

# **Programme Outcomes, Programme Specific Outcomes and Course Outcomes For PG Programmes**

**Programme Name: M.Sc in Botany**

*Number of Semesters: Four*



Name of the Department  
**University of North Bengal**  
West Bengal, INDIA

## **Programme Outcomes**

- The Master of Science in Botany Programme is framed to inculcate the students with basic and advanced knowledge in plant sciences.
- Students would be taught with different aspects of the subject comprising of a well thought out combinations of core and elective papers which includes the developments in modern biology and interdisciplinary sciences.
- Students would be engaged in field trips so as to enhance their practical experiences with the diversity of plant forms and also the impact of ecological variations on the same.
- Students would be exposed to hands on experiences of performing different experiments and usage of different instruments to develop their overall expertise and prepare them for the future.

## **Programme Specific Outcomes**

- Students after completing this programme will have a complete knowledge about the different branches of the subject including the background and history of the development of the subject, basics and advances of the subject.
- Students would be able to distinguish the different life forms of plants and will have a detailed understanding of the recent systems of classification and techniques of identifying the plants.
- Students would be able to build up on the foundations of the topics including physiology, biochemistry, microbiology, genetics, molecular biology, genetic engineering, plant development, pharmacognosy and so on and would be able to explore the further advances in the topics on their own.
- Students would be able to utilize their experience of executing dissertation work and using different tools and techniques in their future research and development assignments.
- The program will assist students in preparing different national level academic competitive examinations like NET, GATE, SET etc.

## Course Outcomes

SEMESTER—I		
Course Code	Course Name	Course Outcomes
BOTA-CT-101	MICROBIOLOGY-Gr-A & B	<p>Knowledge gained:</p> <ul style="list-style-type: none"> <li>Students will understand the diversity of microbial life forms and the recent system of their classification.</li> <li>Students will gain complete knowledge regarding the morphological and anatomical features of bacteria and viruses, different metabolic pathways associated with bacteria, concepts of the nutritional requirements and growth patterns and also learn about the basics and advances in bacterial genetics.</li> </ul> <p>Skills gained:</p> <ul style="list-style-type: none"> <li>Students will also learn about the importance of microorganisms in human welfare right from their usage in food and beverages to their utility in pharmaceuticals and biotechnology.</li> </ul> <p>Competency developed:</p> <ul style="list-style-type: none"> <li>Students will be able to understand the concept of plant-microbe interaction, the importance and mechanism of it.</li> </ul>
COURSE CODE: BOTA-CT-102	MYCOLOGY AND PLANT PATHOLOGY – Gr-A & B	<p>Knowledge gained:</p> <ul style="list-style-type: none"> <li>Students will understand the role of fungi in different sector of life with special reference to agriculture.</li> <li>Students will learn about different plant-pathogen interactions, their diagnosis and control.</li> </ul> <p>Skills gained:</p> <ul style="list-style-type: none"> <li>Students will learn about sustainable agriculture</li> </ul> <p>Competency developed</p> <ul style="list-style-type: none"> <li>Students will also learn about recent molecular developments of plant-microbe interaction.</li> </ul>
COURSE CODE: BOTA-CT-103	TAXONOMY OF ANGIOSPERMS-Gr- A & B	<p>Knowledge gained:</p> <ul style="list-style-type: none"> <li>Students will understand differences between Plant taxonomy and systematic; components, importance and data sources in systematics.</li> <li>Students will understand the principle of nomenclature, history and recent development in classifications.</li> </ul> <p>Skills gained:</p> <ul style="list-style-type: none"> <li>Students will understand the concept of phenetics and cladistics.</li> </ul> <p>Competency developed</p> <ul style="list-style-type: none"> <li>Students will acquire knowledge of different methods of collecting and preserving plants, biodiversity conservation and ethnobotany.</li> </ul>

