

## **Semester I**

### **PAPER CC1- ALGAE AND MICROBIOLOGY**

#### **Course objectives and expected outcome:**

Phycology is an important branch of biology since algae is such a vital part of aquatic ecosystem. They can perform photosynthesis and provide food source for other organisms, and provide shelter and protection for animals. Understanding the biology of algae is increasingly important in terms of evolution as it can provide the foundation of aquatic food chain.

In this course students get an elaborate idea of different groups of algae in detail in terms of their general characteristics, ecology, significant contribution and role in the environment, agriculture and biotech industries.

This course also offers a fundamental and basic knowledge on microbial world including bacteria and virus. This includes the growth and metabolism pattern of microorganisms, economic use of virus in terms of vaccines and economic use of bacteria in terms of industry and agriculture. Moreover the course focuses broadly on the biological characteristics, classification, replication and other important aspects of both virus and bacteria. In addition to that, the course includes practical training on important techniques of microbiology like gram staining, endospore staining, study of bacteria from root nodule/curd sample and demonstration of models of virus through photographs.

1. Algae can grow quite well in waste water where other organisms would not survive. Phycologists have developed ways to clean up waste water naturally by using algae.
2. As the course includes both fundamental and applied aspects of phycology, the students will be benefitted by both and this can direct them towards research in the field of phycology.
3. Microbiology is one of the most vital fields hence studying microbiology will make the students skilful in understanding the basic concept of role of microorganisms in several industries.

### **PAPER CC2- BIOMOLECULES AND CELL BIOLOGY**

#### **Course objectives and expected outcome:**

This course includes in details about the several biomolecules like carbohydrate, lipids, proteins, nucleic acid which deals with structure, types and properties of biomolecules. This course further deals with the basic idea of bioenergetics and enzymes which is extremely important in understanding nature of any biological reaction taking place in any organism and in nature as a whole. Another part of the course encompasses the general idea of cell biology. The objective of this course is to impart students the basic knowledge of how cells work. The course also offers elaborate practical classes. The practicals include qualitative test for biomolecules and experiments designed on vital biological processes like protoplasmic streaming, plasmolysis, deplasmolysis, staining techniques, effect of organic solvent on membrane permeability etc that will help the students in obtaining detailed idea about how the cells work.

1. Knowledge on biomolecules and cell biology is fundamental in proceeding in applied biological fields. Basic knowledge on components and structure of cell is vital.
2. biotechnology uses techniques and information from cell biology to genetically modify crops to produce alternative characteristics and to produce and ensure high quality food at low cost.
3. this will encourage students to pursue cell biology as an exciting career option.

PAPER- GE4: BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

**Course objectives and expected outcome:**

This generic course includes microbes, algae, fungi, archegoniates, bryophytes, pteridophytes, gymnosperm.

This course offers a preliminary but very useful outlook and background knowledge of microbe and lower plant groups and archegoniate. Characteristic features, economic and evolutionary significance of each group is studied in details under this course. This course contains basic microbiology experiments and identification of vital members of each of the groups and their characteristic features. This course aims at giving a broad perspective of the lower plant groups, archegoniates and microorganisms and their significance in the living world.

1. The course can help the students to understand the biodiversity and how evolution has taken place in the plant kingdom.
2. This course also helps the students in understanding the microbial diversity and its significance in the living world.

**Semester II****PAPER CC3- MYCOLOGY AND PHYTOPATHOLOGY****Course objectives and expected outcome:**

This course offers a broad overview of mycology and phytopathology. Mycology is the study of fungi and this gives knowledge about general features of this group of organism. This course provides detailed insight on general characteristics, lifecycle, ecology of different members of each group of fungi; importance of mushroom; symbiotic association in lichen; applied mycology which deals with importance of fungi in agriculture, pharmaceutical and other industries. The other part of this course covers phytopathology which deals with etiology and symptology of several bacterial and viral diseases in plants; prevention and control of plant diseases; role of quarantine. These topics are of utmost importance in order to fully understand the disease biology.

