTC-601T	Core-XII	Phytopathology and crop protection	3
		BOTC-601P	Core-XII	Phyto pathology and crop protection	1
		BOTC-602T	Core-XIII	Plant Resources and Economic botany	3
		BOTC-602P	Core-XIII	Plant Resources and Economic botany	1
		BOTC-603T	Core-XIV	Plant biotechnology and Bioinformatics	3
		BOTC-603P	Core-XIV	Plant biotechnology and Bioinformatics	1
		BOTC-604T	Core-XV	Analytical techniques in plantScience.	3
		BOTC-604T	Core-XV	Analytical techniques in plant Science.	1
		BOTC-601T	Minor-VI	Microbiology & Immunology	3
		BOTM-601P	Minor-VI	Microbiology & Immunology	1
		Total credit			**20**
UG DEGREE					

Credit System:

S.N.	Components	Hours/ Week	Hrs/ Sem.	Credit
1	Lecture	1 Hour	15 Hours	1
2	Tutorial	1 Hour	15 Hours	1
3	Practicum, Laboratory Work, Seminar/Group Discussion	2 Hours	30 Hours	1
4	Experiential Learning, Internship, Community Engagement & Services, Field Visit/Industrial Visit, Studio Activities, Field Practices/Projects, etc.	2 Hours	30 Hours	1

Modes of assessment:

Assessment	Sub-Components	Marks	Details
In-Semester Assessment (40% of total, 40 marks)	Sessional Exam 1	10 marks (Mandatory)	First written/objective test to assess ongoing learning.
	Sessional Exam 2	10 marks (Mandatory)	Second written/objective test to evaluate progress.
	GD/Group Activities	10 marks (Choose any 2 of these)	Collaborative tasks fostering critical thinking, communication, and application skills.
	Seminars/Assignments/Projects/Field Studies	10 marks (Choose any 2 of these)	Collaborative/Individual tasks but individual reports/presentations
	Other Academic Activities		Written exam covering full course, emphasizing problem-solving and application-based questions (2-hour duration for 3/4-credit courses).
End-Semester Examination (60% of total)	Courses without Practicals.	60 marks	Written exam covering full course, emphasizing problem-solving and application-based questions (2-hour duration for 3/4-credit courses).
	Courses with Practicals.	Theory: 45 marks and Practical: 15 marks	Theory exam (45 marks) covering full course; practical exam (15 marks) assessed by internal and external examiners, to be conducted before theory exams.

Semester-I

Course Title: **Cryptogams**
Nature of course: **Major/Core-I**
Course Code: **BOTC-101T + BOTC-101P**
Marks: **100[En:45T+ 15P,In:40]**

Course outcomes:

After the completion of the course the students will be able to

1) Describe different groups of plant kingdom like Algae, Fungi, Bryophyte & Pteridophyte.
2) Organize the plants into different categories based on morphological characteristics.
3) Analyze the interrelationship among different species and genera within each group of plants.

Learning outcomes:

1) Understand the various groups in the Kingdom up to Pteridophytes
2) Compare various organisms based on morphology and reproductive characters.
3) Classify different groups of plants

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2,CO3		
Procedural						
Metacognitive						

Mapping of Course out comes to Programme out comes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2,4
CO2	3	2	2	2	2	2	2	2.4
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation.

Modes of internal assessment:

1. Two internal examinations
2. Group discussion / seminar
3. Home assignments
4. Seminar presentation
5. Other activity

AttainmentofCOs:

1. Continuous evaluation through in and end-semester theory and practical examinations.
2. Field collection and identification of specimens.
3. Submission of collected specimens.
4. Practical record book.

Course Title: Cryptogams
Course Code:BOTC-101T
Marks:45(En)

Total lectures- 45
No. of classes- 13

Algae **Marks- 12**

Unit –1.

General characters, classification and economic importance of algae; its phylogeny and distribution in India.

Unit –2.

Vegetative structure: cell; algal chromatophores and pigments; range of thallus structure. Reproduction: vegetative, asexual and sexual reproduction.

Unit –3.

A comprehensive knowledge of the following classes with special reference to the structure and life histories of the genera mentioned below:

a) Myxophyceae: *Nostoc* and *Anabaena*
b) Cholorophyceae: *Chlorella, Volvox, Oedogonium,* and *Chara*
c) Bacillariophyceae: A general account Diatoms and its importance
d) Phaeophyceae: *Ectocarpus, Fucus*
e) Rhodophyceae: *Polysiphonia, Batrachospermum.*

No. of classes-17

Fungi **Marks- 12**

Unit –1.

Salient features of fungi, fungal cell structure and nutrition.

Unit –2.

Classification of fungi, Economic importance of fungi.

Unit –3.

Comparative account of structure, method of reproduction and mode of spore dispersal of fungi.

Unit –4.

Comprehensive knowledge of the following groups with special reference to the structure and life histories of the genera mentioned below from an evolutionary point of view.

(a) Mastigomycotina: *Albugo, Pythium*.(b) Zygomycotina: *Rhizopus.* (c) Ascomycotina: *Peziza, Penecillium*(d) Basidiomycotina: *Puccinia, Cyathus, Agaricus* (e) Deuteromycotina: *General account*

Mycorrhiza ectomycorrhiza, endomycorrhiza, VAM and their significance.

Lichen a general account with particular reference to types and their detailed cell structure. Mode of reproduction, nutrition and economic importance.

No. of classes-07

Bryophytes **Marks- 10**

Unit-1

General features, classification, thallus organization, morphology, anatomy and reproduction. of *Riccia*, *Marchantia, Anthoceros, Sphagnum*

Unit-2

Reproduction and evolutionary trends in bryophytes. Ecological and economic importance of Bryophytes.

No. of classes-08

Pteridophytes **Marks- 11**

Unit-1

General features and Classification, Morphology, Anatomy and Reproduction of *Psilotum, Lycopodium, Selaginella, Equisetum and Ophioglossum, Marselia*.

Unit-2 Heterospory and seed habit, stelar evolution, Ecological and economic importance.

Course Title:Cryptogams
Course Code:BOTC-101P

Marks:15 **No. of classes-15**

1Study of vegetative and reproductive structures of *Anabaena, Nostoc, Volvox, Oedogonium, Chara, Vaucheria, Ectocarpus, Polysiphonia and Batrachospermum*

2.Study of vegetative and reproductive structures of *Phytophthora, Peziza*. *Albugo, Aspergillus, Saccharomyces, Penicillium, Puccinia andAlternaria*

3. Study of vegetative and reproductive structures of *Riccia, Marchantia, Anthoceros, Sphagnum, and Polytrichum*

4.Study of vegetative and reproductive structures of *Lycopodium Selaginella, Equisetum and Ophioglossium, Marselia*

5.Morphological studies of different types of Lichen.

Suggested readings:

1. Lee,R.E. (2008). Phycology,Cambridge University Press, Cambridge. 4th 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. 8th edition.
5. Alexopoulos, C.J., Mims,C.W., Blackwell, M.(1996).Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition
6. Webster,J. and Weber,R.(2007). Introduction to Fungi,Cambridge University Press, Cambridge. 3rd 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. TataMcGraw 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
12. Alexopoulos,C.J.,Mims, C.W., Blackwell,M.(1996).Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
13. Webster,J. and Weber,R.(2007).Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition
14. Sethi,I.K. and Walia,S.K.(2011).Textbook of Fungi and theirAllies, Macmillan Publishers India Ltd.
15. Parihar,N.S.(1991). An introduction to Embryophyta:Vol.I.Bryophyta. Central Book Depot. Allahabad.
16. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R.(2005).Biology.Tata McGraw Hill, Delhi.

17. Vanderpoorten, A. & Goffinet, B.(2009)Introduction to Bryophytes. Cambridge University Press
18. Vashistha, P.C., Sinha,A.K., Kumar,A. (2010). Pteridophyta. S.Chand. Delhi, India

Semester-I

Course Title: **Cryptogams**
Nature of course: **Minor-I**
Course Code: **BOTM-101T + BOTM-101P**
Marks: **100[En:45T+ 15P, In:40]**

Course outcomes:

4) Describe different groups of the plant kingdom like Algae, Fungi, Bryophyte &Pteridophyte.

5) Organize the organisms into different categories based on morphological Characteristics

6) Analyze the interrelationship among different species and genera within each group of plants

Learning Outcomes:

4) Understand the various groups in the Kingdom uptopteridophytes

5) Compare various organisms based on morphology and reproduction

6) Classify different groups of plants

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2,CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2,4
CO2	3	2	2	2	2	2	2	2.4
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3for highest correlation,2 for moderate correlation, and1 for lowest correlation

Modes of internal assessment:

1.Two internal examinations
2. Group discussion/ Seminar
3. Home assignments
4. Other activity

AttainmentofCOs:

1.Continuousevaluationthroughinandend-semestertheoryandpracticalexaminations

2.Fieldcollectionandidentificationof specimens
3.Submissionofcollectedspecimens
4.Practicalrecordbook

Course Title: Cryptogams
Course Code:BOTM-101T

Marks:45(En)
Total lectures- 45

Algae **No. of classes-13**
Marks- 12

Unit –1.
General characters, classification and economic importance of algae; its phylogeny and distribution in India.
Unit –2.
Vegetative structure: cell and thallus structure; algal chromatophores and pigments; range of thallus structure. Reproduction: vegetative, asexual and sexual reproduction.
Unit –3. A comprehensive knowledge of the following classes with special reference to the structure and life histories of the genera mentioned below:
a) Myxophyceae: *Nostoc* and *Anabaena* b) Cholorophyceae: *Chlorella, Volvox, Oedogonium,* and *Chara*
c) Bacillariophyceae: A general account Diatoms and its importance d) Phaeophyceae: *Ectocarpus*
e) Rhodophyceae: *Polysiphonia*

No. of classes-17
Fungi **Marks- 12**
Unit –1.
Salient features of fungi, fungal cell structure and nutrition.
Unit –2.
Classification of fungi, Economic importance of fungi.
Unit –3.
Comparative account of structure, method of reproduction and mode of spore dispersal of fungi.
Unit –4.
Comprehensive knowledge of the following groups with special reference to the structure and life histories of the genera mentioned below from an evolutionary point of view.
(a) Mastigomycotina: *Albugo, Pythium*. (b) Zygomycotina: *Rhizopus.* (c) Ascomycotina: *Peziza, Penecillium*(d) Basidiomycotina: *Puccima, Cyathus, Agaricus*(e) Deuteromycotina: *General account*

Mycorrhiza ectomycorrhiza, endomycorrhiza, VAM and their significance.

Lichen a general account with particular reference to types and their detail cell structure. Mode of reproduction, nutrition and economic importance.

No. of classes-07
Bryophytes **Marks- 10**
Unit-1
General features, classification, thallus organization, morphology, anatomy and reproduction. of *Marchantia, Anthoceros, Sphagn*
Unit-2
Reproduction and evolutionary trends in bryophytes. Ecological and economic importance of bryophytes.

Pteridophytes **No. of classes-08**
Unit-1 **Marks- 11**
General features and Classification, Morphology, Anatomy and Reproduction of *Psilotum, Selaginella, Equisetum and Ophioglossum, Marselia*.
Unit-2 Heterospory, stelar evolution, Ecological and economic importance.

Course Title:Cryptogams
Course Code:BOTM-101P

Marks:15 **No. of classes-15**
1. Study of vegetative and reproductive structures of *Anabaena, Nostoc, Volvox, Oedogonium, , Chara, Vaucheria, Ectocarpus, Polysiphonia and Batrachospermum*
2.Study of vegetative and reproductive structures of *Phytophthora, Peziza*. *Albugo, Aspergillus, Saccharomyces, Penicillium Puccinia andAlternaria*
3.Study of vegetative and reproductive structures of *Riccia, Marchantia, Anthoceros, Sphagnum, Funaria and Polytrichum*
4.Study of vegetative and reproductive structures of *Selaginella, Equisetum and Ophioglossium, Marselia*
5.Morphological studies of different types of Lichen.

