B. Sc.I Year
Deptt. of Botany
Govt. P.G. College, Ramnagar (Nainital)

COURSE OUTCOME

B. Sc.I Year

PAPER-I: ALGAE, FUNGI, BACTERIA, VIRUSES AND LICHENS

- To understand the introduction, classification and salient features of algae and their place among the organism.
- To understand about the reproduction, types of lifecycles and alternation of generation in algae.
- To role of algae as food, fodder, in agriculture, industry and publichealth.
- Providing knowledge about Introduction and salient features of Fungi. To get knowledge regarding outline of classification of fungi.
- To understand about the Somatic structure of fungi andEcological groups of fungi, Importance of fungi both beneficial and harmful.
- To understand the Pathology of fungal plant diseases: A brief idea about disease symptoms, control of plantdiseases; brief idea about the exclusion, eradication and protection of plants.
- To understand about the Life history ofimportant genera of algae and fungi.
- To understand Diversity of Microbiology, a general account.Providing introductory knowledge about Archaebacteria and Eubacteria, reproduction and economic importance.
- To understand characteristics, nature, replication,transmission of viruses and economic importance of Viruses.
- To understand general characteristics, structure, reproduction, economic importance, symbiotic relationship and habitats of Lichens.

PAPER – II: BRYOPHYTA, PTERIDOPHYTAANDGYMNOSPERM

- To get knowledge regarding distribution, habitat,characteristic features and economicandecological importance alternation of generation ofBryophyta.
- To understand about the Life history andcomparative study of *Riccia, Marchantia, Pellia, Anthoceros* and *Funaria.*
- To get introductory knowledge about introduction and salient features, classification, alternation of generation and economic importance of Pteridophyta.
- To understand about the Life history and comparative study of some important genera of bryophytes, pteridophytes and gymnosperms.
- To provide general account of information about introduction and salient features of Gymnosperms.
- To understand comparative study of *Cycas, Pinus* and *Ephedra* on the basis of morphology and anatomyof the vegetative plant body, sporophylls (their arrangement) and sporangia spores, maleand female gametophytes, pollination, fertilization, embryology and seed germination.
- To understand about the fossils, their types and process of fossilization.

B. Sc.II Year

PAPER I – TAXONOMY, PLANT ANATOMYANDEMBRYOLOGY

- To get general idea in of the classification proposal by Bentham & Hooker and Hutchinson.

- To know about ICBN, Botanical Survey of India, Botanical gardens and Herbaria
- To understand distinguishing features of the following families Ranunculaceae, Brassicaceae, Rutaceae, Fabaceae, Rosaceae, Apiaceae, Asteraceae, Solanaceae, Lamiaceae, Orchidaceae, Liliaceae, Poaceae.
- To learn about Meristematic and Permanent tissues with special reference to Root and Shoot apical meristems and their function; Simple, Complex and Special types of tissues.
- To know structure and functions of epidermis and stomata, and anatomy of dicot and monocot (root, stem and leaf)
- To understand about Root-stem transition, Secondary growth secondary growth and anomalous secondary growth in root and stem.

PAPER II – CYTOGENETICS, PLANT BREEDING AND BIOTECHENOLOGY

- To learn about cell structure, cell connections and Structure and functions of cell organelles.
- To study Cell division: cell cycle.
- To understand the structure and function of Eukaryotic chromosome, DNA structure & replication.
- To know general account of structural (deficiency, duplication, inversion & translocation) and numerical (Euploidy & Aneuploidy), alteration in chromosomes.
- To learn about sex chromosomes, sex determination andSex linked inheritance.
- To understand the aims and objectives, basic techniques of plant breeding.
- To know role of Biotechnology in modern life.
- To understand tools and techniques of genetic engineering.
- To learn and understand Plant tissue culture technique.
- To know Industrial Biotechnology and Biotechnology with regard to microorganisms.

B. Sc. III Year

PAPERI - PLANT PHYSIOLOGY, MORPHOGENESIS AND BIOCHEMISTRY

- To understand transpiration and its significance, about mineral nutrition, translocation in phloem.
- To get knowledge about aerobic and anaerobic respiration andphotosynthesis.
- To understand seed germination and dormancy, plant growth, physiology of flowers and growth regulators.
- To know about Carbohydrates, protein and fats and lipids in plants.

PAPER II– ECOLOGY, ECONOMIC BOTANYAND BIOSTASTICS

- To understand about the interaction of plant and environment, Population, ecological succession.
- To know about Ecosystem, Biogeochemical cycles, environmental pollution and Biodiversity and its conservation.
- To understand about Introduction, scope and importance of statistics in plant science.
- To know about aim of sampling, classification, tabulation and graphic presentation of data.
- To measures of dispersion, measure CorrelationandModern approach of statistical packages.
- To understand about the brief knowledge of Botany and commercial utilization and uses of the Cereals and millets, fruits, fibres,vegetables,timbers,medicinal plants, oils and beveragesplants.

