

ANNEXRE 1

Course outcome (Paper specific)

Botany Hons

CC1

The Branch of science that deals with the study of algae is called Phycology. It also consists of the study of different other prokaryotic organisms like blue-green algae and cyanobacteria. Many scientists also call this Branch of science as algology. The algae have many medicinal uses too. Some algae are even used to make life-saving drugs. Some of them can cure degenerative diseases too. For these medical reasons also, Phycology is an essential branch of science. Algae are a primary ingredient in toothpaste. It is also one of the components of ice cream. They are generally used as food ingredients, fertilizers, thickeners, dyes, pharmaceuticals, fuels, pollution controls, nutritional supplements, sewage treatments, and animal feed. Algae are usually found in foods such as sushi and individual salads. Apart from food and medicine, there are many applications of algae. The researchers always try to dig out something or the other fact or experimental works regarding the algae. So it can be used as **pharmaceuticals, food and dairy, confectionary, dyeing and tanning** materials for industrial use. From the study of algae students are aware of biotechnological uses of algae as **SCP, bioplastic and biofertilizer**.

Microbiology is the study of the biology of microscopic organisms - viruses, bacteria, algae, fungi, slime molds, and protozoa. The methods used to study and manipulate these minute and mostly unicellular organisms differ from those used in most other biological investigations. Microbiology has proven to be essential in the health industry for the production of **vaccines and antibiotics** as well as in the **agricultural, food, biofuel, and cosmetic industries**. The scope in this field is immense due to the involvement of microbiology in many fields like **medicine, pharmacy, dairy, industry, clinical research, water industry, agriculture, chemical technology and nanotechnology**.

CC2

Mycology

Mycology, the study of fungi, a group that includes the mushrooms and yeasts. Many fungi are useful in medicine and industry. Mycological research has led to the development of such antibiotic drugs as penicillin, streptomycin, and tetracycline, as well as other drugs, including statins (cholesterol-lowering drugs).

They can also propel nitrogen fixation and phosphorus mobilization, two of the main nutrients required for plant development and productivity. Fungi, as food, play a role in human nutrition in the form of mushrooms, and also as agents of fermentation in the production of bread, cheeses, alcoholic beverages, and numerous other food preparations.

Secondary metabolites of fungi are used as medicines, such as antibiotics and anticoagulants. So, this knowledge can be obtained by studying the fungus.

Plant pathology

Plant pathology is a field of biology that focuses on understanding the nature of disease in plants as well as on more practical aspects of preventing and controlling plant diseases in crop plants that are important to agriculture.

CC3

Plant Anatomy

The study of plant anatomy helps us to understand the structural adaptations of plants with respect to diverse environmental conditions. It also helps us to distinguish between monocots, dicots, and gymnosperms. Such a study is linked to plant physiology. Hence, it helps in the improvement of food crops. We can improve the quality of crops by studying the anatomy of plants. - It will help to study similar characters between plants and hence their common ancestry. - It plays an important role in the taxonomic aspect. - We can detect adulterants in the drugs.

CC4

Archegoniate plants belong to the bryophytes, pteridophytes, and gymnosperms. Bryophytes are very important in initiating soil formation on barren terrain, in maintaining soil moisture, and in recycling nutrients in forest vegetation. Indeed, discerning the presence of particular bryophytes is useful in assessing the productivity and nutrient status of forest types.

The first vascular type plants to evolve on land are pteridophytes. They are utilized for medicinal and ornamental purposes, as well as acting as a soil binder.

Gymnosperms are also very important ecologically. Gymnosperms are a good source of food. Seeds of these non-flowering plants are widely used as an edible species, used for producing various food products. These plant species include: ginkgo, pinus, cycas, etc. A few species of gymnosperms are a good source of starch and are also used in the production of sago. They provide food and shelter for numerous animals and insects. Gymnosperms also prevent soil erosion in forests.

CC5

Paleobotany

Paleobotany is the scientific study of ancient plants, using plant fossils found in sedimentary rocks. These fossils can be impressions or compressions of the plants left on the rock's surface, or "petrified" objects, such as wood, which preserve the original plant material in rocklike form. The primary goals of paleobotany are to discover the earliest appearances of various groups of plants, and to understand the evolutionary relationships among these taxa.