Suggested readings

1. Lee,R.E. (2008). Phycology,CambridgeUniversity Press,Cambridge. 4th edition.
2. Kumar,H.D.(1999).IntroductoryPhycology.AffiliatedEast-WestPress,Delhi.
3. Sahoo,D.(2000).Farmingtheocean:seaweedscultivationandutilization.Aravali International, New Delhi.
4. Campbell,N.A.,ReeceJ.B.,UrryL.A.,CainM.L.,WassermanS.A.MinorskyP.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
5. Alexopoulos,C.J.,Mims,C.W.,Blackwell,M.(1996).IntroductoryMycology,John Wiley & Sons (Asia) Singapore. 4th edition
6. Webster,J.andWeber,R.(2007).IntroductiontoFungi,CambridgeUniversityPress, Cambridge. 3rd edition
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8. Parihar,N.S.(1991).AnintroductiontoEmbryophyta:Vol.I.Bryophyta.Central Book Depot. Allahabad.
9. Raven,P.H.,Johnson,G.B.,Losos,J.B.,Singer,S.R.(2005).Biology.TataMcGraw Hill, Delhi.
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Delhi.
17. Vanderpoorten,A.&Goffinet,B.(2009)IntroductiontoBryophytes.Cambridge University Press
18. Vashistha,P.C.,Sinha,A.K.,Kumar,A. (2010).Pteridophyta.S.Chand.Delhi, India

SEMESTER-I
Title of the Course: Natural Resource Management
Nature of course:MDC-I
Course code:UG-MDC-BOT-101
Total Credits: 03
Marks:100[End: 60, In: 40]

Course outcomes:

1. Distinguish between renewable and non-renewable resources
2. Analyse threats to natural and biological resources of NEIndia
3. Examine management strategies for sustainable utilization of resources

Learning outcomes:

1. DifferentiatenaturalandbiologicalresourcesofNEIndia
2. Identifythethreatsandissuesrelatedtothenaturalresources.
3. Execute conservation and management strategies for natural resources

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programmeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2,4
CO2	3	2	2	2	2	2	2	2.4
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

Attainment of COs:

1. Continuousevaluationthroughinandendsemestertheoryandpracticalexaminations
2. Field demonstration of natural resources
3. Demonstration of modern tools like GIS
4. Participation in seminar/conference
5. Practical record book

SEMESTER-I

Title of the Course: Natural ResourceManagement
Course code: UG-MDC-BOT-101
Total Credits: 03
Marks:60 Total Lectures:45

UNIT 1: Natural resources:No. of classes-03 Definition and types, Natural resources of NE India. Renewable and non-renewable
sources of energy.

UNIT 2: No. of classes-11 Sustainable utilization of land and water resources. Soil degradation and management; water resources (Freshwater, marine, estuarine)wetlands; Threats and management strategies and their management.

UNIT 3: Biodiversity: No. of classes-08

Definition, types, significance, threats, management strategies, CBD, Bioprospecting

UNIT 4: No. of classes-15 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.

Suggested readings:

1. Vasudevan,N.(2006).EssentialsofEnvironmentalScience.NarosaPublishingHouse, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.

SEMESTER-I

Title of the Course	**:**	**MushroomCultureTechnology**
Nature of course	**:**	**SEC-I**
Coursecode	**:**	**UG-SEC-BOT-101T**
Total Credits	**:**	**03**
Distribution of Marks	**:**	**100[End:60(Theory:45,Pract:15),In:40]**

Course outcomes:

1. Distinguishbetweenedibleandnonediblemushrooms
2. Executethecultivationofcommerciallyimportantmushrooms

Learning outcomes:

1. Identifythecommercialandedible mushrooms
2. Executemanagementstrategiesforcommercialproductionof mushrooms

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1,		
Procedural			CO2			
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2,4
CO2	3	2	2	2	2	2	2	2.4
AVERAGE	3	2	2.0	2.0	2.0	2.0	2.0	

Modesofinternalassessment:

1. Twointernal examinations
2. Group discussion/ Seminar
3. Homeassignments
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fielddemonstrationofmushrooms
3. Participationinseminar/conference
4. Practicalrecordbook
5. Hands-onpractice

Title of the Course: Mushroom Culture Technology
Course code:UG-SEC-BOT-101T
Marks: 45(En)

Total Lectures:30

Unit1:No. of classes- 07

Introduction, Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.Types of ediblemushroomsavailablein India –*Volvariellavolvacea, Pleurotus citrinopileatus, Agaricus bisporus.*

Unit2: No. of classes- 16

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 polythenebag.Pureculture: Medium,sterilization,preparationof spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, bananaleaves.Factorsaffectingthemushroombedpreparation –LowCOsttechnology,composting technology in mushroom production.

Unit3: No. of classes- 07

Storage: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions.

Title of the Course:Mushroom Culture Technology
Course cod:UG-SEC-BOT-101P

Marks: 15(En)No. of classes- 15

1. Identification of edible mushroom,

2. Demonstration of spawn preparation, Demonstration of culture & packaging technique of mushroom.

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. NitaBahl(1984-1988)HandbookofMushrooms,IIEdition,Vol.I&Vol. II

Semester-II

Course Title: **Spermatophytes**
Nature of course: **Major/Core-II**
Course Code: **BOTC-201T + C-BOT-201P**
Marks: **100[En:45T+ 15P, In:40]**

Course outcomes:

1) Describedifferentgroupsofgymnospermsand angiosperms
2) Examinethemorphologyandreproductiveprocessesin Gymnospermsand AngiospermsCharacteristics
3) Analyzetheinterrelationshipamongdifferentspeciesandgeneraof Gymnosperms and Angiosperms

LearningOutcomes:

1) Understandthevariousgroups in Gymnospermsand Angiosperms
2) Comparevariousgroupsin Gymnospermsand Angiospermsbasedon morphology and reproduction
3) Examinethereproductivestructureinvariousgroupsin Gymnospermsand Angiosperms

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2,CO3		
Procedural						
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	1	1	1.8
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	2	1	1	2	2	1.8
AVERAGE	3	2	2.0	1.7	1.7	1.7	1.7	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Oneinternalexaminations
2. Group discussion/ Seminar
3. Homeassignments
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandendsemestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Course Title: Spermatophytes
Course Code: BOTC-201T
Marks: 45(En)

Totallectures-45

Unit-1GymnospermsNo. of classes- 08

General characteristics, classification, morphology, anatomy and reproduction of Gymnosperms. Patterns of embryo development in Gymnosperms. Ecological and economic importance of Gymnosperms. General account and life cycle of *Cycas, Pinus, Ginkgo and Gnetum.*

Unit.2 Fossil plantsNo. of classes- 07

Processoffossilization;earlylandplants(*PsilophytonandRhynia*),Cycadeoidea, *Sphenophyllum*,Geologicaltimescale,importanceoffossil study.

Unit. 3Angiosperms Morphology No. of classes- 10

Phyllotaxy and venation types; Racemose and Cymose inflorescence types, special inflorescences; Floral morphology, formula and diagram; Aestivation; Fruit and placentation. types; Modification (morphology) of leaves, stem, and root.

Unit. 4:Plant Taxonomy No. of classes- 07

Introduction to taxonomic hierarchy, alpha and omega taxonomy, identification, classification, and nomenclature; Species concept; Field inventory; Botanical gardens; Physical & Virtual herbarium; BSI; Classification types (artificial, natural, phylogenetic) with brief idea to Linnaeus, Bentham & Hooker, and Takhtajan system.

Unit.4.Structure of mature anther and ovuleNo. of classes- 06

Anther wall: structure and functions, palynology and scope (a brief account); pollen wall proteins; pollen viability, storage and germination, structure of mature ovule.

Unit 5: Pollination and Fertilization No. of classes- 07

Pollination types and; adaptations for pollination; Syngamy and Double fertilization; Structure of embryo and endosperm,embryo-endosperm relationship; nutrition of embryo; polyembryony, apomixes and parthenocarpy self incompatibility.

Course Title:Spermatophytes

Course Code: BOTC-201P

Marks: 15(En)No. of classes- 15

1. Study of morphology and reproductive parts of *Cycas, Pinus,Ginkgo&Gnetum.*
2. Study of Fossil plants (Photographs/specimen).
3. Study of morphology of leaf phyllotaxy (opposite, alternate, whorled); venation (reticulate, parallel); Inflorescence (racemose, cymose).

4. Mounting of five (5) properly dried and pressed specimens (wild) with label to be pasted in the record book.
5. Study of pollen morphology and pollen tube formation.
6. Study of types of embryos and endosperms (Permanent slides/ photographs)

Suggested readings

1. Bhatnagar,S.P.&Moitra,A.(1996).Gymnosperms.NewAgeInternational(P)Ltd Publishers, New Delhi, India.
2. Bhojwani,S.S.andBhatnagar,S.P.(2011).TheEmbryologyofAngiosperms,Vikas Publishing House. Delhi. 5th edition.
3. Shivanna,K.R.(2003).PollenBiologyandBiotechnology.OxfordandIBHPublishing Co. Pvt. Ltd. Delhi.
4. Raghavan,V.(2000).DevelopmentalBiologyofFloweringplants,Springer,Netherlands.
5. Johri,B.M.l(1984).EmbryologyofAngiosperms,Springer-Verlag, Netherlands.

Semester-II

Course Title: **Spermatophytes**
Nature of course: **Major/Core-II**
Course Code: **BOTM-201T + BOTM-201P**
Marks: **100[En:45T+ 15P, In:40]**

Course outcomes:

4) Describe different groups of gymnosperms and angiosperms

5) Examine the morphology and reproductive processes in Gymnosperms and Angiosperms Characteristics

6) Analyze the interrelationship among different species and genera of Gymnosperms and Angiosperms

Learning Outcomes:

4) Understand the various groups in Gymnosperms and Angiosperms

5) Compare various groups in Gymnosperms and Angiosperms based on morphology and reproduction

6) Examine the reproductive structure in various groups in Gymnosperms and Angiosperms

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2,CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programmeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	1	1	1.8

CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	2	1	1	2	2	1.8
AVERAGE	3	2	2.0	1.7	1.7	1.7	1.7	

3for highest correlation,2 for moderate correlation, and1 for lowest correlation

Modes of internal assessment:

1. Two internal examinations
2. Group discussion/ Seminar
3. Home assignments
4. Any other activity

Attainment of COs:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Field collection and identification of specimens
3. Submission of collected specimens
4. Practical record book

Course Title: Spermatophytes

Course Code:BOTM-201T

Marks: 45(En)Total lectures-45

Unit-1.GymnospermsNo. of classes- 08

General characteristics, classification, morphology, anatomy and reproduction of Gymnosperms. Patterns of embryo development in Gymnosperms. Ecological and economic importance of Gymnosperms. General account and life cycle of *Cycas, Pinus, Ginkgo and Gnetum.*

Unit.2. Fossil plantNo. of classes- 07

Process of fossilization; early land plants (*Psilophyton and Rhynia*), Cycadeoidea, *Sphenophyllum*, Geological time scale, importance of fossil study.

Unit. 3:Angiosperms Morphology No. of classes- 10

Phyllotaxy and venation types; Racemose and Cymose inflorescence types, special Inflorescences; Floral morphology, formula and diagram; Aestivation; Fruit and placentation. types; Modification (morphology) of leaves, stem, and root.

Unit. 4:Plant Taxonomy No. of classes- 07

Introduction to taxonomic hierarchy, Alpha and Omega taxonomy, identification, classification, and nomenclature; Species concept; Field inventory; Botanical gardens; Physical

& Virtual herbarium; BSI; Classification types (Artificial, Natural, Phylogenetic) with brief idea to Linnaeus, Bentham & Hooker, and Takhtajan system.

Unit.5 Structure of mature anther and ovuleNo. of classes- 06

Anther wall: structure and functions, palynology and scope (a brief account); pollen wall proteins; pollen viability, storage and germination, structure of mature ovule.

Unit 5: Pollination and Fertilization No. of classes- 07

Pollination types and; adaptations for pollination; Syngamy and Double fertilization; Structure of Embryo and Endosperm, Embryo-Endosperm relationship; nutrition of embryo; Polyembryony, apomixes and Parthenocarpy Self Incompatibility.

Course Title: Spermatophytes
Course Code: BOTM-201P

Marks: 15(En)No. of classes- 15

1. Study of morphology and reproductive parts of *Cycas, Pinus,Ginkgo&Gnetum.*
2. Study of Fossil plants (Photographs/specimen).
3. Study of different types of roots(Morphology only).
4. Study of morphology of leaf phyllotaxy (opposite, alternate, whorled); venation (reticulate, parallel); Inflorescence (racemose, cymose).
5. Mounting of five (5) properly dried and pressed specimens (wild) with label to be pasted in the record book.
7. Studyof pollen morphology and pollen tube formation.
8. Study of types of Embryos and Endosperms (Permanentslides/ Photographs)

Suggested reading

1. Bhatnagar,S.P.&Moitra,A.(1996).Gymnosperms.NewAgeInternational(P)Ltd Publishers, New Delhi, India.
2. Bhojwani,S.S.andBhatnagar,S.P.(2011).TheEmbryologyofAngiosperms,Vikas Publishing House. Delhi. 5th edition.
3. Shivanna,K.R.(2003).PollenBiologyandBiotechnology.OxfordandIBHPublishing Co. Pvt. Ltd. Delhi.
4. Raghavan,V.(2000).DevelopmentalBiologyofFloweringplants,Springer,Netherlands.
5. Johri,B.M.l(1984).EmbryologyofAngiosperms,Springer-Verlag, Netherlands.

