



**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. To enhance the skill of conservation, agriculture, research and careers in biotech, pharma and environmental sectors.

Program Outcome:

On successful completion of the FYUGP program, students will be 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 properties of cells and their functions.
4. Fundamental knowledge for performing 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, photoperiodism 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, agriculture 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 theoretical instructions.
2. Tutorials: Provide more clarification/ 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, herbarium 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 and software to solve biological problems.
6. Project Work/ Dissertations: Fostering independent research works.
7. Group discussions and Seminars/ 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. Herbarium 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. Seminar presentations.
4. In semester/sessional examinations (both theoretical 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)	Mark s	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 Archaeobacteria; 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 : <i>Nostoc</i> , <i>Chlamydomonas</i> , <i>Volvox</i> , <i>Spirogyra</i> , <i>Chara</i> . Economic importance of Algae	6	10	3		9
Unit-4	Fungi: General Features (Distribution, Morphology, Nutrition) Reproduction & Classification (Einsworth, 1973). A brief account of: <i>Mucor</i> , <i>Penicillium</i> , <i>Agaricus</i> . A brief idea of Fungi <i>imperfecti</i> . 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

	<p>General features (Distribution & Morphology, Alternation of Generation) Adaptation to land habit, Classification and Evolutionary Trends.</p> <p>A Brief Account of : <i>Marchantia & Funaria</i></p> <p>Pteridophytes:</p> <p>General features (Distribution & Morphology, Alternation of Generation); <i>Reproduction, Classification, Stellar Diversity & Evolution, Heterospory & Seed habit. A brief account of : Lycopodium, Selaginella & Pteris</i></p>					
Unit-6	<p>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,</p> <p>MS-Word, PowerPoint, Excel, concept on biological databases, Basics at SPSS</p> <p>Collection, Identification, Preparation and Preservation of Herbarium and Museum specimens.</p>	12	12	6		16
PRACTICAL [Credit : 01]						
	<ol style="list-style-type: none"> Study of structure of TMV and Bacteriophage (electron micrographs/models). Study of morphology of <i>Nostoc</i>, <i>Chalydomonas</i>, <i>Volvox</i>, <i>Spirogyra</i>, <i>Chara</i> (Temporary preparation of slides). Study of Mucor, Penicillium, Agaricus. Study of vegetative and reproductive parts of <i>Marchantia</i> and <i>Funaria</i> (preparation of slides). Study of <i>Lycopodium/ Selaginella</i> (morphology, strobilus, and spores), <i>Adiantum/ Pteris</i> (morphology). Study of <i>Cycas/ Pinus</i> and <i>Gnetum</i> (morphology, leaf/ needle, megasporophyll and microsporophyll) Study of leaf venations in dicots and monocots (at least two specimens each) 	30	40			

8. Study of different types of inflorescences and fruits.					
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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 quaternary); 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]						
	<ol style="list-style-type: none"> 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 <i>Hydrilla</i> and <i>Vallisneria</i> 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 field experiments. 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	Tutorial (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 of chemicals, 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 strip and preparation of buffers (Phosphate /citrate buffer) 9. Working with instruments - Centrifuge, autoclave, laminar air flow, hot air oven, incubator, light microscope, spectrophotometer/colorimeter, 10. Slide preparation and staining of plant materials. 11. Determination of cell/spore size using	30	40			

