

Department of Botany

Programme Outcome

PO 1 : Knowledge about Plant diversity: India is the house of about 17000 species of flowering plants, 64 Gymnosperms, 1200 Pteridophytes, 2850 Bryophytes, 1300 Fungi and 12500 Algae. Eastern Himalaya and Western Ghat are botanically rich areas of world significance. Endemic plants in Eastern Himalaya are 3500 and in western Ghat 1600 respectively

PO 2: The number of **medicinal plants** grow and used in India are between 3000-5000 and roughly 1000 threatened with extinction.

PO 3 : Creation of ability to identify plants. students will be able to know the external characters of the aforesaid groups of plants, their importance, natural habitats, and art of identifying them.

PO 4 : Molecular information: the learners will know how can the plants survive in extreme environmental conditions, how can they acquire raw materials and synthesize food for the entire living organisms from the resources available in the environment, what are the genetic magics by which they can combat an adverse situation for survival.

PO 5: Applied aspects: students can apply aforesaid information for benefit of science and mankind. Both classical Botany as well as molecular Botany has immense scope for research work.

PO 6: Entrepreneurship: Lastly the Skill Enhancement Courses and Discipline Specific Courses will be helpful for the students if they like to be in entrepreneurship.

Course Outcome:

Course Code	Course Name	Course Outcome
CC1	PHYCOLOGY AND MICROBIOLOGY	<p>A basic knowledge of the two core courses Phycology and Microbiology is included in this syllabus. Students are given a detailed knowledge about the microbial world starting with the very basic structural features, the chemical constitution and ultra structural details , the molecular biology behind the genetics and finally the modern classification system of the microbes are explained.</p> <p>Practical The basic simple staining , Gram staining protocol and knowledge of the basic media preparations are topics under this course.</p>
CC2	MYCOLOGY AND PHYTO-PATHOLOGY	<p>MYCOLOGY General Account: Introducing the subject Mycology, the students can acquire knowledge about the present position of the fungi in the living world, general characteristics, structure and various spore forms and mechanism of spore dispersal. Explaining the peculiar types of sexual reproduction in fungi, gradual degeneration of sex, parasexuality and sexual compatibility mechanisms.</p>
		<p>Classification: Classifying Fungi with diagnostic characters and general characteristics of different sub-divisions under the Kingdom Mycota.</p>
		<p>Life History: Discussing in detail the life history of typical selected fungal genera common in India.</p>
		<p>Mycorrhiza: Describing the interesting mycorrhizal relationship with fungi and the roots of higher plants and their practical application in agriculture and forestry.</p>
		<p>Lichen: Acquiring knowledge about details of symbiotic relationship between algae and fungi as lichen, their types, reproduction and importance in human welfare as well as environment.</p>
		<p>Practical: Investigating the vegetative and reproductive structures of fungal genera and creating the ability to perform the micrometry successfully to measure the spores of fungi for identification and classification. Acquainting the students about the ecology, diversity and distribution of macrofungi in different localities, their comparative morphology helped in</p>

		<p>identification and collection procedure and preservation of Macrofungi through the botanical excursion.</p> <p>Gaining idea about the recognition of edible and poisonous mushrooms in the field which have practical importance of common people.</p>
		<p>PHYTOPATHOLOGY</p> <p>Terms and Definitions:</p> <p>Introducing the concept of disease, relationship with host, scope and importance of Phytopathology.</p> <p>Explaining the living and non-living agents causing diseases in plants, symptomatology, types of diseases and their virulence, epidemiology and the diagnosis of the disease through Koch's postulates.</p>
		<p>Host-Parasite Interaction:</p> <p>Informing the students how recognition between host and pathogen occurs at the molecular level during host parasite interaction resulting in penetration and infection and development of disease by process of releasing enzymes, pathotoxins, hormones etc. by the pathogen.</p> <p>Acquiring knowledge of host defense mechanism like pre-existing and induced defense mechanisms both morphological, biochemical and systemic acquired resistance towards immunization in host plants.</p>
		<p>Plant Disease Management:</p> <p>Explaining and evaluating the practice of management of disease in the field through preventive as well as therapeutic methods including biocontrol and integrated disease management.</p>
		<p>Symptoms, causal Organism disease cycle and control measures of diseases:</p> <p>Describing symptoms, causal organism, disease cycle, environmental conditions and control measures of selected important plant diseases which may cause epidemics in India as well as in different parts of the world.</p>
		<p>Practical:</p> <p>Giving the students Hands on training for preparation of fungal media, sterilization process using various apparatus and instruments in the laboratory.</p> <p>Creating interest on Hands on training of Koch's postulates for isolation of pathogen from diseased leaf, inoculation of fruit and subculturing techniques.</p> <p>Creating ability to identify pathological specimens macroscopically and also from the microscopic permanent slide preparations.</p>
CC3	PLANT ANATOMY	<p>A detailed account of the internal organization of the plant organs is studied under this course. The primary and the secondary anatomical structures are both discussed in details. The anomaly that arise in certain plant species are also discussed here. Finally the</p>

