STRUCTURE OF THE SYLLABUS FOR 4 YEAR UG PROGRAMME

SCHOOL NAME - ROYAL SCHOOL OF LIFE SCIENCES (RSLSC)
DEPARTMENT NAME - BOTANY
PROGRAMME NAME - B.Sc. Botany

1st SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BOT142M101	Cryptogamic botany (Algae, Bryophytes & Pteridophytes)	100	3	3-0-0
Major (Core)	BOT142M112	Cryptogamic botany practical	100	3	0-0-6
Minor	BOT142N141	Diversity of Plants	100	3	3-0-0
Interdisciplinary (IDC)	IKS1	Indian Knowledge System – I	100	3	3-0-0
Ability Enhancement course (AEC)	AEC982A101	Communicative English I	100	1	1-0-0
Ability Enhancement course (AEC)	Behavioural Science-I	Behavioural Science – I	100	1	1-0-0
Skill Enhancement Course (SEC)	BOT142S121	Plant disease identification and control	100	3	3-0-0
Value Added Course (VAC)	VAC1	Course from available basket	100	3	3-0-0
MOOCs	MOOCs	*MOOCs/online course will be identified by the dept from the list of courses available on MOOC online platform/SWAYAM Platform	100	3	3-0-0
		TOTAL CREDIT FOR 1st SEMESTER		23	
2nd SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BOT142M201	Phanerogams – Gymnosperms & Angiosperms	100	3	3-0-0
Major (Core)	BOT142M212	Phanerogams Practical	100	3	0-0-6
Minor	BOT142N201	Economic Botany	100	3	3-0-0
IDC	IKS2	Indian Knowledge System – II	100	3	3-0-0
AEC	AEC982A201	Communicative English and Behavioural Science – II	100	2	2-0-0
SEC	BOT142S221	Plant Identification and Herbarium Techniques	100	3	3-0-0
VAC	VAC2	Course from available basket	100	3	3-0-0
MOOCs	MOOCs	*MOOCs/online course will be identified by the dept from the list of courses available on MOOC online platform/SWAYAM Platfor	100	3	3-0-0

		TOTAL CREDIT FOR 2nd SEMESTER		23	
3rd SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BOT142M301	Plant morphology, Anatomy & Taxonomy	200	4	4-0-0
Major (Core)	BOT142M312	Plant Morphology, Anatomy & Taxonomy – Practical	200	4	0-0-8
Minor	BOT42N301	Ethno-botany	200	4	4-0-0
IDC	IDC3	Basket Course	200	3	3-0-0
AEC	AEC982A301	Communicative English and Behavioural Science – III	200	2	2-0-0
SEC	BOT142S321	Floriculture	200	3	3-0-0
MOOCs	MOOCs	*MOOCs/online course will be identified by the dept from the list of courses available on MOOC online platform/SWAYAM Platfor	100	3	3-0-0
		TOTAL CREDIT FOR 3rd SEMESTER		23	
4th SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BOT142M401	Microbiology & Mycology	200	3	3-0-0
Major (Core)	BOT142M402	Genetics & Plant breeding	200	3	3-0-0
Major (Core)	BOT142M403	Traditional medicinal plants of India	200	3	3-0-0
Major (Core)	BOT142M414	Practical: Microbiology, Genetics & Plant breeding	200	3	0-0-6
Minor	BOT142N401	Ecology, Environment and Biodiversity conservation	200	3	3-0-0
Minor	BOT142N402	Bio resource Management	200	3	3-0-0
AEC	AEC982A401	Communicative English and Behavioural Science – IV	200	2	2-0-0
MOOCs	MOOCs	*MOOCs/online course will be identified by the dept from the list of courses available on MOOC online platform/SWAYAM Platfor	100	3	3-0-0
		TOTAL CREDIT FOR 4th SEMESTER		23	
5th SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BOT142M501	Plant Physiology & Biochemistry	300	4	4-0-0

Major (Core)	BOT142M502	Cell & Molecular Biology	300	4	4-0-0
Major (Core)	BOT142M513	Practical: Plant Physiology, Biochemistry, Cell & Molecular Biology	300	4	0-0-8
Minor	BOT142N501	Environmental & Industrial Microbiology	300	4	4-0-0
Internship/Project	BOT142M521	Internship/In- Plant Training/Project After 4th semester exam	300	4	0-0-12
		TOTAL CREDIT FOR 5th SEMESTER		20	
6th SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BOT142M601	Reproductive Biology of Angiosperms	300	4	4-0-0
Major (Core)	BOT142M602	Plant Ecology & Ecosystem Analysis	300	4	4-0-0
Major (Core)	BOT142M603	Farming Systems and Sustainable Agriculture	300	4	4-0-0
Major (Core)	BOT142M614	Practical: Reproductive Biology, Ecology, Agronomy	300	4	0-0-8
Minor	BOT142N601	Agronomy & Sustainable Development	300	4	4-0-0
		TOTAL CREDIT FOR 6th SEMESTER		20	
7th SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BOT142M701	Biostatistics & Bioinformatics	400	4	4-0-0
Major (Core)	BOT142M702	Applied Microbiology	400	4	4-0-0
Major (Core)	BOT142M703	Plant Biotechnology	400	4	4-0-0
Major (Core)	BOT142M714	Practical: Biostatistics, Biotechnology, Microbiology	400	4	0-0-8
Minor	BOT42N701	Plant Biotechnology	400	4	4-0-0
		TOTAL CREDIT FOR 7th SEMESTER		20	
8th SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BOT142M801	Genetic Engineering in Plants	400	4	4-0-0
Minor	BOT142N801	Research Methodology	400	4	4-0-0
Project / Dissertation	BOT142M821	Dissertation	400	12	0-0-24
IN LIU OF DISSERTATION					

	BOT142M802	Advanced plant systematics	400	4	4-0-0
	BOT142M803	Advanced plant physiology and biochemistry	400	4	4-0-0
	BOT142M804	Environmental Pollution and conservation	400	4	4-0-0
TOTAL CREDIT FOR 8th SEMESTER				20	

DETAILED SYLLABUS OF 1ST SEMESTER

MAJOR SUBJECT: CRYPTOGAMIC BOTANY (ALGAE, BRYOPHYTES & PTERIDOPHYTES)
Subject Code: BOT142M101, COURSE LEVEL: 100
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology and chemistry up to class 12

Course objective: To introduce the students to the diversity and type study of Cryptogams, their economic importance, and their evolution to present times.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	The course shall **infer** the students with the understanding of the wide diversity of cryptogams, their economical, ecological & evolutionary variations and roles.	**BT -2**
CO2	The learners shall **develop** an understanding of the transition of early land plants from aquatic to terrestrial habitats.	**BT-5**
CO3	The students shall be able to **outline** the applications of phycology, bryology & pteridology.	**BT -5**

Detailed Syllabus

Module	Course content	Lecture hours
I	**Major Groups of Algae I: Cyanophyta, Chlorophyta and Charophyta**: General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction.Type study of *Nostoc, Volvox and Chara* **Major Groups of Algae II: Xanthophyta, Pheophyta and Rhodophyta**: General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Type study of *Vaucheria*, *Ectocarpus* and *Polysiphonia*	**15**
II	**Introduction to Archegoniates**: Unifying features of archegoniates. Transition to land habit and its evolutionary significance. Alternation of generations. **Bryophytes:** General characteristics, Origin and evolution of bryophytes, Type Studies: Classification (up to family), morphology, anatomy and reproduction, evolutionary trends of *Riccia, Marchantia, Anthoceros, Sphagnum and Funaria (development stages not included).* Ecological and economic importance of Bryophytes	**15**
III	**Pteridophytes:** General characteristics; Classification; Early land plants (*Cooksonia* and *Rhynia*). Type Studies: Classification (up to family), morphology, anatomy	**15**

	andreproduction of *Psilotum*, *Selaginella*, *Equisetum*, *Marsilea* and *Pteris*.	
IV	Apogamy, and apospory, heterospory and seed habit, telome theory, stelar evolution.Ecological and economic importance of pteridophytes. Recent studies and development in Cryptogamic Botany	**15**
Tota		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Text Books:

1. Bhattacharya K., Ghosh A. K., & Hait G. (2017). A Textbook of Botany. Vol I & II. NCBA Kolkatta.
2. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
3. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.

Reference books:

1. Lee, R.E. Phycology. 2018. Cambridge University Press, Cambridge
2. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
3. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
4. R.S. Chopra. Taxonomy of Indian mosses: an introduction. 2009. Publications & Information Directorate, CSIR, New Delhi.
5. A Manual Of Cryptogamic Botany: Adapted To The Requirements Of The Science And Art Department(Classic Reprint). 2018. Charlotte M. W. Ross. Forgotten Books Publisher.

MAJOR SUBJECT: CRYPTOGAMIC BOTANY - PRACTICAL

Subject Code: BOT142M112, COURSE LEVEL: 100

L-T-P-C = 0-0-6-3, Credit Units: 03

SCHEME OF EVALUATION: Practical (P)

Prerequisite: Basic knowledge of biology and chemistry up to class 12

Course objective: To introduce the students to the world of algae, mosses and ferns by showing them live specimens and photographs and enable the students to have a hands-on experience of observing of the first landplants and their diversity

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Employ** practical knowledge of lower plants	**BT - 3**
CO2	**Discover** early land plants and their diversity	**BT - 3**

CO3	**Examine** the morphology, anatomy and reproductive structures of the lower plants	**BT - 4**

Detailed Syllabus

Module	Course content	Lecture hours
I	**Algae:** ***1.*** Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas,* Volvox, *Oedogonium, Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia,***</br>2. Temporary preparations and permanent slides (subject to availability, a minimum of 5 genera to be studied).	**20**
II	**Bryophytes:** 3. Study of *Riccia & Marchantia*- Morphology of thallus, vertical section of thallus through Gemma cup. 4. *Anthoceros, Sphagnum, Funaria* (as per availability) - Morphology of thallus, L.S of sporophyte (temporary slide), transverse section of thallus (permanent slide). temporary slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.	**20**
III	**Pteridophytes:** 5. *Selaginella*- Morphology, whole mount of leaf with ligule, transverse section of stem (temporary slides). 6. *Equisetum*- Morphology, transverse section of internode, mount of sporangiophore, mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide). 7. *Pteris*- Morphology, transverse section of rachis, vertical section of sporophyll, mount of sporangium, mount of spores (temporary slides), transverse section of rhizome.	**20**
IV	8. Field study, sample collection and diversity study of cryptogams	**30**
Total		**90**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • SUBMISSION

Text books:

1. Santra S. Practical Botany Vol.1 and 2. 2015. NCBA Publisher.
2. Bendre and Kumar. Practical Botany Vol.1 and 2. 2018. Rastogi Publications.

Reference Books:

1. Internet : https://www.biodiversitylibrary.org/item/90703#page/3/mode/1up.
2. Pandey.B.P. Modern Practical Botany Vol. 1, 2, 3. 2011. S.Chand Publication.