Palynology

Palynology is a useful tool in many applications, including a survey of atmospheric pollen and spore production and dispersal (aerobiology), in the study of human allergies, the archaeological excavation of shipwrecks, and detailed analysis of animal diets. Pollen grains are utilized in forensic applications because they are exceptionally impervious to chemical attack. They can remain at a crime scene for long time after the event under investigation happened.

CC6

Reproductive biology of plants, the science of the origin and formation of new plants. In a broader sense, plant embryology studies not only embryonic development but also the formation of the generative sphere, the formation of sex cells in the generative sphere, and fertilization. Embryological evidence has been used in solving the taxonomical problems at almost all levels.

CC7

Plant systematics is a branch of biology that includes and extends classical taxonomy, but its main purpose is to reconstruct the development of plant life. It uses morphological, anatomical, embryological, chromosomal, and chemical data to classify plants into taxonomic categories.

CC8

Phytogeography is concerned with all aspects of plant distribution, from the controls on the distribution of individual species ranges (at both large and small scales, see species distribution) to the factors that govern the composition of entire communities and floras.

In phytogeography the basic data elements are occurrence records (presence or absence of a species) with operational geographic units such as political units or geographical coordinates. These data are often used to construct phytogeographic provinces (floristic provinces) and elements.

CC9

Economic Botany is the interaction of people with plants. Economic botany is closely related to the field of ethnobotany - that word is based on two Greek roots: ethnos (race: people: cultural group) and botanikos (of herbs) and can mean the plant lore of a race or people as well as the study of that lore

Economic botanists work to find ways that will allow the plant to be used sustainably. This sustainable use also applies when plants are used to make other things besides foods and medicines. For example, trees are used to make furniture in many areas.

CC10

Plant genetics is the study of genes, genetic variation, and heredity specifically in plants. genetics is used for a study of the mechanism of heredity and variation, on the other hand it has provided tools for the study of the fundamental biological processes examined and taught in areas, like plant physiology, biochemistry, biosystematics, ecology, plant pathology, microbiology,

The study of plant genetics has major economic impacts: many staple crops are genetically modified to increase yields, confer pest and disease resistance, provide resistance to herbicides, or to increase their nutritional value.

CC11

Cell and Molecular Biology encompasses study of the structure and function of organisms and biological processes at the level of cells, and the macromolecules that define them (DNA, RNA, proteins, lipids, and carbohydrates).

Courses in the Cell and Molecular Biology major provide the basis for understanding the mechanisms of health and disease in plants and humans both. It is used in plant science to show that two plants that look different have the same genetic origin. Cell biology is also used for human health, to diagnose the disease and disorders, to treat the disease, for making antibiotics etc.

CC12

Biochemistry, study of the chemical substances and processes that occur in plants, animals, and microorganisms and of the changes they undergo during development and life.

Biochemistry combines biology and chemistry to study living matter. It powers scientific and medical discovery in fields such as pharmaceuticals, forensics and nutrition. With biochemistry, you will study chemical reactions at a molecular level to better understand the world and develop new ways to harness these.

CC13

Plant physiology deals with different plant structures and their functioning. It enables analysing processes in plants, namely – photosynthesis, mineral nutrition, respiration, transportation, and ultimately plant development and growth which are traits displayed by living entities.

The study of physiological processes determines plant growth, development, and economic production. The study of crop physiology is important to regulate the plants' disease and other physiological disturbances. It helps in the improvement of crop production and the quality of food.

CC14

Metabolism is the set of life-sustaining chemical transformations within the plant cell. On one hand, primary metabolism comprises all metabolic pathways that are essential to the plant's survival, generating compounds (metabolites) that are directly involved in the growth and development of the organism.

Metabolism in plants is the collection of interrelated biochemical reactions that maintain plant life. A series of metabolic processes happen in different parts of the plants such as leaves, stems, and roots. These processes include photosynthesis, respiration, and nitrogen fixation.

The application of plant metabolism to industrial biotechnology has mainly focused on improving cell metabolism to increase productivity – higher product yield, production rate, and cell growth efficiency (energy efficiency), and to eliminate or reduce undesirable by-products.