Semester-II
TitleoftheCourse:Phytodiversityand Human Welfare
Nature of course : MDC-II Course
code:UG-MDC-BOT-201
Total Credits:03
DistributionofMarks: 100 [End:60,In: 40]

Course outcome

1. Determine thelevelofplant diversity
2. Examinethecauseoftheloss ofbiodiversity
3. Analysethebiodiversityconservationstrategies
4. Evaluatetheroleofplantsinhuman welfare

Learningoutcomes

1. Distinguishthebiodiversitylevels
2. Analysethreatsto biodiversity
3. Understandtheconservationstrategiesforbiodiversity
4. Examinetheroleofplants,inhuman welfare

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO3	CO4		CO2
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	1	1	2	2	2.0
CO4	3	3	2	2	2	1	1	2.0
AVERAGE	3.0	2.2	2.2	1.7	1.7	1.7	1.7	

Modesofinternalassessment:

1. Twointernalexaminations
2. Group discussion/ Seminar
3. Homeassignments
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend semester theoryandpracticalexaminations
2. Fielddemonstrationoflocalfloraandfauna
3. Demonstrationofbiodiversityconservationmodels
4. Participationinseminar/conference

Title of the Course :Phytodiversity and Human Welfare
Course code:UG-MDC-BOT-101
Total Credits:03
Marks:60
Total Lectures:45

Unit 1: **No. of classes- 12**

Phytodiversityanditsscope-Geneticdiversity,Speciesdiversity,Plantdiversityatthe eCOsystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Phytodiversity, Precautionary principle and methodologies for valuation,

Unit 2: **No. of classes- 13**

Loss of Phytodiversity: Loss of genetic diversity, species diversity, eCOsystem diversity and loss of agrobiodiversity, Projected scenario for Phytodiversity loss, Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodologyforexecution-IUCN,UNEP,UNESCO,WWF,NBPGR;Biodiversitylegislation and conservations, Biodiversity information management and communication

Unit 3: **No. of classes- 10**

Conservation of Phytodiversity: Conservation of genetic diversity, In situ and ex situ conservation, Socialapproaches to conservation, Biodiversity awareness programmes, Sustainable development.

Unit 4: **No. of classes- 10**

Role of plants in relation to Human Welfare; Importance of forestry product, their utilization and commercial aspects , Avenue trees and Ornamental plants of India. Fruits and nuts and important fruit crops their commercial importance. Alcoholic beverages through ages.Uses of microbes.

Suggested readings

1.Krishnamurthy,K.V.(2004).AnAdvancedTextBookofBiodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

Semester-II
TitleoftheCourse:Biofertilizers
Nature of course:SEC-II
Course code: UG-SEC-BOT-201
Total Credits:03
Marks:100[End:60(Theory: 45,Pract:15),In: 40]

Course outcome

1. Identifymicrobesusedasbiofertilizer
2. Implementationoforganiccultivationusingbiofertilizers
3. Analysethestrategiesforbiofertilizerproduction

Learningoutcomes

1. Describebiofertilizersandtheirimportance
2. Analysetheissuesinvolveinorganic agriculture
3. Understandthestrategiesforbiofertilizerproduction

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural		CO3		CO2		
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	1	1	1.8
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	2	1	1	2	2	1.8
AVERAGE	3	2	2.0	1.7	1.7	1.7	1.7	

Modesofinternalassessment:

1. Twointernalexaminations
2. Group discussion/ Seminar
3. Homeassignments
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fielddemonstrationoflocalfloraandfauna
3. Demonstrationofbiodiversityconservationmodels
4. Participationinseminar/conference

Title of the Course: Biofertilizers

Course code:UG-SEC-BOT-201TTotal Lecture= 30

Credit: 02

Marks:45

Unit 1: **No. of classes- 05**

Factorsand essentialnutrients affecting plant growth and their role in plant life; concept about different types of fertilizers.biocontrol agents.

Unit 2:No. of classes- 10

Microbes used as biofertilizer (nitrogen fixers, phosphate solubilizers)Rhizobium – isolation, identification, mass multiplication, carrier based inoculants. Cyanobacteria and process of nitrogen fixation, *,Azolla*and*Anabaenaazo*ll*ae*association,*Azolla*in rice cultivation.

Unit 3: **No. of classes- 07**

Mycorrhizal and its typesand association;colonizationof AM. Isolationand inoculum production of AM, and its influence on growth and yield of crop plants. Use of mycorrhiza in agriculture.

Unit 4: **No. of classes- 08**

Organicfarming concept. Recyclingofbio-degradable

municipal,agriculturalandIndustrialwastes–biocompost and vermicompost makingmethods,field Application of compost.

Title of the Course: Biofertilizers

Course code:UG-SEC-BOT-201P

Credit: 01

Marks: 15No. of classes- 15

1. Demonstration/field visit to biofertilizer producing units,

2. Identification of some common biofertilizers.

Suggested readings

1.Dubey,R.C.,2005 ATextbookofBiotechnologyS.Chand&Co,NewDelhi.
2. Kumaresan, V.2005,Biotechnology,SarasPublications,NewDelhi.
3.JohnJothiPrakash,E.2004.OutlinesofPlantBiotechnology.Emkay Publication, New Delhi.
4.Sathe,T.V.2004VermicultureandOrganicFarming.Dayapublishers.
5.SubhaRao,N.S.2000,SoilMicrobiology,Oxford&IBHPublishers,New Delhi.
6.Vayas,S.C,Vayas,S.andModi,H.A.1998Bio-fertilizers and organic Farming AktaPrakashan, Nadiad

Semester-III

TitleoftheCourse:Cell Biology and Immunology

Nature of course:Core/Major-III Course

code: BOTC-301T

Total Credits: 04

Marks:100[End: 60(Theory: 45,Pract:15),In: 40]

CourseOutcomes:

1) Differentiatethestructureandfunctionsofcellularcomponents
2) Evaluatethecelldivisionmechanismandcellcycle.
3) Analyzecell signaling mechanism.
4) To understand the basic immunological processes

Learning Outcomes:

1) Understandthecellstructureandfunctionsofcellorganelles.
2) Analyzecelldivisionandcellcyclemechanisms.
3) Interpretthecell signaling mechanisms**.**
4) To describe immunologicalconcepts

MappingofCOwithBloomTaxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO3	CO2	
Procedural						

Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	3	2	2	2.3
CO3	3	2	3	3	3	2	2	2.4
AVERAGE	3.0	2.0	2.3	2.3	2.7	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternal assessment

1. Two internalexaminations
2. Groupdiscussion/ Seminar
3. Homeassignments
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandendsemestertheoryandpracticalexaminations
2. Laboratorypracticeson cells,cellularorganelles andcellularprocesses
3. Practicalrecordbook/fieldbook
4. Seminar/groupdiscussion

Title of the Course: Cell Biology and Immunology
Course code: BOTC-301T
Credit:3
Marks: 45
TotalLectures:45

Unit1:Thecell **No. of classes- 05**

Cell as a unit of structure and function; cell theory, Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

Unit2:Cell walland plasma membrane **No. of classes- 06**

Chemistry, structure and function of Plant cell wall; Overview of Fluid mosaic model; Chemical composition of membranes; membrane function.

Unit3:Cell organelles **No. of classes- 12**

Nucleus; Structure-nuclear envelope, nuclear pore complex, nuclear lamina, organizationofchromatin;nucleolus.Microtubules,microfilamentsandintermediaryfilament.

Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous natureofmitochondria and chloroplast; Ribosomes types, components and function; Lysosomes.

EndoplasmicReticulum–Structure,targetingandinsertionofproteinsintheER,Golgi Apparatus.

Types of cell division, stages of mitosis and meiosis; Phases of eukaryotic cell cycle, Regulation of cell cycle-checkpoints, role of protein kinases, significance.

Unit5:MembranetransportandProtein sorting&targeting No. of classes- 10

Membrane transport – Passive, active and facilitated transport, membrane channels, gates and pores; endocytosis and exocytosis; protein glycosylation, proteinsorting and export from Golgi apparatus; protein folding & processing; Smooth endoplasmicreticulum and lipid synthesis, export of proteins and lipids.

Unit6:Immunology No. of classes- 12

Immune response, discrimination between self and non-self, innate and acquired immune response; Innate Immunity: Anatomic and Physiological Barriers, Inflammation, Toll receptors and PAMPs, DAMPs , Defensisns, and Complement system, NK Cells; Antigen: Antigenicity vs immunogenicity, B and T cell epitopes; Immunoglobulins: Basic structure, Ig fold and domains, Classes and subclasses of Ig, Biological activities of Igs, B cell receptor; MHC and Antigen Presentation; Cytokines and cytokine receptors; autoimmunity

Title of the Course: Cell Biology and Immunology

Course code: BOTC-301P
Credit:1
Marks: 15No. of classes- 15

1. StudyofplantcellstructurewiththehelpofepidermalpeelmountofOnion/Crinum/Rheo.
2. Demonstrationofthephenomenonofprotoplasmicstreamingin*Hydrilla* leaf,*Vallisnaria*
3. Measurement of cell size by of micrometric method.
4. Cell counting using haemocytometer.(Yeast/pollen grains).
5. Study of cell and its organelles with the help of electronmicrographs(Demonstration).
6. Cytochemical staining of: DNA-Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
7. Study the phenomenon of plasmolysis and deplasmolysis.
8. Study different stages of mitosis and meiosis.

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'sWorldoftheCell,Pearson EducationInc. 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.;SinauerAssociates,MA.

Semester-III

TitleoftheCourse:PlantBiochemistry&Molecular Biology
Nature of course:Core/Major-IV
Course code:BOTC-302
TotalCredits :04
Marks:100[End: 60(Theory: 45,Pract:15),In: 40]

Course outcomes:

1. Differentiatethebiomoleculesoflivingorganisms,theirinteractionsforperpetuationoflife
2. Analyzestructure-functionrelationshipsofnucleic acidsand protein
3. Distinguishbetweenreplication,transcriptionandtranslationinprokaryotesand eukaryotes
4. Interpretthegeneexpression mechanisms

LearningOutcomes:

1. Identifythevarious biomoleculesand understandtheir function
2. Differentiatethecellularprocessessuchasreplication,transcriptionandtranslation

3.understand geneexpression mechanism

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual			CO4	CO1, CO2, CO3		
Procedural						
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1

CO3	3	2	3	1	1	2	2	2.0
CO4	3	3	2	2	2	1	1	2.0
AVERAGE	3.0	2.2	2.2	1.7	1.7	1.7	1.7	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternal assessment

1. Twointernalexaminations
2. Group discussion/ Seminar
3. Homeassignments
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheory andpracticalexaminations
2. Laboratorypracticesonbiochemicalandmolecularbiologyprocesses
3. Practicalrecordbook/fieldbook
4. Seminar/groupdiscussion

Title of the Course: Plant Biochemistry & Molecular Biology
Course code: BOTC-302T
Credits:03
Marks: 45
TotalLectures:45

Unit 1: Biomolecules:No. of classes- 10

Typesandsignificanceofchemical bonds;Structureandproperties of water;pHand buffers.

Carbohydrates: Nomenclature and classification; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides.

Lipids: Definitionandmajorclassesofstorageandstructurallipids; Fatty acidsstructure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.

Proteins: Structureofaminoacids;Levelsofproteinstructure-primary,secondary,tertiaryand quarternary; Protein denaturation and biological roles of proteins.

Nucleicacids: Structureofnitrogenousbases;Structureandfunctionofnucleotides;Typesof nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit 2: BioenergeticsNo. of classes- 05

Lawsofthermodynamics,conceptoffreeenergy,endergonicandexergonicreactions,coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.

Unit 3: EnzymesNo. of classes- 05

Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activationenergy,lockandkeyhypothesis,induced-fit theory),Michaelis–Mentenequation, enzyme inhibition and factors affecting enzyme activity.

Unit4:Genetic materialand its organizationNo. of classes- 05

DNAasthecarrierofgeneticinformation(Griffith's,Hershey&Chase,Avery,McLeod&Mc Cartyexperiment);denaturationandrenaturationofDNA,;OrganizationofDNA-Prokaryotes, Viruses, Eukaryotes. RNA Structure; Organelle DNA-mitochondria and chloroplast DNA.

Unit5:ReplicationandTranscriptionof DNANo. of classes- 10

Generalprinciples–bidirectional,semi-conservativeandsemi-discontinuousreplication,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.

Unit6:Geneticcodes&TranslationNo. of classes- 10

Genetic codes: salient features; Ribosome structure and assembly, mRNA; Charging of tRNA,aminoacyltRNA synthetases;Variousstepsinproteinsynthesis,factorsinvolvein initiation, elongation and termination of polypeptides; Post-translational modifications of proteins.

Title of the Course: Plant Biochemistry & Molecular Biology
Course code: BOTC-302P
Credits:01
Marks: 15No. of classes- 15

1Qualitativetestsforcarbohydrates,reducingsugars,non-reducingsugars,lipidsand proteins.