<p>micrometer.</p> <p>12. Preparation of PDA/NA medium for growth and maintenance of fungal/bacterial cultures.</p> <p>13. Calculation of mean, mode, median, standard deviation using data set. (Primary data set)</p> <p>14. Drawing of tables, graphs and to carry out statistical calculation using Microsoft Excel using primary data set.</p> <p>15. Preparation of herbarium specimen: Collection, processing, mounting, and labelling of plant specimen.</p> <p>16. Identification of plants in the field – family/ genus/ species</p>					
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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	<ol style="list-style-type: none"> 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 ⁺ /K ⁺ 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]						
	<ol style="list-style-type: none"> 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	Tuitorial (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]						
	<ol style="list-style-type: none"> 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	<p>On successful completion of the course, students will have:</p> <ol style="list-style-type: none"> 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	Tutorial (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]						
<ol style="list-style-type: none"> 1. Study of vegetative and reproductive structures of Mastigomycotina (<i>Phytophthora</i>) and Zygomycotina (<i>Mucor/ Rhizopus</i>) by temporary mounts and through permanent slides. 2. Study of vegetative and reproductive structures of Ascomycotina (<i>Aspergillus and Penicillium/Peziza</i>) and Basidiomycotina (<i>Agaricus and Puccinia</i>) by temporary mounts and through permanent slides. 3. Study of vegetative and reproductive structures of Deuteromycotina (<i>Alternaria and Colletotrichum/ Fusarium</i>) 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	<ol style="list-style-type: none"> 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	Tutorial (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, and 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 and in pollution and waste management.	7	12			7
PRACTICAL [Credit : 01]						
	<ol style="list-style-type: none"> 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 : <ol style="list-style-type: none"> 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	Tutorial (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

	<p>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).</p> <p>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.</p> <p>Natural Rubber: Para-rubber: tapping, processing and uses.</p> <p>Fibres: Classification based on the origin of fibres; Cotton, Coir and Jute (morphology, extraction and uses).</p>					
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]						
	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	Tuitorial (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 and Expressivity, 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 Paramecium	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: CIB method. Role of Transposons in mutation. DNA repair 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 seed ratios (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		<p>On successful completion of the course, students will :</p> <ol style="list-style-type: none"> 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	Tutorial (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 Biotic Factors, 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, Lotka Volterra 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	<p>Phytogeography and Climate Change: Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Vegetation types of NE India with special reference to Assam.</p> <p>Climate change: Basic concepts; global warming, causes and consequences (Rise in Sea levels, Glacier melting, Biodiversity Loss), Adaptation, Mitigation, Global and National Efforts, Concept on Sustainable Development, Sustainable Development Goals (SDGs). Environmental impact assessment, Environmental laws, Climate Resilient Crops.</p>	7	10	1		7
PRACTICAL [Credit : 01]						
	<ol style="list-style-type: none"> 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 samples by rapid field tests. 6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. <ol style="list-style-type: none"> 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 CO ₂ 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, plant nomenclature. 2. Detailed knowledge of the phylogenetic and evolutionary relationships of angiosperms. 3. Able to obtain knowledge on various herbaria and botanical gardens in India and abroad, their role in plant systematics. 4. Acquainted with practical knowledge on vegetative and reproductive structures of angiosperms. 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	Tutorial (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 and Rules (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]						
	<ol style="list-style-type: none"> 1. Study of vegetative and floral characters of locally available angiospermic plants belonging to the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Fabaceae, Solanaceae, Asteraceae, Lamiaceae, Euphorbiaceae, Musaceae, Orchidaceae. 2. Field visits to familiarise students with vegetation of an area and identification of plant species / Visit to Academic or Research Institutions. 3. Mounting of properly dried and pressed specimens of at least 10 (ten) wild plant species with herbarium labels (to be 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. Microgametogenesis; 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 <i>in vitro</i> pollination; Modification of stigma surface, parasexual hybridization; Cybrids, <i>in vitro</i> 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 <i>Paeonia</i> . Seed structure, importance, and apomixes: their; Classification; Cause and applications.	8	14	1		9
PRACTICAL [Credit : 01]						
	<p>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.</p> <p>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.</p> <p>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).</p> <p>4. Female gametophyte through permanent</p>	30	40			30

<p>slides/ photographs: Types, ultrastructure of mature egg apparatus.</p> <p>5. Intra-ovarian pollination; Test tube pollination through photographs.</p> <p>6. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.</p> <p>7. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages.</p>					
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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	<ol style="list-style-type: none"> 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	Tutorial (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, CO ₂ reduction: C ₃ , C ₄ -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 Hydrolysis					
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]						
	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	Tutorial (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