SEC A

Applied Phycology accepts papers covering all algal groups, including cyanobacteria, related to the following topics: Seaweed resources, macroalgal and microalgal aquaculture, integrated aquaculture.

Chlamydomonas reinhardtii is the most popular microalgae in **pharmaceutical biotechnology**, antibodies, **vaccines**, erythropoietin, and viral protein 28 are the recombinant proteins produced from microalgae. *Spirulina maxima* produce phenolic compounds that may stop proliferation and induce apoptosis in liver cancer cells might be responsible for the **anticancer activity against human liver cancer** .

Mycology, the study of fungi, a group that includes the mushrooms and yeasts. Many fungi are useful in medicine and industry. Mycological research has led to the development of such antibiotic drugs as penicillin, streptomycin, and tetracycline, as well as other drugs, including statins (cholesterol-lowering drugs). **Mycology also has important applications in the dairy, wine, and baking industries and in the production of dyes and inks.**

Microbes are also used in pharmaceutical industries for synthesis of chemical drugs, chemical compounds and other compounds. It also leads to discovery of cell mechanisms allows pharmacists to discover antimicrobial drugs that would prevent an escalating number of communicable diseases. Industrial Microbiology is a branch of applied microbiology in which microorganisms are used for the production of important substances, such as antibiotics, food products, enzymes, amino acids, vaccines, and fine chemicals.

Pharmacists and microbiologists work synergistically to ensure that drug therapies target the opportunistic microbes without harming its human host. Another important role in pharmaceuticals is the use of microbes for the medically important studies, such as Bacteriorhodopsin, a protein from the plasma membrane of *Halobacterium salinarum*, is widely used in many biohybrid electronic devices.

SEC B

Mushroom culture is a biotechnological process that recycles ligninocellulosic wastes, since mushrooms are food for human consumption and the spent substrate can be used in different ways. In modern approaches breeding programme of different strains are performed. The breeding of new strains will improve the development of high yield and resistance to diseases, increase productivity and diminish the use of chemicals for pest control. The breeding of new strains will improve the

DSE A

Biostatistics

Biostatistics is assisting the medical research industry to safeguard public health at both small and large scales. By integrating quantitative capabilities, biostatisticians collaborate with biomedical experimenters to specify and solve health issues that threaten public health and quality of life.

Biostatistics provides us with scientific, historical data and results; they give us direction for the future. If we examine certain diseases or trends in diseases, biostatistics should be guiding us on the right path. Biostatistics is considered one of the foundational disciplines in public health. Specifically, biostatisticians conduct quantitative and qualitative research to help identify population health trends and risk factors.

DSE A

Medicinal and Ethnobotany

Medicinal plants, also called medicinal herbs, have been discovered and used in traditional medicine practices since prehistoric times. Plants synthesize hundreds of chemical compounds for various functions, including defense and protection against insects, fungi, diseases, and herbivorous mammals. Medicinal plants in a particular area play a key role in maintaining the health of the native communities. Also, they are subjected to produce income sources for the “localities.” Thus, they provide the livelihood for a large number of people living in that area.

As for example Fenugreek (*Trigonella foenum graecum*) used as an anti-cancerous drug against breast cancer.

Ethnobotany

Ethnobotany is the study of interrelations between humans and plants; however, current use of the term implies **the study of indigenous or traditional knowledge of plants**. It involves the indigenous knowledge of plant classification, cultivation, and use as food, medicine and shelter. The scientific discipline of ethnobotany – the study of human interactions with plants – has applications in many fields of current global concern, including food security, climate change, biodiversity conservation and human health.

DSE B

Biotechnology is the technologies applied to biology, molecular biology, genetics, and many other subfields of biology. Biotechnology utilizes cellular and biomolecular processes to create technologies and products that help improve our lives and the nature. By making useful food, such as bread and cheese, and preserving dairy products, we have done these for many years by now. Recent biotechnology develops breakthrough products and technologies to fight diseases, reduce our environmental harm, feed the hungry, use less and cleaner energy, and have safer, cleaner and more efficient industrial manufacturing processes.