2.Cytochemicalstainingof DNA. Feulgenandcell wallintheepidermalpeelofonion using Periodic Schiff's (PAS) staining technique.

3.Estimationofplant proteinsbyBiuret/Lowry method.

4.Estimationof reducing and non-reducingsugars in plant samples.

5.IsolationofgenomicDNA

6.DNAestimationbydiphenylaminereagent/UV Spectrophotometry.

7.StudyofDNAreplicationmechanismsthroughphotographs(Rollingcircle,Theta replication and semi-discontinuous replication).

8.StudyofstructuresofprokaryoticRNApolymeraseandeukaryoticRNApolymeraseII through photographs.

9.Photographsestablishingnucleicacidasgeneticmaterial(MesselsonandStahl's,Avery et al, Griffith's, Hershey & Chase's and Fraenkel &Conrat's experiments)

Suggested readings

1. Taiz,L.,Zeiger,E.,(2010).PlantPhysiology.SinauerAssociatesInc.,U.S.A.5th Edition.
2. Hopkins,W.G.,Huner,N.P.,(2009).IntroductiontoPlantPhysiology.John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya,D.,(1999).ExperimentsinPlantPhysiology-ALaboratoryManual.

Narosa Publishing House, New Delhi.

Semester-III Title of the Course: Angiosperm SystematicsNature of course: Minor-III

Coursecode:BOTM-301T
Total Credits: 04
Marks:100[End: 60(Theory: 45,Pract:15),In: 40]

Course outcomes:

1. Identifythediversityof angiosperms,includingmajorfamilies,genera,andspecies.
2. Develop proficiency in using taxonomic keys, morphological features, and molecular data to classify and identify angiosperms.
3. Abilitytointerpretphylogenetictreesandunderstandtheirimplicationsfor classification and evolution
4. Evaluationofphylogeneticanalyses,andtaxonomiccontroversieswithin angiosperm

LearningOutcomes:

1. Identify angiosperm taxaatthefamily,genus,and specieslevels usingmorphological, anatomical, and molecular characters
2. Classifythelocalangiospermflorabasedontheirmorphological,anatomical,and molecular characters
3. Analysisoftheevolutionaryrelationshipsamongangiospermsandmajorcladesof angiosperms
4. Examinethephylogeneticanalyses,andtaxonomiccontroversieswithinangiosperm

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO3	CO4		CO2
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.4
CO2	3	2	2	2	2	2	2	2.4
CO3	3	2	3	1	1	2	2	2.0
CO4	3	2	3	2	2	2	2	2.3

AVERAGE	3	2	2.5	1.7	1.7	2	2	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Twointernalexaminations
2. Group discussion/ Seminar
3. Homeassignments
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course: Angiosperm Systematics

Course code:BOTM-301T

Total Credits:03

Marks:45 **Total Lecture = 45**

Unit 1: Plant Systematics **No. of classes- 10**

Aim, introduction and significance of systematics; Taxonomic evidences from palynology, cytology, and molecular data; Taxonomic documentation: Flora, e-Flora, Monographs, Manuals & Journals; Taxonomic Keys- Single access and Multi-access.

Unit 2: Botanical nomenclature **No. of classes- 07**

ICN and its principles; Names of taxa; Author citation; Type concept; Effective and valid publication; Rejection of names; Principle of priority; Names of hybrids.

Unit 3: Systems of classification **No. of classes- 10**

Major contributions of Theophrastus, Bauhin, Linnaeus, Adanson, Bessey, Hutchinson, Takhtajan; Classification outline, advantages & disadvantages of Bentham & Hooker, Engler & Prantl system; History and development of Angiosperm Phylogeny Group (APG)classification.

Unit 4: Numerical Taxonomy **No. of classes- 08**

Principles of numerical taxonomy; Phenetics and cladistics; Unit characters; OTUs; Character coding; Character-taxon matrix; Cluster analysis; Dendrogam, cladogram & phylogram.

Unit 5: Phylogeny of Angiosperms **No. of classes- 10**

Terms and concepts (plesiomorphy and apomorphy, homology and analogy, parallelism and convergence, monophyletic, paraphyletic, polyphyletic clades); Origin and evolution of angiosperms; Co-evolution of angiosperms and animals.

Title of the Course: Angiosperm Systematics

Course code:BOTM-301T

Total Credits:01

Marks:15No. of classes- 15

1. Study and dissection of floral parts of locally available wild plant species (minimum 07).

2. Mounting of few properly dried and pressed specimens (wild) with label to be pasted in the herbarium sheets.

Suggested reading

1. Singh,(2012).PlantSystematics:Theory and Practice Oxford & IBH Pvt. Ltd., NewDelhi. 3rdedition.

2. Jeffrey,C.(1982).AnIntroductionto Plant Taxonomy. Cambridge University Press, Cambridge.

3. Judd,W.S.,Campbell,C.S.,Kellogg,E.A.,Stevens,P.F.(2002).Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.

4. Maheshwari, J.K.(1963).Flora of Delhi. CSIR, NewDelhi.

Semester-III Title of the Course :Plants and Traditional Knowledge

Nature of the Course : MDC-III Course

Code :UG-MDC-BOT-301

Total Credits :03

Marks :100[End:60,In:40]

Course outcomes:

1. Discusstheindigenouspracticesofethnicgroups ofNortheastIndia
2. Useof traditionalknowledgesystemof the regionforsustainabledevelopment
3. Comparemedicinalandagronomicvaluesofbiologicalresourcesoftheregion
4. Protectionoftraditionalknowledgethrough IPR

Learningoutcomes:

1. Understandthetraditionalpracticesofethniccommunitiesoftheregion
2. ImplementationofIKSforsustainabledevelopmentgoals
3. Applythe indigenous knowledgein daily life
4. Analyzethe IPRforprotectionoftraditionalknowledge

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1			CO4	

Procedural			CO2	CO3		
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	2	2	3	3	2	2	2	2.3
CO2	2	2	3	3	2	2	2	2.3
CO3	2	2	3	3	2	2	2	2.3
CO4	2	2	3	3	2	1	1	2.0
AVERAGE	2.0	2.0	3.0	3.0	2.0	1.8	1.8	

3forhighest correlation,2 formoderatecorrelation, and1 for lowestcorrelation

Modesofinternal assessment

1. Two internalexaminations
2. Homeassignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpracticalexaminations
2. Demonstrationoftraditionalpracticesofethniccommunities(medicine,food,beverages)
3. Demonstrationoftraditionalmethodsofconservationoffoodandbeverages
4. Participationinseminar/conference

Title of the Course:Plants and Traditional Knowledge
Course Code:UG-MDC-BOT-301
Total Credits:03
Marks:60Total Lectures-45

Unit 1: Basics of Plant Traditional Knowledge. No. of classes- 07
Brief history, scope and importance of Traditional Knowledge Systems, Concept and importance of Traditional Systems of treatment: Ayurveda, Siddha and Unani. Role and importance of AYUSH in promoting scientific exploration of Traditional Knowledge.

Unit 2: Study of plants used in Traditional Systems. No. of classes- 08
Concept of Ethnobotany: Brief history, importance, materials and methods of Ethnobotanical Investigation, study of plants used by dominant ethnic tribes in N.E. India. Sarpogondha, Basak, Tulsi, Turmeric, Ginger, Ashoka, Arjun spp.

Unit 3: Terminologies and Principles of Traditional Knowledge. No. of classes- 10
Brief Knowledge on Prior Informed Consent (PIC), Benefit sharing, Intellectual Property Rights (IPR), Ethnic foods, Food Botanicals and community Knowledge, Bio- cultural Knowledge and skills, Food preservation and Traditional Knowledge (TK).

Unit 4: Traditional Knowledge and Conservation. No. of classes- 07

Role of T.K. in conservation and management of Agro-diversity, cultural diversity, Forestry, Climate change. Community knowledge in sustainable management of natural resources.

Unit 5: Traditional Knowledge and Future. No. of classes- 13
India as a vast reservoir of Traditional Knowledge: documentation and scientific validation. Need for Conservation of Traditional Knowledge, Policy implications. Application of modern tools and techniques in conservation of TK.

Semester-III
TitleoftheCourse:Horticulture
Natureof course:SEC-III
Coursecode:UG-SEC-BOT-301
Total Credits:03
Marks:100[End: 60(Theory: 45,Pract:15),In: 40]

Course outcome:

1. Demonstratethenursery andgardeningtechnique
2. Implementationofnurserytechniquefor entrepreneur

Learningoutcome:

1. Operatecommercialnurseryfor livelihood
2. Describethevalueofplants in nursery and horticulture

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual			CO2			
Procedural			CO1			
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.4
CO2	3	2	2	2	2	2	2	2.4
AVERAGE	3	2	2.0	2.0	2.0	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandendsemestertheoryandpracticalexaminations
2. Demonstrationofestablishednurseriesofthe locality
3. Demonstrationofnurserybedpreparation,cuttingsandgrafting
4. Practicalrecordbook

Title of the Course:Horticulture
Course code:UG-SEC-BOT-301T
Total Credits:02
Marks:45Total Lectures:30

Unit 1: Introduction to HorticultureNo. of classes- 06
Definition, Importance and scope of horticultural and floricultural crops. Divisions of horticulture with suitable examples and their importance. Export scenario and scope for Horticulture in India. Landscaping in Horticulture.

Unit 2: Classification & Vegetative propagation of Horticulture Crops No. of classes- 07
Introduction to annuals, biennials, perennials, herbs, shrubs, trees, climbers, succulents, cacti, palms, orchids, bulbous ornamentals, medicinal and aromatic plants.
Cuttings: propagation by root, leaf and stem cuttings; layering: techniques of simple, serpentine, mound, trench and air layering; Grafting and Budding.

Unit 3: Introduction to flowers and fruit crops No. of classes- 05
Concept of floriculture and pomology. Distribution and cultivation of Orchids, Asters, Roses, Mango, Banana, Citrus and Pine apples. Orchard Management.

Unit 4: Introduction to vegetable and plantation crops No. of classes- 07
Origin, history, distribution, cultivation and uses of Arecanut and Coconut .Importance, varieties, climate and soil, seeds and sowing, manuring, diseases and their control, Cultivation of Brinjal, Tomato, Coriander.

Unit 5: Entrepreneurships, Sustainable Production and extension programmes No. of classes- 05
Entrepreneurships in Horticulture, Sustainable Production Practices for Local Fruit Production; Grading, packing, storage and marketing of fruits. Agro Horticultural Societies, Krishi Vignan Kendras (KVK).

Title of the Course:Horticulture
Course code:UG-SEC-BOT-301P
Total Credits:01
Marks:15No. of classes- 15

1. Study the tool/ equipment used in horticulture
2. Identification and prepare a list of annuals, biennials, perennials.
3. Study and identification of horticultural crops with special reference to palms, ornamentals, medicinal and aromatic plants.
4. Identification of common disease on vegetable crops.
5. Demonstration experiments on cutting, layering, grafting and budding.

.Suggested reading

1.Prasad and Kumar, 2014.: Principles of Horticulture 2nd Edition Agribios India
2. Kumar, N., 1990 Introduction to Horticulture. Rajyalakshmi Publications, Nagarkoil, Tamilnadu
3.Jithendra Singh, 2002. Basic Horticulture. Kalyani Publishers, Hyderabad
4. Kausalkumar Misra and Rajesh Kumar, 2014 Fundamentals of Horticulture Biotech books
5. Brady Nyle C and Ray R Well 2014 Nature and Properties of Soil Pearson Educational Inc , New Delhi

Semester-IV

Title of the Course :PlantEcologyandPhytogeography
Nature of course : Core/Major-V
Coursecode :BOTC-401
Total Credits:04
Marks :100[End: 60(Theory: 45,Pract:15),In: 40]

Course outcomes:

1. UnderstandingPlantEcologicalPrinciples
2. InterpretofPlantAdaptations
3. ExamineECOsystem Dynamics
4. ExplainPhytogeographicalConcepts

Learning outcomes:

1. Describetheplantecological concepts
2. Discussplantadaptationsconcerningthe environment
3. Interpretthedynamicsof eCOsystems
4. Explaintheconceptofvegetationindifferentgeographicalregions

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural		CO4	CO2	CO3		
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE

CO1	2	3	2	3	2	2	2	2.3
CO2	2	3	2	3	3	2	2	2.8
CO3	3	3	2	2	3	2	2	2.8
CO4	2	3	2	2	2	2	2	2.3
AVERAGE	2.2	3.0	2.0	2.5	2.5	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course : Plant Ecology and Phytogeography
Nature of course : Core/Major-V
Course code :BOTC-401T
Total Credits :03
Marks :45 Total Lecture : 45

Unit 1: Introduction to plant ecology No. of classes- 05

Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, homeostasis.

