Darrang College (Autonomous), Tezpur-784001

Syllabus for FYUGP

Subject: BOTANY

Course Type: MAJOR

Approved by:
Board of Studies meeting held on 24-12-2025
&
Academic Council vide Resolution no. 2, dated- 29-12-2025

Botany

DARRANG COLLEGE (AUTONOMOUS), TEZPUR-784001

SYLLABUS FOR FYUGP B.SC. BOTANY

PREREQUISITE

FOR MAJOR IN BOTANY, A STUDENT MUST PASS IN BIOLOGY AT XII LEVEL.

FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP) IN BOTANY, Darrang College (Autonomous)

INTRODUCTION :

Aim of FYUGP in Botany is designed with the following Objective

1. To build strong foundational knowledge in Plant Science through its various branches, like Morphology, Anatomy, Taxonomy, Pathology, Ecology, Cytology, Genetics, Molecular Biology and Biotechnology.
2. To emphasize regional Biodiversity, including Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperm and Angiosperms.
3. To develop skills for sustainable plants' resources and uses.
4. To foster critical thinking on environmental issues and prepare graduates for research or biological entrepreneurship.
5. Equipping students with theoretical knowledge and practical skills, covering modern and traditional botany.
6. T enhance the skill of conservation, agriculture, research and carriers in biotech, pharma and enviromental sectors.

Program Outcome:

On successesful completion of the FYUGP program , students will able to obtain:

1. Knowledge with the concept of different plant groups, viz. Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms including Viruses and Bacteria.
2. Knowledge of plant diversity, distribution, morphology and anatomy.
3. Knowledge of physiochemical propertiesof cells and their functions.
4. Fundamental knowledge for perform laboratory and field experiments and to prepare analysis of data and interpretation of results.
5. Knowledge of physiological processes , viz. metabolism, nutrition, plant-water relation, photosynthesis, respiration, growth and development, photoperidism etc.
6. Knowledge of systematic and taxonomic study of plants.
7. Knowledge of plants' diseases and their controls.
8. Knowledge of microbial diversity, their ecology and economic importance.
9. Knowledge of different biomolecules, viz. carbohydrates, fats-lipids, proteins, nucleic acid; their chemical nature and applications.
10. Knowledge of plant tissue cultures, genetic engineering, plant breeding techniques and their applications.
11. Applications and economic importance of various plant groups in industries, agricultures and medicine for human welfare.

Teaching-Learning Process

The key components of teaching-learning process in Botany for the Four-Year- Under

-Graduate Program (FYUGP) in Botany are:

1. Traditional Lectures: Provide foundational knowledge and theoritical instructions.

2. Tutorials: Provide more clearification/ concept of difficult topic. More applicable for slow learners in small groups.

3. Practical and Laboratory Works: Essential for developing hands-on- skills such as microscopy, slide preparation, specimen identification, harberium preparation and conservation and conducting experiments.

4. Field Studies/ Industrial Visits: Give opportunities to study plants in their natural habitats, explore local biodiversity and understand industrial processing of plant products.

5. Use of ICT Tools: Incorporates informations and communications Technology (ITC) tools, biological databases abd software to solve biological problems.

6. Project Work/ Dissertations: Fostering indipendent research works.

7. Group discussions and Seminers/ Workshops: Enhancing communication, critical thinking and team work skills.

Teaching-Learning Tools:

1. White board/Green board/Black board
2. LCD Projectors and Monitors
3. Smart boards
4. Demonstration models
5. Laboratory Equipments, viz. microscopes, spectrophotometer, centrifuge, autoclaves, pH meters, laminar air-flow etc.
6. Specimens and Slides.
7. Habarium Library.
8. Tissue Culture Laboratory
9. Shade house and Green house.
10. Mushroom cultivation room.
11. Botanical garden.

Assessment Methods:

Student progress is continuously evaluated through a combination of formative and summative assessment techniques, including:

1. Home assignments
2. Report based on projects, industry visits or field study
3. Seminer presentations.
4. In semester/sessional examinations (both theoritical and practical)
5. End semester examinations (both theory and practical)

FYUGP STRUCTURE

SEMESTER	TYPE	COURSE	COURSE CODE	CREDIT
1	Major	Major-1 (Plant and Microbial	BOT-MJ-01014	4

		Diversity)		
	*Minor	Minor-1 (Plant and Microbial Diversity)	BOT-MN-01014	4
	SEC	SEC-1 (Mushroom cultivation technique)	BOT-SEC-01013	3
2	Major	Major-2 (Cell Biology and Biomolecules)	BOT-MJ-02014	4
	Minor	Minor-2 (Cell Biology and Biomolecules)	BOT-MN-02014	4
	SEC	SEC-2 Biofertilizer	BOT-SEC-02013	3
*Here, the minor paper indicates the minor paper offered by the Department of Botany for the students other than Botany Major.				
3	Major	Major-3 (Laboratory and Field Techniques in Plant Science)	BOT-MJ-03014	4
		Major-4 (Plant Physiology)	BOT-MJ-03024	4
	*Minor	Minor-3 (Laboratory and Field Techniques in Plant Science)	BOT-MN-03014	4
	SEC	SEC-3 (Environmental Ethics)	BOT-SEC-03013	3
*Here, the minor paper indicates the minor paper offered by the Department of Botany for the students other than Botany Major.				
4	Major	Major-5 (Morphology and Anatomy of Angiosperms)	BOT-MJ-04014	4
		Major-6 (Mycology and Phytopathology)	BOT-MJ-04024	4
		Major-7 (Microbiology)	BOT-MJ-04034	4
		Major-8 (Plant Resources and Economic Botany)	BOT-MJ-04044	4
	*Minor	Minor-4 (Plant Resources and Economic Botany)	BOT-MN-04014	4
*Here, the minor paper indicates the minor paper offered by the Department of Botany for the students other than Botany Major.				
5	Major	Major-9 (Genetics)	BOT-MJ-05014	4
		Major-10 (Plant Ecology, Phytogeography and Climate Change)	BOT-MJ-05024	4
		Major-11 (Plant Systematics)	BOT-MJ-05034	4
	*Minor	Minor-5 (Plant Systematics)	BOT-MN-05014	4
	Internship	Internship		4
*Here, the minor paper indicates the minor paper offered by the Department of Botany for the students other than Botany Major.				
6	Major	Major-12 (Reproductive Biology of Angiosperm)	BOT-MJ-06014	4
		Major-13 (Plant Metabolism and Biochemistry)	BOT-MJ-06024	4
		Major-14 (Molecular Biology)	BOT-MJ-06034	4
		Major-15 (Applied Plant Biology)	BOT-MJ-06044	4
	Minor	Minor-6 (Applied Plant Biology)	BOT-MN-06014	4
*Here, the minor paper indicates the minor paper offered by the Department of Botany for the students other than Botany Major.				
B.Sc. Botany with Honours				
7	Major	Major-16 (Plant Breeding,	BOT-MJ-07014	4

		Genomics and Bioinformatics)		
		Major-17 (Conservation Ecology and Biodiversity Assessment)	BOT-MJ-07024	4
		Major-18 (Plant diseases, diagnostic and management)	BOT-MJ-07034	4
		Major-19 (Environmental Microbiology)	BOT-MJ-07044	4
		Research Component (RC1) Research Methodology	BOT-RC-07014	4
8	Major	Major-20 (Molecular Genetics and Cell Signalling)	BOT-MJ-08014	4
		Major-21 (Fungal Diversity, Genetics, and Applications)	BOT-MJ-08024	4
		Major-22 (Exploring Cryptogams and Gymnosperms)	BOT-MJ-08034	4
		Major-23 (Plant Growth and Morphogenesis)	BOT-MJ-08044	4
		One Mocs course related to advance techniques		4
		Or		
		One Seminar/Project based course and presentation.		4
OR				
B.Sc. Botany Honors with Research				
7	Major	Major-16 (Plant Breeding, Genomics and Bioinformatics)	BOT-MJ-07014	4
		Major-17 (Conservation Ecology and Biodiversity Assessment)	BOT-MJ-07024	4
		Major-18 (Plant diseases, diagnostic and management)	BOT-MJ-07034	4
		Major-19 (Environmental Microbiology)	BOT-MJ-07044	4
		Research Component (RC1) Research Methodology	BOT-RC-07014	4
8	Major	Dissertation-8		16
		One Mocs course related to advance techniques		4
		Or		
		One Seminar/Project based course and presentation.		4
M.Sc. Botany				
Research with course works				
9	Major	Major-24 (Advance Genetics)	BOT-MJ-09014	4
		Major-25 (Ecological Restoration and Remediation)	BOT-MJ-09024	4
		Major-26 (Microbial Diversity)	BOT-MJ-09034	4
		Major-27 (Applied Microbiology)	BOT-MJ-09044	4
		Major-28 (Advanced Plant Physiology and Biochemistry)	BOT-MJ-09054	4
10	Major	Dissertation Phase – I		20

BOTANY

SYLLABUS FOR MAJOR COURSE

DETAIL SYLLABUS OF 1ST SEMESTER

Title of the course	**Major-1 (Plant and Microbial Diversity)**
Course code	**BOT-MJ/MR-01014**
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. This paper will explain the origin of life, the diversity of Bacteria, Viruses, Algae, Fungi & Lichen, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms on the planet, and how they may be related to each other. The emphasis will also be on the hands- on approach and laboratory techniques for identification of the plant and microbial groups using various morphological features.

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Origin of Life: Theories of Origin of Life, Concept of Kingdom**	2	4	1		3
Unit-2	**Bacteria & Viruses:** **Bacteria:** General Features, Bacterial Cell Structure , Types of Bacteria, Reproduction (Conjugation, Transformation & Transduction). Introduction to Archaebacteria; Economic Importance of Bacteria **Virus:** General features, Reproduction, Life Cycle (Lytic & Lysogenic); RNA Viruses (TMV), DNA Virus (CMV)	8	10	4		12
Unit-3	**Algae:** General Features, Cell Structure, Range of Thallus Structure and Photosynthetic Pigmentation in Algae. Reproduction, Classification (F.E. Fritch, 1945). A brief account of : *Nostoc, Chlamydomonas, Volvox, Spirogyra, Chara.* Economic importance of Algae	6	10	3		9
Unit-4	**Fungi**: General Features (Distribution, Morphology, Nutrition) Reproduction & Classification (Einsworth, 1973). A brief account of: *Mucor, Penicillium, Agaricus.* *A* brief idea of Fungi *imperfecti.* Economic importance of Fungi **Lichen:** General account of Lichen (Distribution, Morphology & Types) Reproduction & Economic Importance	7	12	3		11
Unit-5	**Bryophytes:**	10	12	5		15

	General features (Distribution & Morphology, Alternation of Generation) Adaptation to land habit, Classification and Evolutionary Trends. A Brief Account of : *Marchantia & Funaria* **Pteridophytes*:*** General features (Distribution & Morphology, Alternation of Generation)*; Reproduction, Classification, Stellar Diversity & Evolution, Heterospory & Seed habit. A brief account of :* *Lycopodium, Selaginella & Peteris*					
Unit-6	**Biostatistics, computing and field skills:**Data types- primary and secondary, methods of data collection,sample and sampling methods - merits and demerits; technical and biological replicates; Tabulation and presentation of data, Descriptive statistics - Mean,Median, Mode, Variance, Standard Deviation, Standard error, Coefficient of Variation, MS-Word, PowerPoint, Excel, concept on biological databases, Basics at SPSS Collection, Identification, Preparation and Preservation of Herbarium and Museum specimens.	12	12	6		16
PRACTICAL [Credit : 01]						
1. Study of structure of TMV and Bacteriophage (electron micrographs/ models). 2. Study of morphology of *Nostoc, Chalydomonas, Volvox, Spirogyra, Chara* (Temporary preparation of slides). 3. Study of Mucor, Penicillium, Agaricus. 4. Study of vegetative and reproductive parts of *Marchantia* and *Funaria* (preparation of slides). 5. Study of *Lycopodium*/ *Selaginella* (morphology, strobilus, and spores), *Adiantum*/ *Pteris* (morphology). 6. Study of *Cycas*/ *Pinus* and *Gnetum* (morphology, leaf/ needle, megasporophyll and microsporophyll) 7. Study of leaf venations in dicots and monocots (at least two specimens each)		30	40			

8. Study of different types of inflorescences and fruits.					

DETAIL SYLLABUS OF 2ND SEMESTER

Title of the course	**Major-2 (Cell Biology & Biomolecules)**
Course code	**BOT-MJ/MR-02014**
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. The core aim of cell biology is to understand the structure, function and behaviour of cells, the fundamental units of life. Simultaneously, the study of biomolecules explores the molecules that make up cells and carry out essential biological processes. By understanding both, it is an aim to unravel the complexities of life, from individual cellular mechanisms to the overall workings of organisms.