1. Fungi has a wide range of utility in medicine and food production
2. Students can learn about the role of fungi in biotechnology, food industry, agriculture and production of biological controls.
3. Studying phytopathology gives the vast understanding of disease causing factors and simultaneous preventive controls for the several plant diseases.

**PAPER CC4- ARCHEGONIATE****Course objectives and expected outcome:**

This course encompasses the plant groups like Bryophytes, Pteridophytes and Gymnosperm. This includes studying the characteristic features of each group and studying the life cycle of important members of each group. Each of the topic includes the ecological and economic importance of all the groups.

1. Bryophytes , Pteridophytes and gymnosperm have immense ecological and evolutionary significance. Understanding that will be instrumental for students to understand how adaptation played an important role in transition to land habit.
2. All the groups have tremendous economic importance as well in form of availability of tannins, resin, gum etc and other economically important products produced by these group of plants. Knowledge about the economic aspect of these groups of plants will be important.

## **PAPER GE2- PLANT ECOLOGY AND TAXONOMY**

### **Course objectives and expected outcome:**

This course covers two very important topics of plant science, namely Ecology and taxonomy. In ecology, students learn about ecological factors different plant communities general idea about ecosystem and phytogeography. Ecology seeks to understand the vital connections between plants and animals and the world around them. Taxonomy is the science of classifying living organisms based on certain sets of characters for easy identification and study. The entire course is designed in a way the students get a broad overview of importance of classification. The course includes introduction to plant taxonomy, identification, taxonomic hierarchy, botanical nomenclature, biometrics, numerical taxonomy and cladistics.

1. While studying plant sciences, it is of utmost importance for the students to know how crucial it is to describe different species and how description of each new species is preserved and used for comparison.
2. The course will benefit the students in understanding the rules of nomenclature and also the evolutionary relationship among living organisms.
3. Taxonomy also provides basis for genetic analysis are performed on the basis of systematic. Hence students with a general idea of taxonomy can interconnect other aspects of biology.

## **Semester III (Total marks- 350)**

### **PAPER C5T- ANATOMY OF ANGIOSPERMS**

#### **Course objectives and expected outcome:**

Studying plant anatomy allows a student to conceptually integrate organismal structure and function. Further, it helps to reveal the relationships between structure, function, taxonomy, ecology, and developmental genetics. This course principally focuses on topics namely scope of plant anatomy, structure and development of plant body, different types of tissues, vascular cambium and wood and adaptive and protective systems present in angiosperms. This course also has a scope of studying anatomical details of plants through microscopy and museum specimens. Our course aims to help students understand the arrangement of tissue and cells types within the dermal, ground, and vascular tissue systems in vascular plants; the characteristics of specialized cells and their components. The course also deals with the relationship between internal structure, physiology, and ecology.

1. The anatomy and ecological significance of different types of tissues
2. The taxonomic and evolutionary variation in xylem and phloem components
3. Anatomical adaptation of plants associated with specific habitats.
4. Understanding the process of woody secondary growth in stems
5. The detailed study regarding the scope of anatomy gives a vast overview on wood technology, archaeology, forensics, and paleontology.

### **PAPER C6T- ECONOMIC BOTANY**

### **Course objectives and expected outcome:**

Plants are extremely important in the lives of people throughout the world. People depend upon plants to satisfy such basic human needs as food, clothing, shelter, and health care. These needs are growing rapidly because of a growing world population, increasing incomes, and **urbanization**. Plants provide food directly, of course, and also feed livestock that is then consumed itself. In addition, plants provide the raw materials for many types of pharmaceuticals, as well as tobacco, coffee, alcohol, and other drugs. The fiber industry depends heavily on the products of cotton, and the lumber products industry relies on wood from a wide variety of trees (wood fuel is used primarily in rural areas). Approximately 2.5 billion people in the world still rely on subsistence farming to satisfy their basic needs, while the rest are tied into increasingly complex production and distribution systems to provide food, fibre, fuel, and other plant-derived **commodities**. Our course aims help the students to understand the immense importance of plants and plant derived products. It helps them to know all the aspects of Economic use of plants including staple cereals, legumes, spices, beverages, starch sources, fibre, timber, rubber, oils, and medicines.