Unit 2: Environmental factors No. of classes- 08

Soil: Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.

Water: Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table. Light, temperature, wind and fire **:**Variations; adaptations of plants to their variation.

Unit 3: Biotic interactions No. of classes- 06

Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop.

Unit 4: Population Ecology No. of classes- 07

Characteristics and Dynamics. Ecological Speciation. Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

Unit 5: Functional Ecology No. of classes- 07

Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids.Principles and models of energy flow; Production and productivity; Ecological efficiencies; Ecological energetics; Biogeochemical cycles (C, N and P cyle).

Unit 6: Phytogeography No. of classes- 12

Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local vegetation types of NE India with special reference to Assam.

Climate change: Basic concepts; global warming, causes and consequences (Rise in Sea levels, Glacier melting, Biodiversity Loss), Adaptation, Mitigation, Global and National Efforts, Concept on Sustainable Development, Sustainable Development Goals (SDGs).

Title of the Course: Plant Ecology and Phytogeography

Nature of course : Core/Major-V
Course code :BOTC-401P
Total Credits :01
Marks :15No. of classes- 15

1. Studyofinstrumentsusedtomeasuremicroclimaticvariables:Soilthermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, Raingaugeandlux meter.
2. Analysisforcarbonates,chlorides,nitrates,sulphates,organicmatterandbase deficiency from two soil samples by rapid field tests.
3. Determinationofdissolvedoxygenofwatersamplesfrompollutedand unpolluted sources.
4. Studyofmorphologicaladaptationsofhydrophytesandxerophytes(foureach).
5. Quantitativeanalysisofherbaceousvegetationfordensityandabundanceinthe college campus

Suggested reading

1. Odum,E.P.(2005).Fundamentalsofecology.CengageLearningIndiaPvt.Ltd.,NewDelhi. 5th edition.
2. Singh,J.S.,Singh,S.P.,Gupta,S.(2006).EcologyEnvironmentandResourceConservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson,D.M.(2007).FundamentalProcessesinEcology:AnEarthSystemsApproach. Oxford University Press. U.S.A.
4.Kormondy,E.J.(1996).Conceptsofecology.PHILearningPvt.Ltd.,Delhi,India.4th edition.

Semester-IV

Title of the Course :AngiospermSystematics
Nature of course: Core/Major-VI Course code:BOTC-402
Total Credits:04
Mark:100[End: 60(Theory: 45,Pract:15),In: 40]

Course outcomes:

1. Identifythediversityof angiosperms,includingmajorfamilies,genera,andspecies.
2. Develop proficiency in using taxonomic keys, morphological features, and molecular data to classify and identify angiosperms.
3. Abilitytointerpretphylogenetictreesandunderstandtheirimplicationsfor classification and evolution
4. Evaluationofphylogeneticanalyses,andtaxonomiccontroversieswithin angiosperm

LearningOutcomes:

1. Identifyangiospermtaxaatthefamily,genus,andspecieslevelsusing morphological, anatomical, and molecular characters
2. Classifythelocalangiospermflorabasedontheirmorphological,anatomical,and molecular characters
3. Analysisoftheevolutionaryrelationshipsamongangiospermsandmajorcladesof angiosperms
4. Examinethephylogeneticanalyses,andtaxonomiccontroversieswithin angiosperm

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO3	CO4		CO2
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.4
CO2	3	2	2	2	2	2	2	2.4
CO3	3	2	3	1	1	2	2	2.0
CO4	3	2	3	2	2	2	2	2.3
AVERAGE	3	2	2.5	1.7	1.7	2	2	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course:Angiosperm Systematics

Course code:BOTC-402T

Total Credits:03

Marks:45 Total Lecture : 45

Unit 1: Plant Systematics No. of classes- 08

Aim, introduction and significance of systematics; Taxonomic evidences from palynology, cytology, and molecular data; Taxonomic documentation: Flora, e-Flora, Monographs, Manuals & Journals; Taxonomic Keys- Single access and Multi-access.

Unit 2: Botanical nomenclature No. of classes- 07

ICN and its principles; Names of taxa; Author citation; Type concept; Effective and valid publication; Rejection of names; Principle of priority; Names of hybrids.

Unit 3: Systems of classification No. of classes- 10

Major contributions of Theophrastus, Bauhin, Linnaeus, Adanson, Bessey, Hutchinson, Takhtajan; Classification outline, advantages & disadvantages of Bentham & Hooker, Engler & Prantl system; History and development of Angiosperm Phylogeny Group (APG)classification.

Unit 4: Numerical Taxonomy No. of classes- 10

Principles of numerical taxonomy; Phenetics and cladistics; Unit characters; OTUs; Character coding; Character-taxon matrix; Cluster analysis; Dendrogam, cladogram & phylogram.

Unit 5: Phylogeny of Angiosperms No. of classes- 10

Terms and concepts (plesiomorphy and apomorphy, homology and analogy, parallelism and convergence, monophyletic, paraphyletic, polyphyletic clades); Origin and evolution of

angiosperms; Co-evolution of angiosperms and animals.

Title of the Course:Angiosperm Systematics
Course code:BOTC-402P
Total Credits:01
Marks:15No. of classes- 15

1. Study and dissection of floral parts of locally available wild plant species (minimum 10).
2. Field study to know flora or institutional visit and to prepare field report to be submitted in the examination.
3. Mounting of few properly dried and pressed specimens (wild) with label to be pasted in the herbarium sheets.

Suggested reading

1. Singh,(2012).PlantSystematics:TheoryandPracticeOxford&IBHPvt.Ltd.,NewDelhi. 3rdedition.
2. Jeffrey,C.(1982).AnIntroductiontoPlantTaxonomy.CambridgeUniversityPress, Cambridge.
3. Judd,W.S.,Campbell,C.S.,Kellogg,E.A.,Stevens,P.F.(2002).PlantSystematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Maheshwari,J.K.(1963).FloraofDelhi.CSIR,NewDelhi.
5. Radford,A.E.(1986). FundamentalsofPlantSystematics.HarperandRow,New York.

Semester-IV

Title of the Course :PlantAnatomyandEmbryology
Nature of course: Core/Major-VII
Coursecode:BOTC-403
Total Credits: 04
Marks:100[End: 60(Theory: 45,Pract:15),In: 40]

Course outcomes;

1. Recognizeanatomicalpartsof plantanddifferentembryologicalstagesof plant
2. Explaintheadaptiveandprotectivesystemsofplants
3. Examinethedevelopmentalstagesofplants

Learning outcomes:

1. Understandthebasicanatomicalandembryologicalfeaturesofplants
2. Discusstheadaptiveandprotectivesystemsofplants
3. Distinguishthedevelopmentalpatternsof plants

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO2	CO3		
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2,4
CO2	3	2	2	2	2	2	2	2.4
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course :Plant Anatomy and Embryology
Course code :C-BOT-403T
Total Credits :03
Marks:45 Total Lecture : 45

Unit 1: Differentiation of tissues and organs No. of classes- 15

Simple and complex tissues, Root and shoot apical meristems, Root development: organization of root apical meristem (RAM), initiation of lateral roots, Shoot development: organization of shoot apical meristem (SAM), Structure of dicot and monocot root, stem and leaf.Mechanism of vascular tissue differentiation, secondary growth, wood development in relation to environmental factors; Leaf growth and determination of phyllotaxy, differentiation of stomata & trichomes.

Unit 2: Adaptive and Protective Systems No. of classes- 07

Epidermis, cuticle, lenticels,hydathodes; General account of adaptations in xerophytes and hydrophytes.

Unit 3: Structural organization of reproductive parts of Angiosperm No. of classes- 13

Internal structure of anther and ovule; Processes of microsporogenesis and megasporogenesis, development of male and female gametophyte,structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sacs.

Unit 4: Double fertilization and development of post fertilization structure
No. of classes- 10

Double fertilization, seed-structure appendages and dispersal mechanisms, embryo and endosperm endosperm types, structure, and functions; Dicot and monocot embryo: structure and development, Embryo endosperm relationship, Apomixis, and polyembryony: definition, types and Practical applications.

Title of the Course:Plant Anatomy and Embryology

Course code:BOTC-403P

Total Credits:01

Marks:15No. of classes- 15

1. Studyofmeristemsthroughpermanentslidesandphotographs.
2. Tissues(parenchyma,collenchymasandsclerenchyma);Maceratedxylaryelements,Phloem (Permanent slides, photographs)
3. Stem:Monocot:*Zeamays;*Dicot:*Helianthus*;Secondary:*Helianthus*(onlyPermanentslides).
4. Root:Monocot:*Zeamays*;Dicot:*Helianthus*;Secondary:*Helianthus*(onlyPermanentslides).
5. Leaf:DicotandMonocotleaf(onlyPermanent slides).
6. Adaptiveanatomy:Xerophyte(*Nerium*leaf);Hydrophyte(*Hydrilla*stem).
7. Structureofanther(youngandmature),tapetum(amoeboidandsecretory)(Permanentslides).
8. Typesofovules:anatropous,orthotropous,circinotropous,amphitropous/campylotropous (permanent slides)
9. Femalegametophyte:*Polygonum*(monosporic)typeofEmbryosacDevelopment(Permanent slides/photographs).
10. Ultrastructureofmatureeggapparatuscellsthroughelectronmicrographs.
11. Pollinationtypesandseeddispersalmechanisms(includingappendages,aril,caruncle) (Photographs and specimens).
12. Dissectionofembryo/endospermfromdevelopingseeds.

Suggested reading

1. Mauseth,J.D.(1988).PlantAnatomy.TheBenjamin/CummingsPublisher,USA.
2. Bhojwani,S.S.&Bhatnagar,S.P.(2011).EmbryologyofAngiosperms.Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.

SEMESTER-IV

Title of the Course:GeneticsandEvolutionaryBiology

Nature of course: Core/Major-VIII

Code:BOTC 405

Total Credits:04

Distributionof Marks:100[End: 60(Theory: 45,Pract:15),In: 40]

Course outcomes:

1) Tointerpretthebasicpatternsof inheritance
2) Toevaluategeneticdisordersand mutations
3) Torelateevolutionary forcesleadingtothevariationsanddiversificationof species
4) to examine evidences ranging from fossil records to molecular data and to establishphylogenetic relationships of species.

LearningOutcome:

1) Tounderstand theconcept of inheritance
2) Toanalyzemutationsandgenetic disorders
3) Toexamineforcesof evolution
4) Tointerpretevidenceof evolution

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1		
Procedural				CO3,CO4	CO2	
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	3	2	2	2	2	2	2.3
CO2	3	3	2	2	3	2	2	2.4
CO3	3	2	3	2	3	2	2	2.3
CO4	3	3	3	3	2	2	2	2.6
AVERAGE	3.0	2.5	2.5	2.2	1.5	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuous evaluation throughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Practicalrecordbook

Title of the Course:Genetics and Evolutionary Biology

Course Code:BOTC-404T

Total Credits:03

Marks:45 Total Lecture: 45

Unit-I:Mendeliangeneticsanditsextension No. of classes- 10

Mendelism:History;Principlesofinheritance; Incomplete dominance and co-dominance; Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits; Multiple alleles; Polygenic inheritance. Chromosometheoryofinheritance;Autosome

andsexchromosomes;Probabilityandpedigree analysis.

Unit-II: Extrachromosomal InheritanceNo. of classes- 07 Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast;Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in *Paramecium*.

Unit-III:Linkage,crossing-over,andchromosomemappingNo. of classes- 06

Linkage and crossing over; Cytological basis of crossing over; Genetic mapping, Sex linked, Sex influenced, Sex limited inheritances, quantitative traits/loci.

Unit IV: Chromosomal & gene mutationNo. of classes- 10

Chromosomalmutation:Deletion,Duplication,Inversion,Translocation,Positioneffect, Euploidy and Aneuploidy

Genemutations:Typesofgenemutations;MolecularbasisofMutations;Mutagens–physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method; Transposons.

UnitV:EvolutionNo. of classes- 12

Theories:Lamarck's theory, Darwin's theory, Weismann's germplasm theory; Evolution in bacteria, experimental evolution.

Molecularevolution:Mutationinorganisms,mechanisms,mutationrate,theoriesofmolecular evolution (selection, neutral, nearly neutral).

Population genetics: Hardy Weinberg equilibrium, factors influencing the Hardy Weinberg's equilibrium. Roleofnaturalselection,mutation,geneticdrift.GeneticvariationandSpeciation.

Title of the Course:Genetics and Evolutionary Biology

Course Code:BOTC-404P

Total Credits:01

Marks:15No. of classes- 15

1. Meiosis/mitosisthroughtemporarysquash preparation.
2. Mendel'slawsthroughseedratios.Laboratoryexercisesinprobabilityandchi-square.
3. Chromosomemappingusing three pointtestcrossdata.
5. Incompletedominanceandgeneinteractionthroughseedratios(9:7,9:6:1,13:3,15:1, 12:3:1, 9:3:4).
6. Studyofaneuploidy(examples)
7. Photographs/PermanentSlidesshowingTranslocationRing,LaggardsandInversionBridge.