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Introduction to cell:** Cell theory, Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory); Cytoskeleton, Cell division: Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle.	8	12	4		12
Unit-2	**Cell wall and plasma membrane:** Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of cell membranes; Membrane transport – Passive, active and facilitated transport.	6	12	3		9
Unit-3	**Cell organelles:** Nucleus: Structure-nuclear envelope, Organization of chromatin, Nucleolus, Ribosome, Chloroplast, Mitochondria, Peroxisomes, Endoplasmic Reticulum, Golgi Apparatus, and Lysosomes.	9	8	4		13
Unit-4	**Carbohydrates and Lipids:** Carbohydrates: Nomenclature and classification. Polymers of carbohydrate, Lipids: Definition and major classes of storage and structural lipids; Structure, properties and functions of Essential fatty acids.	9	8	4		13
Unit-5	**Aminoacids and Proteins:** Structure and classification of amino	8	10	4		12

	acids; Levels of protein structure (primary, secondary, tertiary, and quarternary); Protein denaturation and biological roles of proteins.					
Unit-6	**Nucleic acids:** Chemistry of Nucleic Acids; Structure and function of nucleotides & nucleosides; Types of nucleic acids; Structure of A, B, Z types of DNA	5	10	3		8
PRACTICAL [Credit : 01]						
1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins. 2. Study of plant cell structure with the help of epidermal peel mount of Onion/ Rhoeo/ Crinum. 3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* and *Vallisnaria* leaf. 4. Counting the cells per unit volume with the help of haemocytometer. (Yeast/ pollen grains). 5. Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique. 6. Study different stages of mitosis and meiosis.		30	40			

DETAIL SYLLABUS OF 3RD SEMESTER

Title of the course	**Major-3 (Laboratory and Field Techniques in Plant Science)**
Course code	**BOT-MJ-03014**
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	On successful completion of the course, students will : 1. Able to learn fundamental skills important for performing laboratory and fieldexperiments. 2. Able to prepare, analysis of data and interpretation of results.

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Laboratory safety and good practices:** General laboratory safety : dos and don'ts, lab safety measures, code of conduct in laboratory, safe handling of chemicals, glass apparatus, instruments, electrical appliances; First aid practices (acid spills, burns and other injuries), safety symbols, classes/ grades ofchemicals, Laboratory waste management: radioactive,hazardous chemicals and biological wastes, ecological aspects	7	8	1		8
Unit-2	**Handling and maintenance of instruments:** Weighing balance, pipettes and micropipettes, magnetic stirrer, autoclave, laminar airflow, pH and conductivity meter (calibration and use), Incubator(static and shaker), Lux meter, hemocytometer, micrometer, spectrophotometer, Agarose gelelectrophoresis unit, SDS PAGE unit, centrifuge, distillation unit, fractional distillation	7	12	1		8
Unit-3	**Measurements and calculations:** Units of measurements, conversion from one unit to another,Weighing, calculations: scientific notations, powers,logarithm and fractions; measurement of volumes of liquids, basics of titration	4	8			4

Unit-4	**Solutions and Buffers:** Preparation of solutions: stock solution, standard solution. Types of solutions: Normal, Molar, Molal, Percentage, ppm, ppb. Dilution and dilution factors, Acids, Bases, adjustment of pH,Buffers - phosphate, Tris- HCl and Citrate buffer. Standardization and Buffers.	5	8	1		6
Unit-5	**Microscopy and Culture Techniques:** Microscopes: working principles and types (Light and Electron microscopes), sample and slide preparation: fixation, staining, mounting, preservation (for light and electron microscopy), scanning stain Microscope Basic culture media (NA, NB, P D A , MS), selective and differential media, Microbial Culture techniques: plating (streak, spread & pour), serial dilution.	7	12	1		6
Unit-6	**Biostatistics, computing and field skills:**Data types- primary and secondary, methods of data collection,sample and sampling methods - merits and demerits; technical and biological replicates; Tabulation and presentation of data, Descriptive statistics - Mean,Median, Mode, Variance, Standard Deviation, Standard error, Coefficient of Variation, MS-Word, PowerPoint, Excel, concept on biological databases, Basics at SPSS Collection, Identification, Preparation and Preservation of Herbarium and Museum specimens.	10	12	2		11
PRACTICAL [Credit : 01]						
7. Preparation of solutions- molar, molal, normal,percentage, stock solution and dilution 8. Measurement of pH of solutions using pH meter/ pH stripand preparation of buffers (Phosphate /citrate buffer) 9. Working with instruments - Centrifuge, autoclave,laminar air flow, hot air oven, incubator, lightmicroscope, spectrophotometer/colorimeter, 10. Slide preparation and staining of plant materials. 11. Determination of cell/spore size using		30	40			

micrometer. 12. Preparation of PDA/NA medium for growth and maintenance of fungal/bacterial cultures. 13. Calculation of mean, mode, median, standard deviation using data set. (Primary data set) 14. Drawing of tables, graphs and to carry out statistical calculation using Microsoft Excel using primary data set. 15. Preparation of herbarium specimen: Collection, processing, mounting, and labelling of plant specimen. 16. Identification of plants in the field – family/ genus/ species					

Title of the course	**Major-4 (Plant Physiology)**
Course code	BOT-MJ-03024
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. Knowledge on mechanisms of water, minerals, and nutrient absorption of plants 2. Knowledge on roles of plant hormones and mechanism of flowering in plants 3. Practical knowledge on effects of growth regulators on plant parts 4. Practical knowledge on determination of osmotic and water potential

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Plant-water relations:** Water Potential and its components; Water absorption by roots: aquaporins; Pathway of water movement: symplast, apoplast, transmembrane pathways; Ascent of sap: Mechanisms, cohesion-tension theory, root pressure, guttation; Transpiration: Factors affecting transpiration, anti-transpirants, mechanism of stomatal movement.	5	8			5
Unit-2	**Mineral nutrition and nutrient uptake:** Criteria for essentiality of mineral elements, macro and micronutrients, nutrient solutions for plant growth experiments, roles of essential elements, mineral deficiency symptoms, chelating agents, Ion antagonism and toxicity. Soil as a nutrient reservoir; Transport of ions across cell membrane: Passive and active absorption, electrochemical gradient, facilitated diffusion, carrier systems, proton ATPase pump and ion flux, uniport, symport, antiport, co-transport. Na^t/K^t Pump, Metal porins	8	10	2		10
Unit-3	**Translocation of organic solutes:**Phloem as the path of organic solute translocation: Experimental evidences, Mechanism of solute transport, Pressure-Flow Model and Munch's hypothesis, Phloem loading and unloading, Source – sink relationship.	4	8			4
Unit-4	**Plant growth regulators (PGRs):** Discovery, chemical nature (basic	8	14	2		10

	structure), bioassay and physiological roles of Auxins, Gibberellins, Cytokinins, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid; Synthetic PGRs; Application of PGRs in agriculture and horticulture. Regulation Positioning and Auxin Transporters. Scencsenes, Aging.					
Unit-5	**Physiology of flowering and seed dormancy:** Photoperiodism: SDPs and LDPs, flowering stimulus, florigen concept; Vernalization; Photoreceptors: Phytochrome, crytochrome and phototropin; Discovery, chemical nature, mechanism of action, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR); Seed dormancy: Significances, causes of dormancy, mechanisms to break dormancy. Developmental timings	7	12	1		8
Unit-6	**Plant stress physiology:** Abiotic and biotic stress:Plants' responses to drought, water logging, salinity,heavy metals, freezing, heat stress and pathogen attack. Oxidative stress: Generation of reactiveoxygen species(ROS); Effect of ROS onmetabolism;ROS detoxification mechanisms inplants; Stress mitigation strategies(Enzymatic and non-enzymatic). Effects and Stress in crop plants	7	8	1		8
PRACTICAL [Credit : 01]						
1. Determination of osmotic potential of plant cell sap by the method of plasmolysis. 2. Determination of water potential of given tissue (e.g.,potato tuber) by weight method. 3. Study of the effect of sunlight on the rate of transpirationin excised twig/leaf. 4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of mesophyte/ xerophyte. 5. Effect of carbon dioxide concentration on the rate of photosynthesis. 6. To study the effect of different concentrations of IAA on Gram/Pea/Moong root (IAA Bioassay). 7. Determination of seed germination percentage in different physical conditions (Demonstration)		30	40			

8. To demonstrate water stress by application of PEG/ water withdrawal in germinating seeds /growing plants(Demonstration) 9. Fruit ripening/Rooting from cuttings (Demonstration).					

DETAILS SYLLABUS OF 4TH SEMESTER

Title of the course	Major-5 (**Morphology and Anatomy of Angiosperms)**
Course code	BOT-MJ-04014
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. Knowledge on morphology of angiosperms and developmental biology of plant. 2. Knowledge on structural and anatomical organization of tissue system in plants. 3. Practical knowledge on inflorescences stamens, carpels and fruits of angiosperms.

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Introduction to Plant Morphology and Anatomy:** Morphology of inflorescence, stamens and carpel, fruit; Telome theory, phyllode theory; Role of morphology in plant classification. Application of anatomy in systematics, forensics and pharmacognosy.	6	10			6
Unit-2	**Tissue and Tissue Systems:** Classification of tissues; Simple and complex tissue, Tissue systems, Pits and plasmodesmata; types of vascular bundles; Endodermis, exodermis and origin of lateral root. Hydathodes, cavities, lithocysts and laticifers; Protective tissue system	6	8	1		7
Unit-3	**Structure and Development of Plant Body:** Internal organization of plant body: Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic development. Origin and development of leaves; Structure of dicot and monocot stem, root and leaf; Kranz anatomy.	5	8			5
Unit-4	**Apical meristems:** Concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica-Corpus theory); Organization of root apex (Apicalcell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap.	10	14	1		11
Unit-5	**Vascular Cambium and Wood:** Structure, function and seasonal activity of cambium; Secondary growth in stem	10	12	1		11

	and root. Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.					
Unit-6	**Adaptive and Protective Systems:** Epidermis, cuticle, epicuticular waxes, trichomes (uni- and multicellular, glandular and non-glandular, two examples of each), stomata (classification); Anatomical adaptations of xerophytes and hydrophytes	5	8			5
PRACTICAL [Credit : 01]						
1. Study of special types of inflorescences – Cyathium, Hypanthodium, Verticillaster. 2. Study of special types of fruits- Spurious fruits (Halies Apple); Aggregate fruits (Custard apple, Michelia, Periwinkles, Halies); Multiple fruits (Pineapple, Jack fruits). 3. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples. 4. Apical meristem of root, shoot and vascular cambium (permanent slides/ photographs) 5. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular. 6. Root anatomy : monocot, dicot – primary and secondary growth; periderm; lenticels. 7. Stem : monocot, dicot – primary and secondary growth; periderm; lenticels. 8. Leaf : isobilateral, dorsiventral, C4 leaves (Kranz anatomy). 9. Adaptive Anatomy : xerophytes, hydrophytes 10. Secretory tissues : cavities, lithocysts and laticifers.		30	40			30

Title of the course	**Major-6 (Mycology and Phytopathology)**
Course code	BOT-MJ-04024
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	On successful completion of the course, students will have: 1. Knowledge on general features of fungi and their classification 2. Knowledge on different classes of fungi, symbiotic fungi, and their characteristics 3. Knowledge on the application of fungi in different fields 4. Knowledge of plant pathogens and some important plant diseases 5. Practical knowledge on different classes of fungi based on their morphological and reproductive features 6. Practical knowledge on morphology, anatomical features of symbiotic fungi and locally available important plant pathogens. 7. Understanding biotechnological applications of fungi in industry, agriculture, and medicine.