MINOR SUBJECT: DIVERSITY IN PLANTS
COURSE LEVEL: 100, SUBJECT CODE: BOT142N101,
CREDIT UNITS: 3, L-T-P-C: 3-0-0-3
SCHEME OF EVALUATION: Combined Theory & Practical (TP):

Course objective: Develop an understanding of the various groups of Plant kingdom and Acquire knowledge about the evolution from lower plants to higher plants in the Plant kingdom.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recognize** various plant groups of plants from primitive to highly evolved	**BT 1**
CO2	**Infer** foundation for further studies in Botany	**BT 2**

Module	**Topic and Course content**	**Lecture hours**
	Theory	
I	**Microbes:** Discovery, general characteristics and economic importance of viruses and bacteria. **Fungi:** General characteristics, range of thallus organization, reproduction, ecological and economic importance of fungi. General account and significance of symbiotic associations: Lichens and Mycorrhiza.	**11**
II	**Algae:** General characteristics, range of thallus organization, reproduction, ecological and economic importance of algae.	**11**

III	**Archegoniates:** Unifying features, Alternation of generations. **Bryohytes:** General characteristics, range of thallus organization, reproduction, ecological and economic importance, adaptation to land habit. **Pteridophytes:** General characteristics, ecological and economic importance.	**11**

IV	**Gymnosperms:** General characteristics, ecological and economic importance. **Angiosperms:** General characteristics, ecological and economic importance	**11**
Total		**44**
Practical		
1	Study of preserved botanical specimens, different instruments used in a laboratoryand Microscopy; handling of microscope.	**1**
2	Study of different staining procedures (single, double and Gram staining), Preparation of Gram stain and other important stains used in laboratory.	**1**
3	Study of different types of bacteria through photographs and permanent slides	**1**
4	Study of various structures of *Nostoc* and *Fucus* through temporary preparations and permanent slides	**2**
5	Study of various structures of *Rhizopus* and *Agaricus* through temporary preparations and permanent slides	**2**
6	Study of various growth forms of lichen and different types of mycorrhiza through photographs	**1**
7	Study of vegetative and reproductive structures of *Marchantia* through temporary preparations andpermanent slides	**2**
8	Study of vegetative and reproductive structures of *Selaginella* and *Equisetum* through temporarypreparations and permanent slides	**2**
9	Study of vegetative and reproductive structures of *Cycas* and *Pinus* through temporary preparations andpermanent slides	**2**
10	Study of floral structures of *Hibiscus* sp. and *Tagetes* sp. (Marigold).	**1**
Total		**15**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
44	30	16 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Text Books:

1. Bhattacharya K., Ghosh A. K., & Hait G. (2017). A Textbook of Botany. Vol I & II. NCBA Kolkata.
2. B. P. Pandey . Botany for Degree students – Biodiversity. 2010. S. Chand Publishers.

Reference Books:

1. Gangopadhyay A. Plant Biodiversity.2007. Gene-Tech Books.

2. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
3. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.
4. Santra S. Practical Botany Vol.1 and 2. 2015. NCBA Publisher.
5. Bendre and Kumar. Practical Botany Vol.1 and 2. 2018. Rastogi Publications.

SEC 1: PLANT DISEASE IDENTIFICATION AND CONTROL
Subject Code: BOT142S121, L-T-P-C: 0-0-3-3, Credit Units: 03
SCHEME OF EVALUATION: Practical (P)

Pre-requisite: Basic knowledge of biology and chemistry up to class 12

Course objective: To introduce and develop basic concepts to the world of plant disease focusing on the management and control of pathogens and epidemics.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	To **describe and identify** the physical dimensions, forms, functions and habitats of pathogens	**BT 2 and BT 3**
CO2	To **experiment with different** plant diseases in different crops	**BT 3**
CO3	To **examine and infer** from the studied specimen the type and its management of the disease in the plant kingdom	**BT 4**

Detailed Syllabus

Module	**Course content**	**Lecture Hours**
I	Plant disease introduction**:** Terms and concepts; Symptomology and identification of fungal, viral and bacterial plant diseases. Host-Pathogen relationships; Disease cycle and role of environment in disease development; prevention and control of plant diseases. Quarantine and its significance in control of plant diseases.	**15**
II	Major epidemics and their social impacts. Legislative, cultural, and biological protection measures of plant diseases. Koch's postulates. Factors influencing infection, colonization, and development of symptoms.	**15**

III	**Laboratory and Analytical Techniques** Preparation and sterilization of common media. Methods of isolation of plant pathogens and their identification. Preservation of microorganisms by pure culture method. Methods of inoculation. Detection and Diagnosis of pathogens in seeds and other planting materials.	**15**

IV	Collection and study of Fungal, Bacterial and Viral Diseases of Crop Plants Project on Management and control of Plant diseases	**15**
Total		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • SUBMISSION

TEXT BOOKS:

1. Paul Khurana, S. M. 2009: Pathological Problems of Economic crop plants and their management.
2. Dubey, R.C. and Maheshwari, D.K. (1999). A text book of Microbiology, S. Chand & Company Ltd.,New Delhi, India

REFERENCE BOOKS:

1. Pelczar, M.J. Microbiology. 2005.Tata McGraw-Hill Co, New Delhi
2. Planke, J. E. Vander. (2013) Plant Diseases Epidemics and control.
3. Sinclair W.A. and H.H. Lyon. Diseases of Trees and Shrubs. 2005. Cornell University Press.
4. Webster J and Weber R.W.S. Introduction to Fungi. 2007. Cambridge University Press.
5. Lucas J.A. Plant Pathology and Plant Pathogens. 2011. John Wiley and Sons Ltd.
6. Williamson VM, Kumar A (2006) Nematode resistance in plants: the battle underground. Trends inGenetics 22: 396–403.

DETAILED SYLLABUS OF 2ND SEMESTER

MAJOR SUBJECT: PHANEROGAMS: GYMNOSPERMS & ANGIOSPERMS
Subject Code: BOT142M201, COURSE LEVEL: 100
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce the students to the world of phanerogams and their evolutionary significance, their detailed taxonomy, and their life cycles.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Identify** the phanerogams, their vegetative and reproductive structures and their importance.	**BT 1**
CO2	**Explain** evolutionary lines in each group of gymnosperms and angiosperms	**BT 2**
CO3	**Relate** the differences and the affinities between the Gymnosperms & Angiosperms.	**BT 3**

CO1:

Detailed Syllabus

Modules	Course content	Lecture Hours
I	**Gymnosperms I:** History and recent systems of classification of gymnosperms; origin and evolution of gymnosperms; affinities of gymnosperms with pteridophytes and angiosperms; distribution of gymnosperms in India; Ecological and economic importance of gymnosperms; **Gymnosperms II:** Gymnosperms: General characteristics. Classification Morphology and reproduction of Cycas, Pinus and Gnetum (Developmental details not to be included).	**15**
II	**Angiosperms**: General characteristics; Classification, Basic concept of APG; Basal angiosperms and Magnoliids; Basal monocots; Petaloid monocots; Commelinids; Basal eudicots and Caryophyllids; Rosids; Asterids. Evolutionary trend in angiosperms. Origin and evolution of stamen, and carpel.	**15**

III	**Angiosperm Morphology** (stems, roots, leaves & flowers, inflorescence): morphology and modification of stems, roots, leaves, and buds. Types of inflorescence,Flower: parts of a typical flower, fruits and type of placentations, definition and types of seeds. **Palynology:** Pollen morphology; basic concepts of applied palynology. Role in taxonomic studies	**15**
IV	**Origin and evolution of Plants**: Origin and evolution of plants through Geological Time scale. **Paleobotany**- Paleobotanical records, fossil plants, process of fossilization- impressions, compressions, petrification, moulds and casts, pith casts. Radiocarbon dating. **Fossil taxa**- Rhynia, Lepidodendron, Lepidocarpon, Lyginopteris and Cycadeoidea. Significance of paleobotany in exploration of fossil fuels.	**15**
Total		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Text Books:

1. C.J.Chamberlain. Gymnosperms: Structure And Evolution. 2009. Andesite Press.
2. Bhattacharya K., Ghosh A. K., & Hait G. (2017). A Textbook of Botany. Vol I & II. NCBA Kolkatt

Reference Books:

1. A.V.S.S.Sambamurty. A Textbook Of Bryophytes, Pteridophytes, Gymnosperms And Paleobotany. 2006.
   I.K. International Publishing House Pvt.Ltd.
2. J. M. Coulter, C.J.Chamberlain. Morphology Of Gymnosperms. 2016. Wentworth Publishers.
3. W.N. Stewart and G.W. Rothwell. Paleobotany and the evolution of plants. 2010. Cambridge University Press
4. Charlotte M. W. Ross (2018) A Manual Of Cryptogamic Botany: Adapted To The Requirements Of TheScience And Art Department (Classic Reprint).. Forgotten Books Publisher.

MAJOR SUBJECT: PHANEROGAMS - PRACTICAL
COURSE LEVEL: 100, Subject Code: BOT142M212,
L-T-P-C: 0-0-6-3, Credit Units: 03
SCHEME OF EVALUATION: Practical (P)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart practical knowledge on various group of phanerogams, their diversity, morphology, anatomy and their fossil counterparts.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	The course will help the students to **gain** practical knowledge of vascular plants	**BT2**
CO2	They will be equipped to identify various anatomical structures of plant body	
CO3	They will be able to identify economic importance of various plants	

Detailed Syllabus

Module	Course content	Lecture hours
I	**Gymnosperms:** 1. Study of morphological, anatomical, and reproductive features of gymnosperms available in the region.	**20**
II	**Angiosperms:** 2. Study of morphological, anatomical, features of modified organs of angiosperms. 3. Study of types of inflorescence, and fruits. study of dicotyledonous angiospermic flower showing various parts by analytical drawing and identify up to genus. 4. Study of types of placentation and types of seeds of angiosperms.	**20**
III	**Paleo botany and palynology:** 7. Study of fossil gymnosperms from photographs and museum specimens. 8. Preparation of pollen grain slides by following different techniques.	**20**
IV	**9.** Study of various modified structures of angiosperms from available sources. 10. Field visit and collection 11. Mounting of properly dried and pressed specimen of gymnosperms and angiosperms with herbarium label (to be submitted along with the record book) (atleast two specimens for each group)	**30**
Total		**90**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • SUBMISSION

Text books:

3. Santra S. Practical Botany Vol.1 and 2. 2015. NCBA Publisher.
4. Bendre and Kumar. Practical Botany Vol.1 and 2. 2018. Rastogi Publications.

Reference Books:

3. Internet : https://www.biodiversitylibrary.org/item/90703#page/3/mode/1up.
4. Pandey.B.P. Modern Practical Botany Vol. 1, 2, 3. 2011. S.Chand Publication.

MINOR SUBJECT: ECONOMIC BOTANY
Subject Code: BOT142N201, COURSE LEVEL: 100
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Course objective: To enable the students to have an understanding on how cultivated plants originated and how they are introduced across the world.

Course outcomes:

CO1:	**Explain** a brief idea on various methods used for extraction of various plant products like rubber etc., and **outline** the industrial applications of different plant parts for economic purposes	**[BT2]**
CO2:	**Experiment with** various uses of plants in day-to-day life.	**[BT3]**
CO3:	**Discover** an understanding of the economic aspects of various plants**.**	**[BT4]**

Detailed Syllabus

Modules	Course content	Periods
I	Introduction, origin, cereals and legumes: 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. Cereals: Wheat and Rice (origin, morphology,	12

	processing & uses). Brief account of millets. Legumes: Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.	
II	Sugars, starches, spices and beverages: Sources of sugars and starches: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses. 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)	12
III	**Oils and fats and rubber:** **Sources of oils and fats:** General description, classification, extraction, their uses and health implications groundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses). **Essential Oils:** General account, extraction methods, comparison with fatty oils & their uses. Natural Rubber: Para-rubber: tapping, processing and uses.	12
IV	**Medicinal, timber and fiber plants**: Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver, Swvertia, Andrographis and Cannabis; Tobacco (Morphology, processing, uses and health hazards). Timber plants: General account with special reference to teak and pine. Fibers: Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and uses).	12
Total		48

Text Book:

1. Kochhar, S.L. Economic Botany in Tropics, 2012. MacMillan & Co. New Delhi, India.
2. Kochhar, S.L. Economic Botany: a comprehensive study. 2016. Cambridge University Press.
3. Prasad, R.L. Essentials of Economic Botany. 2016. Medtech.

Reference Books:

1. Harlan, J.R. Crops and Man. 2nd ed. 1992.Madison W D: American Society of Agronomy.
2. Chrispeels, M.J. and Sadava, D.E. Plants, Genes and Agriculture. 1994. Jones & Bartlett Publishers.
3. A.V.S.S. Sambamurty and N.S. Subrahmanyam. A Textbook of Modern Economic Botany. 2008. CBS Publisher.
4. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

SEC II: PLANT IDENTIFICATION AND HERBARIUM TECHNIQUES
Subject Code: BOT142S221, COURSE LEVEL: 100
L-T-P-C: 0-0-6-3, Credit Units: 03
SCHEME OF EVALUATION: Practical (P)

Course objective: To impart practical knowledge on various plant identification systems, their preservation and utilization.

