

**SYLLABUS**  
**CHOICE BASED CREDIT SYSTEM**  
**SYLLABUS**  
**M. Sc. BOTANY**  
(Effective from Academic Session 2020-2021)

**Department of Botany**  
**Nowgong College (Autonomous)**  
**Assam -782001**

## First Semester

**Theory: Three Hours**

**Practical: Five hours**

### Allotments of Marks and Credits

<i>Papers</i>	<i>Course work</i>	<i>Internal Assessment</i>	<i>Total</i>	<i>Credit</i>	<i>Class/Week</i>
<b>BOTA-1016</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>6</b>	<b>5</b>
<b>BOTA-1026</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>6</b>	<b>5</b>
<b>BOTA-1036</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>6</b>	<b>5</b>
<b>BOTA-1044</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>4</b>	<b>9</b>
<b>BOTA-1054</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>4</b>	<b>9</b>
<b>Total</b>	<b>400</b>	<b>100</b>	<b>500</b>	<b>26</b>	<b>33</b>

## Semester-I

### BOTANY

#### Postgraduate Course

#### BOTA-1016

#### Diversity – I (Algae, Fungi, Bryophytes)

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:6**

### THEORY

#### Unit-I

Algae: Diversity and classification, recent trends in the classification, pigmentation, morphology and reproduction, phylogeny and interrelationships among different groups, patterns of life cycle and post fertilization stages in Chlorophyta, Xanthophyta, Phaeophyta and Rhodophyta, Ecological importance in different habitats, Algal indicators, Algal blooms, Eutrophication, Productivity in fresh water and marine environment, symbiotic association, Algal culture.

#### Unit-II

Fungi: Characteristics of fungi and cell structure, recent trends in classification and phylogeny, major groups and their interrelationships. Different mode of reproduction, parasexuality and degeneration of sex in fungi.

#### Unit-III

Fungi: Physiological and ecological specialization (coprophilous, cellulolytic, entomogenous and

lignolytic); Mutualism: Mycorrhiza, Lichen; Parasites: common parasites of plants and humans, Saprophytes - decomposition of organic matter, Economic importance.

#### **Unit-IV**

Lichen: Classification and nomenclature, structure and reproduction, mechanism of phycobiont and mycobiont interaction, lichen as ecological indicator.

#### **Unit-V**

Virus: Types and nomenclature of viruses, replication of RNA and DNA viruses, virus-vector relationships, tumor virus, viroids, prions and interferons. Bacterial cell: Ultra structure, cell wall, different groups of bacteria, recent developments in classification.

#### **Unit-VI**

Bryophytes: Origin, evolution, classification, biochemistry, physiology and ecology; 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.

#### ***Suggested Readings: -***

##### UNIT I

1. The Algae World, Dinabandhu Sahoo, Joseph Seckbach, Springer 2015 (16 December 2015)
2. Botany for Degree Students: Algae, B.R Vashishta, Dr. A. K Sinha and Dr. Adarsh Kumar, S Chand & Company; 2nd edition (1 December 2010)
3. Textbook of Algae, O.P. Sharma (Tata McGraw-Hill Education, 2011)
4. The Algae, V.J., D.J. Chapman (Springer, 01-Jan-1973)
5. Algae and Sustainable Technologies Bioenergy, Nanotechnology and Green Chemistry, Atul Kumar Upadhyay, D. P. Singh (9 November 2020; DOI: <https://doi.org/10.1201/9781003001911>)

##### UNIT II, III and IV

1. Botany for Degree Students: Fungi, B.R Vashishta, Dr. A. K Sinha and Dr. Adarsh Kumar, S Chand & Company (1 January 2016)
2. Fungi and Plant Pathology, Saras Publication- Tamil Nadu (1 January 2016)
3. Mycology and Microbiology (A Textbook for UG and PG Courses) (K.V.B.R. Tilak, K.V. Mallaiah, C. Manoharachary, I.K. Kunwar; Scientific Publishers (India); Edition: 1, 2016)

##### UNIT V

1. Prescott's Microbiology, Joanne Wiley, Kathleen Sandman and Dorothy Wood, McGraw-Hill Education; 10th edition (16 February 2016)

## UNIT VI

1. Botany for Degree Students: Bryophytes, B.R Vashishta, Dr. A. K Sinha and Dr. Adarsh Kumar, S Chand & Company; 2nd edition (1 December 2010)
2. Introduction to Bryophytes; Alain Vanderpoorten, Bernard Goffinet; Cambridge University Press, 28-May-2009

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## **BOTANY**

### **Postgraduate Course**

### **BOTA-1026**

### **Diversity – II (Pteridophytes, Gymnosperms and Angiosperms)**

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:6**

## **THEORY**

### **Unit-I**

Pteridophyta: Origin and evolution of Pteridophytes; Telome concept; stellar evolution; heterospory and origin of seed habit; classification of vascular cryptogams. Morphological, anatomical and reproductive diversity, soral evolution in ferns, gametophytic structure in eusporangiate and leptosporangiate forms and evolution of sex.

### **Unit-II**

Palaeobotany: Geological time scale, fossilization process, classification and nomenclature of fossil plants, techniques in studying fossils, fossils vs. evolution. General account of major fossil groups - Psilophytales, Zosterophyllales, Sphenophyllales, Calamitales, Coenopteridales.

### **Unit-III**

Gymnosperms: Classification and salient features of major taxa; characteristics, affinities and relationships of Ginkgoales, Coniferales, Taxales and Gnetales.

### **Unit-IV**

Angiosperms: Historical background of Plant Taxonomy; Pre Darwinian, Post Darwinian and recent system of classifications (Takhtajan, Cronquist, APG); recent trends in Taxonomy; ICN- History, Principles and major rules of nomenclature, type concept, principles of priority and its limitation, effective and valid publication, author citation; plant collection and documentation; importance of

botanical gardens and herbaria in taxonomic studies: important botanical gardens in India and abroad; Botanical Survey of India.

### **Unit-V**

Phylogeny and affinities of Magnoliales, Ranunculales, Euphorbiales, Scrophuriales, Lamiales, Asterales, Orchidales, Zingiberales, Poales.

### **Unit-VI**

Morphology: Origin and evolution of Angiosperms; Inflorescence and flowers; Co- evolution of flower and pollinators; Morphology of stamens and carpels; staminodia; nectaries; types of ovaries, morphology of inferior ovary; placenta and placentation.

### ***Suggested Readings: -***

A Text Book of Archegoniates. Baman Chandra Acharya. Kalyani Publishers 2020.