		<p>different anatomical adaptations that the plants make under various environmental conditions are discussed in this section.</p> <p>Practical The entire theory portion is demonstrated practically in these classes. The students learn about the basic differential staining protocols.</p>
CC4	ARCHAEGONIATE	<p>BRYOPHYTES General Account: Discussing general characteristics of Bryophytes and classification of bryophytes with diagnostic characters up to Class.</p>
		<p>Life History: Describing the gametophytic structure, reproduction, development of sporophyte, its structure and spore dispersal mechanism of selected genera.</p>
		<p>Phylogeny: Creating interest on phylogeny by discussing the unifying features of archegoniates and their transition to land habit, origin of bryophytes and evolution of sporophytes.</p>
		<p>Importance: Evaluating how bryophytes take part in plant succession, pollution monitoring along with economic importance.</p>
		<p>Practical: Explaining the morphological characteristics of the selected genera under theoretical syllabus including <i>Riccia</i> and <i>Porella</i> and their reproductive structures through macroscopic and microscopic observation.</p>
		<p>PTERIDOPHYTES General Account: Acquiring knowledge about colonization and rise of early land plants. Classifying vascular plants up to division with diagnostic characters and suitable examples.</p>
		<p>Life History: Describing the sporophytic plant body, reproduction and structure of gametophytes of selected common genera of Pteridophytes.</p>
		<p>Understanding the Telome concept and explaining the origin of different groups of Pteridophytes in the light of Telome concept.</p>
		<p>Analyzing the phenomenon of Heterospory among the members of Pteridophytes and assessing the Origin of Seed Habit from Heterospory.</p>
		<p>Evaluating the economic importance of Pteridophytes with respect to food, medicine and agriculture for human welfare.</p>
		<p>Practical: Demonstrating the morphological structure of</p>

		<p>sporophytic plant body of selected genera under theoretical syllabus along with <i>Lycopodium</i>, <i>Ophioglossum</i> and <i>Marsilea</i> and also through microscopic observation of reproductive structures from permanent slides.</p> <p>Working out of the reproductive structures of <i>Selaginella</i>, <i>Equisetum</i> and <i>Pteris</i>.</p> <p>Familiarizing of the natural habitats of archegoniates through botanical excursion.</p> <p>GYMNOSPERMS</p> <p>The study of the various groups of the gymnosperms plants are covered under this part.</p>
CC5	PALAEOBOTANY AND PALYNOLOGY	Students gain a detailed knowledge about the extinct plant fossils and the world of pollens in this course
CC6	REPRODUCTIVE BIOLOGY OF ANGIOSPERMS	Students are able to work out, describe and identify plants upto genus from different angiosperm families . They get an idea about the different plant families of angiosperms from local and long educational trips.
CC7	PLANT SYSTEMATICS	<p>1. Introduction: Discussing the need of classification and basic terminology associated with that. Classifying the phases of taxonomy and the status of India in that respect.</p> <p>2. Nomenclature: Analyzing the requirements of common rules and regulation for naming a plant which is to be accepted globally. Discussing the principle and some important rules of ICN.</p> <p>3. Systems of classification: Classifying the classification systems and discussing the characters emphasized by different taxonomists and merits and demerits of representative system. Analyzing the need for collective classification system to accommodate all upcoming characters regularly from all corners of the world. Systematics in practice: analyzing the need for conservation of documents either by preserving plant flowering twigs or by photographs to identify a plant globally and to produce researchers to explore flora of a region or a nation scientifically and also ex situ conservation by making Botanic Gardens. Discussing the roles of some important herbaria of India and of the world.</p> <p>4. Phenetics and Cladistics: Discussing the ways of interpreting of a collection of documents into groups and probable phylogenetic relationships within the</p>