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Introduction to Fungi :** General characteristics of fungi: Cell and Cell wall composition; Nutrition; Classification of Fungi (Ainsworth, 1973); General characteristics of Myxomycota and Eumycota; Symbiotic fungi (Lichen & Mycorrhiza): Structural organization and types.	9	10	1		10
Unit-2	**Lower Fungi :Mastigomycotina& Zygomycotina:** Characteristics features; Reproduction, Heterothallism; Life cycle with reference to Phytophthora and Mucor	6	8			6
Unit-3	**Higher fungi: Ascomycotina & Basidiomycotina:** Characteristic features; Reproduction; Different fruiting bodies; Life cycle with reference to Puccinia and Agaricus	6	12			6
Unit-4	**Fungi Imperfecti : Deuteromycotina:** General characteristics; Thallus organization; Reproduction; Heterokaryosis & Parasexuality; Classification with special reference to Alternaria and Colletotrichum	5	8			5

Unit-5	**Phytopathology:** Concept of plant disease; Symptoms of plant diseases; Etiology and disease cycle; disease resitency; Control of plant diseases and quarantine; Bacterial diseases – Citrus canker. Viral diseases - Tobacco Mosaic viruses, vein clearing. Fungal diseases - Early blight of potato, Black stem rust of wheat, White rust of crucifers	9	12	1		10
Unit-6	**Applied Mycology:** Role of fungi in biotechnology; food industry (Flavour& texture, Fermentation, Organic acids & Enzymes); Pharmaceutical (Secondary metabolites); Agriculture (Biofertilizers & Biological control); Mushroom cultivation; Medical mycology.	7	10	1		8
PRACTICAL [Credit : 01]						
1. Study of vegetative and reproductive structures of Mastigomycotina (*Phytophthora*) and Zygomycotina (*Mucor/ Rhizopus*) by temporary mounts and through permanent slides. 2. Study of vegetative and reproductive structures of Ascomycotina (*Aspergillus and Penicillium/Peziza*) and Basidiomyctina (Agaricus and Puccinia) by temporary mounts and through permanent slides. 3. Study of vegetative and reproductive structures of Deuteromycotina (Alternaria and Colletotrichum/ Fusarium) by temporary mounts and through permanent slides; Study of thallus and reproductive structures of lichen and mycorrhiza through permanent slides/photographs. 4. Study of symptoms of locally available plant diseases caused by fungi, bacteria, and virus by preparation of disease album and bottle specimens. 5. Applied mycology: Photographs/report on fungi used in medicine, fungi used as biological control agents, fungi used in industry, fungi causing human infections.		30	40			30

Title of the course	**Major-7 (Microbiology)**
Course code	BOT-MJ-04034
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. Knowledge on microbial diversity and distribution in different habitats 2. Knowledge on ecological and economic importance of microorganisms in our day-to-day life 3. Knowledge on growth, reproduction and life cycles of viruses and microorganisms 4. Knowledge on genetic recombination of bacteria 5. Practical knowledge on microscopy, slide preparation, staining and morphological study of microorganisms 6. Knowledge on pathogenic microorganisms, host-pathogen interaction, and immunity 7. Practical knowledge on isolation and pure culture of bacteria/fungi from soil samples

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Introduction to microbial world :**History of development of Microbiology as a subject, Germ theory of diseases, Koch postulates. Mode of nutrition, Microbial Metabolism, Growth and growth curves, Ecological importance of microorganisms.	6	6			6
Unit-2	**Viruses:**Characteristics of viruses, viroids and prions; Biomolecules and genetic materials of viruses; Morphological structure of TMV. Life cycle and reproduction of bacteriophage; Viral diseases of common plants and animals	7	10	1		8
Unit-3	**Bacteria:**General characteristics of bacteria,ultra-cellular structure, Actinomycetes, Mycoplasma and growth and nutrition, reproduction – binary fission and endospore formation, horizontal gene transfer and genetic recombination in bacteria (conjugation, transformation and transduction). Examples of agriculturally and industrially important bacteria.	7	12	1		8
Unit-4	**Environmental Microbiology:** Role of microorganisms in biogeochemical cycles (C, N, Pand S); Microorganisms	7	8	1		8

	in extreme environments (cold desert, hot water spring, marine water, hydrothermal vent, aquifers)					
Unit-5	**Pathogenic microorganisms and Host Immunity:** Bacterial pathogens causing diseases in plants, animals and humans; transmission of zoonotic disease (viral disease); fungal pathogens causing diseases in agriculturally important crops; host-pathogen interactions; pathogenesis; disease symptoms; host defense mechanisms; Host immunity - immune responses against pathogens; types of immunity; humoral and cell mediated immunity; hypersensitivity and autoimmunity; concept of Rh antigens.	7	12	1		8
Unit-6	**Applied Microbiology:** Application of microorganisms in food industries for food fermentation and SCP production; in agriculture for biofertilizer, biopesticides in industries for alcohol and organic acid productions; citric acid and acetic acid; in genetic engineering for GMO development and other research purposes; in space and oil exploration andin pollution and waste management.	7	12			7
PRACTICAL [Credit : 01]						
1. Slide preparation and Gram staining of bacteria (Curd bacteria) 2. Slide preparation and study of Nostoc, Anabaena, Mucor,Rhizopus, Aspergillus, Penicillium, Colletotrichum,Cladosporium 3. Pure culture isolation of soil bacteria/fungi through serial dilution plating and subsequent sub-culturing methods, 4. Measurement of microbial cells/spores with the help of micrometers. 5. Study on symptoms of plant viral diseases 6. Collection and study of diseases caused by virus, bacteria and fungi in crop plants		30	40			30

Title of the course	**Major-8 (Plant Resources and Economic Botany)**
Course code	BOT-MJ-04044
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	On successful completion of the course, students will : 1. Know the centre of origin, domestication, and loss of genetic diversity 2. Understand the evolution of new crops /varieties 3. Know about the germplasm diversity 4. Understand the economic values of various plant species. 5. Understand the importance of ethnobotany in the present context.

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Origin of Cultivated Plants**: Centres of Origin, their importance with reference to Vavilov's work. Introductions, domestication, and loss of crop genetic diversity; evolution of new crops/varieties, importance of germplasm diversity and conservation. Classification of plant resources on the basis of their uses.	6	8			6
Unit-2	**Food and Food Adjuncts:** Cereals and millets: Rice and wheat (origin, morphology, processing, post-harvest management & uses); Brief account of millets and their climatic and nutritional importance. (Food adulteration) Legumes: Origin, morphology, cultivation, uses and commercial importance of Chick pea, Pigeon pea, Soybean and Lentil. Importance of legumes to man and ecosystem. Spices: Listing of important spices, their family and part used. Economic importance with special reference to Assam. Study of fennel, saffron, clove, black pepper and bhut chilly Beverages: Tea, Coffee (morphology, processing, cultivation, Types & uses).	11	14	1		12
Unit-3	**Plants and Plant Products of Industrial Value:** Oils and Fats: General description, classification, extraction, their uses and health	11	14	1		12

	implications groundnut, coconut, soybean, and mustard. Essential Oils: General account, extraction methods, comparison with fatty oils. Essential oil yielding plants of NE India, their botanical identity and uses. (Gonchana kosu). Sugar and starches: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Potato: morphology, propagation, post-harvest management, uses of potato and starches. Natural Rubber: Para-rubber: tapping, processing and uses. Fibres: Classification based on the origin of fibres; Cotton, Coir and Jute (morphology, extraction anduses).					
Unit-4	**Drug-yielding plants:** Therapeutic and habit-forming drugs with special reference to Rauwolfia, Digitalis, Aloe vera and Cannabis; Tobacco (Morphology, processing, uses and health hazards).	5	8			5
Unit-5	**Forest Products:** Timber and Non-Timber Forest Products (NTFP) and their importance. Biodiversity Act (Bamboo, cane species and medicinal plants.)	5	8			5
Unit-6	**Ethnobotany Hours:** Definition, concept and scope; relevance of ethnobotany in present context; IPR Traditional knowledge with reference to NE India.	5	8			5
PRACTICAL [Credit : 01]						
1. Cereals: Study of useful parts: Rice/Bean (habit sketch,study of paddy and grain, starch grain, micro-chemical test). 2. Legumes: Bean, (habit, fruit, seed structure, micro-chemical tests). 3. Beverages: Tea (plant specimen, tea leaves). 4. Oils and fats: Coconut and Mustard, Groundnut, 5. Rubber: Specimen, photograph/model of tapping,samples of rubber products. 6. Test for alkaloids: Neem, Vinca rosea. 7. Fibre-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibre and test for cellulose), Jute (specimen, transverse section of stem, test for lignin).		30	40			30

DETAIL SYLLABUS OF 5TH SEMESTER

Title of the course	**Major-9 (Genetics)**
Course code	BOT-MJ-05014
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. Knowledge of Mendelian and non- Mendelian inheritance in organisms. 2. Knowledge of Chromosomes and their role of inheritance. 3. Knowledge of gene and chromosomal mutations 4. Knowledge of basic concepts of population and evolutionary genetics 5. Ability to work out problems related to Mendel's experiments, Chromosome mapping and gene interaction

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Mendelian genetics and its extension:** Mendelism: History; Principles of inheritance; Incomplete dominance and codominance; Chromosome theory of inheritance; Chromosome: Autosomes and sex chromosomes; Allel, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance andExpressivity, oligogenic and Polygenic inheritance.	11	14	2		13
Unit-2	**Extrachromosomal Inheritance:** Chloroplast mutation: Variegation in Four o'clock plant;Mitochondrial inheritance in yeast; Maternal effects- shell coiling in snail; Infective heredity- Kappa particles in Paramaecium	4	6			4
Unit-3	**Linkage, crossing over and chromosome mapping:** Linkage and crossing over – Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numerical based on gene mapping; Sex Linkage.	7	10	1		8
Unit-4	**Variation in chromosome number and structure:**Deletion, Duplication,	6	8			6

	Inversion, Translocation,Position effect, Euploidy and Aneuploidy.					
Unit-5	**Fine structure of gene and Gene mutations:**Classical vs molecular concepts of gene; Ciston, Racon, Muton, Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method. Role of Transposons in mutation. DNArepair mechanisms	9	12	1		10
Unit-6	**Population and Evolutionary Genetics:** Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.	4	10			4
PRACTICAL [Credit : 01]						
1. Mendel's laws through seed ratios. 2. Chromosome mapping using point test cross data. 3. Incomplete dominance and gene interaction through seedratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4). 4. Permanent Slides showing Translocation Ring,Photograph showing Laggards and Inversion Bridge.		30	40			30

Title of the course	**Major-10 (Plant Ecology, Phytogeography and Climate Change)**
Course code	BOT-MJ-05024
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	On successful completion of the course, students will : 1. Understand the concept of ecology, ecosystems, and importance of factors. 2. Understand the population, community, biodiversity, and conservation strategies. 3. Understand the concept of phytogeography, endemism, and floristic distributions. 4. Understand the science of climate change and sustainable development strategies 5. Know the adaptation and mitigation against climate change-induced phenomena.