#### **UNIT I**

1. Botany for Degree Students: Pteridophytes, B.R Vashishta, Dr. A. K Sinha and Dr. Adarsh Kumar, S Chand & Company; 2nd edition (1 December 2010)
2. A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany; [A. V. S. S. Sambamurty](#); 30 December 2013
3. Pteridophyta, O.P.Sharma; McGraw Hill Education; 1 July 2017

#### **UNIT II**

1. An Introduction to Paleobotany. Arnold Chester A. McGraw Hill Book Company.
2. Paleobotany: The Biology and Evolution of Fossil Plants, Thomas N. Taylor, Edith L. Taylor, Micheal Krings, Academic Press, 21-Jan-2009 - Science
3. Elements of Paleobotany Dr. A. K. Siddiqui. Kitab Mahal. Sarojini Naidu Marg, Allahabad.

#### **UNIT III**

1. Botany for Degree Students: Gymnosperms, B.R Vashishta, Dr. A. K Sinha and Dr. Adarsh Kumar, S Chand & Company; 2nd edition (1 December 2010)

#### **UNIT IV, V and VI**

1. Plant Systematics, Gurcharan Singh, 4<sup>th</sup> edition, CBS Publishers & Distributors, 30 October, 2020)
2. Plant Taxonomy, O.P Sharma, McGraw Hill Education; 2nd edition (1 July 2017).
3. Advanced Plant Taxonomy, A.K Mondal, New Central Book Agency; 2nd Revised edition (1 January 2009)
4. Plant Taxonomy, Akhil Baruah, EBH Publishers (India) (1 January 2013)
5. Advanced Morphology of Angiosperms, Akhil Baruah. Aavishkar Publishers & Distributors (1 January 2008)
6. Flora of Assam. Volume 1-5. U. N. Kanjilal et.al. 2013. M/S Bishen Singh Mahendra Pal Singh, Dehradun.

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## **BOTANY**

### **Postgraduate Course**

### **BOTA-1036**

#### **Plant Ecology, Environment and Resource Management**

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:6**

#### **THEORY**

##### **Unit –I**

The Environment- physical and biotic; Definition, principle and scope of ecology, ecological factors. Concept of habitat and niche, resource partitioning; character displacement.

##### **Unit -II**

Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection). Community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Methods of studying plant communities. Ecological succession- types; mechanisms; changes involved in succession; concept of climax. Ecosystem- types; structure; function; energy flow and mineral cycling (C, N, P & S).

##### **Unit -III**

Biodiversity – concept, components and types; importance of biodiversity conservation, Principles and practices, different approaches for biodiversity conservation-In-situ and ex- situ conservation.

##### **Unit -IV**

Environmental pollution- sources, types of pollutants of various industrial effluents such as pulp and paper mills, oil exploration and refinery, petrochemicals, iron and steel industries, domestic wastes, organic debris, agricultural wastes, pesticides. Effects of pesticides on soil components, residual toxicity and pollution. Global climate change: greenhouse effects, ozone layer depletion, acid rain.

##### **Unit -V**

Origin, evolution, botany, cultivation and uses of (i) Food & beverage (ii) fiber & oil (iii) medicinal and aromatic plants; important timber-yielding plants and NTFPs. Green revolution: Benefits and adverse consequences, innovations for meeting world food demands, GMO, INM, IPM.

##### **Unit -VI**

Dynamic phytogeography and its basic principles, theories and hypotheses, centres of origin of cultivated plants, plant migration, theory of tolerance, age and area hypothesis, concept of endemism, mega centres of endemism in India, endemic plants of India with special reference to N E India,

phytogeographic regions of the world and India and their characteristic vegetations. Characteristic flora of N E India.

***Suggested Readings: -***

UNIT I - VI

1. Ecology and Environment, P.D Sharma, Rastogi Publications; 13th edition (1 January 2017)
2. Elements of Ecology, Thomas M. Smith and Robert Leo Smith, Pearson; 4th edition (19 February 1998)
3. Fundamentals of Ecology, Eugene P. Odum and Gary W. Baret, Cengage; 5th edition (15 November 2017)
4. Pathfinder Academy: CSIR-JRF-NET Life Sciences Book Combo Set with Ecology Paperback; [Pranav Kumar & Usha Mina](#); Pathfinder Publication; 1 January 2020
5. Environmental Pollution. Dr. R. K. Khitoliya. S. Chand & Company PVT. LTD.
6. Fundamentals of Plant Ecology and Phytogeography. Arun Chandra Sahu. Kalyani Publishers 2021
7. The Nature and Properties of Soils (Brady and Weil; Pierson/Prentice Hall Publisher) The current edition is the 14th edition.  
website: <https://www.soils.org/files/certifications/fundamentals-exam-objectives.pdf>

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**BOTANY**

**Postgraduate Course**

**BOTA-1044**

**Algae, Fungi, Bryophytes and Pteridophytes**

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:4**

**PRACTICAL**

1. Study of range of thallus organization and reproductive structures of algae with the help of suitable representatives.
2. Gram staining, flagella staining, capsule staining and acid-fast staining of bacteria.
3. Collection and study of symptoms of virus infected plants.
4. Study of morphological, anatomical and reproductive features of some fungi growing in Assam
5. Study of morphological and anatomical features of some lichens growing in Assam
6. Study of some important genera of Bryophytes available in NE India with respect to their

morphology, anatomy and reproductive structures.

7. Study of some important fossil and living members of major groups of Pteridophytes.

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## **BOTANY**

### **Postgraduate Course**

#### **BOTA-1054**

#### **Gymnosperms, Angiosperms, Plant Ecology and Resource Management**

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:4**

### **PRACTICAL**

1. Study of morphological, anatomical and reproductive features of gymnosperms available in the region.
2. Study of Angiospermic plants with analytical drawings, botanical description and identification up to the rank of species
3. Study of special types of inflorescence, primitive and advance flowers, ovaries and fruits
4. Collection and preparation of herbarium specimens of common plants for familiarization of herbarium techniques.
5. Determination of minimum size and number of quadrates necessary to study herbaceous communities
6. Determination of abundance, density, frequency, basal cover of plant communities by quadrat method.
7. Estimation of above ground and below ground biomass from unit area.
8. Effect of biotic disturbances on botanical composition.
9. Study of similarity between plant communities using index of similarity and dissimilarity.
10. Estimation of dissolved oxygen content in eutrophic and oligotrophic water samples.
11. Study on effects of effluents/contaminants on plant growth.
12. Morpho-anatomical adaptive features of hydrophytes and xerophytes.
13. Preparation of a map of India showing biogeographical zones.
14. To plot Biosphere Reserves/ Ramsar sites/ National Parks/Wildlife Sanctuaries located in different biogeographical zones of India in general and NE India in particular.
15. Morphological and anatomical studies on economically important plants/ Part (s) of Cotton, Jute, Tea, Bay leaf, Rauwolfia, Tulsi.