		<p>groups.</p> <p>5. Data sources in taxonomy: Discussing about the newer areas of information coming from interdisciplinary works to be utilized to interpret the relationship between two or more group and can also be utilized as an important character in modern day classification of plants.</p> <p>6. Diagnostic features, systematic position, and economically important plants of some families: Classifying plants based on number of cotyledons and the characters associated with them. Discussing some important characters of some representative families of each of the aforesaid groups and the economically important members of those family considered.</p> <p>7. Practical : Developing skills to represent a plant with morphological characters by description and drawing, and from the characters of the specimen, identification of family characters and ultimately identification of the Genus by consulting a familiar key. Practicing the art of preserving plant specimen following the methods of collection from fields. Observing flora of a different geographical region art of writing field record. Visiting Central National Herbarium, Howrah, and Acharya Jagadish Chandra Bose Indian Botanic Garden to learn and exchange thought with the scientists.</p>
SECA	APPLIED PHYCOLOGY, MYCOLOGY AND MICROBIOLOGY	<p>Explaining the alternate source of food, Fungi serves such food for human as mushroom SCP. Describing the industrial production of Cheese and Ethanol. Explaining the fungal source and uses of useful substances like Cellulase, Tryptophan, Riboflavin, Griseofulvin and Cyclosporin-A which are produced industrially. Analyzing the consumption of contaminated food materials which may cause Mycotoxicosis due to Aflatoxin showing detrimental effects in human beings and cattle. The industrial sources ,uses and preparation of the products of the algae and the various microbes are also important part of the syllabus of this group.</p>
CC8	PLANT GEOGRAPHY, ECOLOGY AND	PLANT GEOGRAPHY Phytogeographical Regions:

	EVOLUTION	Introducing the idea of distribution of plants on earth surface and in India, Classification of Phytogeographical regions of India and study of dominant flora of three phytogeographical regions of India.
		Endemism: Discussing about the confinement of plant species in an area, endemic species in Indian flora, factors responsible for endemism and explanation of theories of endemism.
		ECOLOGY Preliminary Idea On: Explaining ecology and giving idea on different terms like Habitat and Niche, Ecotone and edge-effect, Microclimate, Ecads, Ecotypes, Ecoclines.
		Community Ecology: Discussing the Community, how the process of ecological succession occurs through seral stages to develop a community from a pioneer stage to climax stage. Creating knowledge of waste disposal in the polluted environment through Phytoremediation.
		Conservation Biodiversity: Students will acquire knowledge about the present position and types of Biodiversity, strategies for conservation of Biodiversity and Biodiversity Hotspots.
		EVOLUTION Understanding the idea of evolution, various theories of evolution including phyletic gradualism, punctuated equilibrium and stasis. Explaining the selection types, speciation, coevolution, reproductive isolation and adaptive radiation. Analyzing the phylogeny of living organisms from the lower group of bacteria to algae, fungi, bryophyte, pteridophyte and gymnosperms; and creating a Phylogenetic tree.
		Practical: Conducting a visit to study the local flora of a community, students will be able to determine the minimal size of the quadrat. Creating ability to calculate frequency, density and abundance of plant components to get a conclusion about the herbaceous vegetation of a particular region. Analyzing the comparative anatomical studies of leaves from polluted and non-polluted areas, and thus tracing the effect of pollution on the plants and students can gain the practical knowledge. Assessing the amount of dissolved O ₂ of water samples collected from various sources.