1. Understanding and knowledge of the cultivated plants, staple cereals legumes.
2. Knowledge on the use and importance of spices beverages oils starches.
3. Knowledge on the use and importance of rubber timber fibre yielding plants
4. Knowledge on the use and importance of drug yielding plants.

### **PAPER-C7T: GENETICS**

#### **Course objectives and expected outcome:**

Genetics is an integral part of Biology. It can be used as a basic tool to employ several techniques for increasing yield and vigour of plants. Understanding the principles of basic Plant genetics will help the students to gain insight into the following topics, and generate interest about how nature and evolution works and variation comes into play.

Basic principle of Mendelian genetics and its extension

Extra chromosomal inheritance

Linkage crossing over and gene mapping

Variation in chromosome number and structure

Gene mutations

Fine structure of gene

Population and Evolutionary Genetics.

1. Basic knowledge about how heredity works and how it affects broad societal issues including health and disease, food and natural resources and environmental sustainability
2. Understanding the role of genetic mechanisms in evolution.
3. The knowledge required to design execute and analyze the results of genetic experiments.
4. The ability to evaluate conclusions that are based on genetic data.
5. Understanding the role of genetic technologies in broader industries like biotechnology and pharmaceuticals.

### **PAPER SEC-1 (SKILL ENHANCEMENT COURSE): BIOFERTILIZERS**

#### **Course objectives and expected outcome:**

This course offers a general account about microbes used as fertilizers with special emphasis on *Rhizobia*, *Azospirillum*, *Cyanobacteria*, *Azolla* and Mycorrhizal association.

Another aspect of this course focuses on organic farming which includes topics like green manuring, organic fertilizers, recycling of biodegradable waste, biocompost and vermicompost. This will

motivate students about the organic approach in agriculture and use of environment friendly beneficial microbes as source of fertilizers instead of harmful chemical ones.

1. Learning about the basics of sustainable agriculture in form of biofertilizers and organic farming will expose them to the broader perspective of agricultural biotechnology.
2. This will motivate the students in pursuing their future career in this line which will in the long run help the sustainable development of Agriculture.
3. Use of biofertilizers is also going to be economically more feasible.

#### PAPER GE-3: ECONOMIC BOTANY AND PLANT BIOTECHNOLOGY

##### **Course objectives and expected outcome:**

Plants are extremely important in the lives of people throughout the world. People depend upon plants to satisfy such basic human needs as food, clothing, shelter, and health care. These needs are growing rapidly because of a growing world population, increasing incomes, and **urbanization**. Plants provide food directly, of course, and also feed livestock that is then consumed itself. Plant biotechnology will facilitate the farming of crops with multiple durable resistance to pests and diseases, particularly in the absence of pesticides. With increasing world population and hence more hungry mouths to feed crops should be engineered to meet the demands and needs of consumers. In this regard, this course is of utmost importance because it encompasses both economic botany and plant biotechnology. This course includes broad overview of economic plants producing cereals, legumes, spices, beverages, oil, fats, fibres etc and at the same time it covers the basic aspects of plant biotechnology including plant tissue culture and basic recombinant DNA techniques.

1. Understanding and knowledge of the cultivated plants, staple cereals legumes.
2. Knowledge on the use and importance of spices beverages oils starches.
3. Biotechnology is the booming topic in the entire area of biology. The knowledge of plant biotechnology in this course will provide the fundamental basis for them to study this topic in details.