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Ecology and Ecosystem:** Ecology: Basic concepts, Levels of organization, Inter-relationships between the living world and the environment. Ecosystem: Structure, functions, and types, trophic organisation, food chains and food webs, ecological pyramids, homeostasis. Laws of limiting factors	7	8	1		8
Unit-2	**Ecological Factors:** Climatic, Edaphic and BioticFactors, Factorial interactions, Plant adaptation to environmental factors (light, temperature, wind, and fire); autotrophy, heterotrophy; symbiosis, commensalism, ammensalism, parasitism, parasitoidism. Aquatic ecology- concept.	7	8	1		8
Unit-3	**Population ecology:** Population characteristics, Growth curve, LotkaVolterra model, population regulation, rand k-selection. Types of ecological speciation, Ecological equivalents.	7	12			7
Unit-4	**Plant communities:** Plant Community: Basic concept, types, characters (analytical and synthetic), Dynamics: succession – processes, types, models; climax concepts, Habitat and Niche: concept &types.	7	12			7
Unit-5	**Functional Ecology:** Principles and	7	10			7

	models of energy flow; Production and productivity; Ecological efficiencies; Ecological energetics; Biogeochemical cycles (C, N and P) and water cycle.					
Unit-6	**Phytogeography and Climate Change:** Principles; Continental drift; Theory of tolerance; Endemism;Brief description of major terrestrial biomes (oneeach from tropical, temperate & tundra); Phytogeographical division of India; Vegetation types of NE India with special reference to Assam. Climate change: Basic concepts; global warming, causes and consequences (Rise in Sea levels, Glaciermelting, Biodiversity Loss), Adaptation, Mitigation,Global and National Efforts, Concept on Sustainable Development, Sustainable Development Goals(SDGs). Environmental impact assessment, Environmental laws, Climate Resilient Crops.	7	10	1		7
PRACTICAL [Credit : 01]						
1. Determination of minimal quadrat size and number for the study of herbaceous vegetation in the college campus by species area curve method (species to be listed). 2. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus. 3. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law. 4. Study of instruments used to measure micro climatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer,rain gauge and lux meter. 5. Analysis for carbonates, chlorides, nitrates, sulphates,organic matter and base deficiency from two soil samplesby rapid field tests. 6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. a) Study of morphological adaptations of hydrophytes and xerophytes (four each). b) Study of biotic interactions of the following: Stem parasite, Root parasite, Epiphytes, Predation (Insectivorous plants). 7. Local field visit to nearby areas to familiarise	30	40			30

students with various plant communities. 8. Soil respiration study in two agricultural systems to determine the CO2 evolution.					

Title of the course	**Major-11 (Plant Systematics)**
Course code	BOT-MJ-05034
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	On successful completion of the course, students will : 1. Able to obtain knowledge on plant identification and classification systems, plantnomenclature. 2. Detailed knowledge of the phylogenetic and evolutionary relationships of angiosperms. 3. Able to obtain knowledge on various herbaria and botanical gardens in India andabroad, their role in plant systematics. 4. Acquainted with practical knowledge on vegetative and reproductive structures ofangiosperms. 5. Acquainted students with practical knowledge on vegetation of an area

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Significance of Plant systematics:** Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Functions and importance of Herbarium and botanical garden; Important herbaria and botanical gardens of the world and India; Taxonomic literatures; Categories and taxonomic hierarchy; Concept of taxa (family, genus, species).	7	8	1		8
Unit-2	**Botanical nomenclature:** History, Principles andRules (ICN); Ranks and names; Typification, Author citation, Effective and Valid publication, Rejection of names, Principle of priority and its limitations.	5	8			5
Unit-3	**Systems of classification:** Major contributions of Theophrastus, Bauhin, Linnaeus, Adanson, de Candolle, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker, Engler and Prantl, Takhtajan; Brief account of Angiosperm Phylogeny Group(APG) classification.	8	12	1		9
Unit-4	**Numerical taxonomy and cladistics:** OTUs, characters, character weighting	6	8			6

	and coding; Cluster analysis; Phenograms & Cladograms (definitions and differences).					
Unit-5	**Phylogeny of Angiosperms:** Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).	6	10			
Unit-6	**Angiospermic Families:** Detail study of the following families: Magnoliaceae, Fabaceae, Asteraceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Musaceae, Zingiberaceae, Poaceae	9	14	2		11
PRACTICAL [Credit : 01]						
1. Study of vegetative and floral characters of locally available angiospermic plants belonging to the followingfamilies (Description, V.S. flower, section of ovary,floral diagram/s, floral formula/e and systematic positionaccording to Bentham & Hooker's system of classification): Fabaceae, Solanaceae, Asteraceae, Lamiaceae, Euphorbiaceae, Musaceae, Orchidaceae. 2. Field visits to familiarise students with vegetation of anarea and identification of plant species / Visit toAcademic or Research Institutions. 3. Mounting of properly dried and pressed specimens of atleast 10 (ten) wild plant species with herbarium labels (tobe submitted with the record book).		30	40			30

DETAILS SYLLABUS OF 6TH SEMESTER

Title of the course	**Major-12 (Reproductive Biology of Angiosperm)**
Course code	BOT-MJ-06014
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. Knowledge on detailed morphological and reproductive structures of angiosperm. 2. Knowledge on embryology and embryological abnormalities in angiosperms. 3. Practical knowledge on developmental biology of embryo and endosperms.

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Introduction to reproductive biology of Angiosperms:** History (contributions of G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, and scope.	3	4	1		4
Unit-2	**Reproductive development:** Induction of flowering; flower as a modified shoot. Flower development: process (transition).	3	6	1		4
Unit-3	**Anther and pollen biology:** Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Micro-gametogenesis; Pollen wall structure, MGU (male germ unit) structure; Palynology and scope (a brief account); NPC system; Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.	8	14	2		10
Unit-4	**Ovule:** Structure; Types; Special structures endothelium, obturator, aril, caruncle and hypostase; Female gametophyte- megasporogenesis and Megagametogenesis; Types of embryo-sacs. Organization and ultrastructure of mature embryo sac.	5	10	1		6
Unit-5	**Pollination and fertilization:** Pollination types and significance;	10	12	2		12

	adaptations; structure of stigma and style; path of pollen tube into the ovule; double fertilization. Basic concept of Self incompatibility (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self-incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and *in vitro* pollination; Modification of stigma surface, parasexual hybridization; Cybrids, *in vitro* fertilization.					
Unit-6	**Embryo, Endosperm and Seed:** Structure and types; General pattern of 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 apomixes: their; Classification; Cause and applications.	8	14	1		9
PRACTICAL [Credit : 01]						
1. **Anther:** Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bi-celled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation. 2. **Pollen grains:** Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs, fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test for germination: Calculation of percentage germination in different media using hanging drop method. 3. **Ovule:** Types-anatropous, orthotropous, amphitropous/ campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs). 4. **Female gametophyte through permanent**		30	40			30

slides/ photographs: Types, ultrastructure of mature egg apparatus. 5. Intra-ovarian pollination; Test tube pollination through photographs. 6. **Endosperm:** Dissections of developing seeds for endosperm with free-nuclear haustoria. 7. **Embryogenesis:** Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages.					

Title of the course	**Major-13 (Plant Metabolism and Biochemistry)**
Course code	BOT-MJ-06024
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. Knowledge in basic understanding of plant metabolism and their regulation 2. Knowledge in concepts of carbon assimilation, oxidation, ATP synthesis 3. Knowledge in basic concepts of carbohydrate, Lipid and Nitrogen metabolism 4. Knowledge in basic concepts of signal transduction 5. Practical knowledge in separation of pigments, estimation of sugars, rate of respiration. 6. Ability to perform experiments on chromatographic techniques, spectrophotometric analysis.

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Concepts of metabolism:** Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes; classification, nomenclature, Concept of coenzyme, apoenzyme and prosthetic group; Enzyme inhibition (allosteric, covalent modulation); Isozymes, Enzymes Kinetics	5	8	1		6
Unit-2	**Carbon assimilation:** Role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centers, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q-cycle, CO2 reduction: C3, C4-pathways, Crassulacean acid metabolism; Photorespiration, organisational framework of organelles for photorespiration and it's significant in evaluation.	7	12	1		8
Unit-3	**Carbon oxidation and ATP Synthesis:** Glycolysis and its regulation, oxidative decarboxylation of pyruvate, TCA cycle and regulation, amphibolic role, anaplerotic reactions, mitochondrial electron transport,	8	12	2		10

	oxidative phosphorylation, cyanide-resistant respiration, pentose phosphate pathway; Factors affecting respiration; ATP synthesis: substrate level phosphorylation, chemiosmotic mechanism, ATP synthase, Boyer's conformational model, Racker's experiment, Jagendorf's experiment, role of uncouplers. Significance and biological polymers given by ATP Hyrdrolysis					
Unit-4	**Carbohydrate, Lipid:** Synthesis and catabolism of sucrose, starch and cellulose, Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α-oxidation.	7	8	1		8
Unit-5	**Nitrogen assimilation:** Biological nitrogen fixation (legumes and non-legumes), biochemistry of nitrogen fixation, ammonia assimilation and transamination. Amino Acid & Nucleotides as part of Nitrogen metabolism.	3	6	1		4
Unit-6	**Mechanisms of Signal Transduction:** Receptor- ligand interactions, Second messenger concept, Calcium-calmodulin, MAP kinase cascade, two-component system. Intra cellular membrane traffic.	4	8	1		5
Unit-7	**Secondary Metabolites:** Shikimate Pathway: Role in biosynthesis of secondary metabolites; Biosynthesis and physiological roles of terpenes, phenols and nitrogenous compounds.	3	6	1		4
PRACTICAL [Credit : 01]						
1. Chemical separation of photosynthetic pigments by solvent method/paper chromatography 2. Estimation of sugar content by DNSA method 3. Determination of titratable acid number (TAN) in plant materials\ 4. Quantification of chlorophyll a, b and total chlorophyll and determination of chlorophyll a/b ratio 5. Estimation of phenol/tannin/flavonoid by colorimetric method 6. Estimation of protein in plant sample by Lowry's method/Biuret method 7. Separation of amino acids by paper		30	40			30

chromatography 8. Demonstration of Thin layer chromatography (TLC)/Column chromatography 9. To compare the rate of respiration by Ganong's respirometer in different parts of plant (Demonstration)						

Title of the course	**Major-14 (Molecular Biology)**
Course code	BOT-MJ-06034
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. Knowledge of structure, organization, and replication mechanism of DNA 2. Detailed knowledge of central dogma, mechanism of transcription and processing of different types of RNA 3. Knowledge of genetic code, molecular mechanisms associated with various steps in protein synthesis and post translational modifications 4. Ability to isolate genomic DNA from plant samples

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Nucleic acids:** Carriers of genetic information: Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment.	3	4			3
Unit-2	**The Structures Genetic Material:** DNA Structure: Miescher to Watson and Crick- historic perspective, Organization of DNA-Prokaryotes, Salient features of double helix, denaturation and renaturation, cot curves; valueparadey, Viruses, Eukaryotes. Organelle DNA - mitochondria and chloroplast DNA. The Nucleosome Chromatin structure-Euchromatin, Heterochromatin-Constitutive and Facultative Heterochromatin. Mutations : Natural and artificial.	7	12	1		8
Unit-3	**The replication of DNA**: Chemistry of DNA synthesis (Kornberg's discovery); General principles –	8	12	2		10

	bidirectional, semi- conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA; Enzymes involved in DNA replication. **Central dogma and genetic code:** Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)					
Unit-4	**Transcription:** Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E. coli. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing.	8	12	2		10
Unit-5	**Processing and modification of RNA:** Split genes- concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' poly A tail); Ribozymes; RNA editing and mRNA transport.	6	10	1		7
Unit-6	**Translation:** Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.	6	10	1		7
PRACTICAL [Credit : 01]						
1. DNA isolation from any plant material. 2. DNA estimation by diphenylamine reagent/UV Spectrophotometry (Demonstration). 3. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication). 4. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs. 5. Study of the following through photographs:		30	40			30

Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.					