		Assessing the amount of free CO ₂ of water samples from different sources to get an idea of the quality of water.
CC9	ECONOMIC BOTANY	This course deals with the economically important plants and their morphological, anatomical and biochemical specificities.
CC10	GENETICS	The detailed idea about genetics is given to the students. Starting with the understanding of the pioneering work of the 'Father of Genetics' to the modern day approaches to understand the complex inheritance phenomena are all dealt with. Understanding of Crossing over, Mutation , Chromosomal aberrations and the various levels of ploidy are all aimed at. A basic understanding of the concept of gene and its structure is also provided. Practical To learn the very basic techniques to study plant chromosomes and it's various anomalies is the primary goal of the practical classes.
SECB	PLANT BREEDING	To study the introduction and objectives of breeding , the breeding systems and the various modes of reproduction in crop plants are the objectives. The important achievements and undesirable consequence of plant breeding are also discussed in details.
CC11	CELL AND MOLECULAR BIOLOGY	Study and understanding the very basic structural and functional unit the 'cell' and then delving deep into the molecular functioning of the cell at the various levels starting with transcription, translation and the post event modifications are dealt with here. A brief account of the effect of de-regulation of the cellular and molecular machinery with the effect of developing carcinogenesis concludes this course. Practical The basic quantification techniques of the macromolecules like DNA , RNA and proteins are taught here. The technique of micrometry and quantification using haemocytometer is also included.
CC12	BIOCHEMISTRY	Biochemical foundation: Analyzing the need of energy of making and generation of energy in breaking different types of bonds which are essential for maintenance of life processes. Explaining the structure of water which makes it inevitable for life. How hydrogen ion concentration can affect three dimensional structure of biomolecules and the role of buffer to fix pH at a particular point so that experiments can be performed <i>in vitro</i> .

		<p>Molecules of life: Classifying biomolecules which are present in living being and also explaining the structural peculiarities that make them unique for their function.</p> <p>Energy flow and enzymology: Discussing how the laws of thermodynamics are equally applicable to biological systems and how prediction can be made of a chemical reaction. Assessing the roles of ATP to act as energy currency from thermodynamic point of view. Classifying different types of enzymes, the structural requirements to function and discussing the mystery of performing a biological reaction at a much less energy level in comparison to a chemical reaction. Analyzing the effect at a varying concentration of substrate and enzyme and laws formulated from the results.</p> <p>Cell membrane: Discussing the functions of a biological membrane. Evaluating the chemistry of the membrane which support the movement of ions through them and classifying the types of ion transport through membranes.</p> <p>Phosphorylation: Discussing the way of generation of usable energy in the form of ATP after enzymatic breakdown of complex molecules through respiration and analysing the similarities and differences with light energy transfer and ATP production in photosynthesis.</p> <p>Practical: Qualitative: Creation of ability to detect the presence of different organic acids, carbohydrates and proteins from plant samples through chemical tests and also to identify the nature of carbohydrates. Assessing the presence of some mineral ions absorbed and utilized by the plants and retained in their body (present in their ash) which will predict the need of a plant for better growth. Quantative: Assessing the perfection to detect the amount of a carbohydrate, an element, an organic acid, enzyme activities and amount of protein which are common organic/ inorganic molecules present in a plant.</p>
DSEA1	INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY	Having importance as an applied subject, discussing the scope of microbes in the industry for production of various substances required for human welfare and also the scope of microbes in the environment.

		<p>2.Describing in detail the structure of fermenter and fermentation process including solid state fermentation, liquid state fermentation; batch, fed-batch and continuous fermentation for the synthesis of industrial product.</p> <p>Explaining the components of bioreactor and the ranges of bioreactors constructed as per requirement in laboratory or in industry.</p> <p>3.Discussing the microbial production of industrial products, students can learn the preparation of media, inoculum selection and preservation; and fermentation condition.</p> <p>Explaining the harvesting and details of downstream processing for recovery of pure product like filtration, centrifugation, cell disruption, solvent extraction, spray drying and lyophilization to obtain the important products like enzymes, organic acids, alcohols and antibiotics.</p> <p>4.Explaining the interesting thing is that how the microbial enzymes of industrial interest can be utilized many times through the process of enzyme immobilization.</p> <p>5.Analyzing practical aspects of presence of microbes in the environment and assessing the quality of environment through the isolation techniques of microorganisms from air water and soil.</p> <p>6.Analyzing the microbial flora of water, it's role in waste water treatment to combat water pollution; assessing the number of microbes as indicator of water quality and to learn how to check the coliform and fecal coliform bacteria in water.</p> <p>7.Describing the role of microbes in agriculture towards the benefit of mankind like biological fixation, importance of mycorrhizae in agriculture and bioremediation of contaminated soil.</p> <p>8.Practical:</p> <p>Creation of interest and hands on training about the principles and functioning of instruments in Microbiology laboratory.</p> <p>Hands on training on sterilization techniques through various sterilizers in the laboratory and preparation of culture media in aseptic condition.</p> <p>Acquainting the students about the preparation of slant, stab and pouring Petri plates for the culture of microorganisms presently and in future.</p>
DSEB1	PLANT BIOTECHNOLOGY	<p>The detailed study of the theory and practicals of the various plant tissue culture techniques and the discussion of the modern concept of plant biotechnology and it's applications are discussed here.</p>