Learning Outcomes: At the end of the course the student will be:

CO1	**Identify, describe,** and practice different methods of plant identification Systems	BT 2 & 3
CO2	**Categorize** different techniques used in preservation and utilize its knowledge in various fields of application	BT 4

Detailed Syllabus:

Module	Course content	Lecture hours
I	**Plant identification:** Introduction, importance of plant identification. **Tools of identification:** Expert determination, Herbarium, taxonomic literature (Floras, Manuals, Monographs, Icons, Journals, Supporting literature), taxonomic keys, interactive keys/ visual keys, Computers in identification, molecular plantidentification.	**22**
II	**Plant nomenclature:** History of organized nomenclature, International Code of Nomenclature for Algae, Fungi and Plants (ICN)- ranks of taxa, valid and effective publications, principle of priority, changes of names, rejection of names, name ofhybrids, and cultivated plants.	**22**
III	**Herbarium:** Introduction, definition, history, objective, types of herbaria, importance, major herbaria in the world and India. **Herbarium techniques:** Preparation for collection; field equipment, kinds of field work, Ethical guidelines for field works. Maintenance of Herbarium.	**22**
IV	**Herbarium Techniques for special types of plants:** Aquatic plants, cane, bamboo, succulents, rhizomatous plants, resinous plants, algae, Lichens, wild mushrooms, and bryophytes. **Digital/virtual herbarium**: Introduction and importance of digital herbaria. **Practical/ Project based on the syllabus.**	**24**
Total		**90**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • HERBARIUM PREPARATION & SUBMISSION

Textbooks:

1. Simpson, M. G. 2006. Plant Systematics. Elsevier, Amsterdam
2. Rao and Jain 1976. A Handbook of Field and Herbarium methods
3. Singh, G. 2012. Plant Systematics- Theory and Practice. Oxford and IBH Publishing Co Pvt Ltd, NewDelhi
4. Sharma and Sharma 2007. Taxonomy. Pragati Prakashan, Meerut

Reference Books:

5. Anderson, N. O., and J. D. Walker. 2003. Effectiveness of Web-based versus live plant identification tests. Horttechnology 13:199-205.
6. Dirr, M. A. 1998. Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics,Culture, Propagation and Uses. Stipes Publishing, Champaign, IL
7. Kahtz, A. W. 2000. Can computer assisted instruction be used by students for woody plant identification. Horttechnology 10:381-384

MAJOR SUBJECT: PLANT TAXONOMY, MORPHOLOGY, & ANATOMY
Subject Code: BOT142M301, COURSE LEVEL: 200
L-T-P-C=4-0-0-4, Credit Units: 04
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce the students to the different tissue systems in angiosperms and their morphology, how they function and the theories of root and shoot development.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recognize** the various tissue organization of the plant body	**BT1**
CO2	**Describe** the development and functions of various tissue systems inside the plant body.	**BT2**
CO3	**Differentiate** between stem and root based on internal organisation	**BT4**
CO4	**Correlate** between flower morphology and methods of reproduction in angiosperms	**BT4**
CO5	**Identify** and **Describe** various angiospermic families based on their features	**BT2**

Detailed Syllabus

Modules	**Course content**	**Lecture hours**
I	**Introduction and organization of plant body:** **Morphology of Stem**: Characteristics, and Modifications of stem **Morphology of Roots**: Characteristics and Modifications of roots	**15**

II	**Morphology of Leaf:** Characteristics and Modifications of leaf; Phyllotaxy. **Morphology of Flower:** Flower as a modified shoot, morphology of stamen and carpel.	**15**
III	**Shoot and Root:** Organization of shoot and root apex (Apical cell theory, Histogen theory, Korper-Kappe theory, Tunica Corpus theory); Quiescent centre. Anatomical features of monocot and dicot stem and root. **Secondary growth** in dicot and monocot stem. Anomalous secondary growth**.** **Anatomy of Leaf:** Structure of dicot and monocot leaf anatomy.	**15**
IV	**Angiosperm Taxonomy:** Aims of taxonomy, History of classification- Artificial, Natural (Bentham and Hooker), Phylogenetic (Engler & Prantl, Hutchinson, Takhtajan), APG system- a brief idea. **Distinguishing features of the following families:** Magnoliaceae, Brassicaceae, Fabaceae, Malvaceae, Cucurbitaceae, Euphorbiaceae, Apiaceae, Rubiaceae, Solanaceae, Acanthaceae, Verbenaceae, Lamiaceae, Asteraceae. Arecaceae, Musaceae, Zingiberaceae, Orchidaceae, Poaceae.	**15**
Total		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Textbook:

1. B.P. Pandey. Plant Anatomy. 2001. S. Chand Publication.
2. Evert, R.F. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. 2006. John Wiley and Sons, Inc.
3. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.

Reference Books:

1. Annie Ragland. Fundamentals Of Plant Anatomy and Microtechniques. 2016. Saras Publication.
2. Charles B. Beck. An introduction to plant structure and development (plant anatomy for 21st century). (2nd edition). 2010. Cambridge University Press.
3. James D. Mauseth. Plant Anatomy. 2008. The Blackburn Press.
4. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
5. 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.

6. Katherine Esau. Anatomy Of Seed Plants.2006. Wiley Publications.
7. Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper and Row, New York.

MAJOR SUBJECT: PLANT MORPHOLOGY, ANATOMY & TAXONOMY - PRACTICAL
Subject Code: BOT142M312, COURSE LEVEL: 200
L-T-P-C=0-0-8-4, Credit Units: 04
SCHEME OF EVALUATION: Practical only (P)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart practical knowledge on various group of angiosperms, have a clear concept on cellular structure of plants by microscopic observation, have a hands-on experience on economically important plant parts used, and do microchemical tests to observe the molecules present there.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	The course will help the students to **gain** practical knowledge of vascular plants.	**BT1**
CO2	They will be equipped to **identify** various anatomical structures of plant bodies.	**BT2**
CO3	They will be able to **describe** the economic importance of various plants.	**BT2**

Detailed Syllabus

Module	**Course content**	**Lecture hours**
I	1. Morphological features of flowers and special types of inflorescences	**22**
II	2. Preparation of temporary and permanent slides of stained T.S. and L.S. of: • monocot and dicot stem • monocot and dicot root 3. Adaptive anatomy in xerophytes and hydrophytes.	**22**
III	4. Study of floral characters of the following families (Minimum 5 subject to availability of any one specimen from each family): • Brassicaceae –*Brassica/Rorippa* • Apiaceae - *Coriandrum / Foeniculum* • Rubiaceae – *Ixora/Hedyotis* • Asteraceae - *Vernonia/Ageratum/ Eclipta/Mikania* • Solanaceae - *Solanum nigrum/Solanum indicum* • Lamiaceae - *Salvia/Ocimum* • Acanthaceae – *Justicia/Phlogocanthus* • Euphorbiaceae - *Euphorbia hirta/E.milii/E. pulcherrima*	**24**

	• Musaceae - *Musa* • Poaceae - *Triticum/Avena/Oryza*	
IV	5.Field visits (Local) 6. Mounting of a properly dried and pressed specimen of plant specimens with herbarium label (to be submitted in the record book).	**22**
Total		**90**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • HERBARIUM SUBMISSION

Reference Books:

1. Santra S. Practical Botany Vol.1 and 2. 2015. NCBA Publisher.
2. Bendre and Kumar. Practical Botany Vol.1 and 2. 2018. Rastogi Publications.
3. Internet : https://www.biodiversitylibrary.org/item/90703#page/3/mode/1up.
4. Pandey B.P. Modern Practical Botany Vol. 1, 2, 3. 2011. S. Chand Publication.

MINOR SUBJECT: ETHNOBOTANY
Subject Code: BOT142N301, COURSE LEVEL: 200
L-T-P-C=4-0-0-4, Credit Units: 04
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce the students to the various ways plants are used in a particular culture and region, to present its scope as an interdisciplinary science and its relevance in modern times.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Describe** various traditional methods of medical treatments in various communities of India	**BT2**
CO2	**Compute** the traditional knowledge of prominent tribes of Assam	**BT3**
CO3	**Infer** the applications of the ethnomedicine in modern pharmaceutical systems	**BT4**

Detailed syllabus:

Module/ Experiment	Topic/ Course content	Lecture hours
Theory		
I	Basic concept of society, community and groups, Characteristics and of rural communities, Scope and Importance of botany in Rural Economy and Employment Generation, Importance in food and nutritional security, Ecotourism.	**12**
II	Ethnobotany in North -east India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany.	**12**
III	Ethnomedicine, ethnoecology, ethnic communities of NE India. Application of natural products to certain diseases - Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases	**12**
IV	Herbs used by dominant communities of Assam- Bodo, Tiwa, Karbi, Garo and Rabha in their day-to-day life.	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

References:

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.

2. S.K. Jain (ed.) Glimpses of Indian Ethnobotany, Oxford and I B H, New Delhi – 1981
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. Internet based latest research papers.

SEC: FLORICULTURE
Subject Code: BOT142S321, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: The student will learn the techniques of floriculture, the economic importance of different plants used in floriculture and the commercial aspect of floriculture.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recognize** field-based application on flower cultivation and marketing.	**BT1**
CO2	**Identify** gardening techniques for different flowers	**BT2**

Detailed Syllabus:

Module	**Content**	**Lecture hours**
I	Importance and scope of floriculture and landscape gardening, Types of gardens, garden elements, styles of gardening, famous gardens in India and abroad, principles of gardening.	**9**
II	Ornamental plants, flowering annuals, herbaceous perennials, divine vines, shade and ornamental trees, ornamental bulbous and foliage plants, cacti and succulents, palms and cycads, ferns and selaginellas, cultivation of plants in pots, indoor gardening, bonsai.	**9**
III	Methods of propagation of flowers, sexual and vegetative methods of propagation, soil sterilization, seed sowing, pricking, planting and transplanting, shading, defoliation, wintering, mulching, topiary, role of plant growth regulators, maintenance of cut flowers	**9**
IV	Commercial floriculture, factors affecting flower production, production and packaging of cut flowers, flower arrangements, methods to prolong vase life, cultivation of important cut flowers (Carnations, Asters, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Lilium, Orchids). Mode of transportation and preservation of loose and cut flowers.	**9**
Total		**36**

Projects based on the syllabus such as:

1. Digital album of world-famous gardens.

2. Development of model gardens in RGU campus.

3. Exhibition of floral arrangements of both fresh and dry flowers.

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**

00	60	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

DETAILED SYLLABUS OF 4TH SEMESTER

MAJOR SUBJECT: MICROBIOLOGY & MYCOLOGY
Subject Code: BOT142M401, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce and develop basic concepts to the world of microbes focusing on the diversity and fundamental biological processes of bacteria, viruses & Fungi.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	To **describe** the physical dimensions, forms, functions and habitats of bacteria, plant & animal viruses, the ecological role of fungi and the biotechnological application of certain species of all the three groups	**BT2**
CO2	To **distinguish** between the micro and macro forms of life and their value-addition to the environment.	**BT2**
CO3	To **illustrate** the differences between the antagonistic and beneficial roles of bacteria, viruses & Fungi in the plant kingdom	**BT3**

Detailed Syllabus

Module	Course content	Lecture hours
I	**Introduction to microbial world**: Introduction to microbial world, microbial nutrition, growth and metabolism. **Viruses**: Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus(T-phage), lytic and lysogenic cycle; RNA virus (TMV). Economic importance of viruses	**12**
II	**Bacteria**: Discovery, general characteristics, types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts), cell structure, nutritional types, reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Economic importance of bacteria.	**12**
III	**Introduction to fungi:** Introduction to true fungi, Affinities with plants and animals; Cell wall composition; Nutrition; Classification. General account of Chytridiomycetes, Zygomycota, Ascomycota Basidiomycota and Oomycota: Heterokaryosis and parasexuality.	**12**

IV	**Allied Fungi:** General characteristics; Status of Slime moulds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies. **Symbiotic associations**: Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization. Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance. **Applied Mycology:** Role of fungi in biotechnology, Application of fungi in industries and Agriculture (Biofertilizers)	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

SUGGESTED READINGS:

Textbooks:

1. Dubey, R.C. and Maheshwari, D.K. (1999). A textbook of Microbiology, S. Chand & Company Ltd., New Delhi, India
2. Pelczar, M.J. Microbiology. 2005.Tata McGraw-Hill Co, New Delhi
3. Tortora G.J., Funke B.R., Case C.L., Weber D and Bair W. Microbiology: An Introduction (13th Edition). 2018. Pearson Publisher.