SEMESTER—II		
Course Code	Course Name	Course Outcomes
BOTA-CT-107	Plant Physiology - Gr- A  Plant Biochemistry Gr-B	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn about properties of water, their role in plant life, water potential and measuring system, transport of water through vascular tissues, possible challenges during adverse condition and their mitigation measures.</li> <li>Students will be taught about the concept photosensory biology, mechanism of light mediated physiological control of stomatal regulation, response in dark and their mechanism and their overall coordinated cascades.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>During this course students will learn about transport of assimilates from leaf to root, possible theories involved, crisis during pathogenic injury and the process of partitioning in different tissues.</li> <li>Students will also gain the knowledge about plant growth regulators, structure function relationship, physiology and homeostasis and control of signalling by degradation of repressors through ubiquitin ligation.</li> </ul> <p><b>Competency developed</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge on the structural and biochemical properties of different macromolecules and also on cellular energetics.</li> </ul>
BOTA-CT-108	Cytology and Genetics- Gr – A & B	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge about cell theory and evolution.</li> <li>Students will learn the concepts of Mendelian Genetics and the recent views on the same.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge on basics of plant breeding, hybridisation techniques and marker-assisted selection.</li> </ul> <p><b>Competency developed</b></p> <ul style="list-style-type: none"> <li>Students will be able to understand the concepts of transcription, translation, mutation and gene regulation.</li> </ul>
BOTA-CT-109	Phycology and Bryology – Gr – A  Pteridology, Gymnology, Palaeobotany – Gr-B	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will understand the structural diversity of algae, bryophytes, pteridophytes, gymnosperms; classification systems, morphological and anatomical features and evolution of the different life forms.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn the structural details and life history of different fossil plants.</li> </ul> <p><b>Competency developed</b></p> <ul style="list-style-type: none"> <li>Students will also gain knowledge regarding the applications of the lower group of plants.</li> </ul>
SEMESTER—III		
Course Code	Course Name	Course Outcomes
BOTA-CT-113	Plant Development – Gr- A  Plant Metabolism – Gr- B	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will acquire knowledge about embryogenesis from zygotic development and functional perspectives of different histogens.</li> <li>Students will also know about root, shoot and leaf development and the key molecular mechanisms involved during development.</li> <li>During this course students will learn about transformation of shoot apical meristem into inflorescence and floral meristem and the involvement of hormone florigen during juvenile to adult transition.</li> </ul>

		<p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>This course will also highlight students about floral organogenesis and their possible molecular mechanisms along with distortion of development during gene mutation.</li> <li>Students will have complete understanding of the two major cellular processes viz. photosynthesis and respiration and the pathways associated with them.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge regarding the lipids as a source of energy and also how they are synthesized.</li> <li>Students will also get aware of nucleotide and protein biosynthesis and amino acid families and their biosynthesis.</li> </ul>
BOTA-CT-114	<p>Genetic Engineering – Gr- A</p> <p>Bioinformatics and Biostatistics Gr-B</p>	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will acquire knowledge about the tools and techniques of recombinant DNA technology.</li> <li>Students will learn about the development of transgenics, their applications and ethical issues related to their use.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will be exposed to the concept of gene silencing and gene knockouts.</li> <li>Students will gain knowledge regarding the concept and different tools used in bioinformatics, about the different DNA and protein databases.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will be learning the concepts to use different biostatistics tools and methods in data analysis.</li> </ul>
BOTA-CT-115	<p>Ecology – Gr- A</p> <p>Pharmacognosy – Gr- B</p>	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn the concept of molecular evolution and Hardy-weinberg genetic equilibrium.</li> <li>Students will get detailed study of interaction of different population, community and ecosystems and their role in ecosystem</li> <li>Students will learn the applications of ecological concept for benefit to different life forms.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will acquire knowledge about historical perspectives of conceptual development of ethnomedicine.</li> <li>Students will learn about threats of possible drug adulteration and their scientific methods of measurement.</li> <li>Students will be acquainted with vast array of secondary metabolites in plants, their biosynthetic origin, chemical nature and bioactivity.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will have appropriate understanding about the hallucinogenic drugs extracted from psychoactive plants and their bioactive components responsible for drug addiction.</li> <li>This course will also highlight students about floral organogenesis and their possible molecular mechanisms along with distortion of development during gene mutation.</li> </ul>
<p><b>SEMESTER—III ELECTIVE SPECIAL PAPER – I</b></p> <p><b>(BOTA-CT-116)</b></p>		
BOTA-CT-116	I. GENETICS AND BIOINFORMATICS	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn the concepts of gene in pre-DNA era.</li> <li>Students will gain knowledge on the laws of genetic inheritance, gene pyramiding, and also about population genetics.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge on the different types of recombination and genetic markers.</li> <li>Students will get detail information of PCR, its variants and their applications.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will have in depth knowledge on the use of different bioinformatics tools, homology modeling, etc.</li> </ul>
BOTA-CT-116	II. MICROBIOLOGY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will be able to understand and appreciate role of genetic recombination in bacteria.</li> <li>Students will develop theoretical skills of medical microbiology and understand the molecular</li> </ul>