16. Field study report.

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## Second Semester

**Theory: Three Hours      Practical: Five hours**

### Allotments of Marks and Credits

<i>Papers</i>	<i>Course work</i>	<i>Internal Assessment</i>	<i>Total</i>	<i>Credit</i>	<i>Class/Week</i>
<b>BOTA-2016</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>6</b>	<b>5</b>
<b>BOTA-2026</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>6</b>	<b>5</b>
<b>BOTA-2036</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>6</b>	<b>5</b>
<b>BOTA-2044</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>4</b>	<b>9</b>
<b>BOTA-2054</b>	<b>80</b>	<b>20</b>	<b>100</b>	<b>4</b>	<b>9</b>
<b>Total</b>	<b>400</b>	<b>100</b>	<b>500</b>	<b>26</b>	<b>33</b>

## Semester-II

### BOTANY

#### Postgraduate Course

#### BOTA-2016

#### Cytogenetics, Plant Breeding and Evolution

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:6**

### THEORY

#### Unit -I

Cell organelles, structural organization and function of intracellular organelles, cytoskeleton; chromosomes-structure of prokaryotic and eukaryotic chromosomes, centromeres and telomeres. specialized chromosomes, euchromatin and heterochromatin, cell division and cell cycle, regulation and control.

## **Unit-II**

Genome organization, genome size and C-value paradox, DNA packaging, unique and repetitive DNA, linkage, recombination and crossing over, linkage mapping. sex-linked inheritance, cytoplasmic inheritance.

## **Unit-III**

Transcriptional regulation in prokaryotes, operon system for lactose, tryptophan and arabinose metabolism; Molecular basis of mutation, spontaneous, reverse and suppressor mutations, transposable genetic elements.

## **Unit-IV**

DNA damage and repair; Genetic disorders, inborn errors of metabolism, metabolic pathways, overview of the metabolic basis of inherited diseases. `

## **Unit-V**

Principle of plant breeding; distant hybridization, barrier to distance hybridization, techniques for distant hybridization; back Cross methods of plant breeding; breeding for quantitative characters, handling of quantitative data, environmental effect on quantitative characters, estimation of heritability and genetic advance.

## **Unit-VI**

Evolution, co evolution, Lamarckism, Darwinism, synthetic theory, Weismann's theory, modern theory of evolution-mutation theory.

### ***Suggested Readings: -***

1. Principles of Genetics; Gardner E.J.; Wiley India; 8<sup>th</sup> Edition (2015).
2. Cell Biology, Genetics, Molecular Biology; Verma P.S.; S Chand & Co Ltd.
3. Evolutionary Genetics: Concepts, Analysis, and Practice; Glenn-Peter Saetre.
4. Fundamentals of Genetics; B.D. Singh and Payal Bansal; Kalyani Publishers (2017).
5. Cytology, Genetics and Plant Breeding; P.K Gupta.

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**BOTANY**  
**Postgraduate Course**  
**BOTA-2026**

**Microbiology and Plant Pathology**

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:6**

**THEORY**

**Unit-I**

Microbial diversity: 'Species' and 'Strain' concept in microbiology, ICN for virus, bacteria and other microbes, microbiome concept, ecological significance of microbes, microbiology of soil, air, water and milk, Economic importance.

**Unit-II**

Microbial techniques: sterilization techniques, population estimation (direct spore count, CFU, spectrophotometric method), pure culture and visualization techniques, culture preservation and maintenance, taxonomic and functional characterization of microbes.

**Unit-III**

Microbial genetics & Physiology: Mode of reproduction (vegetative, asexual & sexual), genetic recombination, mode of nutrition, growth conditions and nutritional requirements, different metabolic pathways (respiratory and photosynthetic).

**Unit-IV**

Plant Pathology: Principles of plant pathology, mechanism of pathogenesis, symptomatology and epidemiology, host defense mechanism, causal organism and etiology of certain important plant diseases occurred in NE India

**Unit-V**

Immunology: Innate and acquired immunity, antibodies, cells and tissues of the immune system, immune diseases, serological reactions and serodiagnostics, cancer biology,

**Unit-VI**

Applied microbiology: Application of microbes in the field of agriculture, fermented foods and dairy products, industry and bio-waste management.

***Suggested Readings: -***

1. Fungi and Plant Pathology, N. Arumugam, V. Kumaresan and Annie Ragland. Saras Publication-Tamil Nadu (1 January 2016)
2. Mycology and Microbiology (A Textbook for UG and PG Courses) (K.V.B.R. Tilak, K.V. Mallaiah, C. Manoharachary, I.K. Kunwar; Scientific Publishers (India); Edition: 1, 2016.
3. Plant Pathology; R.S. Mehrotra and Ashok Aggarwal (2017).
4. Introduction To Principles of Plant Pathology; R S Singh; Medtech (2017).
5. Plant Pathology at a Glance; R P Singh; Daya Publishing House.
6. Microbiology and Phycology; Amit Jain; Mahaveer Publications.
7. A Textbook of Microbiology; D K Maheshwari and R C Dubey; S Chand Publishing.

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**BOTANY**

**Postgraduate Course**

**PG-BOTA-2036**

**Plant Physiology and Biochemistry**

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:6**

**THEORY**

**Unit-I**

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Biomolecules: their structures and functions: Carbohydrate, lipids, proteins.

**Unit-II**

Enzymes: Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes; Protein synthesis and processing: Nitrate and ammonium assimilation; amino acid biosynthesis. Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins.

**Unit-III**

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective

mechanisms; CO<sub>2</sub> fixation-C<sub>3</sub>, C<sub>4</sub> and CAM pathways.

Respiration and photorespiration: Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Sensory photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement. Scotomorphogenesis and photomorphogenesis.

#### **Unit-IV**

Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Hormones in defence against abiotic and biotic stresses.

#### **Unit-V**

Physiology of plant Reproduction: Reproductive strategies in higher plants and their significance. Flowering as a multi-organ function, floral induction, evocation and development. Regulation of flowering by light and temperature. Role of circadian rhythms. Involvement of hormones. Genetic, molecular and biotechnological aspects. Manipulation of flowering and horticulture. Vegetative propagation with special reference to epiphyllous budding.