DSE B

Natural resource management

Natural Resource Management (NRM) refers to the sustainable utilization of major natural resources, such as land, water, air, minerals, forests, fisheries, and wild flora and fauna. Together, these resources provide the ecosystem services that provide better quality to human life. Natural resources are used to make food, fuel and raw materials for the production of goods. All of the food that people eat comes from plants or animals. Natural resources such as coal, natural gas and oil provide heat, light and power. Properly managed, natural resources provide the foundation for maintaining and improving the quality of life of the world's population and can make invaluable contributions to sustainable growth.

Implications of the syllabus BOTG

CC1/GE 1

Algae form organic food molecules from carbon dioxide and water through the process of photosynthesis, in which they capture energy from sunlight. Algae produce an estimated 30 to 50 percent of the net global oxygen available to humans and other terrestrial animals for respiration. Crude oil and natural gas are the remnants of photosynthetic products of ancient algae. Several companies have grown oil-producing algae in high-salinity ponds and have extracted the oil as a potential alternative to fossil fuels. Algal extracts are commonly used in preparing foods and other products.

Fungi, as food, play a role in human nutrition in the form of mushrooms, and also as agents of fermentation in the production of bread, cheeses, alcoholic beverages, and numerous other food preparations. Secondary metabolites of fungi are used as medicines, such as antibiotics and anticoagulants. Fungi create harm by spoiling food, destroying timber, and by causing diseases of crops, livestock, and humans.

Plant pathology investigates the biotic and abiotic factors behind the failure of plants to reach their genetic potential, and develops interventions to protect plants, reduce crop losses and improve food security.

Bryophytes also play a very important role in the environment: they colonize sterile soils, absorb nutrients and water and release them slowly back into the ecosystem, contributing to the formation of soil for new plants to grow on.

It will help us to differentiate between monocots and dicots. Students can know about the tensile strength of the wood of the plant. The quality of the wood can be studied. Enables to Identify Archaeological Plant Remains: Provides Characters of Taxonomic Significance:

CC2/GE2

The first vascular type plants to evolve on land are pteridophytes. They are utilized for medicinal and ornamental purposes, as well as acting as a soil binder. Pteridophytes constitute a significant and important group in the plant kingdom. As the first true land plants, they offer a very favourable material for the study of various adaptations that have made the colonization of land possible for the plants. Pteridophytes have a long geological history on our planet.

Gymnosperms are a good source of food. Seeds of these non-flowering plants are widely used as an edible species, used for producing various food products. These plant species include: ginko, pinus, cycas, etc. A few species of gymnosperms are a good source of starch and are also used in the production of sago. Gymnosperms have major economic uses. Pine, fir, spruce, and cedar are all examples of conifers that are used for lumber, paper production, and resin. Some other common uses for gymnosperms are soap, varnish, nail polish, food, gum, and perfumes.

Paleobotany is important in the reconstruction of ancient ecological systems and climate, known as paleoecology and paleoclimatology respectively; and is fundamental to the study of green plant development and evolution. A stratified scale based on fossils can be made to establish the age of coal deposits and their position in the succession of rocks. Palaeobotanical studies have served as a tool to ascertain age of coal layers, their lateral extent and quality of coal deposits.

Plant taxonomy allows for the identification of unknown species and their classification by comparing them to known species. The systematics method can be used to analyse genetic constituents. It has a great value in Forestry because all forest trees have been named and classified. It has wide importance in Agriculture, Horticulture, etc

To study ecology, the knowledge of taxonomy / systematic botany became essential, plant ecologist must be aware of the names of plants and their relationship to habitat and environment.

CC3/GE3

Molecular cytogenetic analysis of the chromosomes of crops is a vital part of understanding their evolution, genetics, genetic recombination and karyotypic **stability**. There are several important aspects of our research program that relate to plant breeding. Cytogenetic analysis plays a vital role in the crop improvement. From last few years, cytogenetic analysis has extended in the laboratories for the routine testing and provides significant prognostic and diagnostic results for the human diseases and crop improvements.

Microbiology is the study of microscopic organisms, or living things, that are too small to be seen with the naked eye. These living organisms can only be observed under a microscope, and they are referred to as microbes or microorganisms. Microbiologists are essential in helping us to treat diseases. Many work as biomedical scientists in hospitals and laboratories: testing samples of body tissue, blood and fluids to diagnose infections, monitor treatments or track disease outbreaks.