Title of the course	**Major-15 (Applied Plant Biology)**
Course code	BOT-MJ-06044
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	1. Knowledge of various methods of Plant tissue culture and their application 2. Knowledge of gene cloning, recombinant DNA technology and various methods of gene transfer in plants 3. Knowledge of the application of genetic engineering techniques for agriculture. 4. Ability to demonstrate tissue culture technique; isolate plasmid DNA and to carry out DNA manipulation using restriction enzymes

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	**Plant Tissue Culture:** Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion.	7	10	1		8
Unit-2	**Application of tissue culture:** Micropropagation, androgenesis, secondary metabolite production, Culture of haploids, triploids and hybrids plants; Cryopreservation; Germplasm conservation.	4	6			
Unit-3	**Recombinant DNA technology:** Definitions and history of recombinant DNA technology, Restriction Endonucleases (History, Types I-IV, biological role and application); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).	7	10	1		8
Unit-4	**Gene Cloning:** Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR- mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; PCR	8	12	1		9

Unit-5	**Methods of gene transfer:** Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment;	6	10			6
Unit-6	**Applications of genetic engineering:** Pest resistant (Bt-cotton); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug).	9	12	1		10
PRACTICAL [Credit : 01]						
1. (a) Preparation of MS medium. (b) Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of any plant species. 2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs. 3. Isolation of protoplasts. 4. Construction of restriction map of circular and linear DNA from the data provided. 5. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 6. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs. 7. Isolation of plasmid DNA. 8. Restriction digestion and gel electrophoresis of plasmid DNA.		30	40			30

Title of the course	**Major-15 (Applied Plant Biology)**
Course code	BOT-MN-06014
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	5. Knowledge of various methods of Plant tissue culture and their application 6. Knowledge of gene cloning, recombinant DNA technology and various methods of gene transfer in plants 7. Knowledge of the application of genetic engineering techniques for agriculture. 8. Ability to demonstrate tissue culture technique; isolate plasmid DNA and to carry out DNA manipulation using restriction enzymes

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)
Unit-1	**Plant Tissue Culture:** Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion.	7	10	1	
Unit-2	**Application of tissue culture:** Micropropagation, androgenesis, secondary metabolite production, Culture of haploids, triploids and hybrids plants; Cryopreservation; Germplasm conservation.	4	6		
Unit-3	**Recombinant DNA technology:** Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).	7	10	1	
Unit-4	**Gene Cloning:** Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR- mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; PCR	8	12	1	

Unit-5	**Methods of gene transfer:** Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics - selectable marker and reporter genes (Luciferase, GUS, GFP).	6	10		
Unit-6	**Applications of genetic engineering:** Pest resistant (Bt-cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug).	9	12	1	
PRACTICAL [Credit : 01]					
9. (a) Preparation of MS medium. (b) Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of any plant species. 10. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs. 11. Isolation of protoplasts. 12. Construction of restriction map of circular and linear DNA from the data provided. 13. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 14. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs. 15. Isolation of plasmid DNA. 16. Restriction digestion and gel electrophoresis of plasmid DNA.		30	40		

DETAIL SYLLABUS OF 7TH SEMESTER

B.Sc. Botany with Honours

Title of the course	**Major 16- Plant Breeding, Genomics and Bioinformatics**
Course code	BOT-MJ-07014
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	On successful completion of the course, students will be able to: 1. Explain the principles of plant breeding, hybridization, and selection, as well as the concepts in the improvement of major crop species, polyploidy inheritance, self-incompatibility, and the Hardy-Weinberg law of equilibrium. 2. Apply novel plant breeding tools such as TALEN's, CRISPR-Cas9, and base editing in practical scenarios to improve crop species. 3. Analyze chromosome variations in higher plants, including haploid production systems and the breeding application of haploids, as well as the significance of aneuploidy, trisomic, tetrasomic, and nullisomic conditions in genetic studies. 4. Evaluate the significance of intellectual property rights in plant breeding and assess the use of bioinformatics tools in genomics and functional genomics. 5. Design and conduct practical experiments in plant breeding and bioinformatics, including emasculation techniques, sequence analysis, gene prediction, protein modeling, chromosome analysis, and comparative genomics of bacteria.

Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	Total Hours
Unit-1	Principles of plant breeding, hybridization and selection; concepts in improvement of major crop species; polyploidy inheritance, self-incompatibility.	6	8	-	-	6
Unit-2	QTL mapping using molecular marker, population statistics; heritability, Hardy-Weinberg law of equilibrium, Novel plant breeding tools (TALEN's, CRISPR-Cas9, Base editing).	6	10	1	-	7
Unit-3	Chromosome variation in higher plants; haploid production system, breeding	7	10	1	-	8

Four-year Undergraduate Programme (FYUGP) 4TH Year
Subject: Botany
Semester: 7th Sem
Major 16
BOTMJ07014

Course Name: ***Plant Breeding, Genomics and Bioinformatics***

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no	**Unit content**	**Lecture**	**Tutorial**	**Marks**	**Total hours**
Unit 1	Principles of plant breeding, hybridization and selection; concepts in improvement of major crop species; polyploidy inheritance, self-incompatibility.	6	-	8	6
Unit 2	QTL mapping using molecular marker, population statistics; heritability, Hardy-Weinberg law of equilibrium, Novel plant breeding tools (TALEN's, CRISPR-Cas9, Base editing).	6	1	10	7
Unit 3	Chromosome variation in higher plants; haploid production system, breeding application of haploids; aneuploidy, trisomic, tetrasomic, nullisomic and their significance in genetic studies; parthenogenesis and apogamy, action of physical and chemical mutagens; mutation in crop improvement.	7	1	10	8
Unit 4	Intellectual Property Rights -- Intellectual property rights (IPR); Patents, trade secrets, copyright, trademarks; Geographical Indicators (GI); Registration, subject matter and ownership of IPRs. Plant genetic resources; GATT & TRIPPS; Patenting of biological material; Plant breeders rights (PBRs) and farmers rights.	7	1	10	8
Unit 5	Genomics: Organization of nuclear and organellar genomes, Sequencing Genomes, Comparative genomics, Functional genomics	6		10	6
Unit 6	Bioinformatics: Introduction to bioinformatics, biological databases, data mining and retrieval, scope and application of bioinformatics, nucleic acid and protein sequence analysis, sequence alignment, local and global alignment, database search for homologous sequences- BLAST and FASTA, protein structure analysis,	8	2	12	10

	Ramachandran plot, computer-aided drug discovery.		
PRACTICAL [Credit: 01]			
	1. Principle, techniques and procedure of emasculation. 2. Sequence (protein/DNA) downloading from databases, alignment and homologous sequence search 3. Sequence BLAST, annotation and gene prediction with the help of bioinformatical tools. 4. Protein modelling, structure prediction and Ramachandran plot analysis 5. Chromosome analysis, study of chromosome behaviour in mitosis and meiosis, chromosome anomalies in plant cells. 6. Comparative genomics of bacteria	30	40

Reading list:

1. Acquaah, G. (2012). Principles of Plant Genetics & Breeding. 2nd edition. Hoboken, NJ, Wiley.
2. Allard, R.W. (1999). Principles of Plant Breeding. John Wiley, New York.
3. Singh, B.D. (2022). Plant Breeding: Principles and Methods, 12th edition. New Delhi, Delhi: Kalyani Publishers.
4. Frey, K. J. (1982). Plant Breeding II. Kalyani Publishers, New Delhi.
5. Chopra, V.L. (2023). Plant Breeding: Theory and Practice 2nd Restructured Edition, New India Publishing Agency, New Delhi.
6. Poehlman J. M. and Sleper D. A. (1995). Breeding Field Crops, 4th Ed. Panima Publishing Corporation, New Delhi.
7. Welsh, J. R. (1981). Fundamentals of Plant Genetics and Breeding. John Wiley and Sons, New York.
8. Ahuja, V.K. (2007) Laws related to IPR. LexisNexis, India.
9. Snustad DP, Simmons MJ (2010) Principles of Genetics, John Wiley & Sons Inc., India. 5thedition
10. Pierce BA (2016) Genetics-A conceptual approach, W.H. Freeman and Co. USA, Sixth edition.
11. Primerose SB and Twyman RM (2014), Principles of Gene manipulation and genomics. Wiley Blackwell. Seventh Edition.

Masters Attributes

Course Objective:

This course will give an insight on various plant breeding approaches for crop improvement and related IPR related issues. It will provide a basic understanding on various tools available genomics and bioinformatics.

Course outcomes:

On successful completion of the course, students will be able to:

1. Explain the principles of plant breeding, hybridization, and selection, as well as the concepts in the improvement of major crop species, polyploidy inheritance, self-incompatibility, and the Hardy-Weinberg law of equilibrium.

2. Apply novel plant breeding tools such as TALEN's, CRISPR-Cas9, and base editing in practical scenarios to improve crop species.
3. Analyze chromosome variations in higher plants, including haploid production systems and the breeding application of haploids, as well as the significance of aneuploidy, trisomic, tetrasomic, and nullisomic conditions in genetic studies.
4. Evaluate the significance of intellectual property rights in plant breeding and assess the use of bioinformatics tools in genomics and functional genomics.
5. Design and conduct practical experiments in plant breeding and bioinformatics, including emasculation techniques, sequence analysis, gene prediction, protein modeling, chromosome analysis, and comparative genomics of bacteria.

Theory Credit: 03
Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany Gauhati
University, Guwahati-14

Four-year Undergraduate Programme (FYUGP) 4TH Year
Subject: Botany
Semester: Seventh

Major-17

Code BOT-MJ-07024

Course Name: *Conservation Ecology and Biodiversity Assessment*
Course

Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit No	**Unit Content**	**LECTURE**	**TUTORIAL**	**Marks**	**TOTAL HOURS**
Unit 1	**Conservation Ecology**- objectives of conservation of biotic resources, ethics and values, genetic variation and its loss, variation in natural populations, wildlife habitat – components and related concepts, Species and habitat conservation- prioritizing species and habitat, protected area networks; major approaches to their management, Indian case studies on conservation/management strategy. Biotic potential and environmental resistance, caring capacity, population dynamics, density dependent and density independent limiting factors.	7	1	10	8
Unit 2	**Conservation strategies**- In-situ, Ex-situ and hybrid approaches, conservation: facilities, the establishment of new populations, captive breeding, reintroduction, advantages and disadvantages, Metapopulation-concept, types, and conservation importance	6	1	8	7
Unit 3	**Biodiversity:** Concept, levels, types and Importance, efforts to conserve biodiversity, Methods for biodiversity monitoring, Indicators for biodiversity, megadiversity zones and hot spots; hottest hot spots, mega diversity countries, centres of plant diversity and endemism biodiversity and ecosystem services	6	-	8	6
Unit 4	**Threats to biodiversity:** Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Red data book; Biodiversity Act and biodiversity action plan; IPRs, national and international programs for biodiversity conservation, wildlife values and eco-tourism, wildlife distribution in India, problem in wildlife protection, role of WWF, WCU, CITES, TRAFFIC.	8	2	12	10

	Provisions in the constitutions of india-environmental protection act, wildlife protection act 1972, forest conservation act 1980, Indian forest act 1980(revise); the environment protection act 1986, public interest litigation(PIL) and right to information act – there relevance in conservation, role of Pas in conservation of wildlife in india; overview of wildlife trade- global and regional scnenerio.				
Unit 5	**Biodiversity Assessment:** Concept and Importance, methodology of assessment and analysis of different species groups, plant functional groups, monitoring of different species groups; importance of documentation and use of information technology in biodiversity study, sustainable use of biodiversity; biodiversity loss and its consequences.	6	1	10	7
Unit 6	**Protected Area Network:** Concept, History, Indian Scenario: Biospheres, National Parks and Wildlife Sanctuaries, need of forest and wetland conservation and managemnet, recovery of forest and wetland ecosystems,problems of protected areas in India, connectivity and corridors; population biology of endangered species. Population viability analysis, Wildlife conservation in NE India- Case Studies. Environmental law/act. Role of Pas in conservation of wildlife in india; overview of wildlife trade-global scenario.	6	1	10	7
PRACTICAL [Credit: 01]					
1. Ecological data analysis in Microsoft Excel: Data entering in Excel worksheet; Statistical interpretation in Excel; Data analysis tool, Pak: Basic graphical tools; T-test; Chi-Square test for independence of attributes; Spearman's rank correlation test. 2. Introduction to SPSS : Creation of databases, entry of data, saving and formatting of data, queries of data, sorting and classification of data and others. 3. Demonstration of biodiversity assessment methods in the University campus; 4. Qualitative and Quantitative analysis of vegetation. 5. Field visit to the forest nearby or protected area to study the biodiversity and understand the conservation strategies employing the protected area.		30		40

Reading list:

1. Anna A. Sher, Richard B. Primack · (2019) an Introduction to Conservation Biology. Oxford University Press
2. Anne E. Magurran, Brian J. McGill (2011) Biological Diversity: Frontiers in Measurement and Assessment. Oxford University Press.
3. Fred Van Dyke, Rachel L. Lamb (2020). Conservation Biology: Foundations, Concepts, Applications. Springer International Publishing 6
4. Jase Fitzgerald (2017). Biodiversity: An Introduction. Larsen and Keller Education.
5. Kelsey Malone (2020) Ecology: Evolution, Biodiversity and Conservation CALLISTO REFERENCE.
6. Krishnamurthy KV (2018) an Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
7. Lisa Idzikowski (2019). Biodiversity and Conservation. Greenhaven Publishing LLC
8. Malcolm L. Hunter, Jr., James P. Gibbs, Viorel D. Popescu. (2021). Fundamentals of Conservation biology (4th edition). Wiley
9. Michael O'Neal Campbell. 2021. Critical Research Techniques in Animal and Habitat Ecology. Nova Science Publishers.
10. Peter Stiling (2015). Ecology: Global Insights & Investigations 2nd Edition. McGraw-Hill international edition Reference books
11. PetrosGanatsas (2021). Forest Biodiversity, Conservation and Sustainability. Mdpi AG
12. Singh JS, Singh SP and Gupta SR (2014) Ecology, Environmental Science and Conservation. 4th Edition. S. Chand & Company Pvt. Ltd

Graduate Attributes

Course Objectives: After successful completion of this course, students will be able to:

Understand the principles and objectives of conservation ecology, including conservation ethics, genetic diversity, population dynamics, wildlife habitats, and species conservation strategies. Explain and evaluate various conservation approaches, such as in-situ, ex-situ, and hybrid conservation methods, and assess their applications in biodiversity management. Develop a comprehensive understanding of biodiversity, its levels, significance, ecosystem services, biodiversity hotspots, endemic species, and global conservation priorities. Analyze the major threats to biodiversity and critically examine national and international policies, legal frameworks, and conservation organizations involved in biodiversity protection. Apply biodiversity assessment and monitoring techniques for documenting species diversity, evaluating ecosystem health, and promoting sustainable utilization of biological resources. Understand the concept and significance of Protected Area Networks, including biosphere reserves, national parks, wildlife sanctuaries, forest and wetland conservation, and wildlife management practices, particularly in India and Northeast India. Develop practical skills in ecological and biodiversity data analysis using software tools such as Microsoft Excel and SPSS, including statistical interpretation and biodiversity assessment methodologies. Gain field-based experience in biodiversity assessment and conservation planning through vegetation analysis, field surveys, and visits to protected areas, fostering scientific and conservation-oriented decision-making.

Course Outcomes (COs): After successful completion of this course, students will be able to:

Explain the principles of conservation ecology, including conservation ethics, genetic variation, wildlife habitats, population dynamics, carrying capacity, and factors regulating populations. Compare and evaluate different conservation strategies such as in-situ, ex-situ, and hybrid approaches, and assess their significance in species recovery and biodiversity conservation. Demonstrate an understanding of biodiversity concepts, levels, hotspots, ecosystem services, and methods used for biodiversity monitoring and conservation planning. Analyze major threats to biodiversity, extinction risks, conservation policies, legal frameworks, and the role of national and international organizations in biodiversity protection. Apply biodiversity assessment methodologies to document, monitor, analyze, and interpret biodiversity data for sustainable management of biological resources. Evaluate the significance of protected area networks, wildlife corridors, forest and wetland conservation, and conservation challenges with special reference to India and Northeast India. Use statistical and computational tools such as Microsoft Excel and SPSS for ecological data management, analysis, interpretation, and presentation. Conduct field-based biodiversity assessments and vegetation analyses, and develop practical skills in observing conservation strategies and ecosystem management practices.

Four-year Undergraduate Programme (FYUGP) 4TH Year

Subject: Botany

Semester: Seventh

Major 18

Code: BOT-MJ-07034

Course Name: ***Plant diseases, diagnostic and management***

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	**Unit content**	**No. of classes**	**Marks**
Unit 1	Introduction to Plant Diseases: Koch's postulate and germ theory of diseases, biotic and abiotic causes of plant diseases, symptoms and signs of plant diseases caused by fungi, bacteria, virus, and nematode.	6	6
Unit 2	Dissemination of plant pathogens; disease cycle; physiological changes due to disease in plants; Genetics of plant diseases	8	10
Unit 3	Diagnosis of Plant Diseases: Visual identification of common plant diseases, Laboratory techniques (microscopy, culturing, and serological tests); molecular methods (PCR, DNA sequencing, and ELISA)	8	12
Unit 4	Epidemiology of plant diseases; Disease mapping, forecasting and surveillance techniques	8	8
Unit 5	Concept of plant disease control; Cultural, Chemical, and biological control of plant diseases; Integrated pest management (IPM); Management of soil borne plant pathogens; Management of seed borne pathogens	8	12
Unit 6	Resistant gene identification and development of disease resistant plant (Traditional and biotechnological approach), GMO (bt-cotton, bt-brinjal, bt-chickpea)	7	12
PRACTICAL [Credit: 01]			
8. Study of plant disease symptoms and their causal organisms 9. Isolation and identification of pathogen from diseased plant materials 10. Isolation of soil borne fungal pathogens and their control 11. Proving of Koch's postulate at least one disease		30	40

Reading list:

1. Agrios, G. N. (2005). Plant pathology (5th ed.). Academic Press.
2. Lucas, J. A. (2015). Plant pathology and plant pathogens (4th ed.). Wiley-Blackwell.

3. Schumann, G. L., & D'Arcy, C. J. (2010). Essential plant pathology. American Phytopathological Society Press.
4. Maloy, O. C., & Murray, T. D. (Eds.). (1993). Encyclopedia of plant pathology (Vol. 1-2). Wiley-Interscience.
5. Madden, L. V., Hughes, G., & van den Bosch, F. (2007). The study of plant disease epidemics. American Phytopathological Society Press.
6. Hammond, B. G., & Lemaux, P. G. (2008). Genetically modified crops: Promises, perceptions, and realities. Advances in Agronomy, 98, 1-41.
7. Staskawicz, B. J., & Jones, J. D. (2000). Molecular plant pathology since 2000. Molecular Plant Pathology, 1(1), 9-20.

Graduate Attributes

Course Objective:

This paper will focus on the comprehensive understanding of plant diseases, their diagnosis, and effective management strategies.

Course outcomes:

On completion of the course, students will-

8. Comprehend the fundamental concepts of plant diseases, including Koch's postulates, the germ theory of diseases, and the distinction between biotic and abiotic causes of plant diseases.
9. Analyze the dissemination of plant pathogens, understand the disease cycle, and evaluate the physiological changes induced by diseases in plants, with a focus on the genetic aspects of plant pathogens.
10. Apply various diagnostic techniques for plant diseases, including visual identification, laboratory methods such as microscopy and culturing, and advanced molecular methods like PCR, DNA sequencing, and ELISA.
11. Evaluate the epidemiology of plant diseases, including disease mapping, forecasting, and surveillance techniques, to understand the spread and control of plant pathogens in different environments.
12. Propose and assess various methods for plant disease control, including cultural, chemical, and biological approaches, as well as integrated pest management strategies tailored to manage soil-borne and seed-borne plant pathogens, while also considering the identification and development of disease-resistant plants, including biotechnological approaches such as GMOs.

Theory Credit: 03
Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14

Four-year Undergraduate Programme (FYUGP) 4TH Year

Subject: otany
Semester: Seventh
Major-19

Code:BOT-MJ-07044

Course Name: *Environmental Microbiology*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no.	**Unit content**	**LECTURE**	**TUTORIAL**	**Marks**	**TOTAL HOURS**
Unit 1	Microbiology of soil, water and air (common soil microflora, microbes in soil health improvement, common water microflora, microbial water quality analysis, common air microflora)	6	-	6	6
Unit 2	Culture-dependent microbial study (Growth media, culture techniques, CFU count and enumeration, characterization of isolates and species identification)	7	1	10	8
Unit 3	Culture-independent microbial study (direct microscopic methods, meta-genomics, transcriptomics, proteomics and metabolomics)	7	1	12	8
Unit 4	Microbial interactions (symbiosis, antagonism, parasitism, commensalism, amensalism, cooperation, quorum and anti-quorum sensing)	7	1	8	8
Unit 5	Biogeochemical cycling (Role of microbes in biogeochemical cycling, carbon cycle, nitrogen cycle, sulfur cycle, phosphorus cycle)	7	1	12	8
Unit 6	Scope of microbiology in environmental engineering (reclamation of degraded soil, purification of polluted water, biodegradable waste management)	7	-	12	7
PRACTICAL [Credit: 01]					
1. Enumeration and identification of common soil microbes 2. Enumeration and identification of common water microbes 3. Use of differential media/specific media to identify a particular group of microbes 4. Catalase/Phosphatase test for bacteria 5. MPN test for water quality 6. Methylene blue reductase test for milk quality		30		40	

Reading list:

1. Sylvia DM, Fuhrmann JJ, Hartel PG, Zuberer DA (2005) Principles and Applications of Soil Microbiology, Pearson, USA.

2. Pepper IL, Gerba CP, Gentry TJ (2014) Environmental Microbiology, Academic Press, USA.
3. Atlas RM (2010) Handbook of Microbiological Media, CRC Press, USA.
4. Madigan MT, Martinko JM, Bender K, Buckley D, Stahl D (2018) Brock Biology of Microorganisms, Pearson, USA.
5. Riesenfeld CS, Schloss PD, Handelsman J (2004) Metagenomics: Genomic Analysis of Microbial Communities, Kluwer Academic Publishers, USA.
6. Hugenholtz P, Tyson GW (2008) Metagenomics, Springer, USA.
7. Falkowski PG, Fenchel T, Delong EF (2008) The Microbial Engines That Drive Earth's Biogeochemical Cycles, Science, USA.
8. Fuqua C, Greenberg EP (2002) Signaling in Bacteria: New Insights into Microbial Ecology and Evolution, ASM Press, USA.
9. Schlesinger WH, Bernhardt ES (2013) Biogeochemistry: An Analysis of Global Change, Academic Press, USA.
10. Paul EA (2014) Soil Microbiology, Ecology, and Biochemistry, Academic Press, USA.
11. Bitton G (2011) Wastewater Microbiology, Wiley-Blackwell, USA.
12. Thakur IS (2006) Environmental Biotechnology: Basic Concepts and Applications, I.K. International Publishing House, India.
13. Cappuccino JG, Welsh CT (2016) Microbiology: A Laboratory Manual, Pearson, USA.
14. Benson HJ (2012) Microbiological Applications: Laboratory Manual in General Microbiology, McGraw-Hill, USA.

Graduate Attributes

Course Objective:

The objective of this course is to provide a comprehensive understanding of environmental microbiology, emphasizing microbial communities in soil, water, and air, and their roles in soil health, water purification, and biogeochemical cycles. Students will learn both culture-dependent and culture-independent techniques for studying microbes, including growth media preparation, CFU counting, and advanced genomic methods. The course covers microbial interactions and their ecological significance, and includes practical skills in microbial enumeration, identification, and biochemical testing. It also highlights the application of microbiology in environmental engineering, preparing students for advanced studies or careers in the field.

Course outcomes:

On completion of the course, students will be able to-

1. List common soil microbes and explain their role in the nitrogen cycle.
2. Understand the concept of symbiosis and provide examples of how this interaction benefits soil health.
3. Perform CFU counting and use meta-genomics data to analyze microbial diversity in a soil sample.
4. Analyze results from the methylene blue reductase test to determine milk quality and identify the presence of specific microbial contaminants.

5. Evaluate different microbial bioremediation strategies for purifying polluted water and recommend the most effective method based on scientific evidence.