#### **Unit-VI**

Solute transport and photo-assimilate translocation: uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; mechanisms of loading and unloading of photo assimilates and Tracer Techniques.

#### ***Suggested Readings: -***

1. Outline of Plant Physiology. Robert M. Devlin. 1<sup>st</sup> Edition. Medtech Publisher
2. A Textbook of Plant Physiology, Biochemistry and Biotechnology; S K Verma and Mohit Verma; S Chand Publication. (1995).
3. Plant Physiology and Biochemistry; H. S. Srivastava and N. Shankar; Rastogi Publications (2005). Biochemistry and Physiology of Plant Hormones; Thomas C. Moore; Springer.
4. Plant Physiology and Biochemistry; B.V. Pandey and P. Verma; Ram Prasad Publication (2019).
5. A Quick Approach to Plant Physiology, Biochemistry and Biotechnology; B.Bose, R.K. Singhal and J. Chauhan; Jain Brothers.
6. Developments in Physiology, Biochemistry and Molecular Biology of Plants: Vol. 1; Bandana Bose and A. Hemantaranjan (Editor); New India Publishing Agency (2005).

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## **BOTANY**

### **Postgraduate Course**

### **PG-BOTA-2044**

#### **Microbiology, Plant pathology and Cytogenetics**

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:4**

#### **PRACTICAL**

1. Isolation and pure culture of microbes from soil, air and water
2. Identification and characterization of isolated pure cultures
3. Estimation of water quality
4. Identification and characterization of Curd bacteria and nodule bacteria
5. Methylene blue reductase test for bacterial contamination of milk
6. Estimation of bacterial growth by spectrophotometric method and counting of cells
7. Effect of physical and chemical factors on growth of microbes
8. Study of plant pathogenic fungi from diseased specimens (symptoms, causal organism and their morphological & reproductive characters)
9. Spore measurement and camera lucida diagram
10. Chromosome analysis (Karyotype), study of chromosome behaviour in mitosis and meiosis, chromosome anomalies in plant cells.
11. Principle, techniques and procedure of emasculation.

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## **BOTANY**

**Postgraduate Course**

**PG-BOTA-2054**

**Plant Physiology and Biochemistry**

**Total Lectures:80; Internal Assessment:20; Total marks:100; Credits:4**

### **PRACTICAL**

1. Preparation of normal, molar, molal and ppm solutions
2. Extraction of proteins from plant materials and estimation by Lowry's method using BSA standard curve.
3. Extraction of carbohydrates from plant materials and estimation of reducing and non-reducing sugars.
4. Extraction of oil/fat from plant materials
5. Extraction of plant phenols and estimation of total phenols.
6. Extraction of chloroplast pigments and quantitative estimation; Determination of Chlorophyll a/b ratio and total chlorophyll in C<sub>3</sub>, C<sub>4</sub> and CAM plants.
7. Separation of amino acid mixture by thin layer / paper chromatography.

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**THIRD SEMESTER**  
**Allotment of Marks and Credits**

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOTA-3016	80	20	100	6	5
BOTA-3026	80	20	100	6	5
BOTA-3036 (Open/ Elective)	80	20	100	6	5
BOTA-3044	80	20	100	4	9
BOTA-3054	80	20	100	4	9
Total	400	100	500	26	33

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Examination Time:    Theory .....3 (Three Hours);          Practical...5 (Five Hours)

**BOTA-3016 (Theory)**  
**(Reproductive and Developmental Botany, Biostatistics)**

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**Unit-I**

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogen gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; genomic imprinting; mutants and transgenics in analysis of development.

**Unit-II**

Sporogenesis and Gametogenesis in plants; pollination, double fertilization, embryogenesis, development of endosperms, types of endosperms; polyembryony, seeds and seed development, seed dispersal; apomixis, apospory, parthenocopy; comparative embryology

**Unit-III**

Morphogenesis and organogenesis in plants: Organization of shoot and root apices; shoot and root development; root-stem transition; leaf development and phyllotaxy; Transition to flowering and development of flower



#### Unit-IV

Periderm: Origin and activity, Rytidome, protective tissue in Monocotyedons, bark and cork;  
Cambium: Origin, function, behaviour (normal and abnormal).

#### Unit-V

Palynology: Pollen morphology, ultrastructure, pollen chemistry, viability, storage and adaptation;  
Applications of palynology: aeropalynology and pollen allergy, melissopalynology, forensic palynology, palaeopalynology and hydrocarbon exploration.

#### Unit-VI

Biostatistics: Measures of central tendencies; mean, mode, median, standard errors and standard deviations; Probability; Degrees of freedom, Null hypothesis, T-test, Chi Square test, F-test; Analysis of variance (ANOVA): Variance and co-variance analyses, Correlation and methods of studying the correlation, Regression and methods of studying regression, Statistical software packages and their importance in data analysis.

#### Suggested Readings

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### **BOTA-3026 (Theory)** **(Molecular Biology, Plant Biotechnology & Bioinformatics)**

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#### **Unit-I:**

Physical properties of DNA (UV absorption spectra, denaturation and renaturation), DNA topology, DNA - Protein Interactions, DNA replication, RNA synthesis and processing, small RNAs

#### **Unit-II:**

Cell signalling: Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, bacterial chemotaxis and quorum sensing.

#### **Unit-III:**

Principles of genetic engineering, cloning vectors, enzymes involved in rDNA technology, transformations, IPR, legal and biosafety issues related to GMOs. DNA markers and its application in genetic diversity study, genome analysis, genetic mapping, molecular systematics and diagnosis.

#### **Unit-IV:**

Plant Tissue Culture: importance, requirements, culture medium, culture of plant tissues: root, meristem, anther, pollen and protoplast culture; *in vitro* differentiation: organogenesis and somatic embryogenesis; role of tissue culture in crop improvements, Somatic hybridization: protoplast fusion, cybrids

#### **Unit-V:**

Bioinstrumentation: Principles and types of microscopy, Spectroscopy (Ultraviolet-visible absorption spectroscopy, Fluorescence spectrophotometry, and MASS spectrophotometry), chromatography (Ion-exchange chromatography, Affinity chromatography, Gel filtration chromatography, Gas chromatography, High pressure Liquid Chromatography), electrophoresis techniques (SDS-PAGE), centrifugation techniques.

#### **Unit-VI:**

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.

### **Suggested Readings**

## **BOTA-3036 (Open) (Theory)** **(Environment and Forest Management)**

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#### **Unit- I:**

Concept of environment and ecosystem: Concept of Ecosystem, Components of ecosystem, Characteristics and functioning of an ecosystem, Food chains and food webs, Trophic levels, Ecological pyramids, Geochemical Cycles.

