NARAJOLE RAJ COLLEGE

(NAAC Accredited 'B' Grade Govt. Aided College)
NARAJOLE: PASCHIM MEDINIPUR: WEST BENGAL: Pin-721211
E-mail: narajolerajcollege@rediffmail.com
Website: *https://www.narajolerajcollege.ac.in*

Programme Specific Outcomes (PSOs)

Botany (Hons.)

The students of Botany (Hons.) will acquire their theoretical and experimental basic knowledge about the different branches of Botany like Microbiology, Cell Biology, Molecular Biology, Mycology, Plant Pathology, Plant-biodiversity, Ecology, Plant Systematics, Reproductive Biology, Anatomy, Embryology, Physiology, Metabolism, Genetics, Biotechnology, Breeding, Economic Botany, Biostatistics, Industrial and Environmental Microbiology, Research Methodology, Techniques in Plant Sciences, Bioinformatics, Biofertilizer, Mushroom culture Technology, Medicinal Botany, etc. by studying this programme. They will attain the quantitative and predictive understanding of Botany in different Plantdiversity and their different biological and chemical phenomena.This programme also opens up the career paths to select in many related and sub-related areas like academics, scientific laboratories, instrumentation and industries etc.

After completion of the programme, the graduates will be capable of-

PSO1: Acquiring scientific knowledge about the different core branches of Botany like Microbiology, Cell Biology, Molecular Biology, Mycology, Plant Pathology, Plant-biodiversity, Ecology, Plant Systematics, Reproductive Biology, Anatomy, Embryology, Physiology, Metabolism, Genetics, Biotechnology, Breeding, Economic Botany, Biostatistics, Industrial and Environmental Microbiology, Research Methodology, Techniques in Plant Sciences, Bioinformatics, Biofertilizer, Mushroom culture Technology, Medicinal Botany, etc.

PSO2: Developing scientific thinking, temper, and also ability to use skills in Botany and its related domains of technology for formulating and tackling Plant Sciences related problems.

PSO3: Students will develop an in-depth knowledge of plant biology and its application for the benefit of human beings.

PSO4: To provide knowledge about the various groups of the plant starting from the very simple and primitive to complex and advanced groups.

PSO5: To classify the different groups of plants and examine their evolving morphological and anatomical characteristics theoretically and practically.

PSO6: To become familiar with the biomolecules constituting the plant physiology and detect them in the laboratory by chemical experiments.

PSO7: To create a clear concept regarding the molecular biology of the cell.

PSO8: To become familiar with the various techniques in plant technology and develop the potential to use technology for the development of scientific temper.

PSO9: To study the different techniques in plant sciences.

PSO10: To list down the different environmental factors resulting in developing stress in plants.

PSO11: To widen up the knowledge on bioinformatics, ecological foot printing, and designing the sustainable ecological model.

PSO12: To flourish the potential of microbes by studying industrial and environmental microbiology.

PSO13: To discover the importance of the various plant parts and also their industrial and economic value.

PSO14: To develop a clear concept of the status of natural resources and their justified utilization.

PSO15: To broaden up the use of biofertilizers in different agricultural sectors and encouraging their use by the farmers.

PSO16: To follow up the traditional system of medicinal botany and developing new ways of treatment by compiling the traditional system with modern technologies.

PSO17: To develop practical hands-on mushroom cultivation and raise its production for fulfilling the market demand and also earning a handsome amount of money.

PSO18: To familiarize with the fundamentals of biostatistics.

PSO19: To develop practical hands-on qualitative techniques for analyzing the density and abundance of plant communities.

PSO20: To determine the organic and inorganic matters in the soil.

PSO21: To familiarize with the biodiversity and climatic variance of different localities by participating in excursions.

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Programme Specific Outcomes (PSOs)

Botany (General)

The students of Botany (Gen or DSC) will acquire their theoretical and experimental basic knowledge about the different branches of Botany like Plant -biodiversity, -Ecology, -Taxonomy, -Anatomy, -Embryology, -Physiology, -Metabolism, -Genetics, -Breeding, Economic Botany and Biotechnology, Biofertilizer, Mushroom culture Technology, Ethnobotany, Medicinal Botany etc. by studying this programme. They will attain the quantitative and predictive understanding of Botany in different Plant diversity and their different biological and chemical phenomena. This programme also opens up the career paths to select in many related and sub-related areas like academics, scientific laboratories, instrumentation and industries etc.

After completion of the programme, the graduates will be capable of-

PSO1: Acquiring the Scientific knowledge about the different core branches of Botany like Plant -biodiversity, -Ecology, -Taxonomy, -Anatomy, -Embryology, -Physiology, -Metabolism, -Genetics, -Breeding, Economic Botany and Biotechnology, Biofertilizer, Mushroom culture Technology, Ethnobotany, Medicinal Botany etc.

PSO2: Developing the scientific thinking, temper and also ability to use skills in Botany and its related domains of technology for formulating and tackling Plant Sciences related problems.

PSO3: Students will develop an in-depth knowledge of plant biology and its application for the benefit of human beings.

PSO4: To become familiar with the biomolecules constituting the plant physiology and detect them in the laboratory by chemical experiments.

PSO5: To create a clear concept regarding the molecular biology of the Plant cell.

PSO6: To become familiar with the various techniques in plant technology and develop the potential to use technology for the development of scientific temper.

PSO7: To flourish the potential of microbes by studying industrial and environmental microbiology.

PSO8: To discover the importance of the various plant parts and also their industrial and economic values.

PSO9: To develop a clear concept on the status of natural resources and their justified utilization.

PSO10: To broaden up the use of biofertilizers in different agricultural sectors and encouraging its use by the farmers.

PSO11: To follow up the traditional system of medicinal botany and developing new ways of treatment by compiling the traditional system with the modern technologies.

PSO12: To develop practical hands on the mushroom cultivation and raise its production for fulfilling the market demand and also earning handsome amount of money.

PSO13: To familiarize with the biodiversity and climatic variance of different localities by participating in excursions.

PSO14: To facilitate and encourage students to take up successful career in Botany.

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Course Outcome

Botany (Hons.)

Semester	I
Title of Course	Algae and Microbiology(CC-1)
Paper Code	C1T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-I will acquire the knowledge about the microbial world including virus, bacteria. They will also learn about the characteristic features of algae, life cycle patter and their importance in environment, agriculture, biotechnology and industry.

The theory paper (C1T) of this course (CC-1) provides the student with-

CO1: Classify bacteria, virus and algae up to the groups and list down their characteristics.

CO2: Compare and contrast between lysogenic and lytic cycle.

CO3: Outline the different types of reproduction in bacteria (vegetative, asexual and recombination).

CO4: Justify the contributions of important phycologists.

CO5: Enumerate the range of thallus organization of different algae and also relating them to the different types of pigments, reserve food and method of reproduction.

Semester	I
Title of Course	Alage and Microbiology(CC-1)
Paper Code	C1P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-I will acquire the practical knowledge on gram staining, endospore staining, study of lytic and lysogenic cycle through photograph, electron micrographs study of bacteria and its various mode of reproduction, study of bacteria from root nodules/curd samples. They will also develop a knowledge on vegetative and reproductive structure of algae through electron micrographs, temporary preparations and permanentslides.

The lab paper (C1P) of this course (CC-1) provides the student with-

CO1: To identify and elaborate the lytic and lysogenic cycle of viruses.
CO2: Draw and level of T-Phage and TMV.
CO3: Knowledge related to entire steps of bacterial grams stain process for their identifications .
CO4: Perform slide preparations for the detailed microscopic study of vegetative and reproductive structuresfrom different algal species.