Reference books:

2. Wiley, J.M., Sherwood, L.M. and Woolverton C.J., Prescott. Microbiology. 2017. McGraw Hill International.
3. Madigan M.T., Martinko J.M., Bender K.S., Buckley D.H., Stahl D.A., Brock T. Brock Biology of Microorganisms (14th Edition). 2014. Pearson Publisher.
4. Harvey R.A. and Cornelissen C.N. Lippincott Illustrated Reviews: Microbiology (Lippincott Illustrated Reviews Series) Third, North American Edition. 2012. LWW; Third, North American edition.

MAJOR SUBJECT: GENETICS & PLANT BREEDING
Subject Code: BOT142M402, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To acquaint the students with the basics of plant genetics and heredity.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Describe** Mendel as well as the chromosomal basis of inheritance.	**BT2**
CO2	**Predict** the basis of inheritance and variation caused due to mutation and aberrations.	**BT2**
CO3	**Evaluate** the techniques to create new varieties with a set of desired characteristics.	**BT3**

Detailed syllabus:

Modules	Topics / Course content	Periods
I	History, branches, and applications of genetics. Mendelism: Mendel's laws of inheritance – Law of dominance, law of segregation and law of independent assortment. Monohybrid crosses and Dihybrid crosses. Deviation from Mendel's law: Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy. Penetrance and Expressivity, Polygenic inheritance	**12**
II	Extranuclear inheritance and maternal effect. Chromosomal aberrations: Numerical and structural aberrations. Significance of chromosomal aberration in crop improvement. Mutations: types and causes: Spontaneous and induced mutation.	**14**
III	Fine structure of gene: Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism. Population and evolutionary genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, genetic drift. Genetic variation and Speciation.	**10**
IV	Principles and objectives of Plant Breeding: Domestication and centers of origin of cultivated plants. Plant introduction and Selection methods: mass, pure line and clonal selection. Hybridization and its types; emasculation. Heterosis, hybrid vigor, role of polyploidy in plant breeding and crop improvement.	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**

60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

SUGGESTED READINGS:

Textbooks:

1. Sundarraj D and Thulasidas, G. 1972. Introduction to cytogenetics and Plant Breeding (III Edn.) Popular Book Depot. Madras.
2. Karp, G. 1996. Cell and Molecular Biology. John Wiley and Sons Inc. New York, Singapore.
3. Singh, B.D., 2005. Plant Breeding, principles and methods (7th Revised and enlarged edition). Kalyani publishers, New Delhi.
4. Gupta, P.K., 2007. Genetics - Classical to modern. Rastogi Publications, Meerut, India.

Reference books:

1. Russell, P.J. and Gordey, K., 2002. *IGenetics* (No. QH430 R87). San Francisco: Benjamin Cummings.
2. Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of plant Breeding. Narosa Publishing House. New Delhi.
3. George M. M., 2005. Freifelder's Essentials of Molecular Biology. 4th edition. Narosa Publishing House, New Delhi.
4. George W. Burns, 1969. The Science of Genetics. An introduction to heredity. The Macmillan company. New York.
5. Gardener, J, Simmons, H.J and Snustad, D.P. 1991. Principles of Genetics (8th edition), John Wiley & Sons, New York.
6. Darbeshwar Roy, 2012. Plant breeding - A biometrical Approach. Narosa Publishing House, New Delhi.

MAJOR SUBJECT: TRADITIONAL MEDICINAL PLANTS OF INDIA
Subject Code: BOT142M403, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart knowledge on the traditional methods of using medicinal plants in India and also introducing to the students the basic concept of ethnobotany.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Describe** various traditional methods of medical treatments in various communities of India	**BT2**
CO2	**Compute** the traditional knowledge of prominent tribes of Assam	**BT3**
CO3	**Infer** the various applications of ethnomedicine in modern pharmaceutical systems	**BT4**

Detailed syllabus:

Modules	Topic/ Course content	Lecture hours
I	**History, Scope and Importance of Medicinal Plants:** Ethnobotanical uses of indigenous medicinal plants, indigenous medical systems- Ayurveda and Siddha.	**10**
II	**Conservation of Endangered and Endemic Medicinal Plants:** Introduction to endemic and endangered medicinal plants, red list criteria; In situ and Ex situ conservation strategies of indigenous medicinal plants. Herbal gardens.	**10**
III	**Ethnobotany and Folk medicines:** Examples of ethnobotanically important plants of North East India. Paleo-ethnobotany. Folk medicines ethnic communities of India. Use of natural products for treatment of - jaundice, cardiac ailments, infertility, diabetes, hypertension and skin diseases.	**09**
IV	**Ethnomedicine in NE India**: Case Studies.	**07**
Total		**36**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

SUGGESTED READINGS:

Textbooks:

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
3. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
4. S.K. Jain (ed.) Glimpses of Indian Ethnobotany, Oxford and I B H, New Delhi – 1981
5. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists,

Lucknow, India.

6. Internet based latest research papers.

MAJOR SUBJECT: MICROBIOLOGY, MYCOLOGY, GENETICS & PLANT BREEDING-PRACTICAL
Subject Code: BOT142M414, COURSE LEVEL: 200
L-T-P-C=0-0-6-3, Credit Units: 03
SCHEME OF EVALUATION: Practical (P)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart practical knowledge on various groups of archegoniates, have a clear concept on cellular structure of plants by microscopic observation, have a hands-on experience on economically important plant parts used, and do microchemical tests to observe the molecules present there.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Employ** practical knowledge of bacteria, viruses and fungi	**BT3**
CO2	**Reproduce** the different cell division techniques.	**BT1**
CO3	**Demonstrate** techniques used in plant breeding.	**BT4**

Detailed syllabus:

Module	Course content	Lecture hours
I	1. Sterilization techniques. 2. Preparation of culture media. 3. Preparation of pure culture and slants. 4. Isolation and streaking techniques. 5. Gram staining: Curd and root Nodule **6. Lichens:** Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates.	**24**
II	7. Preparation of temporary slides of certain fungi subjected to availability. 8. *Agaricus*: Specimens of button stage and full-grown mushroom; sectioning of gills of *Agaricus*.	**24**
III	9. Study of cell division – Mitosis in onion root tips, stages of meiosis from permanent slides. 10. Genetic problems based on theory syllabus – monohybrid, dihybrid, test cross and gene interaction, gene interaction *viz.* co-dominance, complementary and supplementary genes, epistasis. 11. Photographs of Inversion bridge, Laggards, Polytene and Lampbrush chromosome.	**22**
IV	12. Field visit to understand fungal diversity and their habitat 13. Hybridization techniques - Emasculation, Bagging and tagging.	**20**

Total	**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • SAMPLE COLLECTION • VIVAVOCE • FIELD VISITS

MINOR SUBJECT: ECOLOGY, ENVIRONMENT AND BIODIVERSITY CONSERVATION
Subject Code: BOT142N401, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course Objectives: The aim of the course is to build up the knowledge among the students about the biodiversity of India and world and different conservation strategies used for preserving the biodiversity.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Describe and Classify** biodiversity, its types, status, hotspot and its conservation status.	**BT1 & BT2**
CO2	**Identify and categorize** the plant under the different categories of threat**.**	**BT4**
CO3	**Evaluate** strategies for biodiversity conservation.	**BT4**

Detailed Syllabus:

Module	Course content	Lecture hours
I	**Ecology:** Definition, types and importance of ecology. Characteristics of population, population size and exponential growth, population dynamics, life history pattern, fertility rate and age structure. Competition and coexistence, intra and inter specific interactions, mutualism and commensalism, prey-predator interactions. Food chain, food webs, energy flow through ecosystem.	**9**
II	**Environment:** Introduction to Environmental Science and Sustainability, Environmental laws; Environmental Stresses and their management, climate change and global warming, atmospheric ozone. Environmental pollutants- air, water, and soil pollution, Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation. Environmental issues, policies, and regulations	**9**
III	**Introduction to biodiversity**: Biodiversity – types, levels, threats, value and uses; distribution and gradients of biodiversity. Biodiversity hotspots with special emphasis on Indian hotspots. **Measures of Biodiversity:** Alfa, Beta and Gamma diversities – Indices of diversity and evenness. **Causes and Consequences of Biodiversity Loss**	**9**
IV	**Introduction to Conservation**: Biodiversity – assessment, conservation and management, Types of conservation. Conservation strategies. Red and Blue Data Book. Role of organizations in the conservation of biodiversity – IUCN, WCED, UNEP, NBPGR, CBD. Biodiversity act of India and related international conventions. Status of biodiversity conservation in India. Sustainable development, natural resource management in changing environment.	**9**

Total	**36**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • CASE STUDIES • VIVAVOCE

Textbooks:

1. Krishnamurthy, K.V. 2017. A textbook of Biodiversity, CRC Press.
2. Sharma, P. D. (2009). Ecology and Environment, Rastogi Publications, Meerut, India

Reference Books:

1. Bharucha, F.R. A textbook of plant geography of India, Oxford University Press, 179 pages
2. Cain, S.A. 1944. Foundations of Plant Geography, Harper & Brothers, N.Y.
3. Schulze E. D., et al. 2010. Plant Ecology. Springer.
4. Chapman, J. L. and Reiss, M. J. (1992). Ecology – Principles and Applications, Cambridge University Press, Cambridge, UK

MINOR SUBJECT: BIORESOURCE MANAGEMENT
Subject Code: BOT142N402, COURSE LEVEL: 200
L-T-P-C=2-0-1-3, Credit Units: 03
SCHEME OF EVALUATION: Theory & Practical (TP)

Prerequisite: Basic knowledge of biology of class XII.

Course Objective: Gain knowledge and skills to effectively manage and sustainably utilize biological resources for various purposes, including conservation, economic development, and environmental stewardship.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Understand** the principles and concepts of bioresource management, including the sustainable use and conservation of biological resources.	**BT2 & BT3**
CO2	**Apply** analytical and problem-solving skills to assess and manage bioresources in various contexts, considering ecological, economic, and social factors.	**BT4**
CO3	**Demonstrate** knowledge of different bioresource management strategies and techniques, such as biodiversity assessment, habitat restoration, and sustainable harvesting practices.	**BT4**

CO4	**Evaluate** the impacts of human activities on bioresources and develop strategies to mitigate negative effects and promote sustainable resource management	

Detailed Syllabus:

Module	Course content	Lecture hours
I	**Biological Resources:** Biodiversity-definition and types; Significance; Threats; Management strategies; Bio-prospecting; IPR; CBD; National Biodiversity Action Plan). Forest types. Forest products – Major and minor. Consequence of deforestation and industrialization. Sustainable use of bioresources.	**12**
II	**Energy, Contemporary practices in resource management:** Renewable and non-renewable sources of energy, 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.	**12**
III	**Acts and policies:** Forest Conservation Act 1981; Environment (protection) Act 1986; Hazardous waste (Management and Handling) Rules 1989; Bio-Medical Waste (Management and Handling) Rules 1998; Environmental Impact Assessment (EIA); Environmental Management Plan (EMP) and Environmental Clearance for Establishing Industry (ECEI); National Biodiversity Act 2002.	**12**
IV	**Practical:** 1. Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation. 2. Collection of data on forest cover of specific area. 3. Ecological modeling.	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
24	12	12 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS AND SAMPLING

Suggested Readings:

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.