#### **Unit- II:**

Biodiversity: Importance and types of biodiversity, Causes and impact of biodiversity loss, Ecologically sensitive area, Biodiversity conservation, *in-situ* and *ex-situ* conservation, Role of Government and NGOs, People participation, community forest management, Eco-tourism, Traditional methods of biodiversity conservation initiatives in India

#### **Unit- III:**

Climate change and environment: Introduction, Causes, Impact, Initiatives. Future initiatives, Technologies to overcome climate change, National & International treaties, Indian initiatives, Disparity between developed and non-developed countries on environment issues related to climate change

#### **Unit- IV:**

Forest Management and Management Systems: Objective and principles; techniques; structure and dynamics, sustained yield relation; rotation, normal forest, growing stock; regulation of yield; management of forest plantations, commercial forests, forest cover monitoring. Village Forest Committees, Joint Forest Participatory Management. Agro-forestry, Social Forestry, Urban Forestry; Application of genetic engineering and tissue culture techniques in forest and environment

management.

**Unit- V:**

Forest legislation: History of forest development; Indian Forest Policy of 1894, 1952 and 1990; National Forest Policy, 1988 of People's involvement, Joint Forest Management, Involvement of women; Forestry policies and issues related to land use, timber and non-timber products, sustainable forest management; industrialisation policies; Indian Forest Act 1927; Forest Conservation Act, 1980; Wildlife Protection Act 1972 and their amendments;

**Unit- VI:**

Case studies on environment and forest management with special reference to North-East India – Afforestation, Human Animal Conflicts and Co-existence and Sustainable Forest management.

**Suggested Readings**

**BOTA-3044 (Practical)**

**(Anatomy, Reproductive and Developmental Botany, Biostatistics)**

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1. Study of anomalous secondary growth of selective families of angiosperms.
2. Study of developmental stages of leaf, stem and root.
3. Preparation of pollen grain slides by following different techniques.
4. Study of microsporogenesis, megasporogenesis, embryo sacs and endosperms with the help of permanent slides.
5. Preparation of permanent slides by the process of microtome technique
6. To work out mean, mode, median, standard errors and standard deviation
7. Field study and visit to different Research Institutions/Universities/Centers/ Botanical Garden/ Herbaria within India.

**BOTA-3054 (Practical)**

**(Molecular Biology, Plant Biotechnology & Bioinformatics)**

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1. Protein isolation and gel electrophoresis
2. DNA isolation, quantification and electrophoresis
3. Restriction digestion and mapping
4. PCR reaction and gel electrophoresis

5. Regeneration of plantlets through tissue culture
6. Culture of Mushroom
7. Sequence (protein/DNA) downloading from databases, alignment and homologous sequence search
8. Sequence BLAST, annotation and gene prediction with the help of bioinformatical tools.
9. Protein modelling and structure prediction

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## FOURTH SEMESTER (Special Papers)

### FOURTH SEMESTER Special Paper (Optional): Angiosperm Taxonomy (AT)

#### Allotment of Marks and Credits

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOTA-AT-4015	80	20	100	5	5
BOTA-AT-4025	80	20	100	5	5
BOTA-AT-4035	80	20	100	5	5
BOTA-AT-4045	80	20	100	5	9
BOTA-AT-4054	80	20	100	4	9
Total	400	100	500	24	33

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Examination Time: Theory .....3 (Three Hours); Practical...5 (Five Hours)

#### BOTA-AT-4015 (Theory)

##### Unit-I

**Basics of Taxonomy:** Concept, Aims and Principles, Alpha and Omega taxonomy; Concept of Phenetic, Phyletic and Phylogenetic classification; Classificatory Systems: Pre and Post- Darwinian Classifications, Recent development of classificatory system in Angiosperms- APG System (upto recent times)

## **Unit-II**

**Phenetic Methods:** Taxometric: Principles, OTUs, coding of characters, Measuring Resemblances, Cluster analysis, Application of Taxometric.

**Phylogenetic Methods:** Cladistic taxonomy, Character analysis, Cladogram construction and Analysis.

## **Unit-III**

**Taxonomic Structure:** Concept of taxon; Taxonomic categories-major and minor categories; Concept of Species.

## **Unit-IV**

**Material basis of Taxonomy:** Concept of Character; Character Correlation, Weighing, Variations; Isolation and Speciation.

## **Unit-V**

**Botanical Nomenclature:** History, Principles and Major rules, Typification, Effective and Valid Publication, Authors' citation, Principles of Priority and Limitations, synonym, basionym, *nomina conservanda*, rejection of names, legitimate and illegitimate names, *nomen nudum*, tautonym, later homonym.

## BOTA-AT-4025 (Theory)

### **Unit-I**

**Sources of Taxonomic Characters:** Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Serology, major areas.

### **Unit-II**

**Modern Approach to Taxonomy:** Molecular Approach in taxonomy, Diagnostic tools, Polymerase Chain Reaction (PCR) analysis, applications of molecular markers in plant taxonomy; Biosystematics: Definition, importance and categories; Role of computers in taxonomic studies, commonly available softwares.

### **Unit-III**

**Taxonomic Literature:** Classical and recent literature of World in general and India in particular (World flora, Indian flora); Taxonomic journals, periodicals, Icones, Check list, Illustrations.

### **Unit-IV**

**Process of Identifications:** Herbarium techniques: Methods of Collection, Identification and Documentation; Roles and importance of herbaria; Botanical Gardens and Museums in taxonomic studies, Major Herbaria and Botanic Gardens in World and India.

### **Unit-V**

**Botanical exploration:** Contributions made in earlier and recent periods. Presentation of Data: Flora, Manuals, Monograph, Revision; Preparation of a flora; Botanical keys, their construction and

uses.

### BOTA-AT-4035 (Theory)

#### **Unit-I: Phytogeography:**

Concept, Static and Dynamic Phytogeography, Phytochoria and botanical provinces of India; Major theories, Ranges, Migration and Barriers; Centres of Origin; Vicariance biogeography; Endemism; IUCN categories; Hotspots, India as a megadiversity country; plant introduction and acclimatization.

#### **Unit-II: Flora of North East India:**

Characteristics of flora of Northeast India; Endemic, Exotics and RET Plants of North East India, their multiplication and conservation.

#### **Unit-III: Botanical Survey of India:**

History, Activities, Publications.

#### **Unit-IV: Origin and Evolution:**

Characteristic features of early Angiosperms; Origin of Angiosperms, Primitive and advanced angiosperms; Evolutionary trends in Angiosperms.