Semester	I
Title of Course	Biomolecules and cell biology (CC-2)
Paper Code	C2T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-I will acquire the knowledge about the biomolecules found in the cell and develop a concept of bioenergetics. The students will also gather knowledge about enzymes, structure and function of cells and its organelles including cell division.

The theory paper (C2T) of this course (CC-2) provides the student with-

CO1: Study of chemical bonds, pH and chemistry of water.

CO2: Learning about the function and properties of biomolecules.

CO3: Relate the origin of eukaryotic cell and prokaryotic cell in due course of evolution.

CO4: Identify the different cellular organelles and state their roles for the functioning of a cell.

CO5: Explain the composition of cell membrane and its transport mechanisms from the prokaryotic to eukaryotic cell.

CO6: Classify enzymes and point out the structure of enzymes and also describe the mechanism of enzyme action.

CO7: Explain the cell division process and differentiate between mitosis and meiosis.

Semester	I
Title of Course	Biomolecules and cell biology(CC-2)
Paper Code	C2P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-I will acquire the practical knowledge about the different quantitative tests for different biomolecules, study of plant cell structure, different cytoplasmic and protoplasmic phenomenon and learning about different stages of mitosis and meiosis under the microscope.

The lab paper (C2P) of this course (CC-2) provides the student with-

CO1: Perform biochemical tests for the detection of different biomolecules like carbohydrates, lipids and proteins.

CO2: Study the plant cell structure and protoplasmic streaming under the microscope.

CO3: Measure the cell size by techniques of micrometry and count the cells per unit volume with the help of haemocytometer.

CO4: Study the organelles of cell and the structure of cell through photographs.

CO5: Study the phenomenon of plasmolysis and deplasmolysisand the effect of organic solvent and temperature on the permeability of the cell.

CO6: Identify and describe the different stages of cell division.

Semester	II
Title of Course	Mycology and Phytopathology (CC-3)
Paper Code	C3T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-II will acquire the knowledge about the different groups of fungiand general terms and concepts related to phytopathology.

The theory paper (C3T) of this course (CC-3) provides the student with-

CO1: List down the general characteristic features of different groups of fungi with reference to their ecology, thallus organization, reproduction, life cycle and their importance.

CO2: Compare the different thallus organization of fungi and their features under the microscope.

CO3: Explain the symbiotic association along with the growth forms and thallus organization of lichen and mycorrhiza and their significance.

CO4: Plan out the different role of fungi in biotechnology, food industry, agriculture, mycotoxin, biological control and medical mycology.

CO5: Predict the symptoms and causal organisms of the bacterial and viral diseases.

CO6: Investigate the role of quarantine.

Semester	II
Title of Course	Mycology and Phytopathology (CC-3)
Paper Code	C3P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-II will acquire the knowledge about the cellular structure of fungi under the microscope. The students will have hands on training on sectioning of different groups of fungi to study the vegetative and reproductive structures. They will also be able to identify various plant disease by studying the symptoms.

The lab paper (C3P) of this course (CC-3) provides the student with-

CO1: Studying the sexual and asexual structures of fungal species under the microscope.

CO2: Studying the herbarium specimens of black stem rust of wheat and infected Barbery leaves and finally study the structures of uredospores and teleutospores under the microscope.

CO3: Learning about fairy rings and bioluminescent mushrooms through photographs.

CO4: To develop a clear concept about the different types of mycorrhizae and lichens through photographs and permanent slides.

CO5: Studying the bacterial diseases through herbarium specimen.

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Semester	II
Title of Course	Archegoniate (CC-4)
Paper Code	C4T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-II will acquire the knowledge about the classification, morphology and reproductive features of bryophytes, pteridophytes and gymnosperms.

The theory paper (C4T) of this course (CC-4) provides the student with-

CO1: Know about the alternation of generations in plants, significance of meiosis, the evolution of sporophytes in bryophytes, the stelar evolution and seed formation habit in pteridophytes.

CO2: Gain knowledge about life cycles of gymnosperms of plants, evolutionary pathway from primitive plants to advance plants.

Semester	II
Title of Course	Archegoniate (CC-4)
Paper Code	C4P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-II will acquire the practical knowledge about the morphology of thallus, T.S, V.S of different groups of bryophytes. They will study the LS of strobilus and cones of pteridophytes and gymnosperms.

The lab paper (C4P) of this course (CC-4) provides the student with-

CO1: Studying the vegetative and reproductive structures of different species of bryophytes by making temporary slides and from permanent slides.

CO2: Prepare the transverse section of synangium and study the entire specimen of *Psilotum.*

CO3: Studying the different species of pteridophytes (*Selaginella*, *Equisetum,* and*Pteris)* by whole mount and transverse/longitudinal sections of plant parts.

CO4: Study the morphology of stem, male and female reproductive structures, transverse/vertical section of plant parts of *Cycas, Pinus* and*Gnetum.*

CO5: Take part in botanical excursions to get familiar with the different geographical diversities of the plants and to develop a clear idea about the morphological and anatomical adaptations related to the habitat of the plants in the different geographical altitudes.

Semester	III
Title of Course	Anatomy of Angiosperms(CC-5)
Paper Code	C5T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-III will acquire the knowledge about the structure and development of plant body, classification and importance of plant tissues including the apical meristems, vascular cambium and wood anatomy.

The theory paper (C5T) of this course (CC-5) provides the students with-

CO1: Identify fragmentary parts of plant materialsprovided characters for identification like flower fruits etc it helps to differentiate the specimens.

CO2: Detect adulterants in crude drugs which helps to identify the original plant parts to maintain quality purity etc.

CO3: Identify different types of woods.

CO4: Identification of archaeological plant remains.

CO5: Carry out meristem culture and state the taxonomic significance.

Semester	III
Title of Course	Anatomy of Angiosperms(CC-5)
Paper Code	C5P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-III will acquire the knowledge about the different tissues and plant parts under the microscope. Anatomical features of wood, phloem, epidermal systems, root, stem, leaf , adaptive anatomy and secretory tissues will also be studied in details under the microscope.

The lab paper (C5P) of this course (CC-5) provides the students with-

CO1: Point out and describe the anatomical details through permanent slides or temporary stained mounts or macerations.

CO2: They will learn about root and shoot apical meristems and vascular cambium.

CO3: The different types of tissues and their distribution.

CO4: They will learn about epidermal systems and tissue organisations in root, stem and leaves.

CO5: The different elements of xylem, phloem and different types of wood.

CO6: Learning about adaptive anatomy and secretory tissues.

Semester	III
Title of Course	Economic Botany (CC-6)
Paper Code	C6T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany(H) of Semester-IIIwill acquire the knowledge about the origin, morphology and economic importance of cereals, legumes, sugarcane, potato, spices, beverages, oil yielding plants, natural rubber, medicinal plants, fibre and timber yielding plants.

The theory paper (C6T) of this course (CC-6) provides the students with-

CO1: Outline the importance of Vavilov's work and discuss plant introduction, crop domestication and importance of germplasm conservation.

CO2: Compare the habit, T.S/L.S of different cereals along with their distinguishable chemical tests.

CO3: Determine the importance of different legumes, sugar and starch yielding plants, their cultivation, morphology, and specific biochemical tests.

CO4: Name the different spices used in the kitchen and also describe their habit, T.S and family.

CO5: Explain the mechanisms of rubber collection and production.

CO6: List down the different phyto-chemicals present in the drug yielding plants and their importance.