#### **Semester IV (Total marks- 350)**

##### **PAPER-CC8: MOLECULAR BIOLOGY**

##### **Course objectives and expected outcome:**

**Plant molecular biology** is an area that helps **study plants** from the cellular and **molecular** level. It helps us decipher several biochemical pathways in **plants** and its which are **important** for higher yield, warding off harmful pathogens and lead to more sustainable agricultural production. Hence this course imparts detailed theoretical and practical insights on the major topics of molecular biology including nucleic acid, structure of genetic material, DNA replication, transcription, and translation. This course gives special stress on demonstrating the fundamental molecular biology processes in forms of pictures and experiments.

1. Students will have a basic understanding about the important molecular biology processes in plants.
2. Career areas including agriculture, food science, healthcare, environmental science and teaching are available which the students will be motivated to take up in the future.

3. Plant molecular biology is a highly specialized science for exploring plant cells and even altering them to increase the usefulness of plants in everyday life. Research in molecular biology has immense prospect, which the students may be motivated to pursue.

### **PAPER-CC9: Plant Ecology and Phytogeography**

#### **Course objectives and expected outcome:**

This course covers very important topics of plant sciences namely Plant Ecology and Phytogeography. Ecology seeks to understand the vital connections between plants animals and the world around them. In this course, students learn in detail about the different ecological factors like soil, water, light, temperature, wind etc; general idea about Ecosystem and population ecology; different plant communities and interactions between them. This also deals with phytogeography which includes principles of continental drift, theory of tolerance and endemism as well as local vegetations of different phytogeographical divisions of India.

1. Students will get detailed knowledge on interdependence between nature animal and plants. this equilibrium is vital for food availability, maintaining clean air and water, and sustaining biodiversity in a changing climate.
2. Lack of Ecological understanding maybe the cause of deprivation of natural resources hence, more students learning Ecology will help tackling major ecological hazards.
3. If we want to conserve and protect nature in general and prevent extinction of species, we need to know how they all fit together at the first place. In this context, studying Ecology and Phytogeography is of utmost significance.

### **PAPER-CC10: Plant Systematics**

#### **Course objectives and expected outcome:**

Plant systematics is a science that includes and encompasses traditional taxonomy; however, its primary goal is to reconstruct the evolutionary history of plant life. It divides plants into taxonomic groups, using morphological, anatomical, embryological, chromosomal and chemical data. Taxonomy is a science of classifying living organisms based on certain set of characters for easy identification and study. The entire course is designed in a way that the students get a detailed overview of importance of classification. The course includes significance of plant systematic, taxonomic hierarchy, botanical nomenclature, system of classification, biometrics, numerical taxonomy, cladistics and phylogeny of Angiosperms. This includes practical study of vegetative and floral characteristics of several families and their subsequent identification.

1. While studying Botany, it is of pivotal importance for the students to know how crucial it is to describe species and how description of each new species is preserved and used for comparison.
2. The course will benefit the students in understanding the rules for nomenclature and also the evolutionary relationship among living organisms.
3. Taxonomy also provide bases for genetic analysis which are performed on the basis of systematics. Hence students with a general idea of taxonomy can interconnect other aspects of biology.

#### **PAPER-GE4: Embryology and Anatomy**

##### **Course objectives and expected outcome:**

Studying plant anatomy allows a student to conceptually integrate organismal structure and function. Further, it helps to reveal the relationships between structure, function, taxonomy, ecology, and developmental genetics. This course principally focuses on theoretical and practical knowledge on types of tissues, organs, secondary growth, adaptive and protective system in plants, structural organization of flower, pollination and fertilization, embryo and endosperm, apomixes and polyembryony.

1. The anatomy and ecological significance of different types of tissues
2. The taxonomic and evolutionary variation in xylem and phloem components
3. Anatomical adaptation of plants associated with specific habitats.
4. Understanding the process of woody secondary growth in stems.