Theory Credit: 03
Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14

Four-year Undergraduate Programme (FYUGP) 4TH Year

Subject: Botany

Semester: seven

Major-19/B

Code : DSC 404

II

Course Name: *Plant Growth and Morphogenesis*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no.	**Unit content**	**LECTURE**	**TUTORIAL**	**Marks**	**TOTAL HOURS**
Unit 1	**Photomorphogenesis:** Photochemical and biochemical properties of phytochromes, cryptochromes and phototropins; phytochrome biosynthesis, cellular localization, roles; Mechanism of action of photomorphogenetic receptors.	7	1	12	8
Unit 2	**Plant developments:** Plant developments: Biochemical changes during development of seeds; Plant movement: tropic and nastic movements.	6	-	8	6
Unit 3	**Post-harvest physiology:** Ripening of fruit and its regulation, post-harvest management; Fruit and vegetable preservation: chemical and non-chemical preservation techniques, nutritional changes during preservation.	7	-	8	7
Unit 4	**Plant Growth Regulators:** A brief idea about discovery, role and possible mechanism of action of Triacontanol, Salicylic acid, and Polyamines. A brief idea about role of plant growth retardants- CCC, Maleic hydrazide, Trizoles and TIBA.	7	1	10	8
Unit 5	**Senescence and Programmed Cell Death (PCD):** Biochemical changes during senescence of leaves and petals and regulation of senescence. PCD: Biochemical changes in cellular level, regulation of PCD, caspases and metacaspases.	7	1	10	8
Unit 6	**Applied Plant physiology:** Foliar nutrition: Conditions, factors affecting efficiency of Foliar nutrition; Advantages, and disadvantages. Chelators and soil conditioners. Phytoremediation: History, Mechanisms and types, Advantages, and disadvantages. Role of tissue culture, and mutants in plant physiological studies.	7	1	12	8
	PRACTICAL [Credit: 01]				

1. Study of changes in starch / protein content during seed development. 2. Study of lipid accumulation during development of oil seeds. 3. Demonstration of hormonal regulation of leaf and petal senescence. 4. To study the effect of different PGRs on seedling growth.	30	40

Suggested Readings:

1. Bajracharya D (1999) Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
2. Bhatla SC, Lal MA (2018) Plant Physiology, Development and Metabolism. Springer Nature Singapore Pte Ltd.
3. Devlin RM (2017) Outline of Plant Physiology. Medtech: Scientific International Pvt. Ltd.
4. Devlin RM, Witham FH, Blaydes DF (2017) Devlin's Exercises in Plant Physiology. Medtech: Scientific international Pvt. Ltd.
5. Hopkins WG, Huner A (2008) Introduction to Plant Physiology (4th edition). John Wiley and Sons. U.S.A.
6. Kochhar SL, Gujral SK (2021) Plant Physiology: Theory and Applications (2nd edition). Cambridge University Press.
7. Malik CP, Srivastava (2015) Text Book of Plant Physiology. Kalyani Publishers, New Delhi.
8. Salisbury FB, Ross CW (2004) Plant Physiology (4th edition). Cengage Learning India Pvt. Ltd., New Delhi, India.
9. Taiz L, Zeiger E, MØller IM, Murphy A (2015) Plant Physiology and Development (6th edition). Sinauer Associates Inc. USA.

Graduate Attributes

Course Objective:

The course objective is to enable students to demonstrate a comprehensive understanding of plant photomorphogenesis, including the photochemical and biochemical properties of phytochromes, cryptochromes, and phototropins, as well as the mechanisms of action and roles of these photomorphogenetic receptors in plant development. Additionally, students will gain insights into biochemical changes during seed development, plant movement mechanisms, and post-harvest physiology with a focus on fruit ripening, preservation techniques, and nutritional changes. Furthermore, the course aims to familiarize students with plant growth regulators such as Triacontanol, Salicylic acid, Polyamines, and growth retardants like CCC, Maleic hydrazide, Trizoles, and TIBA, elucidating their roles and possible mechanisms of action. Finally, students will explore senescence, program med cell death (PCD), and applied plant physiology topics including foliar nutrition, chelators and soil conditioners, phytoremediation mechanisms and applications, as well as the role of tissue culture and mutants in advancing plant physiological studies.

Course outcomes:

On successful completion of the course, students will be able to:

1. Apply knowledge of the mechanism of action of photomorphogenesis receptors in plant responses to light.
2. Apply knowledge of tropic and nastic movements in plants and their adaptive roles.
3. Evaluate the advantages and disadvantages of chemical and non-chemical preservation techniques on nutritional changes in fruits and vegetables.
4. Evaluate the advantages and disadvantages of chemical and non-chemical preservation techniques on nutritional changes in fruits and vegetables.

Theory Credit: 03
Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14

Four-year Undergraduate Programme (FYUGP) 4TH Year

Subject: Botany

Semester: Seventh

Research component-(RC-1)

CODE : BOT-RC-07014

Course Name: *Research Methodology*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no.	**Unit content**	**LECTURE**	**TUTORIAL**	**Marks**	**TOTAL HOURS**
Unit 1	Research methodology: Research concept, Identification of research gap, Understanding the scientific question(s), Novelty of research in support of existing literatures, setting hypothesis and objectives, writing research proposal/synopsis.	6	-	6	6
Unit 2	Experimental designs: Formulation of research problem, sampling technique, methods selection, experimental set up, data generation/acquiring, Coding/decoding and reproducibility of data.	7	1	10	8
Unit 3	Statistical analysis and data representation: SD, SE, Correlation and Regression, Test of significance, ANOVA, DMRT, data validation, biological significance of data, impact of small sampling size in data analysis, utility of computer/software (MS office, excel, power point, graphics, sigma plot, SPSS etc.) in data analysis and presentation	7	1	12	8
Unit 4	Scientific writings: Forms of scientific writing i.e. research articles, notes, reports, review, monograph, dissertation/thesis, popular article, etc. Components of research article, Writing strategy for a research article. Research ethics and Plagiarism	7	1	8	8

Unit 5	Field Techniques: Collection and preservation techniques of specimens (Algae, Fungi, Higher Plants), Instrumentation and safety measures in laboratory and field, sampling methods/strategy, Principle and application of GIS, GPS, Remote sensing Unit	7	1	12	8
Unit 6	Basic knowledge on analytical (Principle and application of UV-Vis, IR, FTIR and NMR Spectroscopy), Basic knowledge on separation techniques (Principal and application of Chromatography techniques, Gel filtration, Ion exchange, GC, HPLC), Centrifugation, Microscopy (Principle and application of Phase contrast, DIC, Fluorescence, Confocal, SEM, TEM) and molecular techniques.	7	-	12	7
	PRACTICAL [Credit: 01]				
	1. A local field visits for collection and preservation of specimens like algae, fungi, and higher plants. 2. To perform statistical analysis using the software tool like Excel. 3. To work out standard deviation (SD), standard error (SE), correlation and regression, and test of significance. 4. Demonstrations on HPLC and gel filtration. 5. Detection of plagiarism using any plagiarism detection tool.	30		40	

Suggested Readings:

1. Kumar R (2014) Research Methodology: A Step-by-Step Guide for Beginners. Sage Publications, UK.
2. Booth WC, Colomb GG, Williams JM (2016) The Craft of Research. University of Chicago Press, US.
3. Quinn GP, Keough MJ (2002) Experimental Design and Data Analysis for Biologists. Cambridge University Press, UK.
4. Montgomery DC (2019) Design and Analysis of Experiments. Wiley, United States.
5. Box GEP, Hunter JS, Hunter WG (2005) Statistics for Experimenters: Design, Innovation, and Discovery. Wiley-Interscience, US.
6. Zar JH (2010) Biostatistical Analysis. Pearson, US.
7. Schimel J (2012) Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded. Oxford University Press, US.
8. Hofmann AH (2019) Scientific Writing and Communication: Papers, Proposals, and Presentations. Oxford University Press, US.
9. Brower JE, Zar JH, von Ende CN (1998) Field and Laboratory Methods for General Ecology. McGraw-Hill, US.

10. Wegmann M, Leutner B, Dech S (2016) Remote Sensing and GIS for Ecologists: Using Open Source Software. Pelagic Publishing, UK.
11. Skoog DA, Holler FJ, Crouch SR (2017) Principles of Instrumental Analysis. Cengage Learning, US.
12. Upadhyay A, Upadhyay K, Nath N (2014) Biophysical Chemistry: Principles and Techniques. Himalaya Publishing House, India.
13. Kirkup L (2002) Data Analysis with Excel®: An Introduction for Physical Scientists. Cambridge University Press, UK.
14. Leech NL, Barrett KC, Morgan GA (2011) SPSS for Intermediate Statistics: Use and Interpretation. Routledge, US.

Graduate Attributes

Course Objective: The course aims to equip students with a comprehensive understanding of research methodology, covering key aspects such as identifying research gaps, formulating hypotheses, and designing reproducible experiments. Students will learn statistical analysis and data representation using software tools like MS Office, SPSS, and SigmaPlot. Additionally, they will receive training in scientific writing and ethical considerations, as well as field techniques including specimen collection and safety protocols. Basic knowledge of analytical techniques such as spectroscopy and microscopy will also be provided to support research endeavors.

Course outcomes:

On successful completion of the course, students will be able to:

1. Comprehend fundamental research concepts, critically analyze literature to identify gaps, and articulate scientific questions, setting clear hypotheses and objectives within the context of existing studies.
2. Apply experimental design principles to formulate research problems, select sampling techniques, design experimental setups, and ensure reproducibility through proper data coding and decoding.
3. Apply statistical methods and use software tools for data analysis and presentation, understanding the impact of sample size on data validity.
4. Create diverse forms of scientific writing, understand research article components, develop writing strategies, and evaluate ethical considerations and plagiarism.
5. Understand and implement collection and preservation techniques for various specimens (Algae, Fungi, Higher Plants), apply GIS, GPS, and remote sensing, and become proficient in various analytical techniques and microscopy methods while adhering to safety measures.

Theory Credit: 03
Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14

Four-year Undergraduate Programme (FYUGP) 4TH Year

Subject: Botany
Semester: 8th Sem
Major 20
Code-
botmj08014

Course Name: *Molecular Biochemistry*

Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no	**Unit content**	**LECTURE**	**TUTORIAL**	**Marks**	**TOTAL HOURS**
Unit 1	**Proteins and Mass Spectrometry-** Classification of amino acids. Protein Structure: a) Peptide bond, determination of primery structure, end group analysis, sequencing, Solid phase synthesis b) Secondary: alpha-helix bets-structure, β-helix, super secondary structure. c) Tertiary Structure: Forces stabilizing, unfolding/ refolding experimentst. d) Quaternary structure – haemoglobin. e) Ramachandran plot. f) Helix coil transitions, Vander Walls, electrostatic, Hydrogen bonding, and hydrophobic interactions. g) Energy terms in Biopolymer conformational calculation. Application of Mass spectrometer in protein biochemistry, Basics of Mass Spectrometry**:** Mass analyzers-TOF, Ion trap, Quadrupole, Ionization Methods-Electron Impact (EI), Electron Spray Ionization (ESI), Matrix Assisted Laser Desorption Ionization (MALDI), Protein Identification using MS.	8	1	10	9
Unit 2	**Protein biosynthesis** Eukaryotic translation machinery, structure and assembly of the ribosome, initiation, elongation and termination of translation. Unusual Bio-molecules: Prions, Fullerenes, Lectins, Antifreeze proteins, Stress Proteins, Chaperons, Ionophores (Crown ethers, Cryptands) Cyclophanes, Cyclodextrins, Cyclopeptides. Intracellular protein sorting, movement of proteins between cellular compartments: gated, transmembrane and vesicular transport. Protein transport and translocation to nucleus,	8	-	10	8

	mitochondria, chloroplast, peroxisomes, endoplasmic reticular system. Protein degradation.				
Unit 3	**Protein Engineering** Theories of Protein designing: Designing by Rational Approach, Site directed mutagenesis, designing by de- novo synthesis. Methods used in de Novo synthesis- Phage display and error prone PCR. Examples of designer proteins – Dihydrofolate reductase and Subtilisin. Effect of amino acids on structure of proteins, Energy status of a protein molecule, Structure function relations of enzymes, Physical methods such as x- ray crystallography for determination of protein structure, for specific protein function	8	-	10	8
Unit 4	**Kinetics and Regulation of enzyme activity-** Review of uni-substrate enzyme kinetics, multi-substrate enzyme kinetics, Co-operativity phenomenon, Hill and Scatchard plots, protein-ligand binding and its measurement, detailed mechanism of catalysis of serine protease and carbonic anhydrase. Metalloenzymes and Metalloenzymes; Allosteric enzymes and multienzyme systems Allosteric enzymes, sigmoidal kinetics and its physiological significance, symmetric and sequential modes of action and their significance, immobilized enzymes and their industrial applications, study of multienzyme complexes with respect to occurrence, isolation and their properties and polygenic nature eg. pyruvate dehydrogenase and fatty acid synthase.	**7**	-	10	7
Unit 5	**Enzyme regulation** General mechanisms of enzyme regulation: Feed-back inhibition and feed forward stimulation, repression and induction of enzymes, reversible and irreversible covalent modifications of enzymes, flexibility and conformational mobility of enzymes, convergent and divergent evolution of enzymes.	6	-	10	6
Unit 6	**Industrial enzymes** History, sources, uses, screening for novel enzymes, applications, safety and regulatory aspects of industrial enzyme use, Enzyme Nanotechnology in agriculture, cosmetics and industrial processes. Strategies to increase/modify enzyme activity and synthesis. Media, routine and nanotechnological approaches for isolation and purification of extracellular and intra-cellular enzymes, purification- centrifugation, filtration,	**7**	-	**10**	7

	chromatography,polishing and packaging of enzymes. Ramachandran plot, computer-aided drug discovery.				