CO7: Describe the morphology, uses, importance of different beverages, timber, fibre, oil and fat yielding plants along with their family name and T.S.

Semester	III
Title of Course	Economic Botany (CC-6)
Paper Code	C6P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-III will learn about the identification of economic importance plants by studying their morphology and plant parts of economic importance under the microscope.

The lab paper (C6P) of this course (CC-6) provides the student with-

CO1: Perform different types of micro chemical test for the identification of starch and also study the habit of the cereals like wheat and rice.

CO2: Identify the habit, fruit, seed structure and perform different types of microchemical test for the identification of legumes like soyabean and groundnut.

CO3: Enumerate the different sources of sugar and starch and draw the habit sketch and perform different microchemical test for the identification of sugars from sugar cane and starch from potato.

CO4: Draw the habit and perform sections through the black pepper, fennel, and clove and study the morphology of the plant specimen of tea and its leaves and coffee and it's beans.

CO5: To identify the sources of oils and fats from coconut ,mustard and also perform the microchemical test for their identification.

CO6: Study the habit and sketch the same of *Rosa*, *Vetiveria*, *Santalum*, *Eucalyptus* and also to know about their oil extraction process.

CO7: To study the rubber tapping process and rubber product manufacturing process through photographs.

CO8: Study the specimens of *Digitalis*, *Papaver* and *Cannabis* which are the drug yielding plants and also to study there medicinal importance and the disease they are used to cure for.

CO9: Study the specimen of Tobacco plant and different products of tobacco including their medicinal importance.

CO10: Perform sections through the woods of Tectona, Pinus and study their characteristics.

CO11: Study the specimen of cotton plant and whole mount of seed to show lint and fuzz, whole mount of fibre and test for cellulose. Transverse section of the stem of Jute and test for lignin on the transverse section of stem and fibre of jute.

Semester	III
Title of Course	Genetics(CC-7)
Paper Code	C7T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-III will acquire the knowledge about the Mendelian genetics and its extension, about extrachromosomal inheritance, linkage, crossing over, chromosome mapping, variation in chromosome number and structure, gene mutations, fine structure of genes and population and evolutionary genetics.

The theory paper (C7T) of this course (CC-7) provides the student with-

CO1: Develop a comprehensive and detailed understanding of how genetic concepts plays important role in human life and social issues including health and disease, food and natural resources, environmental sustainability, etc.

CO2: Sum up the genetic mechanism of evolution.

CO3: Develop a clear concept of the application of the knowledge of genetics in crop improvement and plant biotechnology.

Semester	III
Title of Course	Genetics (CC-7)
Paper Code	C7P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-III will acquire the practical knowledge about the pre-treatment, fixation, staining and squash and smear preparation and study of mitosis and meiosis under compound microscope. The student will be able analyse pedigree and study Mendel's law through different seed ratios. They will be able carry out blood typing and study the different chromosomal abnormalities and traits evolving them.

The lab paper (C7P) of this course (CC-7) provides the student with-

CO1: Learning about pre-treatment, fixation, staining and squash and smear preparation.
CO2: Hands on training on studying mitosis from onion / garlic / lentil rootand meiosis with pollen mother cell (pmc) of onion / solanum / datura by smear preparation.
CO3: Studying Mendel's laws through seed ratios.
CO4: Studying chromosome mapping using point test cross data.
CO5: Study the pedigree analysis for dominant and recessive autosomal and sex linked traits.
CO6: Studying the incomplete dominance and gene interaction through seed ratios
CO7: Performing blood typing: groups & rh factor.
CO8: Studying photographs/permanent slides showing translocation ring, laggards and inversion bridge.
C09: Studying and learning about of human genetic traits and aneuploidy.

Semester	III
Title of Course	Biofertilizers (SEC-1)
Paper Code	SEC1T (Theory)
Credits	02
Hours	02 hours/week

The students of Botany (H) of Semester-III will acquire the knowledge about the microbes which are used as biofertilizers and about green manuring and organic fertilizers.

The theory paper (SEC1T) of this course (SEC-1) provides the student with-

CO1: Identify, isolate and culture Rhizobium, which is a potent biofertilizer.

CO2: Classify, characterize and learning about the importance and associations of microorganisms like *Azospirillum*, *Azotobactor* and cyanobacteria like *Azolla*and *Anabaena*.

CO3: Learning about different types of mycorrhizal associations.

CO4: Applying the concept of organic farming as a natural way of increasing the productivity in the agricultural field.

Semester	IV
Title of Course	Molecular Biology(CC-8)
Paper Code	C8T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-IV will acquire the knowledge about the carriers of genetic information, their structure and the mechanism of DNA replication, transcription and translation.

The theory paper (C8T) of this course (CC-8) provides the students with-

CO1: Provide in-depth knowledge of how a cell functions at the molecular level.

CO2: Learn about the structure of DNA, how cells replicate, and how information flows from genes to proteins and regulates the cellular processes through signaling.

CO3:Learning about processing and modification of mRNA.

Semester	IV
Title of Course	Molecular Biology(CC-8)
Paper Code	C8P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-IV will acquire the knowledge of replication of DNA through photographs. The students will gain knowledge about the various molecular biology machinery through photographs.

The lab paper (C8P) of this course (CC-8) provides the student with-

CO1:Hands on training on preparation of LB medium and raising *E. Coli.*

CO2:Performing experiment on isolation of genomic DNA from bacteria and plant tissues and its estimation.

CO3:Studying and understanding DNA replication mechanisms through photographs.
CO4: Studying structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
CO5: Studying photographs and learning about experiments establishing nucleic acid as genetic material.
CO6: Studying of splicing mechanism through photographs.

Semester	IV
Title of Course	Plant Ecology and Phytogeography (CC-9)
Paper Code	C9T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-IV will acquire the knowledge about the importance of soil, water, light, temperature, wind, fire, biotic interactions, ecological speciation, ecosystem, plant ecology and phytogeography.

The theory paper (C9T) of this course (CC-9) provides the student with-

CO1: Chalk out the interrelationship between organisms in population and community and also understand their distribution the study of ecological principles provides background knowledge for understanding the problems of forests, soil and surface water.

CO2: Gain knowledge regarding the conservation and management of natural resources, pollution. The study provides plant distribution, their migration and evaluation.

CO3:Discuss on the effects of topographic factors upon plant communities.

Semester	IV
Title of Course	Plant Ecology and Phytogeography(CC-9)
Paper Code	C9P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-IV will acquire the practical knowledge about the instruments used to measure microclimatic variables, determination ofpH of various soil and water samples, organic matter of different soil samples by Walkley & Black rapid titration,study of morphological adaptations and quantitative analysis of herbaceous vegetation.

The lab paper (C9P) of this course (CC-9) provides the student with-

CO1: Study of instruments used to measure microclimatic variables:

CO2: Hands on training to measure the pH of various soil and water samples.

CO3: Learning how to analyse for carbonates, chlorides, nitrates, sulphates, organic matter and determination of organic matter of different soil samples.

CO4: Experimenting to compare the bulk density, porosity and rate of infiltration of water in soils from three different habitats.

CO5: Performing experiments to measure the dissolved oxygen of water samples from polluted and unpolluted sources.

CO6: Studying of morphological adaptations of hydrophytes and xerophytes.

CO7: Determination of minimal quadrat size for the study of herbaceous vegetation by various methods.

CO8: Learning how to perform quantitative analysis of herbaceous vegetation for density and abundance in the college campus.