#### **Unit-V: Phylogeny and Evolution of Angiospermic Taxa:**

Magnoliales, Ranunculales, Euphorbiales, Scrophulariales, Lamiales, Asterales, Alismatales, Orchidales, Poales, Zingiberales.

### **BOTA-AT-4045 (Dissertation)**

**Total Marks: 100 (W60+IA20+P20)**

Dissertation =	60	(Report 40+ <i>Viva-voce</i> 20)
Internal Assessment =	20	(06 marks from assignment, 10 marks from sessional examination and 4 marks from attendance)
Presentation =	20	
Total =	100	

### **BOTA-AT-4054 (Practical)**

1. Floristic studies of locally available angiospermic plants in and around Greater Guwahati, their collections, describing with analytical drawing, botanical keys and identification up to the rank of species.
2. Practices on Nomenclatural problems
3. Plotting of various centres of BSI, Botanical Gardens and Herbaria in different regions of India.
4. Practices on identification of taxa /herbarium specimens.

## **FOURTH SEMESTER**

### **Special Paper (Optional): Plant Ecology (PE)**

#### **Allotment of Marks and Credits**

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOTA-PE-4015	80	20	100	5	5
BOTA-PE-4025	80	20	100	5	5
BOTA-PE-4035	80	20	100	5	5
BOTA-PE-4045	80	20	100	5	9
BOTA-PE-4054	80	20	100	4	9
Total	400	100	500	24	33

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Examination Time: Theory .....3 (Three Hours); Practical...5 (Five Hours)

### **BOTA-PE-4015 (Theory)**

#### **Unit –I**

Development of ecology in India from ancient to recent times, evolutionary ecology, Interaction of ecological factors in the environment. Principles pertaining to limiting factors. Biogeochemical cycles.

## **Unit -II**

Population concepts- characteristics, dynamics and control. mechanisms of population regulation, habitat specific demography, population viability analysis. Species interactions- types of interactions, interspecific competition, herbivory, carnivory, symbiosis, allelopathy, weed-crop interference. Concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations. Ecological amplitude of a species and adaptation - ecads, ecotypes, ecospecies.

## **Unit -III**

Concepts of community and continuum; analysis of communities (analytical and synthetic characters); community coefficients; interspecific associations; ordination; concept of ecological niche, species diversity ( $\alpha$ ,  $\beta$ ,  $\gamma$ ) .

## **Unit -IV**

Vegetation development, temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristics and initial floristic composition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession.

## **Unit -V**

Principles and basic concepts of remote sensing; application of remote sensing in environmental studies: land use mapping, forest survey, habitat analysis, water management, drought monitoring and flood studies, wetland survey, rainfall estimation, pollution studies, soil conservation, watershed management and vegetation mapping. Geographical Information System (GIS) - basic principles and techniques. Importance of Geographical Information System in environmental studies. Global Positioning System (GPS): basic principles, Applications in ecological studies.

## **BOTA-PE-4025 (Theory)**

### **Unit -I**

Ecosystem organization- structure and functions; Terrestrial and aquatic ecosystems, primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition (mechanism, controlling factors); ecosystem nutrient cycles and nutrient budgeting.

### **Unit -II**

Ecosystem stability- Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; Wetlands, its importance & benefits, causes of degradation and its consequences.

### **Unit –III**

Introduction and elements of system ecology; ecosystem modeling, conceptual model, working model, auxiliary variable and foresters diagram. Basic concepts to statistical ecology, fundamental knowledge on pattern analysis, cluster analysis and ordination.

### **Unit –IV**

Introduction to conservation ecology- 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

### **Unit –V**

Methods for biodiversity monitoring, megadiversity zones and hot spots ; biodiversity and ecosystem services- provisioning, regulating, supporting and cultural; threats to biodiversity: Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Red data book; keystone and flagship species. Biodiversity act and biodiversity action plan; IPRs, national and international programs for biodiversity conservation, wildlife values and eco-tourism, wildlife distribution in India, problem in wildlife protection, role of WWF, WCU, CITES, TRAFFIC.

## **BOTA-PE-4035 (Theory)**

### **Unit -I**

Scope of environmental management, basic concepts of sustainable development, advantages of environmental monitoring, deterioration of environmental quality with reference to anthropogenic impact; methods of assessment of environmental quality; Short term studies/ surveys; Rapid assessment; Continuous short and long term monitoring; general guidelines for the preparation of environmental impact statement.

### **Unit –II**

Effect of pollution on water quality, on phytoplankton productivity; bio-indicators of water pollution. biological treatment of wastewater. Biomonitoring of air pollution, active and passive monitoring; air pollution tolerance indices; control of air pollution by plants, green belt design. Plant indicators. Environmental problems of NE India with special reference to shifting cultivation, deforestation, opencast coal mining, oil exploration, encroachment, flood, erosion, landslides etc.;

### **Unit -III**

Environmental Policies and Regulations. Evolution of International Environmental Policies. Environmental Movement in India. International Environmental Treaties and Conventions. Objectives and Provisions of Environmental Acts and Rules of India. IBP, MAB.

### **Unit -IV**

Concepts of ecological restoration, aims and strategies; ecosystem reconstruction, major tools used in restoration, restoration of biological diversity- Acceleration of ecological succession, reintroduction of biota; restoration of degraded ecosystems- Forest, grassland and lake including contaminated soils, mine spoils etc.

### **Unit -V**

Bioremediation, biotransformation, biodegradation and phytoremediation, In situ and Ex situ practices. Use of microbes (algae, bacteria and fungi) and plants to check biodegradation, biotransformation; waste water treatment using aquatic plants; root zone treatment. Ecological techniques for biowaste and e-waste management.

### **BOTA-PE-4045 (Dissertation)**

**Total Marks: 100 (W60+IA20+P20)**

Dissertation =	60	(Report 40+Viva-voce 20)
Internal Assessment =	20	(06 marks from assignment, 10 marks from sessional examination and 4 marks from attendance)
Presentation =	20	
Total =	100	

### **BOTA-PE-4054 (Practical)**

1. Determination of light intensity, relative humidity, wind speed, maximum and minimum temperature at different times of the day.
2. Determination of amount of rainfall.
3. Mapping of vegetation.
4. Analysis of edaphic characters- soil profile, texture, soil moisture, water holding capacity, porosity, pH, organic matter content, quantitative estimation of N, P, K, Na, Ca and C:N.
5. Determination of carbonates, nitrates, chlorides, base deficiency by rapid soil test method.
6. Analysis of water quality- DO, COD, BOD, pH, hardness, alkalinity, conductivity, free CO<sub>2</sub>, chloride, phosphate.
7. Estimation of litter contribution in different forest stands; estimation of litter decomposition rate by litter bag technique, soil respiration.
8. Determination of IVI; lifeform and biological spectrum; phenology; diversity indices in various plant communities.
9. Determination of gross and net primary productivity of aquatic ecosystem by light and dark method; estimation of phytoplankton biomass in terms of chlorophyll.
10. To study primary productivity for herbaceous community by Harvest method; Leaf Area Index.
11. To find out seed output and reproductive capacity of herbaceous plants.
12. To find out allelopathic effects of weeds on cultivated plants.
13. Morpho-anatomical variation of plant species as affected by environmental changes.
14. Ecological data collection for computer use.