		<p>mechanisms underlying the gene cloning.</p> <ul style="list-style-type: none"> <li>Students will be able to understand and appreciate fermentation technology.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will develop practical skills in microbiological techniques and appreciate the versatile role of microbes in day to day products.</li> <li>Students will be able to understand and appreciate role of microbes in sustainable environment.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will also develop both theoretical and practical knowledge regarding study of microbial diversity from extreme environment.</li> <li>Students will be able to appreciate the resourceful part of microbes in overcoming major environmental problems of the world.</li> </ul>
BOTA-CT-116	III. MOLECULAR PLANT PATHOLOGY AND FUNGAL BIOTECHNOLOGY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will understand molecular events of host-pathogen interaction.</li> <li>Students will learn how to prepare biocontrol products.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn different diagnostic techniques applied in pathology and will also be able to diagnose plant disease for proper recommendation of control measures.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will learn basics of research and publications in molecular as well as classical plant pathology.</li> </ul>
BOTA-CT-116	IV. PLANT BIOCHEMISTRY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will have a complete understanding of the structural and functional details of the photosynthetic apparatus, in depth knowledge of the calvin cycle and CO<sub>2</sub> concentrating pathways that leads to the synthesis of sucrose and starch.</li> <li>Students will gain knowledge about the details of starch biosynthesis and sucrose transportation in plants.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge of the mechanism of protein sorting and degradation, nitrogen and sulfur metabolism, hormonal control of plant growth, photoperiodism and the role of phytochrome, flower and fruit development.</li> <li>Students will have an in depth knowledge of plant signaling mechanisms and the pathways associated with it, secondary metabolites and the major pathways of their biosynthesis, and the mechanisms controlling the regulation of genome expression.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge regarding the major instruments used in the field of biochemistry and learn some basic aspects of computational biochemistry.</li> </ul>
BOTA-CT-116	V. PLANT GENETICS AND MOLECULAR BREEDING	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will understand about pre-breeding (interspecific hybridization) for introgression of genes/QTLs from wild relatives. Wild relatives are the reservoir of many important traits such as Abiotic/Biotic stress tolerance.</li> <li>Students will also learn the technique for increasing the genetic base of crop varieties in terms of yield &amp; quality of crop plant (especially in Rice).</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>The students will understand the controversy of GM Crops and its ethical issues and ecological concern.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge on crop improvement because food grain production must be increased to feed more than nine billion people by 2050.</li> </ul>
BOTA-CT-116	VI. PLANT PHYSIOLOGY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn the metabolite flux in plants and their homeostasis, compartmentation and augmentation with programs of differentiation.</li> </ul>

	GY AND PHARMACOGNOSY	<ul style="list-style-type: none"> <li>Students will acquire knowledge about phenolics, alkaloids, glycosides and terpenoids; their biosynthesis in plants and ecological significance.</li> <li>Peptides and brassinosteroids are now emerging field of plant hormone research. Through this chapter students will achieve knowledge molecular mechanism of new phytohormone research.</li> <li>Students will be learning perception and processing of external information by cells through signal transduction mechanism and their functional translation through gene expression and editing.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will understand the action and pharmacology of herbal drugs, their channelling inside the cells and specific nano-carriers for precise targeting of herbal drugs.</li> <li>Students will know the stress mitigation measures by plants and molecular interaction with environment.</li> <li>Students will recognize the quality control attributes of herbal drugs as per international guidelines.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will learn chromatographic techniques of separation of biomolecules which will help them independent during research designing.</li> <li>Also, the students will acquire different techniques of spectroscopy for understanding the nature of biomolecules in modern phytochemical research.</li> </ul>
BOTA-CT-116	VII. PTERIDOLGY, PALAEOBOTANY AND PALYNOLOGY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn about the role of various growth hormones in lower groups of plants and their regulatory mechanisms.</li> <li>Students will learn about the interactions of various lower groups of plants with micro-organisms and the strategies followed by them in conduction of water and photosynthates.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge regarding stress tolerance mechanisms of bryophytes and pteridophytes with special regards to desiccation and will also be learning about bryophyte and pteridophyte model plants.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge regarding the fundamentals, scopes and applications of palynology as a subject.</li> </ul>
BOTA-CT-116	VIII. TAXONOMY OF ANGIOSPERMS AND BIOSYSTEMATICS	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn about the role of ICN in Plant Taxonomy.</li> <li>Students will gain knowledge on the usage of taxonomic evidences as delineate factor for angiosperms and their classification</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will understand the concepts of are phonetic and cladistics.</li> <li>Students will be able to understand the concept of molecular systematics and get acquainted with the preparation of phylogenetic trees and understand the importance in modern biology.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will learn the concept of Ethnic knowledge and Biodiversity conservation.</li> </ul>
<b>SEMESTER—IV</b>		
<b>Course Code</b>	<b>Course Name</b>	<b>Course Outcomes</b>
BOTA-CT-119	Bioresource Utilization, Medicinal	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn about the usage of bio resources and their sources.</li> <li>Students will get detailed study of concept of origin of life.</li> </ul>