Semester	IV
Title of Course	Plant Systematics (CC-10)
Paper Code	C10T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-IV will acquire the knowledge about the significance of plant systematics, taxonomic hierarchy, botanical nomenclature, various systems of classification and about biometrics, numerical taxonomy and cladistics.

The theory paper (C10T) of this course (CC-10) provides the student with-

CO1: Gather a vast knowledge about the systematic way of studying plant kingdom, their classification, knowing about taxonomic hierarchy, the way of giving a universal name i.e. scientific name to a plant with specific author's citation, gaining knowledge about phylogenetic tree, cladogram, parallelism, convergence etc.

CO2:Develop relationship and significance about natural, artificial and phylogenetic system of classification, role of herbarium and arboretum, principle of ICBN, numerical taxonomy.

Semester	IV
Title of Course	Plant Systematics (CC-10)
Paper Code	C10P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-IV will acquire the practical knowledge about studying the key morphological features of plants from different families. They will learn to write description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position for plants from different families.

The lab paper (C10P) of this course (CC-10) provides the student with-

CO1: Students will have hands on training to study vegetative and floral characters of the different families and systematic position according to Bentham and Hooker's system of classification.

Semester	IV
Title of Course	Mushroom Culture Technology (SEC-2)
Paper Code	SEC2T (Theory)
Credits	02
Hours	02 hour/week

The students of Botany (H) of Semester-IV will acquire the knowledge about the importance of mushroom including itscultivation technology, storage and nutrition

<u>The theory paper (SEC2T) of this course (SEC-2) provides the student with-</u>

CO1: Learn about the importance and cultivation technology of mushroom.

CO2: Gain knowledge of the cultivation of different types of edible mushrooms and spawn production and how to manage the diseases and pests of mushrooms.

CO3: Maintain and run mushroom farms in a scientific way. They may set up their unit of mushroom cultivation which can develop into business opportunities in the agriculture biotechnology sector.

Semester	V
Title of Course	Reproductive Biology of Angiosperms(CC-11)
Paper Code	C11T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-V will acquire the knowledge of plant reproductive development and about palynology. They will also learn about the structure of ovule, pollination and fertilization. They will learn about self-incompatibility and development of seeds and embryo.

<u>The theory paper (C11T) of this course (CC-11) provides the students with-</u>

CO1:Understanding of the reproductive biology of angiosperms.

CO2: Deliberate complete knowledge of plant reproduction including fertilization, development of embryo, endosperm, and seed.

CO3:Provide comprehensive information regarding pollination and self-incompatibility.

Semester	V
Title of Course	Reproductive Biology of Angiosperms(CC-11)
Paper Code	C11P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-V will acquire the practical knowledge about plant reproductive biology, studying pollen grains and plants reproductive parts through permanent slides/specimens/photographs.

The lab paper (C11P) of this course (CC-11) provides the student with-

CO1:Learning about anther wall and its ontogeny; through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.

CO2:Students will also study pollen ornamentation and aperture and pollen wall morphology from slides/photographs, fresh material.

CO3:Studying the ovule types, female gametophytes through permanent slides/specimens/photographs.

CO4:Studying the development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages.

Semester	V
Title of Course	Plant Physiology (CC-12)
Paper Code	C12T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-V will acquire the knowledge of plant physiology. They will learn how plant performs basic physiological functions of nutrients uptake and transportation, transpiration, photosynthesis, flowering and seed germination.

The theory paper (C12T) of this course (CC-12) provides the student with-

CO1: Explain the relationship between plant and water and its consequences up to the cellular level, transmembrane pathways, root pressure, guttation, mechanism of stomatal movement.

CO2: Recommend various micro and macro nutrients for the treatment of various plant diseases and list down their deficiency symptoms.

CO3: Explain the nutrient uptake by plants and different modes of transportation of ions through the cell.

CO4: List down the different function of plant growth regulators along with their chemical structure.

CO5: State the physiology of flowering and structure and function of phytochrome, cytochromes and phototropins.

CO6: Calculate the stomatal index, frequency, area of an open stomata and percentage of area open through leaf stomata.

CO7: Conclude the effect of abiotic factors on transpiration and effect of light on seed germination.

Semester	V
Title of Course	Plant Physiology (CC-12)
Paper Code	C12P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-Vwill acquire the practical knowledge of performing different experiments to understand how plant system works. They will study plant respiration, transpiration, seed germination and effect of plant hormones.

The lab paper (C12P) of this course (CC-12) provides the student with-

CO1: Performing experiments to learn about osmotic potential and water potential.
CO2: Studying of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.
CO3: Learn how to calculate the stomatal index and stomatal frequency as well as area of an open stoma and percentage of leaf area from the two surfaces of leaves of a mesophyte and xerophyte.
CO4:Studying the effect of light on seed germination.
CO5:To study the effect of different concentrations of IAA on *Avena*coleoptile elongation (IAA Bioassay).
CO6: Demonstration of some basic plant physiological phenomenon.

Semester	V
Title of Course	Natural Resource Management (DSE-1)
Paper Code	DSE1T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-V will acquire the knowledge about the various types of natural and biological resources. They will also learn about contemporary practices about resource management.

The theory paper (DSE1T) of this course (DSE-1) provides the student with-

CO1: Prioritize the usage of different resources keeping an eye on the present environmental pollution

CO2: State the total forest cover of their locality and the market importance of the various major and minor products obtained from the forest.

CO3: Construct different models for the sustainable utilization of land, water and biodiversity and investigate ways for their management to protect them from degradation

CO4: Calculate and analyse ecological footprint.

CO5: Construct ecological models to understand complex ecological processes and predict how ecosystems can change.

Semester	V
Title of Course	Natural Resource Management (DSE-1)
Paper Code	DSE1P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-Vwill acquire the practical knowledge of estimating solid waste generated by a domestic system, collection of data on forest cover and learning how to measure dominance of woody species.

The lab paper (DSE1P) of this course (DSE1) provides the student with

CO1:They will learn how to estimation of solid waste generated by a domestic system (biodegradable and nonbiodegradable) and its impact on land degradation.

CO2:Collecting of data on forest cover of specific area.

CO3:Learning how to measure dominance of woody species by DBH (diameter at breast height) method.

CO4: Calculating and analysis of ecological footprint and learning about ecological modelling.

Semester	V
Title of Course	Plant Breeding (DSE-2)

Paper Code	DSE2T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-V will acquire the knowledge about plant breeding and its application in crop improvement for the benefits of human being.

The theory paper (DSE2T) of this course (DSE-2) provides the student with-

CO1:Learn about the application of plant breeding in agriculture.

CO2:Know about the methods of crop improvement and breeding.

CO3:Learn about quantitative inheritance, heterosis, and its application.

CO4:Address a particular agronomic problem through a conventional plant breeding approach.

Semester	VI
Title of Course	Plant Breeding (DSE-2)
Paper Code	DSE2P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-VI will acquire the practical knowledge on emasculation, determination of genetic inheritance of characters in monohybrid and dihybrid crosses by Chi-square test and how to identify fertile and sterile pollen grains.

The theory paper (DSE2P) of this course (DSE-2) provides the student with-

CO1: Learning how to identify offspring's having parental genotypes and recombinant genotypes, based on combination of morphological attributes in a dihybrid cross.

CO2:Hands on training on the process of emasculation.

CO3: Determination of genetic inheritance of characters in monohybrid and dihybrid crosses by Chi-square test.

CO4. Performing experiments to identify fertile and sterile pollens with carmine stain and TTC test.

Semester	VI
Title of Course	Plant Metabolism (CC-13)
Paper Code	C13T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-VI will acquire the knowledge about the carbon, lipid and carbohydrate metabolism, nitrogen assimilation and mechanism of signal transduction.