## Suggested Readings

R S Ambast and N K Ambast (2019) A Text book of plant ecology (15<sup>th</sup> Edition). CBS Publishers and Distribution, New Delhi

## FOURTH SEMESTER

### Special Paper (Optional): Mycology and Plant Pathology (MPP)

#### Allotment of Marks and Credits

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOTA-MPP-4015	80	20	100	5	5
BOTA-MPP-4025	80	20	100	5	5
BOTA-MPP-4035	80	20	100	5	5
BOTA-MPP-4045	80	20	100	5	9
BOTA-MPP-4054	80	20	100	4	9
Total	400	100	500	24	33

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Examination Time: Theory .....3 (Three Hours); Practical...5 (Five Hours)

#### BOTA-MPP-4015 (Theory)

##### Unit-I

History and development of mycology, ultra structure of fungal cell, Different groups of fungi; systematics and phylogenetic relationship among different groups of fungi; modern trends in identification and classification of fungi.

##### Unit-II

Fungal reproduction: different mode of reproduction in fungi, different reproductive structures, parasexuality, degeneration of sex, heterothallism. Spore dispersal mechanism in fungi.

##### Unit-III

Fungal physiology, growth, nutrition, development and metabolism in fungi, nutritional specialization in parasitic fungi.

##### Unit-IV

Ecology of fungi, distribution of fungi, role of fungi in biogeochemical cycling, fungi of terrestrial

and aquatic environments, fungi of extreme environments.

### **Unit-V**

Fungal biotechnology: Genetically modified fungi, fungi as biocontrol agent, Edible and poisonous mushrooms, cultivation of mushrooms, industrially important fungi as a source of antibiotics, organic acids, enzymes and proteins, IPR.

## **BOTA-MPP-4025 (Theory)**

### **Unit- I**

The concept of diseases in plants, history of plant pathology, role of fungi and other organisms as causes of plant diseases, losses caused by plant diseases, Symptoms of plant diseases caused by fungi, bacteria and viruses.

### **Unit-II**

Diagnosis of plant diseases, Koch's postulate and germ theory of diseases, pathogenesis and host range, stages of development and disease cycle, dissemination of plant pathogens.

### **UNIT-III**

Epidemiology and disease forecasting, Effects of environmental factors on epidemiology; Control of plant diseases, chemical and biological disease control, integrated disease management (IDM), physiological changes due to disease in plants (photosynthesis, movement of water, respiration, permeability of cell membrane, growth and transcription and translation).

### **Unit-IV**

Genetics of plant diseases, genes and disease, mechanism of variability, types of plant resistance to pathogens, Genetics of Virulence in pathogens and resistance in host, Enzymes, toxins and growth regulators in plant disease development.

### **Unit-V**

Symptomatology, disease cycle, control measures and management of some important plant diseases of Assam caused by fungi, bacteria, virus and nematode.

## **BOTA-MPP-4035 (Theory)**

### **Unit I**

Defense mechanisms in plants, structural and chemical defenses, defense through lack of essential factors, induced structural and biochemical defenses, plant immunization- systemic acquired resistance, Induced resistance, plantibodies.

### **Unit II**

Biotechnology and plant diseases – resistant gene identification and insertion in suitable host for crop improvement, strategies for development of disease resistance in plants; GMO (bt- cotton, bt- brinjal, bt-chickpea); Use of immunological techniques in plant pathology.

### **Unit-III**

Aerobiology and Plant diseases: Air microflora, air sampling techniques, factors affecting the distribution of air microflora, air-borne plant diseases, aero-allergens

### **Unit-IV**

Soil borne diseases: Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, root exudates, and soil and root borne pathogens, Associative and antagonistic effects; Suppressive soils, biological control- concepts and potentialities for managing soil borne pathogens.

### **Unit-V**

Morphology and anatomy of infected seeds; transmission of pathogens from seed to plants, Seed-borne diseases and pathogens, Toxins affecting seed quality and its impact on human and animal health, management of seed-borne diseases, seed health testing and methods for detecting seed microorganisms, Quarantine and seed certification.

BOTA-MPP-4045 (Dissertation)

**Total Marks: 100 (W60+IA20+P20)**

Dissertation =	60	(Report 40+ <i>Viva-voce</i> 20)
Internal Assessment =	20	(06 marks from assignment, 10 marks from sessional examination and 4 marks from attendance)
Presentation =	20	
Total =	100	

BOTA-MPP-4054 (Practical)

1. Study of vegetative and reproductive structure of different fungal specimens
2. Study of disease symptoms and causal organisms
3. Isolation and identification of pathogen from diseased plant materials
4. In vitro inhibition of plant pathogens by different plant extracts
5. Estimation of spore population and root colonization of mycorrhiza
6. Extraction of cellulase/pectinase/xylanase from diseased plants
7. Proving of Koch's postulate at least one disease

8. Study of the effect of fungicides and plant extracts on the germination and growth of plant pathogenic fungi
9. Isolation and enumeration of microbes from soil samples
10. Study of effect of physical and chemical factors on the growth of plant pathogens.

## FOURTH SEMESTER

### Special Paper (Optional): Plant Physiology and Biochemistry (PPB)

Paper(s)	Allotment of Marks and Credits			Credit	Class/week
	Course work	Internal Assessment	Total		
BOTA-PPB-4015	80	20	100	5	5
BOTA-PPB-4025	80	20	100	5	5
BOTA-PPB-4035	80	20	100	5	5
BOTA-PPB-4045	80	20	100	5	9
BOTA-PPB-4054	80	20	100	4	9
Total	400	100	500	24	33

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Examination Time: Theory .....3 (Three Hours); Practical...5 (Five Hours)

#### BOTA-PPB-4015 (Theory)

##### Unit-1

Membrane transport and translocation of water and solutes: Membrane transport of proteins. Root microbe interactions in facilitating nutrient uptake.