Suggested reading

1. Genetics:Analysis&PrinciplesAuthor:RobertJ.BrookerPublisher:McGraw-HillScience Engineering; 4 edition (21 January 2011)

2. Concepts of Genetics Authors: William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino, Darrell KilliannPublisher: Benjamin-Cummings Pub Co; Student edition (19 November 2014)

3. IntroductiontoGeneticAnalysis(IntroductiontoGeneticAnalysis (Griffiths) Hardcover–Import,16Feb2007Authors:AnthonyJ.F.Griffiths,SusanR.Wessler,RichardC.Lewontin, Sean B. CarrollPublisher: WH Freeman; 11th ed. 2016 edition (12 January 2015)

Semester-IV

Title of the Course:PlantPhysiologyandMetabolism

Nature of course: Minor-IV

Coursecode:BOTM-401
Total Credits:04
Marks :100[End:60(Theory:45,Pract:15),In:40]

Course outcomes:

1.Abilitytoidentifydifferentphysiologicalprocessesin plant.

2.Abilitytodiscussabsorption,transpiration,photosynthesis,growthinplants.

3. Examine the metabolic process in plants

Learningoutcomes:

1. Demonstratephysiological processesinplants
2. Explaintheabsorption,transpiration, photosynthesis,growthin plants
3. Evaluatethemetabolicactivitiesofplants

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual			CO1			
Procedural				CO2		
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	3	2	3	3	2	2	2.6
CO2	3	3	2	3	3	2	2	2.6
CO3	3	3	3	3	3	2	2	2.7

AVERAGE	3.0	3.0	2.3	3.0	3.0	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Practicalrecordbook

Title of the Course:Plant Physiology and Metabolism

Course code:BOTM-401T

Total Credits:03

Marks:45

TotalLectures:45

Unit1:Plant-water relationsNo. of classes- 07

Water Potential and its components, water absorption by roots, aquaporins, the pathways of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap–cohesion-tension theory.Transpiration and factors affecting transpiration, antitranspirants, and mechanism of stomatal movement.

Unit2:Mineralnutrition&Nutrient UptakeNo. of classes- 08

Essential and beneficial elements, macro and micronutrients, methods of study and useof nutrientsolutions,criteriaforessentiality,mineraldeficiencysymptoms,rolesofessential elements, chelating agents.

Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemicalgradient,facilitateddiffusion,activeabsorption,roleofATP,carriersystems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.

Unit3:Carbonassimilation& metabolismNo. of classes- 10

Photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centre's, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO_2 reduction, photorespiration, C4-pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction. Respiration: aerobic and anaerobic, glycolysis and Kreb cycle

Unit4:Translocation inthe phloemNo. of classes- 05

Experimentalevidenceinsupportofphloem as the siteofsugartranslocation.Pressure–Flow

Model; Phloem loading and unloading; Source–sink relationship.

Unit5: Plant growth regulatorsNo. of classes- 07

Discovery, chemical nature(basicstructure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.

Unit 6:Physiology of floweringNo. of classes- 08

Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy. Phytochrome, crytochromes and phototropins**:** Discovery, chemical nature, role in photomorphogenesis, lowenergyresponses(LER) and high irradiance responses (HIR),mode of action.

Title of the Course:Plant Physiology and Metabolism

Course code : UG- M-BOT-401P

Total Credits :01

Marks:15No. of classes- 15

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water potential of given tissue(potato tuber) by weight method.
3. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
4. To study the phenomenon of seed germination (effect of light).
5. Separation of chloroplast pigments by paper chromatography /TLC
6. Separation of chloroplast pigments by solvent extraction

Suggested reading

1. Taiz, L.andZeiger,E.,Plant Physiology,5th edition(Sinauer Associates,USA,2012).

2. URL: http://www.sinauer.com/media/wysiwyg/tocs/PlantPhysiology5.pdf

3. Lambers, H. and Chapin, F.S., Plant Physiological Ecology (Springer,2000).

4. Mukherji, S.andGhosh,A.K. ,Plant Physiology,1st edition (NewCentral Book Agency Private Ltd. Kolkata, 2009).

5. http://www.annualreviews.org/journal/arplant

6. Hormones:http://nptel.ac.in/courses/102103012/27

Semester-V

Title of the Course :PlantPhysiologyandMetabolism
Nature of course : Major/core-IX
Coursecode: BOTC-501
Total Credits:04
Marks:100[End:60(Theory:45,Pract:15),In:40

Course outcomes:

1. Abilitytoidentifydifferentphysiologicalprocessesin plant.

2. Ability todiscussabsorption,transpiration,photosynthesis, growthin plants.

Learningoutcomes:

1. Demonstratephysiologicalprocessesinplants
2. Explaintheabsorption, transpiration, photosynthesis,growthin plants

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual			CO1			
Procedural				CO2		
Metacognitive						

MappingofCourseoutcomes toProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	3	2	3	3	2	2	2.6
CO2	3	3	2	3	3	2	2	2.6
CO3	3	3	3	3	3	2	2	2.7
AVERAGE	3.0	3.0	2.3	3.0	3.0	2.0	2.0	

3forhighestcorrelation,2formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Practicalrecordbook

Title of the Course:Plant Physiology and Metabolism
Course code: BOTC-501T
Total Credits:03
Marks:45 Total Lecture : 45

Unit1:Plant-water relationsNo. of classes- 07

Water Potential and its components, water absorption by roots, aquaporins, the pathways of watermovement,symplast,apoplast,transmembranepathways,rootpressure,guttation.

Ascentofsap–cohesion-tensiontheory.Transpirationandfactorsaffectingtranspiration,antitranspirants, and mechanism of stomatal movement.

Unit 2: Mineral Nutrition & Nutrient UptakeNo. of classes- 08 Essential and beneficial elements, macro and micronutrients, methods of study and useof nutrientsolutions,criteriaforessentiality,mineraldeficiencysymptoms,rolesofessential elements, chelating agents.

Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemicalgradient,facilitateddiffusion,activeabsorption,roleofATP,carriersystems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.

Unit3:CarbonAssimilation&metabolismNo. of classes- 13

Historicalbackground,photosyntheticpigments,roleofphotosyntheticpigments(chlorophyllsand accessory pigments), antenna molecules and reaction centre's, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO_2 reduction, photorespiration, C4-pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction. Respiration: types, glycolysis and Kreb cycle

Unit 4: Translocation in the phloemNo. of classes- 07

Experimentalevidenceinsupportofphloemasthesiteofsugartranslocation.Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship.

Unit5:PlantgrowthregulatorsandphysiologyofffloweringNo. of classes- 10

Plant growth regulators: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.

Physiologyofflowering:Photoperiodism,floweringstimulus,florigenconcept,vernalization.

Phytochrome , crytochromes and phototropins**:** Discovery, chemical nature, role in photomorphogenesis,lowenergyresponses(LER)andhighirradianceresponses(HIR),mode of action; seed dormancy.

Title of the Course:Plant Physiology and Metabolism

Course code:BOTC-501P
Total Credits:01
Marks:15No. of classes- 15

1. Determinationofosmoticpotentialofplantcellsap byplasmolyticmethod.
2. Determinationofwaterpotentialofgiventissue(potatotuber)byweight method.
3. Calculationofstomatalindexandstomatalfrequencyfromthetwosurfacesof leaves of a mesophyte and xerophyte.
4. Tostudythephenomenonof seedgermination(effectof light).
5. Separationofchloroplastpigmentsbypaperchromatography/TLC
6. Separationofchloroplastpigmentsbysolventextraction
7. Quantitativeanalysisofabsorption spectrumofphotosynthetic pigments.

Suggested reading

1. Taiz,L.andZeiger,E.,Plant Physiology,5th edition(SinauerAssociates,USA,2012).
2. URL: http://www.sinauer.com/media/wysiwyg/tocs/PlantPhysiology5.pdf
3. Lambers,H.andChapin, F.S.,PlantPhysiologicalEcology(Springer,2000).
4. Mukherji,S.andGhosh,A.K.,PlantPhysiology,1st edition(NewCentralBookAgency Private Ltd. Kolkata, 2009).
5. http://www.annualreviews.org/journal/arplant
6. Hormones:http://nptel.ac.in/courses/102103012/27

Semester-V

TitleoftheCourse:PlantbreedingandBiostatistics

Nature of course:Major/core-X
Course code: BOTC-501
Total Credits:04
Marks:100[End: 60(Theory: 45,Pract:15),In: 40]

Course outcomes:

1. Describethemethods used inplant breeding to improve crops
2. Demonstrateproficiency inclassicalandmodernplantbreedingtechniques
3. Understandselection criteriaand methodsfor breedingnewvarieties
4. Conductlaboratoryworkrelatedtoplantbreeding
5. Understand the basic concepts and principles of biostatistics.
6. Learn about probability, statistical distributions, and hypothesis testing

Learningoutcomes:

1. Explainthefundamental principles ofplantbreedingandcropimprovement
2. Discusstheadvantagesandlimitationsofdifferentbreedingapproaches
3. Understandselection criteriaand methodsfor breedingnewvarieties
4. Discuss the basic concepts of biostatistics.

Mappingof Course withBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural		CO3	CO2		CO4	
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	3	2	3	3	2	2	2.4
CO2	3	3	3	3	3	2	2	2.6
CO3	3	2	3	2	2	2	2	2.3
CO4	3	3	3	3	3	2	2	2.7
AVERAGE	3.0	2.7	2.7	2.7	2.7	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternal assessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCourse:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course: Plant breeding and Biostatistics

Course code: UG- C-BOT-502T

Total Credits:03

Marks:45 **Total Lecture : 45**

Unit 1:Plant BreedingNo. of classes- 08

Introductionandobjectives.Breedingsystems:modesofreproductionincropplants. Plant genetic resources; Important achievements and undesirable consequences of plant breeding.

Unit 2: Conventional Methods of Crop ImprovementNo. of classes- 10 Introduction and acclimatization; Selection methods: For self-pollinated, cross-pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants: Procedure, advantages and limitations, Distant hybridization.

Unit3:InbreedingdepressionandheterosisNo. of classes- 07

History,geneticbasisof inbreedingdepressionandheterosis;Applications.

Unit4: Non-Conventional Methods of Cropimprovement **No. of classes- 05**

Mutation and Ploidy breeding; and role of biotechnology in crop improvement.

Unit-5: Biostatistics: **No. of classes- 15**

Frequency Distributions and Statistical Measures: mean, mode, median, variance, standard deviation, coefficient of variation, measures of skewness and kurtosis

Probability: Theory of Probability, Conditional Probability, Bayesian Rules, Random variable, Distributions of random variables, Binomial, Poisson Fundamental concepts in applied probability, Chi-square test for independence, P-value and z-score of the statistic. A brief account on statistical software and their use for data analysis

Title of the Course: Plant breeding and Biostatistics

Course code: BOTC-502P
Total Credits:01
Marks:15No. of classes- 15

1. Reproductivebiologyofself-andcross-pollinating plants
2. Vegetativereproduction –Cutting, Budding, graftingandlayering
3. Hybridization: Emasculation, bagging, pollination and production of hybrids
4. Pollen fertility–Tetrazolium test
5. Calculation of mean, median and mode
6. Chi-square test, t-test, ANOVA

Suggested reading

1.Singh,B.D.(2005).Plant Breeding: Principles and Methods. Kalyani Publishers.7th edition.
2. Chaudhari, H.K.(1984). Elementary Principles of Plant Breeding. Oxford– IBH.2nd edition.
3. Chaudhary, R.C.(1999). Introduction to plant Breeding. Oxford– IBH. 11th edition.

SEM-V

Title of the Course :Microbiology

Nature of course:Major/CORE-XI

CourseCode:BOTC-503

Total Credits:04

Marks:100[End:60(Theory:45,Pract:15),In:40] Course outcomes:

1. Toclassifymicroorganismbasedondifferentparameters
2. Todemonstratedifferent processesinvolvedinmicrobiology
3. Todifferentiatebetween microbial groups
4. Toapplymicrobes forhuman welfare
5. Toevaluatedifferent antibioticsandvaccines

LearningOutcome:

1. Todistinguishmicrobesbasedondifferentparameters
2. Tounderstanddifferent microbialprocessesforapplicationinhumanwelfare
3. Tounderstandantibioticclassesandvaccines

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1, CO5				
Procedural			CO2, CO4	CO3	CO6	
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	1	2	2	1	2	1.7
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	2	1	1	1	1	1.5
CO4	2	3	3	2	2	1	1	2.0
CO5	2	2	2	2	2	1	2	1.8
CO6	2	3	3	2	2	1	1	2.0
AVERAGE	2.1	2.4	1.8	1.7	1.5	1.0	1.2	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course : Microbiology
Course Code : BOTC-503T
Total Credits :03
Marks :45 Total Lecture :45

Unit I: Brief history and development of microbiology: No. of classes- 15
Introduction to study of Microbiology, conflict over spontaneous generation, role of microorganisms in disease, scope of microbiology, development of Koch's postulate. Classification of microorganisms; morphological, biochemical and molecular characteristics; nutritional types in microorganisms; Culture media, microbial growth curve uncultured microbes.