#### **PAPER-SEC-2: Mushroom Culture Technology-**

##### **Course objectives and expected outcome:**

Mushroom cultivation can help reduce vulnerability to poverty and strengthen livelihoods through the generation of a fast yielding and nutritious source of food and a reliable source of income. The course focuses in detail the nutritional and medicinal value of edible mushrooms ,cultivation technology,and storage of the same and at the same time emphasizes on the marketing and export value,national and regional level of research in mushroom. It also gives an idea of poisonous mushrooms

1. Mushroom cultivation can be considered as a lucrative career plan for students studying this course.
2. Mushroom cultivation is not only of economic importance but also has important role to play in integrated rural development programme by increasing income and self employment opportunities for village youths, women folk and housewives to make them financially independent.

#### **SEMESTER-V**

##### **PAPER-CC11: Reproductive Biology of Angiosperms**

##### **Course objectives and expected outcome:**

Plant reproductive biology is the study of mechanisms and process of sexual and asexual reproduction in plants. It may encompass a study on pollination mechanisms, gene flow, genetic variation and propagule dispersal between and within populations. Knowledge on reproductive mechanisms of plants can help to assess the adaptive significance and homology of descriptive characters used in plant systematics. The course comprises of the following topics-Reproductive development,anther and pollen biology,ovule,pollination and fertilization, self incompatibility,embryo,endosperm and seeds, polyembryony and apomixes.

- 1.Reproduction is not only the most important step in the life cycle of plants but also the core of their evolutionary process, therefore, study of characteristics of reproductive biology of a species is indispensable in exploring the mechanism by which it has become endangered.



2. Plant reproductive studies are crucial for conservation, hence this will give insight into student's conception of interlinking conservation with evolution.
3. Studying reproductive biology can also give insight into the delimitation and classification of species and infraspecies.
4. Therefore, detailed information on the reproductive biology of plants is essential for developing effective strategies for their conservation and sustainable utilization

## **SEMESTER-V**

### **PAPER-CC12: Plant Physiology**

#### **Course objectives and expected outcome:**

Plant physiology is the study of plant function and behaviour, encompassing all the dynamic processes of growth, metabolism, reproduction, defense and communication that account for plants being alive. This course includes theoretical knowledge of core plant physiology topics like plant water relations, mineral nutrition, nutrient uptake, translocation in phloem, plant growth regulators, physiology of flowering, phytochrome, cryptochrome and phototropins. Apart from the theoretical overview, the course is so designed that it imparts practical understanding of majority of physiological processes in plants.

1. Study of plant physiology provides the students with the basic idea that we can observe the activities of plants with relation to their external environmental conditions such as heat, drought, cold etc.
2. Physiological studies generate important information useful in field of agronomy, horticulture, genetics and plant breeding.
3. Plant physiology is relevant to number of industries, including food, beverage, pharmaceuticals and textile industries.
4. The students studying plant physiology in depth can get a fair overview of the above mentioned aspects of it.

## **SEMESTER-V**

### **PAPER-DSE1: Biostatistics**

#### **Course objectives and expected outcome:**

Biostatistics are the development and application of statistical methods to a wide range of topics in Biology. It encompasses the design of biological experiments, the collection and analysis of data from those experiments and interpretation of results. The goal of Biostatistics is to disentangle the data received and make valid inferences that can be used to solve problems in research. This course particularly aims at better understanding of the principles, variables, limitations and uses of statistics along with collection of primary and secondary data, measurement of central tendencies, correlation and statistical inference. All these cover both the theoretical and practical approaches of Biostatistics.

1. Since, Biostatistics is a vital context in conducting any research, the vast idea of Biostatistics will be crucial for students in answering pressing research questions.
2. It is central to all of Biological science because research needs gathering of evidence and evaluation of the same to come to a conclusion and it is not possible without Biostatistics.
3. They play pivotal role in designing studies to ensure enough data are collected and that they are statistically significant.