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

3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

MAJOR SUBJECT: PLANT TAXONOMY, MORPHOLOGY, & ANATOMY
Subject Code: BOT142M301, COURSE LEVEL: 200
L-T-P-C=4-0-0-4, Credit Units: 04
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce the students to the different tissue systems in angiosperms and their morphology, how they function and the theories of root and shoot development.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recognize** the various tissue organization of the plant body	**BT1**
CO2	**Describe** the development and functions of various tissue systems inside the plant body.	**BT2**
CO3	**Differentiate** between stem and root based on internal organisation	**BT4**
CO4	**Correlate** between flower morphology and methods of reproduction in angiosperms	
CO5	**Identify** and **Describe** various angiospermic families based on their features	

Detailed Syllabus

Modules	**Course content**	**Lecture hours**
I	**Introduction and organization of plant body:** **Morphology of Stem**: Characteristics, and Modifications of stem **Morphology of Roots**: Characteristics and Modifications of roots	**15**
II	**Morphology of Leaf:** Characteristics and Modifications of leaf; Phyllotaxy. **Morphology of Flower:** Flower as a modified shoot, morphology of stamen and carpel.	**15**
III	**Shoot and Root:** Organization of shoot and root apex (Apical cell theory, Histogen theory, Korper-Kappe theory, Tunica Corpus theory); Quiescent centre. Anatomical features of monocot and dicot stem and root. **Secondary growth** in dicot and monocot stem. Anomalous secondary growth**.** **Anatomy of Leaf:** Structure of dicot and monocot leaf anatomy.	**15**
IV	**Angiosperm Taxonomy:** Aims of taxonomy, History of classification- Artificial, Natural (Bentham and Hooker), Phylogenetic (Engler & Prantl, Hutchinson, Takhtajan), APG system- a brief idea; **Distinguishing features of the following families:** Magnoliaceae, Brassicaceae, Fabaceae, Malvaceae, Cucurbitaceae, Euphorbiaceae, Apiaceae, Rubiaceae, Solanaceae, Acanthaceae, Verbenaceae, Lamiaceae, Asteraceae. Arecaceae, Musaceae, Zingiberaceae, Orchidaceae, Poaceae.	**15**

Total	**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Textbook:

4. B.P. Pandey. Plant Anatomy. 2001. S. Chand Publication.
5. Evert, R.F. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. 2006. John Wiley and Sons, Inc.
6. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.

Reference Books:

8. Annie Ragland. Fundamentals Of Plant Anatomy and Microtechniques. 2016. Saras Publication.
9. Charles B. Beck. An introduction to plant structure and development (plant anatomy for 21st century). (2nd edition). 2010. Cambridge University Press.
10. James D. Mauseth. Plant Anatomy. 2008. The Blackburn Press.
11. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
12. 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.
13. Katherine Esau. Anatomy Of Seed Plants.2006. Wiley Publications.
14. Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper and Row, New York.

MAJOR SUBJECT: PLANT MORPHOLOGY, ANATOMY & TAXONOMY - PRACTICAL
Subject Code: BOT142M312, COURSE LEVEL: 200
L-T-P-C=0-0-8-4, Credit Units: 04
SCHEME OF EVALUATION: Practical only (P)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart practical knowledge on various group of angiosperms, have a clear concept on cellular structure of plants by microscopic observation, have a hands-on experience on economically important plant parts used, and do microchemical tests to observe the molecules present there.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	The course will help the students to **gain** practical knowledge of vascular plants.	**BT1**
CO2	They will be equipped to **identify** various anatomical structures of plant bodies.	**BT2**
CO3	They will be able to **describe** the economic importance of various plants.	**BT2**

Detailed Syllabus

Module	**Course content**	**Lecture hours**
I	1. Morphological features of flowers and special types of inflorescences	**22**
II	2. Preparation of temporary and permanent slides of stained T.S. and L.S. of: • monocot and dicot stem • monocot and dicot root 4. Adaptive anatomy in xerophytes and hydrophytes.	**22**
III	4. Study of floral characters of the following families (Minimum 5 subject to availability of any one specimen from each family): • Brassicaceae –*Brassica/Rorippa* • Apiaceae - *Coriandrum / Foeniculum* • Rubiaceae – *Ixora/Hedyotis* • Asteraceae - *Vernonia/Ageratum/ Eclipta/Mikania* • Solanaceae - *Solanum nigrum/Solanum indicum* • Lamiaceae - *Salvia/Ocimum* • Acanthaceae – *Justicia/Phlogocanthus* • Euphorbiaceae - *Euphorbia hirta/E.milii/E. pulcherrima* • Musaceae - *Musa* • Poaceae - *Triticum/Avena/Oryza*	**24**
IV	5.Field visits (Local) 6. Mounting of a properly dried and pressed specimen of plant specimens with herbarium label (to be submitted in the record book).	**22**
Total		**90**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS

		• SAMPLE COLLECTION • HERBARIUM SUBMISSION

Reference Books:

5. Santra S. Practical Botany Vol.1 and 2. 2015. NCBA Publisher.
6. Bendre and Kumar. Practical Botany Vol.1 and 2. 2018. Rastogi Publications.
7. Internet : https://www.biodiversitylibrary.org/item/90703#page/3/mode/1up.
8. Pandey B.P. Modern Practical Botany Vol. 1, 2, 3. 2011. S. Chand Publication.

MINOR SUBJECT: ETHNOBOTANY
Subject Code: BOT142N301, COURSE LEVEL: 200
L-T-P-C=4-0-0-4, Credit Units: 04
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce the students to the various ways plants are used in a particular culture and region, to present its scope as an interdisciplinary science and its relevance in modern times.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Describe** various traditional methods of medical treatments in various communities of India	**BT2**
CO2	**Compute** the traditional knowledge of prominent tribes of Assam	**BT3**
CO3	**Infer** the applications of the ethnomedicine in modern pharmaceutical systems	**BT4**

Detailed syllabus:

Module/ Experiment	Topic/ Course content	Lecture hours
Theory		
I	Basic concept of society, community and groups, Characteristics and of rural communities, Scope and Importance of botany in Rural Economy and Employment Generation, Importance in food and nutritional security, Ecotourism.	**12**
II	Ethnobotany in North -east India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany.	**12**
III	Ethnomedicine, ethnoecology, ethnic communities of NE India. Application of natural products to certain diseases - Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases	**12**
IV	Herbs used by dominant communities of Assam- Bodo, Tiwa, Karbi, Garo and Rabha in their day-to-day life.	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

References:

5. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.

6. S.K. Jain (ed.) Glimpses of Indian Ethnobotany, Oxford and I B H, New Delhi – 1981
7. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
8. Internet based latest research papers.

SEC: FLORICULTURE
Subject Code: BOT142S321, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: The student will learn the techniques of floriculture, the economic importance of different plants used in floriculture and the commercial aspect of floriculture.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recognize** field-based application on flower cultivation and marketing.	**BT1**
CO2	**Identify** gardening techniques for different flowers	**BT2**

Detailed Syllabus:

Module	**Content**	**Lecture hours**
I	Importance and scope of floriculture and landscape gardening, Types of gardens, garden elements, styles of gardening, famous gardens in India and abroad, principles of gardening.	**9**
II	Ornamental plants, flowering annuals, herbaceous perennials, divine vines, shade and ornamental trees, ornamental bulbous and foliage plants, cacti and succulents, palms and cycads, ferns and selaginellas, cultivation of plants in pots, indoor gardening, bonsai.	**9**
III	Methods of propagation of flowers, sexual and vegetative methods of propagation, soil sterilization, seed sowing, pricking, planting and transplanting, shading, defoliation, wintering, mulching, topiary, role of plant growth regulators, maintenance of cut flowers	**9**
IV	Commercial floriculture, factors affecting flower production, production and packaging of cut flowers, flower arrangements, methods to prolong vase life, cultivation of important cut flowers (Carnations, Asters, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Lilium, Orchids). Mode of transportation and preservation of loose and cut flowers.	**9**
Total		**36**

Projects based on the syllabus such as:

1. Digital album of world-famous gardens.

2. Development of model gardens in RGU campus.

3. Exhibition of floral arrangements of both fresh and dry flowers.

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

DETAILED SYLLABUS OF 4TH SEMESTER

MAJOR SUBJECT: MICROBIOLOGY & MYCOLOGY
Subject Code: BOT142M401, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To introduce and develop basic concepts to the world of microbes focusing on the diversity and fundamental biological processes of bacteria, viruses & Fungi.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	To **describe** the physical dimensions, forms, functions and habitats of bacteria, plant & animal viruses, the ecological role of fungi and the biotechnological application of certain species of all the three groups	**BT2**
CO2	To **distinguish** between the micro and macro forms of life and their value-addition to the environment.	**BT2**
CO3	To **illustrate** the differences between the antagonistic and beneficial roles of bacteria, viruses & Fungi in the plant kingdom	**BT3**

Detailed Syllabus

Module	**Course content**	**Lecture hours**
I	**Introduction to microbial world**: Introduction to microbial world, microbial nutrition, growth and metabolism. **Viruses**: Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus(T-phage), lytic and lysogenic cycle; RNA virus (TMV). Economic importance of viruses	**12**
II	**Bacteria**: Discovery, general characteristics, types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts), cell structure, nutritional types, reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Economic importance of bacteria.	**12**

III	**Introduction to fungi:** Introduction to true fungi, Affinities with plants and animals; Cell wall composition; Nutrition; Classification. General account of Chytridiomycetes, Zygomycota, Ascomycota Basidiomycota and Oomycota: Heterokaryosis and parasexuality.	**12**
IV	**Allied Fungi:** General characteristics; Status of Slime moulds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies. **Symbiotic associations**: Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization. Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance. **Applied Mycology:** Role of fungi in biotechnology, Application of fungi in industries and Agriculture (Biofertilizers)	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

SUGGESTED READINGS:

Textbooks:

4. Dubey, R.C. and Maheshwari, D.K. (1999). A textbook of Microbiology, S. Chand & Company Ltd., New Delhi, India
5. Pelczar, M.J. Microbiology. 2005.Tata McGraw-Hill Co, New Delhi
6. Tortora G.J., Funke B.R., Case C.L., Weber D and Bair W. Microbiology: An Introduction (13th Edition). 2018. Pearson Publisher.

Reference books:

5. Wiley, J.M., Sherwood, L.M. and Woolverton C.J., Prescott. Microbiology. 2017. McGraw Hill International.
6. Madigan M.T., Martinko J.M., Bender K.S., Buckley D.H., Stahl D.A., Brock T. Brock Biology of Microorganisms (14th Edition). 2014. Pearson Publisher.
7. Harvey R.A. and Cornelissen C.N. Lippincott Illustrated Reviews: Microbiology (Lippincott Illustrated Reviews Series) Third, North American Edition. 2012. LWW; Third, North American edition.

MAJOR SUBJECT: GENETICS & PLANT BREEDING
Subject Code: BOT142M402, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To acquaint the students with the basics of plant genetics and heredity.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Describe** Mendel as well as the chromosomal basis of inheritance.	**BT2**
CO2	**Predict** the basis of inheritance and variation caused due to mutation and aberrations.	**BT2**
CO3	**Evaluate** the techniques to create new varieties with a set of desired characteristics.	**BT3**

Detailed syllabus:

Modules	Topics / Course content	Periods
I	History, branches, and applications of genetics. Mendelism: Mendel's laws of inheritance – Law of dominance, law of segregation and law of independent assortment. Monohybrid crosses and Dihybrid crosses. Deviation from Mendel's law: Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy. Penetrance and Expressivity, Polygenic inheritance	**12**
II	Extranuclear inheritance and maternal effect. Chromosomal aberrations: Numerical and structural aberrations. Significance of chromosomal aberration in crop improvement. Mutations: types and causes: Spontaneous and induced mutation.	**14**
III	Fine structure of gene: Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism. Population and evolutionary genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, genetic drift. Genetic variation and Speciation.	**10**
IV	Principles and objectives of Plant Breeding: Domestication and centers of origin of cultivated plants. Plant introduction and Selection methods: mass, pure line and clonal selection. Hybridization and its types; emasculation. Heterosis, hybrid vigor, role of polyploidy in plant breeding and crop improvement.	**12**
Total		**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**

60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

SUGGESTED READINGS:

Textbooks:

5. Sundarraj D and Thulasidas, G. 1972. Introduction to cytogenetics and Plant Breeding (III Edn.) Popular Book Depot. Madras.
6. Karp, G. 1996. Cell and Molecular Biology. John Wiley and Sons Inc. New York, Singapore.
7. Singh, B.D., 2005. Plant Breeding, principles and methods (7th Revised and enlarged edition). Kalyani publishers, New Delhi.
8. Gupta, P.K., 2007. Genetics - Classical to modern. Rastogi Publications, Meerut, India.