	<p>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.</p> <p>Central dogma and genetic code: Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)</p>					
Unit-4	<p>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.</p>	8	12	2		10
Unit-5	<p>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.</p>	6	10	1		7
Unit-6	<p>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.</p>	6	10	1		7
PRACTICAL [Credit : 01]						
	<ol style="list-style-type: none"> DNA isolation from any plant material. DNA estimation by diphenylamine reagent/UV Spectrophotometry (Demonstration). Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication). Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs. 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.					
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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	<ol style="list-style-type: none"> 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	Tutorial (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	<p>5. Knowledge of various methods of Plant tissue culture and their application</p> <p>6. Knowledge of gene cloning, recombinant DNA technology and various methods of gene transfer in plants</p> <p>7. Knowledge of the application of genetic engineering techniques for agriculture.</p> <p>8. Ability to demonstrate tissue culture technique; isolate plasmid DNA and to carry out DNA manipulation using restriction enzymes</p>

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

Unit	Content	Lecture (L)	Marks	Tutorial (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]					
	<p>9. (a) Preparation of MS medium. (b) Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of any plant species.</p> <p>10. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.</p> <p>11. Isolation of protoplasts.</p> <p>12. Construction of restriction map of circular and linear DNA from the data provided.</p> <p>13. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.</p> <p>14. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.</p> <p>15. Isolation of plasmid DNA.</p> <p>16. Restriction digestion and gel electrophoresis of plasmid DNA.</p>	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	<p>On successful completion of the course, students will be able to:</p> <ol style="list-style-type: none"> 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

	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.					
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	10	1	-	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, Ramachandran plot, computer-aided drug discovery.	8	12	2	-	10
PRACTICAL [Credit : 01]						
	<ol style="list-style-type: none"> 1. Principle, techniques and procedure of emasculatation. 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	-	30	30

Title of the course		Major 17- Conservation Ecology and Biodiversity Assessment				
Course code		BOT-MJ-07024				
Total Credit (theory-practical)		04 (03+01)				
Contact hours		75 (Theory = 45 + Practical = 30)				
Distribution of Marks		Theory =60 + Practical = 40				
Course outcomes		<p>On successful completion of the course, students will:</p> <ol style="list-style-type: none"> 1. Understand the concept and importance of biodiversity 2. Understand biodiversity changes and factors associated with the changes 3. Understand the biodiversity assessment methods 4. Understand the ecological, social, and economic impacts of biodiversity loss, and 5. Learn the management principles and tools that are used to conserve diversity at various levels. 				
Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45						
Unit	Content	Lecture (L)	Marks	Tutorial (T)	Practical (P)	Total Hours
Unit-1	Conservation Ecology- Concept, principles, postulates and ethics, genetic variation and its loss, variation in natural populations, Species and habitat conservation- prioritizing species and habitat, protected area networks; major approaches to their management, Indian case studies on conservation/ management strategy.	7	10	1	-	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.	7	8	-	-	7
Unit-3	Biodiversity: Concept, levels, types and Importance, 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	8	12	2	-	10

	distribution in India, problem in wildlife protection, role of WWF, WCU, CITES, TRAFFIC.					
Unit-5	Biodiversity Assessment: Concept and Importance, methodology of assessment and analysis of different species 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. Role of remote sensing (RS) and GIS in biodiversity conservation.	7	10	-	-	7
Unit-6	Protected Area Network: Concept, History, Indian Scenario: Biospheres, National Parks and Wildlife Sanctuaries, Wildlife conservation projects, Conservation population, design and management of protected areas; problems of protected areas in India, connectivity and corridors; population biology of endangered species. Population viability analysis, Wildlife conservation in NE India- Case Studies	7	12	-	-	7
PRACTICAL [Credit : 01]						
	<ol style="list-style-type: none"> 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 MS-Access: Creation of databases, tool bars, menu bars, opening of a data bar, entry format, entry of data, saving and formatting of data, queries of data, sorting 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			30