Unit II: Prokaryotic cell structure: No. of classes- 07
Bacterial cell wall, cytoplasmic structure and inclusions bodies, sporulation and spore, diversity in bacterial structure; actinomycetes, rickettsias, mycoplasma; archaea.

Unit III: Viruses: 08 classes
Basic structures, classification, double-stranded and single-stranded DNA and RNA viruses, replication strategies of DNA and RNA viruses; viroids and prions; bacteriphages with suitable examples.

Unit-IV: Application of microbes: No. of classes- 10
Role of microbes in bio-geo-chenical cycling, Biological nitrogen fixation; Industrial application of microbes: alcohol, organic acids, vaccine, antibiotics; microbial biofilm; wastewater treatment; bifertilizer and biopesticides; Microbial diseases and their control: Host- pathogen relationship, mechanisms of virulence, quorum sensing, pathogenesis in plants and animals

Unit: V: Applied microbiology: No. of classes- 13
Study of microbial population in air, air sanitation; microbial population in water, indication of faecal pollution, water purification; Contamination of milk, testing of milk for different microbes, pasteurization; Concept of microbial ecology of soil, rhizosphere, mycorrhiza. Free-living and symbiotic types of Nitrogen fixation, Rhizobium and nodule; Biofertilizers. Industrial production of alcohol, vinegar; Use of microorganisms for bioassay.

Title of the Course: Microbiology
Course Code:BOTC-503P
Total Credits:01
Marks:15No. of classes- 15

1. Bacterialgrowthonsolidandbrothmedia,pureculturetechnique,slant preparation
2. Bacterialcolonymorphologyanddiversity
3. Gramstainingof bacteria
4. Biochemicalcharacterizationofbacteria

5. Determinationofcoliformgroupinwatersamplesbypresumptive,confirmedand completed test.

Suggested reading

1. Willey,J.,Sherwood,L.andWoolvertonC.,Microbiology,10thedition(McGraw-Hill Science, 2017).
2. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R., Microbiology, Publisher McGraw HillEducation (India) Private Limited, ISBN-10 0074623206, 5th Edition, 2001.
3. Tortora,G.J.,Fernke,B.R.andCase,C.L.,Microbiology–AnIntroduction,9th Edition,
4. Basic Immunology: Functions and Disorders of the Immune System, Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai (Elseviers Saunders 4 th Edition).
5. KubyImmunology,ThomasJ.Kindt,BarbaraA.Osborne,RichardA.Goldsby(W.H. Freeman Publishers, Sixth Edition).
6. M. T. Madigan, J. M. Martinko, K. S. Bender, D. H. Buckley, D. A. Stahl, T. Brock, Brock Biology of Microorganisms, 14th Edition , Pearson Hall International, 2017.
7. MolecularandCellBiology(Schaum'sOutlinesseriesspecialIndianedition)byW.D. Stansfield,J.S.C.Colome,R.J.CanoandR.N.Sharan(2010),McGrawHillEducation

SEM-V

Title of the Course :Field Study/ Project Work
Course: Major/CORE-Int./Comm./project
Code: BOTC-504
Total Credits:04
Marks: 100

Title of the Course:Plant Resources andEconomic Botany

Nature of course: Minor-V

Coursecode :BOTM-501

Total Credits:04

Marks:100[End:60(Theory:45,Pract:15),In:40]

Course outcomes:

1. Identifyandclassifyeconomicallyimportantplantspeciesbasedon theirtaxonomic characteristics.
2. Describethediversityofplantspeciesusedbyhumansacrossdifferentgeographical regions.
3. Discussagriculturalandhorticulturaltechniquesusedtocultivateeconomically important plants.
4. Evaluatesustainablepracticesfortheproductionandmanagementofeconomically significant crops

Learningoutcomes:

1. Identifyandclassifyeconomicallyimportantplantspeciesbasedontheirbotanical characteristic
2. Describethetraditional,medicinal,industrial,andcommercialusesofplants
3. Explaintheanatomicalandphysiologicalfeaturesofplantsthatarerelevanttotheir economic uses
4. Understandagriculturalandhorticulturaltechniquesusedinthecultivationand management of economically significant plants

Mappingof Course withBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO2	CO3	CO4	
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	3	3	2	2	2.4
CO2	3	2	2	3	3	2	2	2.4
CO3	3	2	3	3	3	2	2	2.6
CO4	2	2	3	3	3	2	2	2.4
AVERAGE	2.7	2.0	2.5	3.0	3.0	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCourses:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course:Plant Resources andEconomic Botany

Course code: BOTM-501T

Total Credits :03

Marks: 45

Totallectures-45

Unit 1:No. of classes- 07

OriginofCultivatedPlants**:**ConceptofCentresofOrigin,theirimportancewith reference toVavilov'swork.Examplesofmajorplantintroductions;Cropdomesticationandlossof genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.

Unit 2: No. of classes- 10

Cereals:WheatandRice(origin,morphology,processing&uses);Briefaccountofmillets.

Legumes: Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and eCOsystem.

Sugars and starches: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

Unit3:No. of classes- 10

Spices:Listingofimportantspices,theirfamilyandpartused.Economicimportancewith special reference to fennel, saffron, clove and black pepper

Beverages:Tea,Coffee(morphology,processing &uses)

Oils and fats: General description, classification, extraction, their uses and health implications; groundnut, coconut, soybean, mustard and coconut (Botanical name, family & uses).

Unit4No. of classes- 08

NaturalRubber:Para-rubber:tapping,processinganduses.

Drug-yieldingplants:*Cinchona,Digitalis,PapaverandCannabis;Tobacco*(Morphology, uses and health hazards).

Unit5:No. of classes- 10

Timberplants:Generalaccountwithspecialreferencetoteakandpine.

Fibers**:**Classificationbasedontheoriginoffibers;Fibers: Cotton,CoirandJute(morphology, extraction and uses).

Title of the Course:Plant Resources andEconomic Botany

Course code: BOTM-501P

Total Credits :01

Marks :15No. of classes- 15

1. Collectionandsubmissiondifferentcereals,pulses,spices,drugyieldingplant parts and timber (in the form of albums)
2. Identificationoflocallyavailableeconomicallyimportantplantspecies
3. Qualitativedetectionofprotein,carbohydrate, and fatinplantsamples

Suggested reading

1. Kochhar,S.L.(2012). EconomicBotanyinTropics,MacMillan &Co.NewDelhi,India.

2. Wickens,G.E.(2001).EconomicBotany:Principles&Practices.KluwerAcademicPublishers, The Netherlands.

3. Chrispeels,M.J.andSadava,D.E.1994Plants,GenesandAgriculture.Jones&Bartlett Publishers.

SEM-VI

Title of the Course:Phyto Pathology&CropProtection

Nature of course:Core/Major-XII

Course Code:BOTC-601

Total Credits:04

Marks:100[End: 60(Theory: 45,Pract:15),In: 40]

Course outcomes:

1. Identifyanddescribemajorgroupsofplant pathogens
2. Understandthe biology,lifecycles, and modesofactionofvariousplant pathogens
3. Learnintegrateddiseasemanagementstrategies,includingcultural,biological, chemical, and genetic approaches
4. Analyzediseasecyclesandtheinfluenceofenvironmentalconditionsondisease development.

Learningoutcomes:

1. Classifymajor groupsofplant pathogens
2. Describethebiology andlifecycle ofplant pathogens
3. Explaintheplantdisease managementstrategies
4. Evaluatediseasecyclesand development patterns

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO2	CO3	CO4	
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	3	3	2	2	2.4
CO2	3	2	2	3	3	2	2	2.4
CO3	3	2	3	3	3	2	2	2.6
CO4	2	2	3	3	3	2	2	2.4
AVERAGE	2.7	2.0	2.5	3.0	3.0	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course:Phyto Pathology & Crop Protection

CourseCode: BOTC-601T

Total Credits:03

Marks:45

Totallectures-45

Unit: 1 Fundamentals of plant pathology**No. of classes- 07**
Introduction, Concept of plant disease, history of plant pathology, common symptoms of plant diseases.

Unit: 2 Disease development**No. of classes- 08**
Concept of disease cycle, Inoculation, Pre penetration, Penetration and post penetration Host parasite interaction, Dissemination. Epidemics, defence mechanisms,

Unit: 3 Methods of Studying Plant Diseases**No. of classes- 08**
Microscopic study, Macroscopic study, Koch's postulates.
Culture technique, Media, Types and Preparation,
Pure culture methods- streak plate, Pour plate, spread plate, Serial dilution.

Unit: 4. Principles of Plant Disease Control**No. of classes- 07**
Eradication, cultural control practices, Biological control, Chemical control, Use of EMS, Plant Quarantine, IPM

Unit: 5. Resistance- **No. of classes- 05**

Systemic acquired and induced systemic, Disease resistance, R-genes, gene for gene concept, immunity (PTI & ETI), hypersensitive response and cell death.

Unit: 6 Plant Diseases**No. of classes- 10**
Study of Diseases- Club root of Crucifers, Powdery mildew of Pea, Late blight of potato, White rust of Brasicaceae, Rust of wheat, Leaf spot of cabbage, Blast of Paddy, Citrus Canker, Tobacco Mosaic Disease with reference to causal organism, symptoms and signs, disease cycle and control measures.

Title of the Course:Phyto Pathology & Crop Protection
Course Code:BOTC-601P
Total Credits:01
Marks :15No. of classes- 15
1. Studyof commonplant diseases:

Fungal diseases Club root of Crucifers, Powdery mildew of Pea, Late blight of potato, White rust of Brasicaceae, Rust of wheat, Leaf spot of cabbage, Blast of Paddy

Bacterialdiseases–Citruscankerandangularleafspotofcottonandotherlocally available diseases

Viraldisease-tobaccomosaicvirus,Bhendiyellowveinmosaic virus

2.IsolationofplantpathogenandestablishmentofKoch's postulates.

3. Studyofplantoriginandchemicalpesticides.

4.Preparationandsubmissionofplantdisease albums.

SEM-VI

Title of the Course:Plant Resources andEconomicbotany
Nature of course:Major/ core-XIII
Course Code:BOTC602
Total Credits:04
Distributionof Marks:100[End:60(Theory:45,Pract:15),In: 40]

Course outcomes;

1. Identifyandclassifyeconomicallyimportantplantspeciesbasedontheir taxonomic characteristics.
2. Describethediversityofplantspeciesusedbyhumansacrossdifferent geographical regions.
3. Discussagriculturalandhorticulturaltechniquesusedtocultivateeconomically important plants.
4. Evaluatesustainablepracticesfortheproductionandmanagementofeconomically significant crops

Learningoutcomes:

1. Identifyandclassifyeconomicallyimportantplantspeciesbasedontheirbotanical characteristic
2. Describethetraditional,medicinal,industrial,andcommercialusesofplants
3. Explaintheanatomicalandphysiologicalfeaturesofplantsthatarerelevantto their economic uses
4. Understandagriculturalandhorticulturaltechniquesusedinthecultivationand

management of economically significant plants

MappingofCoursewithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO2	CO3	CO4	
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	3	3	2	2	2.4
CO2	3	2	2	3	3	2	2	2.4
CO3	3	2	3	3	3	2	2	2.6
CO4	2	2	3	3	3	2	2	2.4
AVERAGE	2.7	2.0	2.5	3.0	3.0	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course: Plant Resources andEconomicbotany

Code:BOTC-602T

Total Credits:03

Distribution of Marks:45

Total Lectures-45

Unit 1:No. of classes- 10

Origin of Cultivated Plants**:** Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.

Unit 2: **No. of classes- 09**

Cereals: Wheat and Rice (origin, morphology, processing & uses); Brief account of millets. Legumes: Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.

Sugars and starches: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

Unit3:No. of classes- 10

Spices: Listing of important spices, their family and part used. Economic importance with special reference to fennel, saffron, clove and black pepper

Beverages: Tea, Coffee (morphology, processing &uses)

Oils and fats: General description, classification, extraction, their uses and health implications; groundnut, coconut, soybean, mustard and coconut (Botanical name, family & uses).

Unit4:No. of classes- 08

Natural Rubber: Para-rubber: tapping, processing and uses.

Drug- yielding plants: *Cinchona, Digitalis, Papaver and Cannabis; Tobacco* (Morphology, uses and health hazards).