CO1:Describe the role of photosynthetic pigments and different types of carbon assimilation reactions occurring inside the plant and separate the photosynthetic pigments chemically.

CO2: Outline the carbohydrate metabolism and the different pathways involved in the carbon oxidation.

CO3:Examine the effect of abiotic factors on the rate of photosynthesis and the effect of different enzymes on germination and can also compare the rate of respiration in the different parts of a plant.

CO4:Compare and contrast between the different experiments for the mechanism of ATP synthesis.

CO5:Completely establish the lipid metabolism, nitrogen metabolism and the mechanisms of signal transduction.

Semester	VI
Title of Course	Plant Metabolism(CC-13)
Paper Code	C13P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany(H) of Semester-VI will acquire the practical knowledge about how to perform experiments to demonstrate various aspects of plant metabolism.

The lab paper (C13P) of this course (CC-13) provides the student with-

CO1:Performing experiments to separate photosynthetic pigments.

CO2: To study the effect of light intensity and of carbon dioxide on the rate of photosynthesis.

CO3: To perform a comparative study on the rate of respiration in different parts of a plant.

CO4: To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.

CO5: To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.

CO6: Demonstration of fluorescence and absorption spectrum of photosynthetic pigments.

Semester	VI
Title of Course	Plant Biotechnology(CC-14)
Paper Code	C14T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-VI will acquire the knowledge about the molecular biology, gene cloning, gene transformation, plant tissue culture and application of biotechnology in crop improvement.

The theory paper (C14T) of this course (CC-14) provides the student with-

CO1: Discuss with various aspects of plant biotechnology and its role in crop improvement. This course comprises plant tissue culture, molecular biology of gene cloning, and gene transfer.

CO2: Learn about the various application of recombinant DNA technology to develop plants for resistance to pest and disease, tolerance to herbicides, and abiotic factors.

CO3: Develop a clear idea about the scope and importance of biotechnology in crop improvement.

Semester	VI
Title of Course	Plant Biotechnology (CC-14)
Paper Code	C14P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-VI will gain the knowledge on the techniques used to conduct plant biotechnology experiments.

The lab paper (C14P) of this course (CC-14) provides the student with-

CO1: Hands on training on MS media preparation.

CO2: Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.

CO3: Studying of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.

CO4: Construction of restriction map of circular and linear DNA from the data provided.

CO5: They will study different of methods of gene transfer through photographs:

CO6: Study of steps involved in genetic engineering for production transgenic plants through photographs.

CO7: Hands on training on basic molecular biology techniques such as isolation of plasmid DNA, restriction digestion and gel electrophoresis of plasmid DNA.

Semester	VI
Title of Course	Industrial and Environmental Biology (DSE-3)
Paper Code	DSE3T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-VI will acquire the knowledge about various aspects of industrial and environmental microbiology which will include bioreactors / fermenters and fermentation processes, microbial production of industrial products etc.

The theory paper (DSE3T) of this course (DSE-3) provides the student with-

CO1:Gather immense knowledge in many fields like medicine, pharmacy, diary, industry, clinical research, water industry, agriculture and chemical technology.

CO2:Learn about different food processing technology, microbial diversity and their significance in air, soil and water, their isolation method etc.

CO3:Learn about biogeochemical cycle, mycorrhizal association, bioremediation.

Semester	VI
Title of Course	Industrial and Environmental Biology(DSE-3)
Paper Code	DSE3P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-VI will acquire the practical knowledge about the hands on training of sterilization techniques and principles of instruments used in microbiology laboratory.

The lab paper (DSE3P) of this course (DSE-3) provides the student with-

CO1:Principles and functioning of instruments in microbiology laboratory.

CO2:Hands on sterilization techniques and preparation of culture media.

Semester	VI
Title of Course	Analytical techniques in plant sciences (DSE-4)
Paper Code	DSE4T (Theory)
Credits	04
Hours	04 hours/week

The students of Botany (H) of Semester-VI will acquire the knowledge about the principles of different analytical techniques and tools used in plant sciences.

The theory paper (DSE4T) of this course (DSE-4) provides the student with-

CO1: Encompasses a multitude of scientific tools and techniques.

CO2: Provide sound knowledge about the techniques used in biotechnology and molecular biology.

CO3: Learn about the working principle of cutting-edge technology in plant sciences including various kinds of microscopy, flow cytometry, cell fractionation, spectrophotometry, and different types of chromatography.

CO4: Learn how to analyze nucleic acid and proteins by Mass spectrometry, X-ray diffraction, and X-ray crystallography.

CO5: Develop interests among students to know about the technology used to perform a scientific experiment in the modern laboratory and how they are used to solve scientific problems for the benefit of human beings.

Semester	VI
Title of Course	Analytical techniques in plant sciences(DSE-4)
Paper Code	DSE4P (Lab)
Credits	02
Hours	04 hours/week

The students of Botany (H) of Semester-VI will acquire the practical knowledge about the basic analytical techniques in plant sciences. They will also perform some experiments on chromatography.

The lab paper (DSE4P) of this course (DSE-4) provides the student with-

CO1: Studying the basic Blotting technique, DNA fingerprinting, DNA sequencing, PCR through photographs.

CO2: Demonstration of ELISA.

CO3: Hands on training on various methods of chromatography.

CO4: Isolation of chloroplasts by differential centrifugation.

CO5: Estimation of protein concentration through Lowry's methods.

CO6: Hands on training to separate proteins and DNA (marker) using PAGE and AGE respectively.

CO7: Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).

CO8: Preparation of permanent slides (double staining).

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Course Outcome

Botany (GE)

Semester	I
Title of Course	Biodiversity(Microbes, Algae, Fungi and Archegoniate)(GE-1)
Paper Code	GE1T (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of Semester-I will acquire the knowledge about microbial world.They will also come to know about the life cycle, ecological and economic importance of algae, fungi, bryophytes, pteridophytes and gymnosperms.

The theory paper (GE1T) of this course (GE-1) provides the student with-

CO1: Know about biological diversity with reference to the variety of life form on earth.

CO2: They will learn about replication, reproduction process of microbes and their life cycle.

CO3: Provide general information including morphology, life cycle of some specific genus of algae, fungi and archegoniate. The course also aimed to provide their ecological status and economic importance.

Semester	I
Title of Course	Biodiversity(Microbes, Algae, Fungi and Archegoniate)(GE-1)
Paper Code	GE1P (Lab)
Credits	02
Hours	04 hours/week

The students of other science subjects (H) of Semester-I will acquire the practical knowledge about the EM-models of viruses, types of bacteria, EM structure of a bacterium, binary fission ,conjugation, structure of root nodule and gram staining process. They will study the vegetative and reproductive structures of representative members from algae, fungi, bryophytes, pteridophytes and gymnosperms from temporary/ permanent slides.

The lab paper (GE1P) of this course (GE-1) provides the student with-

CO1: Study of different models of viruses T-phage and TMV, photograph study or line drawing of Lytic and Lysogenic cycle.

CO2: Study different types of bacteria from temporary/permanent/photographs,photographic study ofelectron microscopic structure of bacterium, binary fission of bacterium, root nodule structure of bacterium.

CO3: Study of Gram staining procedure.

CO4: Workout of vegetative and reproductive structure different algae.

CO5: Study of asexual and sexual stage of *Rhizopus* and *Penicillium*from temporary mounts and permanent slides.