## **SEMESTER-V**

### **PAPER-DSE2: Plant Breeding**

#### **Course objectives and expected outcome:**

Plant breeding is the science of changing the traits of plants in order to produce desired characteristics. It has been used to improve the quality of nutrition in products for humans and animals and to improve the overall genetic potential of plants. This manipulation involves either controlled pollination, genetic engineering or both followed by artificial selection of progeny. This course contains theoretical and practical learning of the topics which include introduction and objective of plant breeding, methods of crop improvement, quantitative inheritance, inbreeding depression and heterosis, crop improvement and breeding.

1. **With the knowledge of plant breeding techniques, the students can contribute to the incredible efficiency of modern agriculture.**
2. **They can be motivated to become budding plant scientists or plant breeders and can contribute to the society in terms of crop improvements.**

## **SEMESTER-VI**

### **PAPER-CC13: Plant Metabolism**

#### **Course objectives and expected outcome:**

plant metabolism is defined as the complex of physical and chemical events of photosynthesis, respiration and the synthesis and degradation of organic compounds. Plant metabolism comprises of all the essential metabolic pathways that are essential for the survival of the plant like carbon assimilation, carbohydrate metabolism, carbon oxidation, ATP synthesis, lipid metabolism, nitrogen metabolism and mechanism of signal transduction. The course hence elaborates broadly all the theoretical and practical aspects of above mentioned topics.

1. The students will understand the basics of plant metabolism, this will create the basis for better understanding the response of plants to altered environmental conditions such as (abiotic/biotic stress, nutrient starvation)
2. This basic understanding will help them to understand the basic stress tolerance mechanisms of plants and will help them in their future research if they choose to pursue it as a career.

## **SEMESTER-VI**

### **PAPER-CC14: Plant Biotechnology**

#### **Course objectives and expected outcome:**

Plant biotechnology involves breeding to improve plants for various reasons such as increasing yield and quality, heat and drought resistance, resistance to phytopathogens, increasing biomass and enhancing the nutritional quality of the crops.

Biotechnology is the booming topic in the entire area of biology. The knowledge of plant biotechnology in this course will provide the fundamental basis for them to study this topic in details. Plant biotechnology will facilitate the farming of crops with multiple durable resistance to pests and diseases, particularly in the absence of pesticides. With increasing world population and hence more hungry mouths to feed crops should be engineered to meet the demands and needs of consumers. In this regard, this course is of utmost importance because it encompasses various

aspects of plant biotechnology namely plant tissue culture techniques, recombinant DNA technology, Gene cloning, methods of gene transfer and applications of Biotechnology.

1. Biotechnology is the booming topic in the entire area of biology. The knowledge of plant biotechnology in this course will provide the fundamental basis for them to study this topic in details.

2. Biotechnology has monumental significance in changing the present scenario of agricultural pharmaceutical and food industries for coping with increasing needs.

### **PAPER-DSE3: Industrial and environmental Biotechnology**

#### **Course objectives and expected outcome:**

This course consists of scope of microbes in industry and environment, bioreactors and fermentation process, microbial production of industrial products, microbial enzymes, microbial flora of water and microbes in agriculture for remediation of contaminated soil.

Industrial Biotechnology studies the method of using biotechnology for producing and processing materials, bioenergy, chemical, and other pharmaceutical products whereas environmental biotechnology focuses on bioremediation of environment using microorganisms.

1. Environmental Biotechnology benefits in a way to keep environment safe and clean for the use of future generations utilizing the natural resource like microorganisms, hence it is a field of great potential that students can explore.

2. Students will learn the prospect of using microorganisms for industrial and pharmaceutical several other economically important products.

### **PAPER-DSE4: Research Methodology**

#### **Course objectives and expected outcome:**

This course gives the students exposure to the different aspects of conducting research in Biological science i.e. Definition and concept of research, general laboratory practices, data collection and documentation, overview of biological problems, methods to study plant cell or tissue structure, Plant microtechniques, The art of scientific writing and its presentation.

1. The course will make the students well equipped about the basic requirement to form proper habits that are required in pursuing research.

2. At the end of the course, students will have a clear idea about the prerequisite skill sets that are needed for executing experiments for their upcoming master's project as well as future research undertakings.