Unit5: No. of classes- 08

Timber plants: General account with special reference to teak and pine.

Fibers**:** Classification based on the origin of fibers; Fibers: Cotton, Coir and Jute (morphology, extraction and uses).

Title of the Course: Plant Resources andEconomicbotany
Code:BOTC-602T
Total Credits:01
Marks:15No. of classes- 15

1. Collectionandsubmissiondifferentcereals,pulses,spices,drugyieldingplant parts and timber (in the form of albums)
2. Identificationoflocallyavailableeconomicallyimportantplantspecies
3. Qualitativedetectionofprotein,carbohydrate, and fatinplantsamples

Suggested reading

1. Kochhar,S.L.(2012). EconomicBotanyinTropics,MacMillan &Co.NewDelhi,India.

2. Wickens,G.E.(2001).EconomicBotany:Principles&Practices.KluwerAcademicPublishers, The Netherlands.

3. Chrispeels,M.J.andSadava,D.E.1994Plants,GenesandAgriculture.Jones&Bartlett Publishers**.**

SEM-VI

Title of the Course	**:**	**PlantBiotechnology and Bioinformatics**
Nature of course	**:**	**Major/ core-XIV**
Code	**:**	**BOTC-603**
Total Credits	**:**	**04**
Distributionof Marks	**:**	**100[End:60(Theory:45,Pract:15),In: 40]**

Course outcome

1. Understandthebasicconceptsandprinciplesofplantbiotechnology.
2. Comprehendthestructureandfunctionofgenes,genomes,andgeneticengineeringtechniques
3. Develop skills in plant tissue culture techniques, including micropropagation, callus culture, and somatic embryogenesis.
4. Applytissueculturemethodsforplantbreedingandconservation
5. Learnaboutbiologicaldatabases,sequencealignment,andmolecularevolution

Learningoutcomes:

1. Explainthebasicconceptofbiotechnology
2. Demonstratethetissueculturetechnique

Mappingof Course withBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1 CO5	CO2			
Procedural		CO6 CO7	CO3 CO4			
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	3	3	2	2	2.6
CO4	3	3	3	3	3	2	2	2.7
CO5	3	3	3	3	3	2	2	2.7

CO6	3	3	3	3	3	2	2	2.7
CO7	3	3	3	3	3	2	2	2.7
AVERAGE	3.0	2.6	2.7	2.7	2.7	2.0	2.0	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCourses:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollectedspecimens
4. Practicalrecordbook

Title of the Course: Plant Biotechnology and Bioinformatics
Code:BOTC-603T
Total Credits :03
Marks:45 Total Lecture: 45

Unit1:PlantTissueCulture No. of classes- 15

Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).

Unit2:RecombinantDNAtechnologyandapplicationofbiotechnologyNo. of classes- 15

Steps involved in genetic engineering, restriction enzymes and cloning vectors, Methods of gene transfer, construction of genomic and cDNA libraries,

Application of biotechnology**:** Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticulturalvarieties(Moondustcarnations);Roleoftransgenicsinbioremediation(Superbug);edible vaccines;Industrialenzymes(Aspergillase,Protease,Lipase);GentiallyEngineeredProducts–Human Growth Hormone; Humulin; Biosafety concerns.

Unit 3: Introduction to BioinformaticsNo. of classes- 15 Introduction to bioinformatics,

Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System. National Center for Biotechnology Information (NCBI), BasicLocalAlignmentSearchTool(BLAST),ConceptofAlignment,MultipleSequence Alignment, Basic concept of Phylogenetic Analyses.

Title of the Course:Plant Biotechnology and Bioinformatics
CourseCode:BOTC-603P
Total Credits :01
Marks:15No. of classes- 15

1. PreparationofMSmedium.
2. Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.
3. Study of anther, embryoand endosperm culture,micropropagation,somaticembryogenesis& artificial seeds through photographs.
4. ConstructionofrestrictionmapofcircularandlinearDNAfromthedata provided.
5. Study of methodsof genetransfer throughphotographs: *Agrobacterium*-mediated,direct gene transfer by electroporation, microinjection, microprojectile bombardment.
6. Studyofstepsofgeneticengineeringforproductionof Bt-cotton,Goldenrice,Flavr-Savr tomato through photographs.
7. Nucleicacidandproteindatabases.
8. Sequenceretrievalfromdatabases.
9. Sequence alignment.

SEM-VI

Title of the Course	**:**	**Analyticaltechniquesinplantscience**
Nature of course	**:**	**Major/ Core-XV**
Code	**:**	**BOTC-604**
Total Credits	**:**	**04**
Distributionof Marks	**:**	**100[End:60(Theory:45,Pract:15),In: 40]**

Course outcomes:
CO1: Understanding the basic principles of the tools and techniques in plant science.

CO2:Abilitytoapplytechnologiestosolvecomplexbiologicalquestionsin Life Sciences. CO3:

Ability to operate sophisticated instruments used in biological science

LearningOutcome:

1. Describetheinstrumentsusedinmodern biology
2. Demonstratetheinstrumentsandtechniquesusedinlifesciences**.**

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				

Mapping of Course with Bloom's taxonomy

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2,4
CO2	3	2	2	2	2	2	2	2.4
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

Oneinternalexamination(theory)

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCourses:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Practicalrecordbook

Title of the Course :Analytical techniques in plant science
CourseCode :BOTC-604T
Total Credits :03
Marks :45 Total Lecture = 45

Unit 1 : Imaging and related techniquesNo. of classes- 12

Principlesofmicroscopy;Lightmicroscopy;Fluorescencemicroscopy;Confocalmicroscopy; Useoffluorochromes:(a)Flowcytometry(FACS);(b)Applicationsoffluorescence microscopy:Chromosomebanding, FISH, chromosomepainting;TransmissionandScanning electronmicroscopy–samplepreparationforelectronmicroscopy,cryofixation,negative staining, shadow casting, freeze fracture, freeze etching.

Unit2:CellfractionationNo. of classes- 08

Centrifugation:Differentialanddensitygradientcentrifugation,sucrosedensitygradient, CsCl2gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3: Radioisotopes & SpectrophotometryNo. of classes- 08Radioisotopes:Useinbiologicalresearch,auto-radiography,pulsechaseexperiment.

Spectrophotometry: Principle and its application in biological research.

Unit 4 : ChromatographyNo. of classes- 07

Principle;Paperchromatography;Columnchromatography,TLC,GLC,HPLC,Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit5:CharacterizationofproteinsandnucleicacidsNo. of classes- 10

Massspectrometry;X-raydiffraction;X-raycrystallography;Characterizationofproteinsand nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Title of the Course :Analytical techniques in plant science
CourseCode:BOTC-604P
Total Credits :01
Marks :15No. of classes- 15

1. StudyofBlottingtechniques:Southern,NorthernandWestern,DNAfingerprinting, DNA sequencing, PCR through photographs.
2. DemonstrationofELISA.
3. Toseparatesugarsbythinlayer chromatography.
4. Isolationofchloroplastsbydifferentialcentrifugation.
5. Toseparatechloroplastpigmentsbycolumn chromatography.
6. Toestimateprotein concentration hroughLowry'smethods.
7. ToseparateproteinsusingPAGE.
8. ToseparationDNA(marker)usingAGE.
9. Studyofdifferentmicroscopictechniquesusingphotographs/micrographs(freezefracture, freeze etching, negative staining, positive staining, fluorescence and FISH).

SemesterVI

Title of the Course: Microbiology&Immunology Nature
of course:Minor VI
Code:BOTM-601
Total Credits :04
Distributionof Marks :100[End:60(Theory:45,Pract:15),In: 40]

Course outcomes:

1) Toclassifymicroorganismbasedondifferentparameters
2) Todemonstratedifferent processesinvolvedinmicrobiology
3) Todifferentiatebetweenmicrobial groups
4) Toapplymicrobes forhuman welfare
5) Tounderstandthebasicimmunological processes
6) Toevaluatedifferent antibioticsandvaccines

LearningOutcome:

1) Todistinguishmicrobesbasedondifferentparameters
2) Tounderstanddifferent microbialprocessesforapplicationinhumanwelfare
3) Todescribeimmunologicalconcepts
4) Tounderstandantibioticclassesandvaccines

MappingofCOwithBloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1, CO5				
Procedural			CO2, CO4	CO3	CO6	
Metacognitive						

MappingofCourseoutcomestoProgrammeoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	1	2	2	1	2	1.7
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	2	1	1	1	1	1.5
CO4	2	3	3	2	2	1	1	2.0
CO5	2	2	2	2	2	1	2	1.8
CO6	2	3	3	2	2	1	1	2.0
AVERAGE	2.1	2.4	1.8	1.7	1.5	1.0	1.2	

3forhighest correlation,2 formoderatecorrelation, and1 forlowestcorrelation

Modesofinternalassessment:

1. Two internal examinations
2. Home assignments
3. Group discussion/ Seminar
4. Any other activity

AttainmentofCOs:

1. Continuousevaluationthroughinandend-semestertheoryandpractical examinations
2. Fieldcollectionandidentificationof specimens
3. Submissionofcollected specimens
4. Practicalrecordbook

Title of the Course:Microbiology &Immunology

Course Code : BOTM-601T
Total Credits : 03
Marks : 45 Total Lecture = 45

Unit I: Brief history and development of microbiology:**No. of classes- 08**

IntroductiontostudyofMicrobiology,conflictoverspontaneousgeneration,roleof microorganisms in disease, scope of microbiology, development of Koch's postulate. Classification of microorganisms; morphological, biochemical and molecular characteristics; nutritional types in microorganisms; Culture media, microbial growth curve uncultured microbes.

Unit II: Prokaryotic cell structure:No. of classes- 07

Bacterialcellwall,cytoplasmicstructureandinclusionsbodies,sporulationandspore,diversity in bacterial structure; actinomycetes, rickettsias, mycoplasma; archaea.

Unit III:Viruses:No. of classes- 07

Basic structures, classification, double-stranded and single-stranded DNA and RNA viruses, replicationstrategiesofDNAandRNAviruses;viroidsandprions;bacteriphageswithsuitable examples.

Unit-IV: Application of microbes:No. of classes- 10 Roleofmicrobesin bio-geo-chemicalcycling,Biologicalnitrogenfixation;Industrial applicationofmicrobes:alcohol,organicacids,vaccine,antibiotics;microbialbiofilm;wastewatertreatment;biofertilizerandbiopesticides;Microbialdiseasesandtheircontrol:Host- pathogen relationship, mechanisms of virulence, quorum sensing, pathogenesis in plants and animals

Unit-V:ImmunologyNo. of classes- 13

Immune response, discrimination between self and non-self, innate and acquired immune response;InnateImmunity:AnatomicandPhysiologicalBarriers,Inflammation,Tollreceptors andPAMPs,DAMPs,Defensisns,andComplementsystem,NKCells;Antigen:Antigenicity vs immunogenicity, B and T cell epitopes; Immunoglobulins: Basic structure, Ig fold and domains, Classes and subclasses of Ig, Biological activities of Igs, B cell receptor; MHC and Antigen Presentation; Cytokines and cytokine receptors; autoimmunity

Title of the Course: Microbiology &Immunology
Code : BOTM-601P

Total Credits : 01

Marks: 15No. of classes- 15

1. Bacterialgrowthonsolidandbrothmedia,pureculturetechnique,slantpreparation
2. Bacterialcolonymorphologyanddiversity
3. Gramstainingof bacteria
4. Biochemicalcharacterizationofbacteria
5. Determination of coliform group in water samples by presumptive, confirmed and completed test.
6. Studyof cellsinvolved inimmunology (Photograph/animation)

Suggested reading

1. Willey,J.,Sherwood,L.andWoolvertonC.,Microbiology,10thedition(McGraw-Hill Science, 2017).
2. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R., Microbiology, Publisher McGraw HillEducation (India) Private Limited, ISBN-10 0074623206, 5th Edition, 2001.
3. Tortora,G.J.,Fernke,B.R.andCase,C.L.,Microbiology–AnIntroduction,9th Edition,
4. Basic Immunology: Functions and Disorders of the Immune System, Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai (Elseviers Saunders 4 th Edition).
5. KubyImmunology,ThomasJ.Kindt,BarbaraA.Osborne,RichardA.Goldsby(W.H. Freeman Publishers, Sixth Edition).
6. M.T.Madigan,J.M.Martinko,K.S.Bender,D.H.Buckley,D.A.Stahl,T.Brock, BrockBiologyofMicroorganisms,14thEdition,PearsonHallInternational,2017.
7. MolecularandCellBiology(Schaum'sOutlinesseriesspecialIndianedition)by W. D. Stansfield, J. S.C. Colome, R. J. Cano and R. N. Sharan (2010), McGrawHill Education
8. Delves, P., Martin, S., Burton, D., Roitt, I. Roitt's Essential Immunology (Wiley-Blackwell, 11th Edition).