Title of the course	Major 18- <i>Plant diseases, diagnostic and management</i>
Course code	BOT-MJ-07034
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	<p>On completion of the course, students will-</p> <ol style="list-style-type: none"> 1. 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. 2. 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. 3. 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. 4. 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. 5. 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 [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 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	-	-	6
Unit-2	Dissemination of plant pathogens; disease cycle; physiological changes due to disease in plants; Genetics of plant diseases	7	10	1	-	8
Unit-3	Diagnosis of Plant Diseases: Visual identification of common plant diseases, Laboratory techniques (microscopy, culturing, and serological tests); molecular methods (PCR, DNA	7	12	1	-	8

	sequencing, and ELISA)					
Unit-4	Epidemiology of plant diseases; Disease mapping, forecasting and surveillance techniques	8	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	7	12	1	-	8
Unit-6	Resistant gene identification and development of disease resistant plant (Traditional and biotechnological approach), GMO (bt-cotton, bt- brinjal, bt-chickpea)	7	12	-	-	7
PRACTICAL [Credit : 01]						
	<ol style="list-style-type: none"> 1. Study of plant disease symptoms and their causal organisms 2. Isolation and identification of pathogen from diseased plant materials 3. Isolation of soil borne fungal pathogens and their control 4. Proving of Koch's postulate at least one disease 	30	40	-	30	30

Title of the course	Major 19- Environmental Microbiology
Course code	BOT-MJ-07044
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	<p>On completion of the course, students will be able to-</p> <ol style="list-style-type: none"> 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 [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tutorial (T)	Practical (P)	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	10	1	-	8
Unit-3	Culture-independent microbial study (direct microscopic methods, meta-genomics, transcriptomics, proteomics and metabolomics)	7	12	1	-	8
Unit-4	Microbial interactions (symbiosis, antagonism, parasitism, commensalism, amensalism, cooperation, quorum and anti-quorum sensing)	8	8	-	-	8
Unit-5	Biogeochemical cycling (Role of microbes in biogeochemical cycling, carbon cycle, nitrogen cycle, sulfur cycle, phosphorus cycle)	7	12	1	-	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]						
		30	40	-	30	30

<ol style="list-style-type: none"> 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 					
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Title of the course	RC1 - Research Methodology
Course code	BOT-RC-07014
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	<p>On successful completion of the course, students will be able to:</p> <ol style="list-style-type: none"> 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 [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tutorial (T)	Practical (P)	Total Hours
Unit-1	Research methodology: Research concept, Identification of research gap, 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	10	1	-	8
Unit-3	Statistical analysis and data representation: SD, SE, Correlation and Regression, Test of significance, ANOVA, Post-hoc analysis, 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	12	1	-	8

Unit-4	Scientific writings: Forms of scientific writing i.e. research articles, reports, review, dissertation/thesis etc. Components of research article, Writing strategy for a research article. Research ethics and Plagiarism	8	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	12	1	-	8
Unit-6	Basic knowledge on analytical (Principle and application of UV-Vis, IR, FTIR and NMR Spectroscopy), Basic knowledge on separation techniques (Principle 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]						
	<ol style="list-style-type: none"> 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	-	30	30