PRACTICAL [Credit: 01]		
. Estimation of protein by UV Spectrophotometer by E280/E260 method 2. Estimation of Riboflavin by Spectrophotometric method. 3. Estimation of Thiamine by thiochrome method 4. Separation of proteins by PAGE 5. Separation of proteins by SDS gel electrophoresis 6. Western Blotting 7. Purification of proteins by isoelectric precipitation 8. Molecular weight determination 9. Changes in carbohydrate, protein content during germination. 10. Isolation and characterization of trypsin inhibitor. 11. Induction of proteinases, amylases, and lipase during germination.	30	40

Four-year Undergraduate Programme (FYUGP) 4TH Year

Subject: Botany

Semester: Eighth

Major-21

CODE:BOT-MJ-08024

Course Name: *Fungal Diversity, Genetics, and Applications* Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit no.	**Unit content**	**LECTURE**	**TUTORIAL**	**Marks**	**TOTAL HOURS**
Unit 1	Introduction to fungal diversity; Global fungal diversity and Biogeography; Understanding Cryptic fungi; Methods for estimation of fungal diversity and conservation	6	-	10	6
Unit 2	Diversity of Soil Fungi; Diversity of Phytopathogenic fungi; Mushroom diversity; Diversity of endophytic fungi and their functional roles	6	-	6	6
Unit 3	Molecular genetic analysis of fungi; Extra chromosomal and transposable genetic elements in fungi; Cell cycle control points in yeast	8	1	10	9
Unit 4	Mating-Type switching in Yeasts; Extra-chromosomal inheritance in fungi; Sex hormones in fungi; Retroposon and retrotransposon in fungi	8	1	14	9
Unit 5	Fungal secondary metabolites (Polyketides, Terpenes, and Indole alkaloids); Heat shock protein in filamentous fungi	5	-	8	5
Unit 6	Biotechnological application of fungi in food, industries, medicines, and agriculture; Myconanotechnology; Mycoremediation and mycofumigation; Mycoses (Types, diagnosis, and treatments)	8	2	12	10
PRACTICAL [Credit: 01]					
1.Isolation and enumeration of soil fungi 2.Study of phytopathogenic fungi from diseased samples 3.Molecular identification of fungal specimen 4.Isolation and determination of secondary metabolites from fungi		30		40	

Reading list:

5. Introduction to Fungi. John Webster and Roland W. S. Weber
6. Introduction to Mycology. C. J. Alexopoulos, C. W. Mims and M. Blackwell.
7. Fungi Nutrition & Physiology. Michael O. Garraway and Robert C. Evans.
8. Physiology of Fungi. Lilian E. Hawker

9. The Mycota; Vol: III: Biochemistry and Molecular Biology. K. Esser and P. A. Lemke.
10. The Mycota; Vol: VII: Systematics and Evolution (Part A). K. Esser and P. A. Lemke.

Graduate Attributes

Course Objective:

This paper will explain the detailed account on the diversity, genetics, and applications of Fungi.

Course outcomes:

On completion of the course, students will-

5. Demonstrate an understanding of the diversity of fungi, their global distribution, and the methods used for estimating and conserving fungal diversity.
6. Analyze the roles of different types of fungi in various ecosystems, including soil, plants, and their applications in agriculture and medicine.
7. Apply molecular genetic techniques to analyze fungal genomes, understand the mechanisms of genetic inheritance, and explore the molecular basis of fungal traits and behaviors.
8. Evaluate the significance of genetic elements, such as mating-type switching and retrotransposons, in fungal evolution and adaptation to different environments.
9. Design and propose biotechnological applications of fungi in food production, industrial processes, medicine, and environmental remediation, considering the principles of mycology and practical feasibility.

Theory Credit: 03
Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany Gauhat

Four-year Undergraduate Programme (FYUGP)
4TH Year
Subject: Botany
Semester: Eight
Major-22
Code- BOTMJ08034
Course Name: *Advanced Plant Taxonomy and Diversity of Angiosperms*
Course Level: 400-499, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45					
Unit No.	**Unit content**	**LECTURE**	**TUTORIAL**	**Marks**	**TOTAL HOURS**
Unit 1	Basics of Taxonomy (Concepts, Aims & Principles): Concept of Taxa; Classificatory Systems: Bentham and Hookers system, Takhtajan's system; Recent development of classificatory system in Angiosperms - APG System; Phenetic and Cladistic taxonomy.	7	**1**	10	**8**
Unit 2	**Sources of Taxonomic Characters (Classical and Experimental):** Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Serology	7	1	10	8
Unit 3	**Botanical Nomenclature (ICN):** History, Principles and Major rules, Typification, Effective and Valid Publication, Authors' citation, Principles of Priority and Limitations, synonym, basionym, nomina conservanda, rejection of names, illegitimate names, nomen nudum, tautonym, later homonym, IBC and Codes, Major changes to the Code of nomenclature.	7	1	12	8
Unit 4	**Herbaria and Botanical Gardens:** Herbarium techniques, Methods of Collection, processing, mounting and preservation; Roles of Herbaria and Botanical Gardens.	6	-	8	6
Unit 5	Taxonomic Literatures: Flora, Manuals, Monograph, Revision, Periodicals; Construction of Botanical keys; Botanical Survey of India.	6	-	8	6
Unit 6	**Diversity of Primitive and Advanced Angiosperms:** Primitive and Advanced characters of angiosperms; Phylogeny and Evolution of Angiospermic Taxa: Magnoliales, Rananculales, Asterales, Alismatales, Poales, Orchidales.	7	2	12	9
PRACTICAL [Credit: 01]					
1. Morphological studies of locally available advanced and primitive angiospermic plants, their taxonomic description with analytical drawing, botanical keys and identification up to the rank of species.		30		40	

2. Herbarium specimen preparation of locally available Angiospermic plants (15–20 Nos.). 3. Plotting of various centers of BSI, Botanical Gardens and Herbaria in different regions of India.		

Reading list:

1. Baruah A (2023) Angiosperm Taxonomy for PG Students, Global Net Publication, New Delhi.
2. Heywood VH (2016) Flowering Plant Families of the World, Firefly Books, Canada.
3. McNeill J (2012) International Code of Nomenclature for algae, fungi, and plants (Melbourne Code), Koeltz Scientific Books, Germany.
4. Mitra JN (1988) An Introduction to Systematic Botany and Ecology. The World Press Private Ltd. Calcutta.
5. Mondal AK (2009) Advanced Plant Taxonomy. New Central Book Agency (P) Ltd.
6. Naik VN (1984) Taxonomy of Angiosperms. Tata Mc Graw-Hill.
7. Pandey BP (2018) A Textbook of Botany: Angiosperm. S. Chand Publishing, 7361, Ram Nagar, Qutab Road, New Delhi-110055.
8. Singh G (2012) Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
9. Stace C (2010) Plant Taxonomy and Biosystematics, Cambridge University Press, United Kingdom.

Graduate Attributes

Course Objective:

This course will provide an understanding of Advanced and Primitive Taxa; Classificatory Systems. Understand the taxonomy in relation to other branches of botany, nomenclature, identification and herbarium techniques.

Course outcomes:

1. Apply classificatory systems to classify Angiosperms, integrating morphological, anatomical, and molecular data.
2. Implement rules of botanical nomenclature to accurately name and describe plant taxa, ensuring compliance with priority and legitimacy guidelines.
3. Expertise in plant collection, herbarium preparation, taxa description, constructing botanical keys and knowledge on taxonomic literatures.
4. Analyze the correlation between plant taxonomy and disciplines such as morphology, anatomy, palynology, cytology, and phytochemistry, using phenetic and cladistic approaches.
5. Evaluate the contributions of herbaria, botanical gardens, museums, and organizations like the Botanical Survey of India in cataloging plant diversity and conservation.
6. Analyze theories of Angiosperm origin, classify primitive and advanced Angiosperms, and interpret evolutionary trends within specific Angiosperm orders.

Theory Credit: 03
Practical Credit: 01
No. of Required Classes: 75 (Theory: 45; Practical: 30)
No. of Contact Classes: 75 (Theory: 45; Practical: 30)
No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name of Institution): P. G. Department of Botany, Darrang College (Autonomous), Tezpur.

Four-year Undergraduate Programme (FYUGP) 4TH Year
Subject: Botany
Semester: Eight
Major-23
CODE-BOTMJ08044
Course- **Dissertation**
Credit – 2
Seminar
Credit -1
Viva
Credit -1

Four-year Undergraduate Programme (FYUGP) 4TH Year
Subject: Botany
Semester: Eight
Major-24
CODE-BOTMJ08054
Laboratory techniques, theory and practice
Credit - 4

THEORY [Total marks: 60] Credit: 03; Total No. of Classes: 45					
Unit No	**Unit contents**	**Lecture**	**Tutorial**	**Marks**	**Total Hours**
Unit-1	**Microscopy** Principles and application of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Transmission and Scanning electron bright and darkfield microscopes, Electron microscopy, Fixation and staining techniques for electron microscope, Micrometry.	8	2	10	7
Unit-2	**Laboratory Instruments** Autoclaves,Centrifuges, Principles of Centrifugation, Types of Laboratory Centrifuges. Working Principle and Application of Hot Air	7	-	10	7

	Oven, Balances, Auto Pipettes, Applications of Microtomes, Laminar Flow Tables, BOD Incubator				
Unit-3	**Microbial Techniques** Sterilization methods, Types of Microbial media: Microbial growth media: Minimal Media, Defined media, Complex media, Enriched media, Selective media, and Differential media. Staining techniques for microbes, Isolation of pure cultures of bacteria by streaking method. Enumeration of colony forming units (CFU) count by spread plate method. Culture transfer Techniques: Streaking, Serial dilution and Plating methods.	8	1	10	9
Unit-4	**CHROMATOGRAPHY** Basic principle and biological applications: Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography, Affinity chromatography.	7	-	10	7
Unit-5	**SPECTROPHOTOMETRY** Properties of Electromagnetic radiations; Beer Lambert's Law, Extinction Coefficient, Principle and Applications of UV-Visible light Spectroscopy. Atomic absorption and Flame emission spectroscopic techniques. Mass spectrometry: X-ray diffraction; X-ray crystallography; Principle & biological applications of IR & NMR.	8	-	10	8
Unit 6	**ELECTROPHORESIS** Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE. Immunoelectrophoresis, Isoelectrofocussing, Capillary Electrophoresis, Polymerase Chain Reaction, DNA sequencing.	7	-	10	7

Source of Study Material

1. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.

2. Willard, H.H., Merritt L.L. Dean J.A. and Settle F.A., "Instrumental Methods of Analysis", 7th Ed., Wadsworth Publishing Co., 1986.

3. Campbell, I.D. and Dwek, R. A., "Biological Spectroscopy", Benjamin Curmmings Publication Co. Inc., 1984.

4. Glasel, J. and Deutscher, M. B., "Introduction to Biophysical Methods for Protein and Nucleic

acid Research", Academic Press, 1995

5. Cappucino, J. and Sherman, N. (2013). Microbiology: A Laboratory Manual. (10th ed.) Pearson Education Limited; ISBN 13: 9780321840226