	Plants and Natural History- Gr- A  Techniques in Botany – Gr- B	<b>Skills gained:</b> <ul style="list-style-type: none"> <li>Students will get information about the Natural History Societies and museums across the world.</li> </ul> <b>Competency developed:</b> <ul style="list-style-type: none"> <li>Students will understand the concepts, techniques and applications of various techniques used in biology.</li> </ul>
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**SEMESTER—IV**  
**ELECTIVE SPECIAL PAPER- II**  
**( BOTA-CT-120)**

Course Code	Course Name	Course Outcomes
BOTA-CT-120	I. GENETICS AND BIOINFORMATICS	<b>Knowledge gained:</b> <ul style="list-style-type: none"> <li>Students will learn the concepts of gene in pre-DNA era.</li> <li>Students will gain knowledge on the laws of genetic inheritance, gene pyramiding, and also about population genetics.</li> </ul> <b>Skills gained:</b> <ul style="list-style-type: none"> <li>Students will gain knowledge on the different types of recombination and genetic markers.</li> <li>Students will get detail information of PCR, its variants and their applications.</li> </ul> <b>Competency developed:</b> <ul style="list-style-type: none"> <li>Students will have in depth knowledge on the use of different bioinformatics tools, homology modeling, etc.</li> </ul>
BOTA-CT-120	II. MICROBIOLOGY	<b>Knowledge gained:</b> <ul style="list-style-type: none"> <li>Students will be able to understand and appreciate role of genetic recombination in bacteria.</li> <li>Students will develop theoretical skills of medical microbiology and understand the molecular mechanisms underlying the gene cloning.</li> <li>Students will be able to understand and appreciate fermentation technology.</li> </ul> <b>Skills gained:</b> <ul style="list-style-type: none"> <li>Students will develop practical skills in microbiological techniques and appreciate the versatile role of microbes in day to day products.</li> <li>Students will be able to understand and appreciate role of microbes in sustainable environment.</li> </ul> <b>Competency developed:</b> <ul style="list-style-type: none"> <li>Students will also develop both theoretical and practical knowledge regarding study of microbial diversity from extreme environment.</li> <li>Students will be able to appreciate the resourceful part of microbes in overcoming major environmental problems of the world.</li> </ul>
BOTA-CT-120	III. MOLECULAR PLANT PATHOLOGY AND FUNGAL BIOTECHNOLOGY	<b>Knowledge gained:</b> <ul style="list-style-type: none"> <li>Students will understand molecular events of host-pathogen interaction.</li> <li>Students will learn how to prepare biocontrol products.</li> </ul> <b>Skills gained:</b> <ul style="list-style-type: none"> <li>Students will learn different diagnostic techniques applied in pathology and will also be able to diagnose plant disease for proper recommendation of control measures.</li> </ul> <b>Competency developed:</b> <ul style="list-style-type: none"> <li>Students will learn basics of research and publications in molecular as well as classical plant pathology.</li> </ul>