Reference books:

7. Russell, P.J. and Gordey, K., 2002. *IGenetics* (No. QH430 R87). San Francisco: Benjamin Cummings.
8. Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of plant Breeding. Narosa Publishing House. New Delhi.
9. George M. M., 2005. Freifelder's Essentials of Molecular Biology. 4th edition. Narosa Publishing House, New Delhi.
10. George W. Burns, 1969. The Science of Genetics. An introduction to heredity. The Macmillan company. New York.
11. Gardener, J, Simmons, H.J and Snustad, D.P. 1991. Principles of Genetics (8th edition), John Wiley & Sons, New York.
12. Darbeshwar Roy, 2012. Plant breeding - A biometrical Approach. Narosa Publishing House, New Delhi.

MAJOR SUBJECT: TRADITIONAL MEDICINAL PLANTS OF INDIA
Subject Code: BOT142M403, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart knowledge on the traditional methods of using medicinal plants in India and also introducing to the students the basic concept of ethnobotany.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Describe** various traditional methods of medical treatments in various communities of India	**BT2**
CO2	**Compute** the traditional knowledge of prominent tribes of Assam	**BT3**
CO3	**Infer** the various applications of ethnomedicine in modern pharmaceutical systems	**BT4**

Detailed syllabus:

Modules	Topic/ Course content	Lecture hours
I	**History, Scope and Importance of Medicinal Plants:** Ethnobotanical uses of indigenous medicinal plants, indigenous medical systems- Ayurveda and Siddha.	**10**
II	**Conservation of Endangered and Endemic Medicinal Plants:** Introduction to endemic and endangered medicinal plants, red list criteria; In situ and Ex situ conservation strategies of indigenous medicinal plants. Herbal gardens.	**10**
III	**Ethnobotany and Folk medicines:** Examples of ethnobotanically important plants of North East India. Paleo-ethnobotany. Folk medicines ethnic communities of India. Use of natural products for treatment of - jaundice, cardiac ailments, infertility, diabetes, hypertension and skin diseases.	**09**
IV	**Ethnomedicine in NE India**: Case Studies.	**07**
Total		**36**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

SUGGESTED READINGS:

Textbooks:

7. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
8. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
9. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
10. S.K. Jain (ed.) Glimpses of Indian Ethnobotany, Oxford and I B H, New Delhi – 1981
11. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists,

Lucknow, India.
12. Internet based latest research papers.

MAJOR SUBJECT: MICROBIOLOGY, MYCOLOGY, GENETICS & PLANT BREEDING-PRACTICAL
Subject Code: BOT142M414, COURSE LEVEL: 200
L-T-P-C=0-0-6-3, Credit Units: 03
SCHEME OF EVALUATION: Practical (P)

Prerequisite: Basic knowledge of biology of class XII.

Course objective: To impart practical knowledge on various groups of archegoniates, have a clear concept on cellular structure of plants by microscopic observation, have a hands-on experience on economically important plant parts used, and do microchemical tests to observe the molecules present there.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Employ** practical knowledge of bacteria, viruses and fungi	**BT3**
CO2	**Reproduce** the different cell division techniques.	**BT1**
CO3	**Demonstrate** techniques used in plant breeding.	**BT4**

Detailed syllabus:

Module	Course content	Lecture hours
I	14. Sterilization techniques. 15. Preparation of culture media. 16. Preparation of pure culture and slants. 17. Isolation and streaking techniques. 18. Gram staining: Curd and root Nodule **19. Lichens:** Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates.	**24**
II	20. Preparation of temporary slides of certain fungi subjected to availability. 21. *Agaricus*: Specimens of button stage and full-grown mushroom; sectioning of gills of *Agaricus*.	**24**
III	22. Study of cell division – Mitosis in onion root tips, stages of meiosis from permanent slides. 23. Genetic problems based on theory syllabus – monohybrid, dihybrid, test cross and gene interaction, gene interaction *viz.* co-dominance, complementary and supplementary genes, epistasis. 24. Photographs of Inversion bridge, Laggards, Polytene and Lampbrush chromosome.	**22**
IV	25. Field visit to understand fungal diversity and their habitat 26. Hybridization techniques - Emasculation, Bagging and tagging.	**20**

Total	**48**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • SAMPLE COLLECTION • VIVAVOCE • FIELD VISITS

MINOR SUBJECT: ECOLOGY, ENVIRONMENT AND BIODIVERSITY CONSERVATION
Subject Code: BOT142N401, COURSE LEVEL: 200
L-T-P-C=3-0-0-3, Credit Units: 03
SCHEME OF EVALUATION: Theory (T)

Prerequisite: Basic knowledge of biology of class XII.

Course Objectives: The aim of the course is to build up the knowledge among the students about the biodiversity of India and world and different conservation strategies used for preserving the biodiversity.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Describe and Classify** biodiversity, its types, status, hotspot and its conservation status.	**BT1 & BT2**
CO2	**Identify and categorize** the plant under the different categories of threat**.**	**BT4**
CO3	**Evaluate** strategies for biodiversity conservation.	**BT4**

Detailed Syllabus:

Module	**Course content**	**Lecture hours**
I	**Ecology:** Definition, types and importance of ecology. Characteristics of population, population size and exponential growth, population dynamics, life history pattern, fertility rate and age structure. Competition and coexistence, intra and inter specific interactions, mutualism and commensalism, prey-predator interactions. Food chain, food webs, energy flow through ecosystem.	**9**
II	**Environment:** Introduction to Environmental Science and Sustainability, Environmental laws; Environmental Stresses and their management, climate change and global warming, atmospheric ozone.	**9**

	Environmental pollutants- air, water, and soil pollution, Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation. Environmental issues, policies, and regulations	
III	**Introduction to biodiversity**: Biodiversity – types, levels, threats, value and uses; distribution and gradients of biodiversity. Biodiversity hotspots with special emphasis on Indian hotspots. **Measures of Biodiversity:** Alfa, Beta and Gamma diversities – Indices of diversity and evenness. **Causes and Consequences of Biodiversity Loss**	**9**
IV	**Introduction to Conservation**: Biodiversity – assessment, conservation and management, Types of conservation. Conservation strategies. Red and Blue Data Book. Role of organizations in the conservation of biodiversity – IUCN, WCED, UNEP, NBPGR, CBD. Biodiversity act of India and related international conventions. Status of biodiversity conservation in India. Sustainable development, natural resource management in changing environment.	**9**
Total		**36**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • CASE STUDIES • VIVAVOCE

Textbooks:

3. Krishnamurthy, K.V. 2017. A textbook of Biodiversity, CRC Press.
4. Sharma, P. D. (2009). Ecology and Environment, Rastogi Publications, Meerut, India

Reference Books:

5. Bharucha, F.R. A textbook of plant geography of India, Oxford University Press, 179 pages
6. Cain, S.A. 1944. Foundations of Plant Geography, Harper & Brothers, N.Y.
7. Schulze E. D., et al. 2010. Plant Ecology. Springer.
8. Chapman, J. L. and Reiss, M. J. (1992). Ecology – Principles and Applications, Cambridge University Press, Cambridge, UK

MINOR SUBJECT: BIORESOURCE MANAGEMENT
Subject Code: BOT142N402, COURSE LEVEL: 200
L-T-P-C=2-0-1-3, Credit Units: 03
SCHEME OF EVALUATION: Theory & Practical (TP)

Prerequisite: Basic knowledge of biology of class XII.

Course Objective: Gain knowledge and skills to effectively manage and sustainably utilize biological resources for various purposes, including conservation, economic development, and environmental stewardship.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Understand** the principles and concepts of bioresource management, including the sustainable use and conservation of biological resources.	**BT2 & BT3**
CO2	**Apply** analytical and problem-solving skills to assess and manage bioresources in various contexts, considering ecological, economic, and social factors.	**BT4**
CO3	**Demonstrate** knowledge of different bioresource management strategies and techniques, such as biodiversity assessment, habitat restoration, and sustainable harvesting practices.	**BT4**
CO4	**Evaluate** the impacts of human activities on bioresources and develop strategies to mitigate negative effects and promote sustainable resource management	

Detailed Syllabus:

Module	Course content	Lecture hours
I	**Biological Resources:** Biodiversity-definition and types; Significance; Threats; Management strategies; Bio-prospecting; IPR; CBD; National Biodiversity Action Plan). Forest types. Forest products – Major and minor. Consequence of deforestation and industrialization. Sustainable use of bioresources.	**12**
II	**Energy, Contemporary practices in resource management:** Renewable and non-renewable sources of energy, 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.	**12**
III	**Acts and policies:** Forest Conservation Act 1981; Environment (protection) Act 1986; Hazardous waste (Management and Handling) Rules 1989; Bio-Medical Waste (Management and Handling) Rules 1998; Environmental Impact Assessment (EIA); Environmental Management Plan (EMP) and Environmental Clearance for Establishing Industry (ECEI); National Biodiversity Act 2002.	**12**
IV	**Practical:** 1. Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation. 2. Collection of data on forest cover of specific area. 3. Ecological modeling.	**12**
Total		**48**

CREDIT DISTRIBUTION

LECTURE/TUTORIAL	PRACTICALS	EXPERIENTIAL LEARNING
24	12	12 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS AND SAMPLING

Suggested Readings:

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.

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

3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

DETAILED SYLLABUS OF 5th SEMESTER

MAJOR SUBJECT: PLANT PHYSIOLOGY & BIOCHEMISTRY
Subject Code: BOT142M501, COURSE LEVEL: 300
Credit Units: L-T-P-C=4-0-0-4
SCHEME OF EVALUATION: Theory (T)

Course objectives: Develop an understanding to the various physiological and biochemical processes operating in a plant system.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Recognize** the fundamental concepts of plant physiology	**BT1**
CO2	**Describe** the different processes affecting plant growth and development:	**BT2**
CO3	**Discover** the roles of different plant hormones in plant growth and development	**BT3**
CO4	**Interpret** their application for crop improvement programs.	**BT4**

Module	Topic and Course content	Lecture hours
I	**Plant-water relations:** Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement. Symplast, apoplast, transmembrane pathways, root pressure, guttation, Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, anti transpirants, mechanism of stomatal movement. Solute Transport: Passive and Active transport: transport of ions across cell membrane, passive absorption, facilitated diffusion, active absorption.	15
II	**Mineral nutrition:** Macro and micronutrients and chelating agents. Mineral deficiency symptoms, roles of essential elements.	15
III	**Photosynthesis:** Mechanism of Electron transport and mechanism of ATP synthesis; The Dark reaction: Calvin cycle, C4 and CAM pathways; Photorespiration. **Respiration:** Glycolysis, TCA cycle; Oxidative phosphorylation Nitrogen metabolism: Biological nitrogen fixation	15
IV	**Physiology of flowering:** Photoperiodism and Photomorphogenesis, flowering stimulus, florigen concept, Vernalization. Role of Phytochrome, cryptochromes and phototropins. Plant growth regulators: Discovery and role of Auxins, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids, Jasmonic acid and Strigolactones.	15
TOTAL		60

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Text Books:

1. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2. Lehninger Biochemistry

Reference Books:

1. Buchanan B.B, Gruissem W. and Jones R. L (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland,USA.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Dennis D. T., Turpin, D. H. Lefebvre D. D. and Layzell D. B.(eds) (1997). Plant Metabolism (Second Edition) Longman, Essex, England.
5. Willium G Hopkins, Norman P Hunar (2009) Introduction To Plant Physiology, Wiley.