CO6: Knowledge about identifying plant disease through herbarium sheet and also work out of some diseased part of plants and comparative study of the pathogens.

CO7:Structure of lichen and mycorrhiza through permanent slide.

CO8: Workout of some representative members of bryophytes, pteridophytes and gymnosperms.

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Semester	II
Title of Course	Plant Ecology and Taxonomy(GE-2)
Paper Code	GE2T (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of Semester-IIwill acquire the knowledge about ecosystem, ecology, ecological factors of ecosystem, plantsuccession, ecotone and edge effect, biogeographical zone,endemism,plant taxonomy,identification of a plant and herbarium.

The theory paper (GE2T) of this course (GE-2) provides the students with-

CO1: Draw interrelationship between organisms in population and community.

CO2: Understand their distribution, effect.

CO3:Study ecological principles providing background knowledge for understanding the problems of forests, soil and surface water.

CO4: Provide the knowledge regarding the conservation and management of natural resources and pollution.

CO5: State the principles of classification, nomenclature, preservation, scope of future study .which has a great value in forestry, agriculture and horticulture.

Semester	II
Title of Course	Plant Ecology and Taxonomy(GE-2)
Paper Code	GE2P (Lab)
Credits	02
Hours	04 hours/week

The lab paper (GE2P) of this course (GE-2) provides the student with-

CO1: Study of different instruments to measure microclimatic variables.

CO2**:**Determination of p^H and analysis of soil sample for carbonates, chlorides, nitrates, sulphates, organic matter, and base deficiency by rapid field test.

CO3: Field study to know about morphological adaptation of hydrophytes and xerophytes.

CO4: Determination of minimum size of quadrat in a herbaceous vegetation by species area curve method.

CO5: Quantitative analysis of herbaceous vegetation of college campus for frequency and comparison with Raunkier's frequency distribution law.

CO6: Workout of taxonomic study of some plant family.

CO7: Hands on training on herbarium preparation.

Semester	III
Title of Course	Economic Botany and Plant Biotechnology (GE-3)
Paper Code	GE3T (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of Semester-III will acquire the knowledge about the morphology and economic importance of cereals, legumes, spices, beverages, oil and fibre yielding plants.They will also learn about plant tissue culture and recombinant DNA technology.

The theory paper (GE3T) of this course (GE-3) provides the student with-

CO1: Relate the origin of plants in relation to specific environmental conditions with reference to Vavilov's work.

CO2: Identify some of the economically important plants like wheat, gram, soybean, black pepper, clove, tea, cotton, groundnut and also study their T.S, microchemical tests and uses.

CO3: Familiarize with the basic techniques and equipment of tissue culture.

CO4: Illustrate the different recombinant DNA techniques and study some of the molecular techniques like PCR, Blotting, AGE and PAGE.

Semester	III
Title of Course	Economic Botany and Plant Biotechnology(GE-3)
Paper Code	GE3P (Lab)
Credits	02
Hours	04 hours/week

The students of other science subjects (H) of Semester-IIIwill acquire the practical knowledge about the different sectional study and microchemical test of some economically important plants,familiarization with basic equipment of tissue culture. They will learn about different tissue culture methods and techniques used in molecular biology.

The lab paper (GE3P) of this course (GE-3) provides the student with-

CO1: Study of different economically important plants such as: Wheat, Gram, Soyabean,Blackpepper, Clove, Tea, Cotton, Groundnut through specimenssectioning and microchemical tests.

CO2:To be familiar with basic equipment in tissue culture.

CO3:Demonstration of each step of anther culture,somatic embryogenesis, endosperm and embryo culture. Basic idea about micropropagation.

CO4: Study of molecular technique through demonstration of PCR,Blotting technique, AGE and PAGE.

Semester	IV
Title of Course	Plant Anatomy and Embryology (GE-4)
Paper Code	GE4T (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of Semester-IV will acquire the knowledge about thecomparative study of root,stem,leaf of a monocot and dicot,secondary growth of root,stem, adaptive and protective systems of plants,pollination and fertilization,embryo and endosperm structure, apomixis and polyembryony.

The theory paper (GE4T) of this course (GE-4) provides the student with-

CO1: Learn about the internal structure of plants.

CO2: Differentiate among monocot and dicot's internal morphology.

CO3: Learn about different adaptive features of plants, their protective mechanism.

CO4: Knowledge about the secondary growth in root and stem. Basic conception of heart wood and sap wood.

CO5: Learn about different pollination mechanism and their adaptation for seed dispersal, embryo and endosperm structure of monocot and dicot, knowledge about apomixis and polyembryony etc.

Semester	IV
Title of Course	Plant Anatomy and Embryology (GE-4)
Paper Code	GE4P (Lab)
Credits	02
Hours	04 hours/week

The students of other science subjects (H) of Semester-IV will acquire the practical knowledge about plant tissue systems and adaptive anatomy. They will learn about the morphology of plant reproductive parts, embryo sac structure, ultrastructure of egg apparatus, pollination types, seed dispersal mechanism etc.

<u>The lab paper (GE4P) of this course (GE-4) provides the student with-</u>

CO1: Study of plant tissue systems through permanent slides.

CO2: Anatomical study of monocot and dicot stem, root and leaf.

CO3: Adaptive anatomy of Xerophyte and hydrophyte.

CO4: Structure of anther through permanent slide.

CO5: Structure of different types of ovules and embryo sac through permanent slides

CO6: Calculation of germinated pollen in a given medium.

CO7: Ultrastructure of mature egg apparatus through electron micrographs.

CO8: Study of pollination types and different seed dispersal mechanismsthrough photographs and specimens

CO9:Dissection of embryo/endosperm from developing seed.

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Course Outcome

Botany (DSC)

Semester	I
Title of Course	Biodiversity (Microbes, Algae, Fungi and Archegoniate)(DSC-1A)
Paper Code	DSC1AT (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of semester –I will acquire the knowledge about the biodiversity of various life form such as microbes, algae, fungi and archegoniate including their characteristic features, classification,important diversification, ecological status and economic significance.

The theory paper (DSC1AT) of this course (DSC-1A) provides the student with-

CO1:Deal with biodiversity of various life form such as microbes, algae, fungi and archegoniate.

CO2:Gain vast knowledge about characteristics feature, classification, genus level important diversification of algae fungi and archegoniate.

CO3: Basic concept of archegoniate and knowledge about alternation of generation.

CO4: Study of general account and reproduction of representative genera from bryophytes, pteridophytes and gymnosperms.

CO5: Develop a clear idea about ecological status and economic significance of respective organisms or plants.

Semester	I
Title of Course	Biodiversity (Microbes, Algae, Fungi and Archegoniate)(DSC-1A)
Paper Code	DSC1AP (Lab)
Credits	02
Hours	04 hours/week

The students of other science subjects (H) of semester –I will acquire the practical knowledge about virus, bacteria, lichen, Agaricus and mycorrhiza. They will study the reproductive structures of some specific species of algae and fungi. Study of morphological, anatomical and reproductive structure of respective genus of archegoniate will also be performed.

The lab paper (DSC1AP) of this course (DSC-1A) provides the student with-

CO1: Study of models of viruses and life cycle of viruses.

CO2: Study of types of bacteria, reproduction and gram staining procedure of bacteria.

CO3: Study of vegetative and reproductive structure of various algal genus.

CO4: Study of asexual and sexual stage *Rhizopus* and *Penicillium*.

CO5: Study of plant pathogens *Alternaria* and *Puccinia* and their host plants.

CO6: Study of growth forms Lichen and Mycorrhiza.

CO7: Study of morphological, anatomical and reproductive structure of Archegoniates.