BOTA-CT-120	IV. PLANT BIOCHEMISTRY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>• Students will have a complete understanding of the structural and functional details of the photosynthetic apparatus, in depth knowledge of the calvin cycle and CO<sub>2</sub> concentrating pathways that leads to the synthesis of sucrose and starch.</li> <li>• Students will gain knowledge about the details of starch biosynthesis and sucrose transportation in plants.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>• Students will gain knowledge of the mechanism of protein sorting and degradation, nitrogen and sulfur metabolism, hormonal control of plant growth, photoperiodism and the role of phytochrome, flower and fruit development.</li> <li>• Students will have an in depth knowledge of plant signaling mechanisms and the pathways associated with it, secondary metabolites and the major pathways of their biosynthesis, and the mechanisms controlling the regulation of genome expression.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>• Students will gain knowledge regarding the major instruments used in the field of biochemistry and learn some basic aspects of computational biochemistry.</li> </ul>
BOTA-CT-120	V. PLANT GENETICS AND MOLECULAR BREEDING	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>• Students will understand about pre-breeding (interspecific hybridization) for introgression of genes/QTLs from wild relatives. Wild relatives are the reservoir of many important traits such as Abiotic/Biotic stress tolerance.</li> <li>• Students will also learn the technique for increasing the genetic base of crop varieties in terms of yield &amp; quality of crop plant (especially in Rice).</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>• The students will understand the controversy of GM Crops and its ethical issues and ecological concern.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>• Students will gain knowledge on crop improvement because food grain production must be increased to feed more than nine billion people by 2050.</li> </ul>
BOTA-CT-120	VI. PLANT PHYSIOLOGY AND PHARMACOLOGY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>• Students will learn the metabolite flux in plants and their homeostasis, compartmentation and augmentation with programs of differentiation.</li> <li>• Students will acquire knowledge about phenolics, alkaloids, glycosides and terpenoids; their biosynthesis in plants and ecological significance.</li> <li>• Peptides and brassinosteroids are now emerging field of plant hormone research. Through this chapter students will achieve knowledge molecular mechanism of new phytohormone research.</li> <li>• Students will be learning perception and processing of external information by cells through signal transduction mechanism and their functional translation through gene expression and editing.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>• Students will understand the action and pharmacology of herbal drugs, their channelling inside the cells and specific nano-carriers for precise targeting of herbal drugs.</li> <li>• Students will know the stress mitigation measures by plants and molecular interaction with environment.</li> <li>• Students will recognize the quality control attributes of herbal drugs as per international guidelines.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>• Students will learn chromatographic techniques of separation of biomolecules which will help them independent during research designing.</li> <li>• Also, the students will acquire different techniques of spectroscopy for understanding the nature of biomolecules in modern phytochemical research.</li> </ul>
BOTA-CT-120	VII. PTERIDOLOGY, PALAEOB	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>• Students will learn about the role of various growth hormones in lower groups of plants and their regulatory mechanisms.</li> <li>• Students will learn about the interactions of various lower groups of plants with micro-organisms</li> </ul>

	OTANY AND PALYNOLGY	<p>and the strategies followed by them in conduction of water and photosynthates.</p> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge regarding stress tolerance mechanisms of bryophytes and pteridophytes with special regards to dessication and will also be learning about bryophyte and pteridophyte model plants.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge regarding the fundamentals, scopes and applications of palynology as a subject.</li> </ul>
BOTA-CT-120	VIII. TAXONOMY OF ANGIOSPERMS AND BIOSYSTEMATICS	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn about the role of ICN in Plant Taxonomy.</li> <li>Students will gain knowledge on the usage of taxonomic evidences as delineate factor for angiosperms and their classification</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will understand the concepts of are phonetic and cladistics.</li> <li>Students will be able to understand the concept of molecular systematics and get acquainted with the preparation of phylogenetic trees and understand the importance in modern biology.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will learn the concept of Ethnic knowledge and Biodiversity conservation.</li> </ul>

**SEMESTER—IV**  
**ELECTIVE SPECIAL PAPER- III**  
**(BOTA-CT-121)**

Course Code	Course Name	Course Outcomes
BOTA-CT-121	I. GENETICS AND BIOINFORMATICS	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn the concepts of gene in pre-DNA era.</li> <li>Students will gain knowledge on the laws of genetic inheritance, gene pyramiding, and also about population genetics.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge on the different types of recombination and genetic markers.</li> <li>Students will get detail information of PCR, its variants and their applications.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will have in depth knowledge on the use of different bioinformatics tools, homology modeling, etc.</li> </ul>
BOTA-CT-121	II. MICROBIOLOGY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will be able to understand and appreciate role of genetic recombination in bacteria.</li> <li>Students will develop theoretical skills of medical microbiology and understand the molecular mechanisms underlying the gene cloning.</li> <li>Students will be able to understand and appreciate fermentation technology.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will develop practical skills in microbiological techniques and appreciate the versatile role of microbes in day to day products.</li> <li>Students will be able to understand and appreciate role of microbes in sustainable environment.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will also develop both theoretical and practical knowledge regarding study of microbial diversity from extreme environment.</li> <li>Students will be able to appreciate the resourceful part of microbes in overcoming major</li> </ul>