MAJOR SUBJECT I: Reproductive biology of angiosperms
SUBJECT CODE: BOT142M601,
COURSE LEVEL: 300
CREDIT UNITS: L-T-P-C = 4-0-0-4
SCHEME OF EVALUATION: Theory (T)

Course Objective: The course is designed to inform the student about the various bioresources and its management.

Course Outcomes: By the end of the course the students will be able to:

CO1:	**Identify** the students about the development of flower, various stages of development of male and female gametophytes and the process of fertilization**.**	BT 1
CO2:	**Recognize** stages of development and reproductive parts of angiosperms	BT2
CO3:	**Predict** various incompatibilities and hybridization process in plants.	BT 3
CO4	**Compare** various types of embryo development and seed types in plants.	BT 4

Detailed Syllabus:

Modules	Course content	Periods
I	Flower as a modified determinate shoot; ABC model of flower development. Development of Anther. Anther wall: Structure and functions, Microsporogenesis and Micro-gametogenesis; Pollen wall structure. Pollen viability. Abnormal features of pollen.	**15**
II	**Ovule Structure, pollination, and double fertilization**: Ovule Structure; Types; Special structures. Megasporogenesis and Mega-gametogenesis (details of *Polygonum* type). Organization and ultrastructure of mature embryo sac. Pollination Pollen pistil interaction. Double fertilization.	**15**
III	**Self-incompatibility**: Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic). Methods to overcome self-incompatibility reactions. Intra-ovarian and in vitro pollination. Parasexual hybridization; Cybrids, in vitro fertilization.	**15**
IV	**Embryo, Endosperm and Seed Structure and types:** Development of dicot and monocot embryo and endosperm. Suspensor: structure and functions; Embryo-endosperm relationship, Nutrition of embryo. Unusual features embryo development in *Paeonia*. Seed structure, importance, and dispersal mechanisms. Polyembryony and apomixes.	**15**
Total		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • ASSIGNMENTS • • • VISITS

Text Book:

1. Bhojwani, S.S. and Bhatnagar, S.P. (2014). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
2. Pandey B.P. Embryology of Angiosperm. 2017. Rastogi publication, Meerut.
3. Raghavan, V. Developmental Biology of Flowering plants. 2000. Springer, Netherlands.
4.

Reference Book:

1. Haig D and Westoby M. Seed size, pollination costs and angiosperm success.1991. Springer-Verlag, Netherlands. (Research Paper).
2. Johri, B.M. Embryology of Angiosperms. 2015. Springer-Verlag, Netherlands.
3. Johri, B.M. Reproductive biology of Angiosperms. 2012. Springer-Verlag, Netherlands
4. Raghavan, V. Molecular embryology of flowering plants. 1997. Cambridge, University Press.
5. Went van J.L. Fertilization in Angiosperm plants. 1992. Springer-Verlag, Netherlands. (Research paper

MAJOR SUBJECT: Plant physiology, Biochemistry, Cell & Molecular biology - Practical
Subject Code: BOT142M513,
COURSE LEVEL: 300
Credit Units: L-T-P-C=0-0-8-4
SCHEME OF EVALUATION: Practical (P)

Course objective: To impart practical knowledge on various cellular and molecular biology techniques

Learning Outcomes: At the end of the course the student will be able to:

CO1	**Identify** basic concepts of plant physiology, including water potential, transpiration, and mineral nutrition.	BT 1
CO2	**Explain** key physiological processes like photosynthesis, photoperiodism, and the role of growth regulators in plants	BT 2
CO3	**Analyze** experimental results related to plant physiology, including water potential, transpiration, and photosynthesis.	BT3
CO4	**Perform** molecular biology techniques, including DNA extraction, gel electrophoresis, and PCR, for genetic analysis.	BT4

Detailed Syllabus:

Module	Course content	Lecture hours
I	1. Determination of Water Potential and its components in plant by gravimetric and weight method. 2. Determination of rate of transpiration using potometer. 3. Identification of mineral deficiency symptoms in plants.	**15**
II	1. Measurement of the rate of photosynthesis using Hill's Reaction. 2. Effect of photoperiod on flowering in short day and long day plants. 3. Effect of plant growth regulators on seed germination and growth.	**15**
III	1. Extraction and purification of DNA from available plant samples and its agarose gel electrophoresis. 2. Spectrophotometric estimation of DNA. 3. Agarose Gel Electrophoresis of the isolated DNA	**15**
IV	1. Primer Designing 2. Polymerase Chain Reaction. 3. Agarose Gel Electrophoresis of the amplified product.	**15**
Total		**60**

CREDIT DISTRIBUTION

LECTURE/TUTORIAL	PRACTICALS	EXPERIENTIAL LEARNING
00	60	30 • INDUSTRY/LAB VISITS • SAMPLE COLLECTION • LAB PERFORMANCE • EQUIPMENT HANDLING

MINOR SUBJECT: INDUSTRIAL & ENVIRONMENTAL MICROBIOLOGY
SUBJECT CODE: BOT142N501,
COURSE LEVEL: 300
CREDIT UNITS: L-T-P-C = 4-0-0-4
SCHEME OF EVALUATION: Theory (T)

Course Objective: The course is designed to impart theoretical as well as practical knowledge on the diversity of microbes in the environment and their interaction in different areas. The course will also help the students understand the utilization of microorganisms in different categories of industries.

Course Outcomes: By the end of the course the students shall be able to:

CO1	**Identify** different types of microorganisms found in the environment and **recognize** their contribution in eth environment.	**[BT1 & BT2]**
CO2	**Outline** different application of microorganism in industries	**[BT4]**
CO3	**Distinguish different diseases caused by** microbes from different sources such as air, soil, and water.	**[BT 4]**

Detailed Syllabus:

Mod-ule	Topics / Course content	Lecture hours
I	Microbial diversity and its role in the environment. Aerobiology: assessment of air quality, airborne diseases and their control, enumeration of microbes from air. Soil Microbiology: soil microflora and their interactions, enumeration of microbes from soil. Bioinoculants and their application.	**15**
II	Water microbiology: ecosystems – fresh water and marine, zonations, eutrophication, water borne diseases and their control. Waste treatment – solid liquid, aerobic and anaerobic methods.	**15**
III	Food Microbiology: Microbial growth in food; Food spoilage and poisoning; Methods of food preservation. Types of fermented foods Fermenters and its types- single, batch, continuous cultures	**15**
IV	Industrial Microbiology: Microorganisms growth in controlled environment; production of alcohol, organic acids, antibiotics, Biopolymers, biofuels, Biosurfactants; Bioconversion Processes; GEMs – Application and hazards.	**15**
TOTAL		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**

60	00	30 • OME ASSIGNMENTS • EMINARS • IVAVOCE • IELD VISITS

Text Book:

1. Whitaker and Stanbury. Principles of Fermentation Technology.
2. Casida. Industrial Microbiology. Tata McGraw Hill.
3. Adams and Moss. Food Microbiology. Cambridge.

Reference Books:

1. Wiley, J.M., Sherwood, L.M. and Woolverton C.J., Prescott. Microbiology. 2017. McGraw Hill International.
2. Brown A.E. and Smith H. Benson's Microbiological Applications: Laboratory Manual in General Microbiology.2016. McGraw-Hill Education.Madigan M.T., Martinko J.M., Bender K.S., Buckley D.H., Stahl D.A., Brock T. Brock Biology of Microorganisms (14th Edition). 2014. Pearson Publisher.
3. Frazier and Westhoff. Food Microbiology. Tata McGraw Hill.
4. Harvey R.A. and Cornelissen C.N. Lippincott Illustrated Reviews: Microbiology (Lippincott Illustrated Reviews Series) Third, North American Edition. 2012. LWW; Third, North American edition.
5. Pelczar, M.J. Microbiology. 2005.Tata McGraw-Hill Co, New Delhi

DETAILED SYLLABUS OF 6th SEMESTER

MAJOR SUBJECT: Cell & Molecular biology
Subject Code: BOT142M502,
COURSE LEVEL: 300
Credit Units: L-T-P-C=4-0-0-4
SCHEME OF EVALUATION: Theory (T)

Course objectives: Develop an understanding to the various physiological and biochemical processes operating in a plant system.
Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Understand** the fundamental concepts of cell and molecular biology.	**BT1**
CO2	**Describe** the components of cells and how cell organelles interact with each other to carry out the fundamental biological process	**BT2**
CO3	**Express** significance of cell division for multicellular organism and the key events that happen during cell cycle.	**BT2**
CO4	**Decipher** and understand the regulation of gene expression	**BT4**

Module	Topic and Course content	Lecture hours
I	**Cell:** Cell as a unit of structure and function; Origin of eukaryotic cell (Endosymbiotic theory); Structural organization of prokaryotic and eukaryotic cells. Cell organelles: Plasma membrane: structure and functions; Membrane transport: ion channels and pumps; Mitochondria: structure, and functions; Chloroplast: structure and organization of photosynthetic complexes; endoplasmic reticulum, rough and smooth; Nucleus structure	15
II	**Cell division**: Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle checkpoints. Eukaryotic Genome Organization: Eukaryotic chromatin and chromosome. Structure of nucleic acids: DNA and its A, B and Z conformations, RNA and its types: t-RNA, r-RNAs and mRNA	15
III	**DNA replication:** Machinery and mechanism in prokaryotes and eukaryotes; RNA transcription: Machinery and mechanism in prokaryotes and eukaryotes; RNA processing: concept of split gene, splicing; RNA editing; Genetic code and exceptions to its universality.	15
IV	**Translation:** Machinery and mechanism (tRNA charging, initiation in prokaryotes and eukaryotes, elongation and termination); Regulation of gene expression in prokaryotes and eukaryotes: lac and tryptophan operon; regulation at transcriptional and post-transcriptional level	15
TOTAL		60

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Textbooks:

1. Cox, M., and Nelson, D. L. 2017. Principles of Biochemistry. Freeman and company, New York.
2. Dale, W.J. and Schontz, V.M. 2011. From Genes to Genomes. John wiley& sons ltd., England.
3. David. M. A., Freyer A.G., and Crotty, D. A. 2003. DNA Science A First Course, Cold Spring Harbor Laboratory Press, New York. Dey, P.M. and Harborne, J.B. (1997). Plant Biochemistry. Acad. Press.

Reference Books:

1. Buchanan, B.B., Gruissem, W. and Jones R.L. (2015). Biochemistry and Molecular Biology of Plants, Wiley Blackwell, Sussex, UK
2. Alberts, B., Bray, D. and Hopkin, K. 2018. Essential Cell Biology. Garland Science, U.S.A
3. Conn, E.E. and Stumpf, P.K. (1994). Outlines of Biochemistry. Wiley Eastern.
4. Dennis, D.T. (1998). Plant metabolism. Longman.
5. Heldt, H. (1997). Plant Biochemistry and Molecular Biology. Oxford Univ. Press.