Semester	II
Title of Course	Plant Ecology and Taxonomy (DSC-1B)
Paper Code	DSC1BT (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of semester –II will acquire the knowledge about plant ecology, ecological factors, plant succession, ecosystem and relationships between plant communities. They will also learn about plant taxonomy, taxonomic hierarchy, taxonomic evidences, rules and principles of botanical nomenclature, identification of plant flora, botanical garden and herbariumpreparation.

The theory paper (DSC1BT) of this course (DSC-1B) provides the students with-

CO1: Study of ecological principles providing background knowledge to understand the problems of forests, soil and surface water.

CO2: Concept of plant growth factors and adaptation of hydrophytic and xerophytic plants.

CO3: Concept of relationship between plant communities and process of plant succession.

CO4: Brief idea about the energy flow trophic organisation, productivity and biogeochemical cycling.

CO5: State the principles of Classification, nomenclature, preservation, documentation; scope of future study which has a great value in phytochemistry, palynology cytology and in molecular data.

CO6: Study of important herbaria and botanical gardens of the world and India.

Semester	II
Title of Course	Plant Ecology and Taxonomy (DSC-1B)
Paper Code	DSC1BP (Lab)
Credits	02
Hours	04 hours/week

The students of other science subjects (H) of semester –II will acquire the practical knowledge about instruments used to measure microclimatic variables and analysis of soil samples. They will know about adaptive features of xerophytic and mesophytes and learn to calculate minimum quadrate size and quantitative analysis of herbaceous vegetation, vegetative and floral character of plant families, process of herbarium preparation.

The lab paper (DSC1BP) of this course (DSC-1B) provides the student with-

CO1: Study of necessary instruments to measure microclimatic variables.

CO2**:** Determination of pH and analysis of soil samples by rapid field test.

CO3: Study of morphological adaptive features of xerophytic and hydrophytic plants.

CO4: Study of biotic interactions of stem parasite, root parasite, epiphytes and predation.

CO5: Study of minimal quadrate size for the study herbaceous vegetation.

CO6: Study of Raunkiaer's frequency distribution law.

CO7: Study of vegetative and floral characters of the plant families and systematic position according to Bentham and Hooker's system of classification.

CO8: Study of Herbarium preparation of any wild plant.

Semester	III
Title of Course	Plant Anatomy and Embryology (DSC-1C)
Paper Code	DSC1CT (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of semester –III will acquire the knowledge about meristematic and permanent tissue system, secondary growth, seasonal activity, adaptive and protective system of plants, concept of pollination, fertilization, embryo,endosperm, apomixis, polyembryony and structural organization of flower.

The theory paper (DSC1CT) of this course (DSC-1C) provides the student with-

CO1: Knowledge of meristematic and permanent tissues in root and shoot.

CO2: Concept of internal structure of root, stem and leaf.

CO3: A basic knowledge of vascular cambium, seasonal activity, secondary growth in root and stem and the concept of wood.

CO4: Learn about different adaptive features of plants, their protective mechanism.

CO5: Ideas about structural organization of flower and the process of fertilization.

CO6: Study of different pollination mechanism and adaptation for seed dispersal.

CO7: Basic understanding about endosperm, dicot and monocot embryo, embryo endosperm relationship.

CO8: Understanding the types and practical application of apomixes and polyembryony.

Semester	III
Title of Course	Plant Anatomy and Embryology (DSC-1C)
Paper Code	DSC1CP (Lab)
Credits	02
Hours	04 hours/week

The students of other science subjects (H) of semester –III will acquire the practical knowledge about organization of vascular bundle in monocot and dicot plant parts, types of ovules, female gametophyte, mature egg apparatus, embryo/endosperm formation in developing seed, pollination types and seed dispersal mechanism.

The lab paper (DSC1CP) of this course (DSC-1C) provides the student with-

CO1: Study of different types of tissues, macerated xylary elements and phloem of plants.

CO2: Study of tissue system in stem of monocot and dicot plants

CO3: Study of adaptive anatomical features of xerophytes.

CO4: Study of anther, tapetum and different types of ovules.

CO5: Study of female gametophyte and ultra-structure of mature egg apparatus.

CO6: Study of pollination types and seed dispersal mechanisms.

CO7: Study of embryo/endosperm from developing seeds.

CO8: Study of calculation of germinated pollen in a given medium.

Semester	III
Title of Course	Bio-fertilizers (SEC-1)
Paper Code	SEC1T (Theory)
Credits	02
Hours	02 hours/week

The students of other science subjects (H) of semester –III will acquire the knowledge about the micro-organisms used as biofertilizer such as Rhizobium, Azospirillum, Azotobacter, Cyanobacteria, VAM, recyclable wastes and application of organic farming.

The theory paper (SEC1T) of this course (SEC-1) provides the student with-

CO1: Basic idea about different microbes used as bio-fertilizers.

CO2: Identification, isolation, multiplication and carrier based inoculants of *Rhizobium*, *Azospirillum* and *Azotobacter*.

CO3: Role of Cyanobacteria in nitrogen fixation process in rice cultivation.

CO4: General accounts of VAM ant its influence on growth and yield of crop plants.

CO6: Knowledge of recycling biodegradable wastes from municipal, agriculture and from industry.

CO7: Concept of organic farming, methods of bio-compost making and field application of vermicompost.

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Semester	IV
Title of Course	Plant Physiology and Metabolism (DSC-1D)
Paper Code	DSC1DT (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of semester –IV will acquire the knowledge about plant water relations, mineral nutrition, phloem translocation, photosynthesis, respiration, enzymes, plant hormones, nitrogen metabolism and plant responses to light and temperature.

The Theory paper (DSC1DT) of this course (DSC-1D) provides the student with-

CO1: Discussion on water potential, Transpiration, factors affecting transpiration, root pressure, guttation and significance of transpiration.

CO2: Role of essential element, micro and macro nutrient in plant growth.

CO3: Brief knowledge about different transporter systems across cell membrane.

CO4: Study of girdling experiment, pressure flow model, phloem loading and unloading process.

CO5: Brief discussion on mechanism of photosynthesis and respiration in details.

CO6: Predict the structure, properties and various mechanisms of enzyme.

CO7: Understanding the concept of nitrogen fixation; assimilation of nitrate and ammonia.

CO8: Discovery and physiological role of plant growth regulators.

CO9: Concept and theory of photoperiodism, phytochrome, phtomorphogenesis in response of light and vernalization of plants.

Semester	IV
Title of Course	Plant Physiology and Metabolism (DSC-1D)
Paper Code	DSC1DP (Lab)
Credits	02
Hours	04 hours/week

The students of other science subjects (H) of semester –IV will acquire the practical knowledge about osmotic potential of cell sap, effect of environmental factors in transpiration, stomatal index, stomatal frequency, catalase activity, effect of pH and enzyme concentration, Hillreaction, effect of light intensity and bicarbonate concentration in photosynthesis, rate of respiration in plant parts, amino acids separation by paper chromatography.

The lab paper (DSC1DP) of this course (DSC-1D) provides the student with-

CO1: Study of osmotic potential of plant cell sap by plasmolytic method.

CO2: Study of environmental factors on transpiration.

CO3: Study of calculation stomatal index and stomatal frequency of mesophyticand xerophytic plants.

CO4: Study of Hill reaction, catalase activity and the effect of pH and enzyme concentration.

CO5: Study of the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis system.

CO6: Study of comparison of respiration rate in plant parts.

CO7: Study of amino acid separation by paper chromatography.