DETAIL SYLLABUS OF 8TH SEMESTER

B.Sc Botany with Honours

Title of the course		Major 20- Molecular Genetics and Cell Signaling				
Course code		BOT-MJ-08014				
Total Credit (theory-practical)		04 (03+01)				
Contact hours		75 (Theory = 45 + Practical = 30)				
Distribution of Marks		Theory =60 + Practical = 40				
Course outcomes		<p>On successful completion of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Identify and describe the different types of RNA (mRNA, tRNA, rRNA, siRNAs, miRNAs) and their roles in gene expression and regulation. 2. Explain the mechanisms of transcription, RNA processing, and the operon concept in prokaryotes, including the roles of RNA polymerases, promoters, enhancers, and transcription factors. 3. Apply molecular genetic techniques such as electrophoresis, restriction digestion, ligation, PCR amplification, and DNA cloning to manipulate and analyze genetic material. 4. Analyze the results of genetic manipulation experiments, such as plant and bacterial transformation, gene silencing using RNAi, and genome editing using CRISPR/Cas9, to assess the effectiveness of these techniques. 5. Evaluate the role and impact of various cell signaling pathways, including hormone-receptor interactions and second messenger systems, in regulating cellular processes and responses. 				
Theory [Total Marks : 60] Credit :03 : Total No. of Classes : 45						
Unit	Content	Lecture (L)	Marks	Tuitorial (T)	Practical (P)	Total Hours
Unit-1	Structure and processing of messenger RNA, transfer RNA, ribosomal RNA, small interfering RNAs and micro RNAs, regulation through RNA processing and decay, alternative splicing	6	8	-	-	6
Unit-2	Transcription, RNA polymerases, initiation, elongation and termination; eukaryotic promoters, enhancers, transcription factors, processing of mRNA for translation. Operon concept in prokaryotes, Mutation and DNA repair	7	12	1	-	8
Unit-3	Molecular genetic techniques, Electrophoresis, restriction digestion, ligation, DNA probes and hybridization, DNA cloning, Cloning and expression vectors, genomic and cDNA library,	8	10	2	-	10

	PCR amplification, Plant and bacterial transformation, DNA sequencing. Genetic manipulation in plants					
Unit-4	Cell Signaling I: Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G protein coupled receptors, Ion channel linked receptors, Enzyme linked receptors	6	8	-	-	6
Unit-5	Cell signaling II: Signal transduction pathways, second messengers, regulation of signaling pathways, bacterial chemotaxis and quorum sensing, to component regulations.	7	12	1	-	8
Unit-6	Applications of molecular genetic techniques: Developing transgenic plants, Genome editing in plants using CRISPR/Cas9 system, Gene silencing using RNAi, Gene therapy	7	10	-	-	7
PRACTICAL [Credit : 01]						
	1. Isolation of genomic DNA from plant materials, purification, estimation, separation with gel electrophoresis and documentation 2. RNA isolation and cDNA synthesis 3. PCR reaction and gel electrophoresis 4. Restriction digestion and mapping 5. Transformation of plasmids in bacteria 6. Plasmid isolation 7. Differential gene expression study using semi quantitative PCR or qPCR	30	40	-	30	30

Title of the course	Major 21- Fungal Diversity, Genetics, and Applications
Course code	BOT-MJ-08024
Total Credit (theory-practical)	04 (03+01)
Contact hours	75 (Theory = 45 + Practical = 30)
Distribution of Marks	Theory =60 + Practical = 40
Course outcomes	<p>On completion of the course, students will-</p> <ol style="list-style-type: none"> 1. Demonstrate an understanding of the diversity of fungi, their global distribution, and the methods used for estimating and conserving fungal diversity. 2. Analyze the roles of different types of fungi in various ecosystems, including soil, plants, and their applications in agriculture and medicine. 3. Apply molecular genetic techniques to analyze fungal genomes, understand the mechanisms of genetic inheritance, and explore the molecular basis of fungal traits and behaviors. 4. Evaluate the significance of genetic elements, such as mating-type switching and retrotransposons, in fungal evolution and adaptation to different environments. 5. 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 [Total Marks : 60] Credit :03 : Total No. of Classes : 45

Unit	Content	Lecture (L)	Marks	Tuitorial (T)	Practical (P)	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	7	10	2	-	9
Unit-4	Mating-Type switching in Yeasts; Extra-chromosomal inheritance in fungi; Sex hormones in fungi; Retroposon and retrotransposon in fungi	8	14	1	-	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	8	12	2	-	10

	agriculture; Myconanotechnology; Mycoremediation and mycofumigation; Mycoses (Types, diagnosis, and treatments)					
PRACTICAL [Credit : 01]						
<ol style="list-style-type: none"> 1. Isolation and enumeration of soil fungi 2. Study of phytopathogenic fungi from diseased samples 3. Molecular identification of fungal specimen 4. Fungal tissue- culture; cultivation of edible mushroom 5. Isolation and determination of secondary metabolites from fungi 	30	40	-	30	30	