MAJOR SUBJECT: PLANT ECOLOGY & ECOSYSTEM ANALYSIS
SUBJECT CODE: BOT142M601,
COURSE LEVEL: 300
Credit Units: L-T-P-C=4-0-0-4
SCHEME OF EVALUATION: Theory (T)

Course Objectives: Develop an understanding to the basic concepts in plant ecology and Ecosystem.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Explain** key concepts in plant ecology, including population dynamics, community interactions, and ecological succession	BT1
CO2	**Apply** ecosystem analysis techniques to assess energy flow, nutrient cycling, and productivity in ecosystems	BT2
CO3	**Analyze** patterns of biodiversity and the impacts of human activities on ecosystems, using data from field and laboratory studies	BT3
CO4	**Evaluate** ecological models and conservation strategies in relation to ecosystem management and biodiversity conservation	BT4

Module	Course Content	Lecture hours
1	**Fundamentals of Plant Ecology** Definition, scope, and relevance of plant ecology in the context of ecosystem functioning. Population structure and dynamics: Growth models (exponential and logistic). Life history strategies: r- and K-selection. Niche Concept: Fundamental and realized niche, niche differentiation, niche overlap, and competition. Intraspecific and interspecific competition, resource partitioning.	**15**
2	**Energy Flow and Ecosystem Functioning** Components, attributes and functioning of ecosystems. Types of ecosystems: Terrestrial (forests, grasslands) and aquatic (wetlands, rivers, lakes). Ecosystem resilience and stability. Energy transfer through food chains and food webs. Trophic levels and ecological pyramids (biomass, energy, and numbers). Primary and secondary productivity. Energy efficiency and flow across trophic levels.	**15**
3	**Biodiversity** Biodiversity Concept, Types and levels of biodiversity: Genetic, species, and ecosystem diversity. Factors affecting biodiversity patterns (latitude, altitude). Global and Indian biodiversity hotspots (e.g., Western Ghats, Himalayas). Biodiversity Indices and Measurement: Measurement of biodiversity using species richness and diversity indices (Shannon-Weiner, Simpson). Application of biodiversity indices in ecosystem analysis.	**15**
4	**Conservation Ecology** Causes of biodiversity loss: Habitat fragmentation, invasive species, pollution, and climate change. Impact of biodiversity loss on ecosystem functioning. In-situ and ex-situ conservation methods. Role of international (IUCN, CBD) and national (Biodiversity Act of India) bodies in conservation.	**15**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • DISCUSSIONS • SEMINARS • COLLABORATIVE PROJECTS • FIELD WORK

Suggested textbooks:

1. Odum, E.P. & Barrett, G.W. (2005). Fundamentals of Ecology. Brooks/Cole.
2. Begon, M., Townsend, C.R., & Harper, J.L. (2006). Ecology: From Individuals to Ecosystems. Wiley-Blackwell.
3. Groom, M.J., Meffe, G.K., & Carroll, C.R. (2006). Principles of Conservation Biology. Sinauer Associates.

Suggested Readings:

1. Molles, M.C. (2015). Ecology: Concepts and Applications. McGraw-Hill Education.
2. Krebs, C.J. (2008). The Ecological World View. University of California Press.
3. Primack, R.B. (2014). Essentials of Conservation Biology. Sinauer Associates.
4. Whittaker, R.J. & Fernández-Palacios, J.M. (2007). Island Biogeography: Ecology, Evolution, and Conservation. Oxford University Press.
5. Chapman, J.L. & Reiss, M.J. (1999). Ecology: Principles and Applications. Cambridge University Press.

MAJOR SUBJECT: Farming systems for sustainable agriculture
SUBJECT CODE: BOT142M603,
COURSE LEVEL: 300
Credit Units: L-T-P-C=, 4-0-0-4,
SCHEME OF EVALUATION: Theory (T) ONLY

Course objective: This course explores the principles and practices of sustainable agriculture and various farming systems.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	**Understand** and articulate the principles of sustainable agriculture	BT1
CO2	**Analyse** different farming systems and their environmental impacts	BT3
CO3	**Evaluate** soil health and fertility management practices	BT3
CO4	**Outline** sustainable farming solutions for local communities	BT4

Detailed Syllabus

Modules	Course content	Lecture hours
I	**Farming System-** Types, & Systems of farming. Factors affecting types of farming. Farming system components, and their maintenance.	**10**
II	**Cropping System:** Cropping systems & pattern, multiple cropping systems, efficient cropping system, and their evaluation. Tools for determining production & efficiencies in cropping and farming system. Soil physico chemical properties and their effect**.** Nutrient cycling in cropping systems.	**17**
III	**Soil fertility & nutrient management -** Soil fertility and productivity; availability of nutrients; relation between nutrient supply and crop growth; Organic farming - basic concepts and definitions. Recycling of organic wastes and residue management Essential nutrients – Criteria of essentiality, nutrient deficiency symptoms; chelates and their role in nutrient cycling.	**17**
IV	**Sustainable agriculture- Concept and importance of sustainable agriculture,** indicators of sustainability, adaptation and mitigation,	**16**

	conservation agriculture strategies in agriculture, High External Input Agriculture (HEIA), Low External Input Agriculture (LEIA), and Low External Input Sustainable Agriculture (LEISA) and their techniques for sustainability. Integrated farming system- components and its advantages.	
Total		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
60	00	30 • OME ASSIGNMENTS • EMINARS • IVAVOCE • IELD VISITS

Textbook:

7. Cropping systems Theory and Practice -Chatterjee B.N. and Maiti S.

Reference Books:

15. Brady NC & Weil R.R 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.

16. Prasad R & Power JF. 1997. Soil Fertility Management for Sustainable Agriculture. CRC Press.

17. Cropping Systems in Tropics – Principles and practices. -Palanniappan S.P.

18. Organic Farming for Sustainable Agriculture by Dahama A. K. Agrobios Publication

19. Hand book of Agriculture, ICAR New Delhi

Paper II: REPRODUCTIVE BIOLOGY, ECOLOGY, AND AGRONOMY (PRACTICAL)
Subject Code: BOT142C612,
Credit Units: L-T-P-C= 0-0-8-4,
SCHEME OF EVALUATION: Practical (P)

Course objective: To impart practical knowledge on various principles of ecology, agronomy and reproductive biology of angiosperms.

Learning Outcomes: At the end of the course the student will be able to:

CO 1	**Apply** key reproductive biology techniques, including floral dissection and pollen analysis.	**BT 3**
CO 2	**Analyze** ecological processes and biodiversity through quantitative ecological tools	**BT 4**
CO 3	**Apply** agronomic principles and techniques for crop management and soil fertility	**BT 3**

Detailed Syllabus

Modules	Course content	Periods
I	1. Study of Vegetative and Floral Characters: floral dissection, study of ovary, and preparation of floral diagrams. 2. Study of Anther: uninucleate, bicelled, dehisced anther stages Development and Pollen Studies: 3. Study of Ovule: anatropous, orthotropous, amphitropous. 4. Pollen Viability Test: Tetrazolium test and germination using hanging drop method.	**15**
II	5. Determination of Minimal Quadrat Size 6. Quantitative Vegetation Analysis: frequency, density, and abundance using quadrat sampling. 7. Biological Oxygen Demand (BOD): Determine BOD in water samples to quantify the oxygen demand	**15**
III	8. Determination of soil pH, EC, organic C, total N, available N, P, K and S in soils. Determination of total N, P, K and S in plants. 9. Estimation of soil moisture. 10. Determination of Bulk and Particle Density, 11. Determination of Field Capacity 12. Interpretation of interaction effects and computation of economic and yield optima.	**15**
IV	13. Manure and Fertilizer Application: Study of methods for applying manure and fertilizers in important field crops 14. Study the quality of compost and vermicompost used in agronomy. 15. Field Visit: Natural habitats and agricultural fields.	**15**
Total		**60**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
00	60	30 • FIELD VISITS • SAMPLE COLLECTION • LAB PERFORMANCE • SUBMISSION

Text Books:

1. Hand book of Agriculture, ICAR New Delhi.
2. Bendre and Kumar. Practical Botany Vol. 2. 2018. Rastogi Publications.
3. Internet : https://www.biodiversitylibrary.org/item/90703#page/3/mode/1up.
4. Pandey.B.P. Modern Practical Botany Vol. 1, 2, 3. 2011. S.Chand Publication.

MINOR SUBJECT: AGRONOMY & SUSTAINABLE DEVELOPMENT
SUBJECT CODE: BOT142N601,
COURSE LEVEL: 300,
CREDIT UNITS: L-T-P-C: 3-0-1-4
SCHEME OF EVALUATION: Theory and Practical

Course objective: First, to develop the theoretical and knowledge foundation on the concept of agronomy and sustainable development and to gain an empirical understanding of the emerging global challenges for sustainable agricultural and environmental development.

Learning Outcomes: After the successful completion of the course the students will be able to:

CO1	Define the basic concepts of agronomy and classify crops based on agronomic and botanical criteria.	**BT 1**
CO2	Explain the principles of soil science and their relevance in soil productivity and fertility.	**BT 2**
CO3	Evaluate current agricultural practices considering sustainable development goals and challenges.	**BT4**

Module	**Topic and Course content**	**Lecture hours**
	Theory	
I	**Introduction to Agronomy:** Agronomy and its scope, Agronomic classification of crops**. Major farming systems. Methods of sowing/planting.** Tillage and its types; Crop rotation: principles and its advantages.	**12**
II	**Principles of Soil Science:** Nature and origin of soils; soil forming processes, classifications of soils. Soil physico-chemical properties and their importance.	**12**
III	**Soil productivity and fertility** - Crop nutrition; Nutrient sources; Nutrient cycling in agro-ecosystems; Fertilizers and biofertilizers; Green manure crops and cover crops	**12**
IV	**Introduction to Sustainable Development:** Its importance and impact; History and Current practices; Sustainable Development Goals (SDGs), Significance and Challenges of Sustainable Development; Dimensions to Sustainable development.	**12**
	TOTAL	**48**
	PRACTICAL	
1	Identification of crops and seeds	**2**

2	Identification of fertilizers and pesticides	**2**
3	Effect of sowing depth on germination	**4**
4	Seed germination and viability test	**4**
5	Determination of soil temperature, pH and moisture content	**4**
6	Determination of water holding capacity of soil	**3**
7	Identification of rocks and minerals	**3**
	TOTAL	**22**

CREDIT DISTRIBUTION		
LECTURE/TUTORIAL	**PRACTICALS**	**EXPERIENTIAL LEARNING**
48	22	20 • HOME ASSIGNMENTS • SEMINARS • VIVAVOCE • FIELD VISITS

Text Books:

1. **A Textbook of Agronomy"** by C. S. Tomar
2. **Soil Science and Agronomy"** by D.K. Das

Reference Books:

1. **A Handbook of Agriculture"** by ICAR
2. **Agricultural Practices in India"** by A. S. Jadeja and P. M. Thaker

VAC II: BIODIVERSITY, CONSERVATION & MANAGEMENT
SUBJECT CODE:
CREDIT UNITS: L-T-P-C = 2-0-1-3
SCHEME OF EVALUATION: Theory & Practical (TP)

Course Objectives:
The aim of the course is to build up the knowledge among the students about the biodiversity of India and world and different conservation strategies used for preserving the biodiversity.

Course Outcomes: By the end of the course the students will be able to:

CO1:	**Describe and Classify** biodiversity, its types, status, hotspot and its conservation status.	**BT1 and BT2**
CO2:	**Identify and categorize** the plant under the different categories of threat**.**	**BT4**
CO3:	**Evaluate** strategies for biodiversity conservation.	**BT4**

Detailed Syllabus:

Module	Course content	Lecture hours
I	**Introduction to biodiversity**: Biodiversity – types, levels, threats, value and uses; distribution and gradients of biodiversity. Biodiversity hotspots with special emphasis on Indian hotspots. Biodiversity and Ecosystem services (BES). Measures of Biodiversity: Alfa, Beta and Gamma diversities	**9**
II	**Causes and Consequences of Biodiversity Loss:** Habitat Loss and Alteration. Loss of Genetic Diversity in Crops.	**9**
III	**Introduction to Conservation**: Types of conservation. Conservation strategies, Role of organizations in the conservation of biodiversity – IUCN, WCED, UNEP, NBPGR, CBD. IUCN - Red data list.	**9**
III	**Conservation Strategies**: Laws and Legal Actions. Status of biodiversity conservation in India. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management). Case Studies on conservation	**9**
Total		**36**

Text Books:

1. Krishnamurthy, K.V. 2017. A textbook of Biodiversity, CRC Press.
2. Sharma, P. D. (2009). Ecology and Environment, Rastogi Publications, Meerut, India

Reference Books:

1. Bharucha, F.R. A textbook of plant geography of India, Oxford University Press, 179 pages

2. Cain, S.A. 1944. Foundations of Plant Geography, Harper & Brothers, N.Y.
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