Semester	IV
Title of Course	Mushroom Culture Technology (SEC-2)
Paper Code	SEC2T (Theory)
Credits	02
Hours	02hours/week

The students of other science subjects (H) of semester –IV will acquire the knowledge eabout beneficial role of mushroom and awareness about poisonous mushroom. They will be able to preserve edible mushroom for long time and will learn different type food preparation from mushroom. The course also provides mushroom cultivation process with mushroom market value and information about mushroom research centre.

The theory paper (SEC2T) of this course (SEC-2) provides the student with-

CO1: Learn about the importance and cultivation technology of mushroom.

CO2: Gain knowledge of the cultivation of different types of edible mushrooms and spawn production and how to manage the diseases and pests of mushrooms.

CO3: Theoretical knowledge provides nutritional and medicinal values of mushroom and awareness of poisonous mushroom.

CO4: Learning the process of short term and long-term storage of mushroom with different types of food preparation from edible mushroom.

CO5: Study of mushroom research center and market value of mushroom provides business opportunities in India and abroad.

Semester	V
Title of Course	Economic Botany and Biotechnology (DSE-1A)
Paper Code	DSE1AT (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of semester–V will acquire the knowledge about the origin cultivated plants, Vavilove's work, botanical description and uses of cereals, legumes, spices and fibre yielding plant, tea processing, role of biotechnology, micropropagation and application of plant tissue culture.

The theory paper (DSE1AT) of this course (DSE-1A) provides the student with-

CO1: Discussion on the origin of plants in relation to specific environmental conditions with reference to Vavilov's work.

CO2: General account of the some economically important plants like wheat, gram soybean, clove, black pepper, tea, ground nut and cotton.

CO3: Knowledge about biotechnology and plant tissue culture techniques in plant science.

CO4: Illustration of different recombinant DNA techniques and study of some molecular techniques like PCR, Blotting, RFLP, RAPD and ELISA.

Estd.-1966

Semester	V
Title of Course	Economic Botany and Biotechnology (DSE-1A)
Paper Code	DSE1AP (Theory)
Credits	02
Hours	04 hours/week

The students of other science subjects (H) of semester –V will acquire the practical knowledge about economically important plants such as wheat, gram, soybean, black pepper, clove, tea, cotton, ground nut through species, basic equipmentused in tissue culture, anther culture, somatic embryogenesis, endospermand embryo culture. They will learn about molecular techniques like PCR, Blotting techniques, AGE and PAGE.

The lab paper (DSE1AP) of this course (DSE-1A) provides the student with-

CO1: Study of some economically important plants like Wheat, Gram, Soybean, Black pepper,Clove Tea, Cotton, Groundnut through specimens, sections and micro chemicaltests.

CO2: Study of the basic equipmentused in tissue culture.

CO3: Study of Anther culture, somatic embryogenesis, endospermand embryo culture and micropropagation.

CO4: Study of some molecular techniques like PCR, Blotting techniques, AGE and PAGE.

Estd.-1966

Semester	V
Title of Course	Ethnobotany (SEC-3)
Paper Code	SEC3T (Theory)
Credits	02
Hours	02 hours/week

The students of other science subjects (H) of semester –V will acquire the knowledge about ethnobotany in the present context, methodology of ethnobotanical studies, role of ethnobotany in medicine, ethnic groups and legal aspects.

The theory paper (SEC3T) of this course (SEC-3) provides the student with-

CO1: Concept of ethnobotany as an interdisciplinary science and the ethnic relations with the indigenous people of India.

CO2: Study to know about the uses of plant parts as food, intoxicants, beverages, resins, oils and many other miscellaneous uses.

CO3: Knowledge about different methodologies for ethnobotanical studies.

CO4: Study about the role of ethnobotany in modern medicine and the role ethnic group and legal aspects in conservation of plant biodiversity.

Semester	VI
Title of Course	Genetics and Plant Breeding (DSE-1B)
Paper Code	DSE1BT (Theory)
Credits	04
Hours	04 hours/week

The students of other science subjects (H) of semester –VI will acquire the knowledge about the law of heredity, sex linked inheritance, linkage, crossing over, mutations, chromosomal aberrations, plant breeding systems, selection methods and hybridization for crop improvement, quantitative inheritance, inbreeding depression and heterosis.

The theory paper (DSE1BT) of this course (DSE-1B) provides the student with-

CO1: Knowledge about the theory of Mendel, Mendelian ratios, pedigree analysis, chi square, multiple allelism, pleiotropism, cytoplasmic and chromosomal theory of inheritance.

CO2: Briefly discussion on linkage, crossing over, sex determination and sex linked inheritance.

CO3: Concept of different types of mutation and effect of mutagens.Study about numerical and structural changes in chromosome.

CO4: Study about importance of plant breeding, breeding system, achievements and undesirable consequences of plant breeding

CO5: Basic concepts of crop improvement procedure, hybridization, selection methods for improved propagated plants, acclimatization and plant genetic resources.

CO6: Briefly discussion on role of biotechnology in crop improvement and knowledge of quantitative inheritance.

CO7: Learn about the genetic basis of inbreeding depression and heterosis and their application in plant biotechnology.

Semester	VI
Title of Course	Genetics and Plant Breeding (DSE-1B)
Paper Code	DSE1BP (Lab)
Credits	02
Hours	04 hours/week

*The students of other science subjects (H) of semester –VI will acquire the practical knowledge **e**about Mendel's laws through seed ratio, genetic map,pedigree analysis, incomplete dominance, gene interactions and basic methods in ivolved in plant breeding.*

The theory paper (DSE1BP) of this course (DSE-1B) provides the student with-

CO1: Learn about probability, chi square test and Mendel's Law through seed ratio.

CO2: Study of chromosome mapping using point test cross data.

CO3: Study of incomplete dominance and gene interaction through seed ratio.

CO4: Study of syndromes due to cause of aneuploidy such as Down's, Klinefelter's, Turner's syndrome through photographs.

CO5: Study of Translocation Ring, Laggards andInversion Bridge through photographs.

CO6: Study of hybridization techniques like emasculation and bagging.

CO7: Study of polyploidy condition in plants.

Semester	VI
Title of Course	Medicinal Botany (SEC-4)
Paper Code	SEC4T (Theory)
Credits	02
Hours	02 hours/week

*The students of other science subjects (H) of semester –VI will acquire the **knowledge**about folk medicines indigenous medicinal plant science, ayurveda, unani, siddha, polyherbal formulations, endangered and endemic medicinal plant conservation, concept of ex-situ and in-situ conservation, ethnomedicine, ethnoecology, ethnic communities of India, application of natural products to various disease.*

The theory paper (SEC4T) of this course (SEC-4) provides the student with-

CO1: Learn about the scope and role of Indigenous Medicinal Plant Sciences, Ayurveda, Siddha and Unani.

CO2: Learn about the history of Umoor-e-tabiya and concept of polyherbal medicine.

CO3: Study about the basic concept of endangered and endemic plant species and their conservation.

CO4: Briefly discussion on ex-situ and in-situ conservation of endangered and endemic plant species.

CO5: Discussion on propagation process of medicinal plants through cuttings, layering, grafting andbudding.

CO6: Study of objective, classification and important component of nursery.

CO7: Basic concept of use of green house for nursery production.

CO8: Briefly discussion on folk medicine, ethnobotany in India, palaeo-ethnobotany, ethnic communities of India.

CO9: Study of application of natural products to certain diseases- Jaundice, cardiac, infertility,diabetics, Blood pressure and skin diseases.

Estd.-1966