		environmental problems of the world.
BOTA-CT-121	III. MOLECULAR PLANT PATHOLOGY AND FUNGAL BIOTECHNOLOGY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>• Students will understand molecular events of host-pathogen interaction.</li> <li>• Students will learn how to prepare biocontrol products.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>• Students will learn different diagnostic techniques applied in pathology and will also be able to diagnose plant disease for proper recommendation of control measures.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>• Students will learn basics of research and publications in molecular as well as classical plant pathology.</li> </ul>
BOTA-CT-121	IV. PLANT BIOCHEMISTRY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>• Students will have a complete understanding of the structural and functional details of the photosynthetic apparatus, in depth knowledge of the calvin cycle and CO<sub>2</sub> concentrating pathways that leads to the synthesis of sucrose and starch.</li> <li>• Students will gain knowledge about the details of starch biosynthesis and sucrose transportation in plants.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>• Students will gain knowledge of the mechanism of protein sorting and degradation, nitrogen and sulfur metabolism, hormonal control of plant growth, photoperiodism and the role of phytochrome, flower and fruit development.</li> <li>• Students will have an in depth knowledge of plant signaling mechanisms and the pathways associated with it, secondary metabolites and the major pathways of their biosynthesis, and the mechanisms controlling the regulation of genome expression.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>• Students will gain knowledge regarding the major instruments used in the field of biochemistry and learn some basic aspects of computational biochemistry.</li> </ul>
BOTA-CT-121	V. PLANT GENETICS AND MOLECULAR BREEDING	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>• Students will understand about pre-breeding (interspecific hybridization) for introgression of genes/QTLs from wild relatives. Wild relatives are the reservoir of many important traits such as Abiotic/Biotic stress tolerance.</li> <li>• Students will also learn the technique for increasing the genetic base of crop varieties in terms of yield &amp; quality of crop plant (especially in Rice).</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>• The students will understand the controversy of GM Crops and its ethical issues and ecological concern.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>• Students will gain knowledge on crop improvement because food grain production must be increased to feed more than nine billion people by 2050.</li> </ul>
BOTA-CT-121	VI. PLANT PHYSIOLOGY AND PHARMACOLOGY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>• Students will learn the metabolite flux in plants and their homeostasis, compartmentation and augmentation with programs of differentiation.</li> <li>• Students will acquire knowledge about phenolics, alkaloids, glycosides and terpenoids; their biosynthesis in plants and ecological significance.</li> <li>• Peptides and brassinosteroids are now emerging field of plant hormone research. Through this chapter students will achieve knowledge molecular mechanism of new phytohormone research.</li> <li>• Students will be learning perception and processing of external information by cells through signal transduction mechanism and their functional translation through gene expression and editing.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>• Students will understand the action and pharmacology of herbal drugs, their channelling inside the cells and specific nano-carriers for precise targeting of herbal drugs.</li> <li>• Students will know the stress mitigation measures by plants and molecular interaction with</li> </ul>

		<p>environment.</p> <ul style="list-style-type: none"> <li>Students will recognize the quality control attributes of herbal drugs as per international guidelines.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will learn chromatographic techniques of separation of biomolecules which will help them independent during research designing.</li> <li>Also, the students will acquire different techniques of spectroscopy for understanding the nature of biomolecules in modern phytochemical research.</li> </ul>
BOTA-CT-121	VII. PTERIDOBOTANY AND PALYNOLOGY	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn about the role of various growth hormones in lower groups of plants and their regulatory mechanisms.</li> <li>Students will learn about the interactions of various lower groups of plants with micro-organisms and the strategies followed by them in conduction of water and photosynthates.</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge regarding stress tolerance mechanisms of bryophytes and pteridophytes with special regards to desiccation and will also be learning about bryophyte and pteridophyte model plants.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will gain knowledge regarding the fundamentals, scopes and applications of palynology as a subject.</li> </ul>
BOTA-CT-121	VIII. TAXONOMY OF ANGIOSPERMS AND BIOSYSTEMATICS	<p><b>Knowledge gained:</b></p> <ul style="list-style-type: none"> <li>Students will learn about the role of ICN in Plant Taxonomy.</li> <li>Students will gain knowledge on the usage of taxonomic evidences as delineate factor for angiosperms and their classification</li> </ul> <p><b>Skills gained:</b></p> <ul style="list-style-type: none"> <li>Students will understand the concepts of are phonetic and cladistics.</li> <li>Students will be able to understand the concept of molecular systematics and get acquainted with the preparation of phylogenetic trees and understand the importance in modern biology.</li> </ul> <p><b>Competency developed:</b></p> <ul style="list-style-type: none"> <li>Students will learn the concept of Ethnic knowledge and Biodiversity conservation.</li> </ul>