Title of the course	Major 22- Exploring Cryptogams and Gymnosperms
Course code	BOT-MJ-08034
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 Classification of algae based on recent trends. 2. Evaluate ecological roles and importance of these groups. 3. Analyze the evolutionary history and diversity of Algae, Bryophytes, Pteridophytes and Gymnosperms. 4. Synthesize knowledge of morphology and reproduction to understand evolutionary adaptations in Cryptogams. 5. Interpret the classification and characteristics of gymnosperm taxa to infer evolutionary relationships

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

Unit	Content	Lecture (L)	Marks	Tutorial (T)	Practical (P)	Total Hours
Unit-1	Algae: Recent trends in the classification, thallus structure and pigmentation among different groups, patterns of life cycle and post fertilization stages in Chlorophyta, Xanthophyta, Phaeophyta and Rhodophyta	6	10	-	-	6
Unit-2	Ecological importance in different habitats, Algal indicators, Algal blooms, Eutrophication, Productivity in fresh water and marine environment, symbiotic association, Algal culture.	7	10	1	-	8
Unit-3	Bryophytes: Origin, evolution, classification, diversity and distribution in North East India, Economic importance. Morphological, anatomical and reproductive diversity, Morphogenesis, Evolution of gametophytes and sporophytes; Bryophytes as pollution indicator and monitoring.	6	10	-	-	6
Unit-4	Pteridophyta: Origin and evolution of Pteridophytes; Telome concept; heterospory and origin of seed habit; classification of vascular cryptogams. Morphological, anatomical and reproductive diversity, soral evolution in ferns. Evolution of stele.	7	10	1	-	8
Unit-5	Palaeobotany: Geological time scale,	6	10	-	-	6

	fossilization process, techniques in studying fossils.					
Unit-6	Gymnosperms: Classification and salient features of major taxa; characteristics, affinities and relationships of Ginkgoales, Coniferales and Gnetales.	7	10	1	-	8
PRACTICAL [Credit : 01]						
	<ol style="list-style-type: none"> 1. Study of some important genera of Algae with respect to their morphology, anatomy and reproductive structures. Algal culture technique. 2. Study of some important genera of Bryophytes available in NE India with respect to their morphology, anatomy and reproductive structures. 3. Study of some important fossil and living members of major groups of Pteridophytes. 4. Study of morphological, anatomical and reproductive features of gymnosperms available in the region. 	30	40	-	30	30

Title of the course		Major 23- Plant Growth and Morphogenesis				
Course code		BOT-MJ-08044				
Total Credit (theory-practical)		04 (03+01)				
Contact hours		75 (Theory = 45 + Practical = 30)				
Distribution of Marks		Theory =60 + Practical = 40				
Course outcomes		<p>On successful completion of the course, students will be able to:</p> <ol style="list-style-type: none"> 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 [Total Marks : 60] Credit :03 : Total No. of Classes : 45						
Unit	Content	Lecture (L)	Marks	Tuotorial (T)	Practical (P)	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	12	1	-	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 Triacntanol, Salicylic acid, and Polyamines. A brief idea about role of plant growth retardants- CCC, Maleic hydrazide, Trizoles and TIBA.	7	10	1	-	8
Unit-5	Senescence and Programmed Cell Death (PCD), Totipotency: Biochemical changes during senescence of leaves and petals and regulation of senescence. PCD: Biochemical changes	7	10	1	-	8

	in cellular level, regulation of PCD, caspases and metacaspases.					
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	12	1	-	8
PRACTICAL [Credit : 01]						
	<ol style="list-style-type: none"> 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	-	30	30