CC13	PLANT PHYSIOLOGY	<p>Plant water relation: Deciphering the mystery of absorption of water from soil by the plant roots and how do they lift water even to a height of 130 meters without any expenditure of energy. Discussing the anatomical peculiarities the plants have which favor the processes. Analyzing the art of controlling water loss through stomata.</p> <p>Mineral nutrition: Classifying mineral elements required for growth on the basis of amount they need. Discussing the role of individual mineral in growth and development of a plant and the effect of absence on the plants.</p> <p>Organic translocation: Explaining the tactics a plant adopt to distribute the photosynthates with minimum loss and less expenditure of energy.</p> <p>Plant Growth regulators: Discussing the miracles showed by a small amount of a chemical (PGRs) with huge effect on growth and development. Analyzing the difference in mode of action and structural peculiarities and the effects they produce.</p> <p>Photo morphogenesis: Discussing the effect of light and low temperature on development of plant organs and the and the way of actions taken by different plant pigments under varying light and dark periods.</p> <p>Seed dormancy: Analyzing the reasons for a seed to remain dormant during unfavorable period. Discussing the methods to break dormancy and analyze the art of germination in biochemical point of view.</p> <p>Physiology of senescence and ageing: Explaining the uniqueness of plants to mobilize nutrients before shedding leaves, or organs to plant body as a sustainable development. Discussing the genetic and molecular machineries that control senescence and abscission.</p> <p>Practical: Creation of interest and performing an experiment in an ideal condition what they have learned from theoretical courses. Discussing how to hypothesize an experiment and analyze the method of interpreting a result and how to depict a result in tabular form or by diagram. What conclusion the learner can draw from the result they got.</p>
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CC14	PLANT METABOLISM	<p>Introduction: Discussing about the concept of metabolism and how it is regulated and involvement of regulatory enzymes.</p> <hr/> <p>Photosynthesis: Understanding the secrets of making carbohydrates from raw materials of the environment and simple implementation of energy transfer from sunlight to chemical energy. Analyzing the structure and assemblage of pigment molecules to capture light energy optimally and protect photochemical damage which may cause due excess energy transfer and also immediate damage control. Discussing the biochemical events takes place to use transformed energy for making bonds between carbon, hydrogen and oxygen. Explaining the need for a strategy to overcome the problem of losing fixed carbon by photorespiration. Classifying plants adopting carbon concentrating mechanism and their significance on evolutionary point of view.</p> <hr/> <p>Respiration : Explaining the need of useable form of energy from stored polymers or from simple sugars for growth and development and the ways by which plants produce ATPs. Analyzing the similarities between plants and other living organism in this context. How cell organelles participate in the process of respiration.</p> <hr/> <p>Nitrogen Metabolism: Discussing about the unique feature of diazotrophs to fix atmospheric dinitrogen which was the main route to supply fixed nitrogen to plants before the discovery of chemical fertilizers for millions of years. Explaining the fact that Nitrogen fertilizers are bye product of petroleum industry and the reservoir of the fossil fuel is diminishing so in future exploitation of biological dinitrogen fixation can save the human race from extinction. Explaining the mechanisms adopted by legumes to use Rhizobia to form nodule and fix Nitrogen.</p> <hr/> <p>Lipid Metabolism: Explaining the role of lipids as stored material for many seeds and how the lipids are broken down to energy and carbon sources for growth of the germinating embryos. Discussed about the cell organelles involved and</p>
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DSEA2	MEDICINAL AND ETHNOBOTANY	<p>The study of the history, scope and importance of medicinal plants , a brief idea about the indigenous medicinal sciences like ayurveda, siddha and unani. Polyherbal formulations are discussed here. The area of Pharmacognosy also forms an important part of this course.</p>
DSEB2	RESEARCH METHODOLOGY	<p>This course has been specifically designed with the aim to make students at the UG level aware of the vast, ever emerging and challenging field of modern scientific research. This is to ultimately motivate them to pursue scientific research in the future.</p>