CC4/GE4

The study of physiological processes determines plant growth, development, and economic production. The study of crop physiology is important to regulate the plants' disease and other physiological disturbances. It helps in the improvement of crop production and the quality of food. Plant physiology can assist foresters to grow better trees by showing them how trees grow. The principal role of plant physiology in forestry is to assist foresters to understand why trees behave as they do under particular environmental conditions and to predict how they will behave under other conditions. Plant physiology can assist foresters to grow better trees by showing them how trees grow. The principal role of plant physiology in forestry is to assist foresters to understand why trees behave as they do under particular environmental conditions and to predict how they will behave under other conditions.

SEC-A

Biofertilizers are required to restore the fertility of the soil. Prolonged use of chemical fertilizers degrades the soil and affects crop yield. Biofertilizers, on the other hand, enhance the water holding capacity of the soil and add essential nutrients such as nitrogen, vitamins and proteins to the soil.

SEC-B

Mushrooms are one of the highest producers of protein per unit of land area and time. As such, they have the potential to ensure a sustainable economy as well as nutritional security. Moreover, the spent mushroom substrate (like straw) left after mushroom cultivation can be reused as compost on farms. Mushroom production can convert the huge lignocellulosic waste materials into a wide diversity of products (edible or medicinal food, feed and fertilizers), protecting and regenerating the environment. Mushroom cultivation can help reduce vulnerability to poverty and strengthens livelihoods through the generation of a fast yielding and nutritious source of food and a reliable source of income.

DSE A

Phytochemistry (plant chemistry) also plays an important role in systematic botany. This is based on the assumption that related plants have a similar chemistry. For example, In Lichens chemical methods are used for identification of genera and species. Medicinal plants are a rich source of phytochemicals and natural compounds such as alkaloids, terpenes, glucosinolates, phenolic compounds, and flavonoids. In this sense, phytochemicals isolated

from medicinal plants have been a source of currently commercial drugs and are continuously studied for this purpose.

DSE B

Economic botanists work to find ways that will allow the plant to be used sustainably. This sustainable use also applies when plants are used to make other things besides foods and medicines. For example, trees are used to make furniture in many areas. Economic botany is, then, a composite of those sciences working specifically with plants of importance to people. Closely allied with economic botany is ethnobotany, a growing field which emphasizes plants in context of the anthropological sciences.

Programme outcome Linked with Course outcome for Botany Advanced

Programme outcome	Course outcome
<p>1. Study of plants is vital because they are fundamental part of earth which generates the oxygen, food, fibres, fuel and medicine that allow human and other life forms to exist.</p>	<p>Taught in papers: CC1 (sem 1) CC9 (sem4) CC13 (sem 6) Sec A1 (sem 3) Sec B1 (sem 3)</p>
<p>2. Botanists study the effects of different types of pollutants on plants. Many plants are sensitive to certain pollutants, some are tolerant at a level, and some can absorb the pollutants. Botanists can advise to law maker on legislation for environmental protection.</p>	<p>Taught in papers: CC8 (sem 3) CC13 (sem 6) DSEB2 (sem 6)</p>
<p>3. By using plan tissue culture technique botanists can grow entire plant from single cell American chestnut recently has been grown by this technique. In India <i>Ginkgo biloba</i> has been grown in Darjeeling by tissue culture technique.</p>	<p>Taught in papers: DSEB1 (sem 5)</p>
<p>4. Plant taxonomists and plant ecologists work to identify new species which could be major new resource for people.</p>	<p>Taught in papers: CC6 (sem 3) CC7 (sem 3) CC8 (sem 3)</p>
<p>5. Many of the chemicals besides food are derived from plants. Botanists study the chemicals produced by plants to find their uses.</p>	<p>Taught in papers: CC11 (sem 5) CC12 (sem 5) Sec A1 (sem 3)</p>
<p>6. The botanical approaches to global change are critical for ecological equilibrium and for the implications these studies have for species conservation and ecosystem management.</p>	<p>Taught in papers: CC4(sem 2) DSEB2 (sem 6) Sec A1 (sem 3)</p>