##### Unit-II

Nitrogen and sulphur metabolism: Regulation of nitrogen fixation, products of nitrogen fixation and their transport, mechanism of nitrate uptake and reduction, transamination, nitrogen metabolism in relation to photosynthesis and respiration, Sulphate uptake, transport, reduction and assimilation.

##### Unit-III

The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development- genetic and molecular analysis, role of vernalization.

##### Unit-IV

Post-harvest physiology: Ripening of fruit and its regulation, post-harvest management. Metabolism of leafy vegetables during storage.

##### Unit-V

Stress physiology: Plant responses to water deficit, salinity, metal ion stress, freezing and heat stress, effect of elevated CO<sub>2</sub> concentration on plant metabolism, Oxidative stress - Generation of reactive oxygen species, Effect of ROS on metabolism, ROX detoxification mechanisms in plants. Biotic stress - effect of fungal infection on plant metabolism; transgenic approach to overcome the abiotic stress in plants.

## **Unit-VI**

Signal transduction: Overviews, receptors and G- proteins, phospholipids signaling, role of cyclic nucleotides, Calcium-Calmodulin cascade, protein kinases and phosphatases, specific signaling mechanisms. e.g., two component sensor – regulator system in bacteria and plants.

### **BOTA-PPB-4025 (Theory)**

#### **Unit-I**

Respiration and lipid metabolism: Overview of plant respiration, anaerobic respiration, modern concept of electron transport and ATP synthesis; glycolysis in plants and its regulation; regulation of pentose phosphate pathway and TCA Cycle; inhibitor of respiration, glyoxylate cycle, synthesis of membrane lipids, structural lipids and storage lipids and their catabolism, gluconeogenesis.

#### **Unit-II**

Photochemistry and photosynthesis: Evolution of photosynthetic apparatus, photo-oxidation of water, mechanism of electron and proton transport, Regulation of PCR Cycle and C4 Pathway, RUBISCO and PEP Case, C3–C4 intermediates, ecological significance and modification of CAM.

#### **Unit-III**

Carbohydrate metabolism: Regulation of starch and sucrose biosynthesis, Synthesis and degradation of cellulose; A brief idea of pectin biosynthesis and enzymes involved in pectin degradation.

#### **Unit-IV**

Organic acid metabolism: Metabolism and roles of oxalic acid, ascorbic acid and malic acid.

#### **Unit-V**

Secondary metabolites: Shikimate Pathway and its role in biosynthesis of Secondary Metabolites. Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

#### **Unit-VI**

Phosphorus nutrition – Forms of phosphorus in soil. Phosphorus uptake, factors controlling 'P' uptake, 'P' fractions in plants. Role of Pyrophosphate in plant metabolism.

### **BOTA-PPB-4035 (Theory)**

#### **Unit-I**

Growth and morphogenesis: photomorphogenesis: phytochromes and cryptochromes and their photochemical and biochemical properties; phytochrome biosynthesis, cellular localization, roles, mechanism of action of photomorphogenetic receptors.



## **Unit-II**

Plant developments: Biochemical changes during development of seeds; phototropism, geotropism and nastic movements.

## **Unit-III**

Senescence and PCD- Biochemical changes during senescence of leaves and petals and regulation of senescence. Programmed Cell Death.

## **Unit-IV**

Enzyme kinetics: Km value, enzyme inhibition, factors responsible for enzyme interaction, abzyme and ribozyme

## **Unit-V**

A brief idea about role of tissue culture, and mutants in physiological studies.

## **Unit-VI**

Plant Growth Regulators – A brief idea about discovery, role and possible mechanism of action of Triacantanol, Brassins, Salicylic acid, Jasmonates and Polyamines. A brief idea about role of plant growth retardants- CCC, Maleic hydrazide, Trizoles and TIBA.

BOTA-PPB-4045 (Dissertation)

**Total Marks: 100 (W60+IA20+P20)**

Dissertation =	60	(Report 40+ <i>Viva-voce</i> 20)
Internal Assessment =	20	(06 marks from assignment, 10 marks from sessional examination and 4 marks from attendance)
Presentation =	20	
Total =	100	

BOTA-PPB-4054 (Practical)

1. Estimation of starch, Ascorbic acid, Polyphenols, Cellulose.
2. Study of Oxalic acid accumulation in leaf tissue.

3. Hormonal regulation of leaf and petal senescence.
4. Study of changes in starch / protein content during seed development.
5. To study the effect of different PGRs on seedling growth
6. Sugar and amino acids analysis of phloem sap with paper chromatography.
7. Estimation of nitrate in different plant parts.
8. Study of lipid accumulation during development of oil seeds.
9. Study of effect of PEG induced water stress on seed germination
10. Measurement of RWC and Osmotic potential
11. Study of protein/ amino acid profile in plants under stress.
12. Study of effect of fungal infection on peroxidase activity.
13. Study of free radicals scavenging enzymes, Catalase and super oxide dismutase.
14. Study of free proline accumulation in plants under stress.
15. Study of seed germination under stress condition.

## **BOTA-4016**

**(Open)**

### **Plant Diversity, Conservation, IPR and Traditional Knowledge**

#### **Allotment of Marks and Credits**

Paper(s)	Course work	Internal Assessment	Total	Credit	Class/week
BOTA- 4016	80	20	100	6	6

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Examination Time: Theory .....3 (Three Hours)

#### **Unit -I**

Plants as basic component of biodiversity, objectives and components of plant systematics; ICN: Principles, Major rules (Typification, Rules of Priority, Effective and Valid publication).

#### **Unit -II**

Biodiversity – concept, components and types; importance of biodiversity conservation, Different approaches for biodiversity conservation.

#### **Unit-III**

Strategies for conservation – in situ conservation: international efforts and Indian initiatives, protected regions for conservation of biodiversity. RET Plants of Northeast India and their

conservation initiatives.

#### **Unit-IV**

Strategies for conservation – ex situ conservation : Principles and practices; botanical gardens, gene banks, seed banks, in vitro repositories, cryobanks; National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR) and their conservation efforts.

#### **Unit-V**

Principles of IPR and Patent law, patent application procedure, Trade Mark, Copyright, Enforcement of IPR, Information Technology related IPR, Computer software and IPR, Biotechnology and IPR, protection of plant varieties, geographical indicators, farmers right, resource rights.

#### **Unit-VI**

Traditional Knowledge: Concept & types of Traditional Knowledge, Holders Protection, need for a Sui-Generis regime, TK vs modern knowledge, digital library, biopiracy & bioprospecting.