Programme Outcomes of B.Sc. (Botany)

- Critically evaluation of ideas and arguments by collection relevant information about the plants, so as recognize the position of plant in the broad classification and phylogenetic level.
- Identify problems and independently propose solutions using creative approaches, acquired through interdisciplinary experiences, and a depth and breadth of knowledge/expertise in the field of Plant Identification.
- Accurately interpretation of collected information and use taxonomical information to evaluate and formulate a position of plant in taxonomy.
- Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists.
- Students will be able to identify the major groups of microorganisms and plants, and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of plants, algae, and fungi that differentiate them from each other and from other forms of life.
- Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history.
- Students will be able to explain how Plants function at the level of the gene, genome, cell, tissue, Flower development. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and mode of life cycle followed by different forms of plants.
- Students will be able to explain the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems.
- Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology.

Programme Specific Outcomes of B.Sc. (Botany)

- **Knowledge and understanding of:**
  - The range of plant diversity in terms of structure, function and environmental relationships.
  - The evaluation of plant diversity.
  - Plant classification and the flora of Maharashtra.
  - The role of plants in the functioning of the global ecosystem.
  - A selection of more specialized, optional topics.
  - Statistics as applied to biological data.
- **Intellectual skills** – able to:
  - Think logically and organize tasks into a structured form.

- Transfer of appropriate knowledge and methods from one topic to another within the subject.
- Understand the evolving state of knowledge in a rapidly developing field.

- **Practical skills:** Students learn to carry out practical work, in the field and in the laboratory, with minimal risk. They gain introductory experience in applying each of the following skills and gain greater proficiency in a selection of them depending on their choice of optional modules.
  - Interpreting plant morphology and anatomy.
  - Plant identification.
  - A range of physiochemical analyses of plant materials in the context of plant physiology and biochemistry.
  - Plant pathology to be added for sharing of field and lab data obtained.
  - Scientific Knowledge: Apply the knowledge of basic science, life sciences and fundamental process of plants to study and analyze any plant form.
- **Problem analysis:** Identify the taxonomic position of plants, formulate the research literature, and analyze non reported plants with substantiated conclusions using first principles and methods of nomenclature and classification in Botany.
- **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and development of the information to provide valid conclusions.
- **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern instruments and equipments for Biochemical estimation, Molecular Biology, Biotechnology, Plant Tissue culture experiments, cellular and physiological activities of plants with an understanding of the application and limitations.
- **The Botanist and society:** Apply reasoning informed by the contextual knowledge to assess plant diversity, its importance for society, health, safety, legal and environmental issues and the consequent responsibilities relevant to the biodiversity conservation practice.
- **Environment and sustainability:** Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Dr. S. S. Maurya

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COURSE OUTCOME

I Semester

Paper I: Microbiology (Bacteria, Viruses and Lichens)

- To understand general account of Microorganisms.
- To learn aboutmethods of isolation and culture of microorganisms.
- To understand themorphology of Bacterial, viruses and lichens.

Paper II: Phycology

- To learn about ecology of Algae and Classification of Algae.
- To understanduseful and harmful aspects of algae.
- To get knowledge on the following orders with detailed study on important genera of algae.

Paper III: Mycology

- To understand general characteristics, classification,reproduction,phylogeny of fungi and economic importance of Fungi.
- To understand general accountof the following classes of fungi with emphasis on life cycle of someimportant genera.

Paper IV: Bryology and Pteridology

- To get knowledge on origin, relationship and evolutionary trends in Bryophytes.
- To understand modern systems of classification of Bryophytes and salient features of some important genera of bryophytes.
- To get knowledge on brief account of the following classes with emphasis on some important genera of Pteridophytes.

II Semester

Paper V: Gymnosperms and Palaeobotany

- To understand history, classification, distribution and evolution of Gymnosperms.
- To get brief account Gymnosperms.
- To know about preservation of fossil plants, types of fossils, modes of formation of different kinds offossils, Gondwana flora.

Paper VI: Diversity and Taxonomy of Angiosperms

- To understand about the important system of classifications of angiosperms.
- To understand about the salient features of International Code of Botanical Nomenclature and Plant Exploration.
- To understand Population and the environment, ecads, ecotypes,evolution and differentiation of species.
- To get brief account on herbarium, Flora, histological, cytological, phytochemical,serological, biochemical and molecular techniques.
- To know about distinguishing features only of the important families and their economic importance.

Paper VII: Plant Morphology, Anatomy and Embryology

- To get information regarding morphology of flower, stamen and carpel, shoot apical meristem, leaf growth and differentiation.
- To understand about the structure of anther andOvule, and their development.
- To understand about the floral characteristics, pollinationmechanism and vectors.
- To understand about the Endosperm development and dormancy.

- To understand about the - General account of Tissue and Anamolous Secondary Growth.

Paper VIII: Cell and Molecular Biology

- To get brief account onStructure, functions and genome organization of cell and cell orgenealles.
- To understand about the structure, protein synthesis, mechanism of translocation, Initiation andtermination.
- To get knowledge on different Techniques used in cell biology with special reference toImmunotechniques, FISH, GISH and confocal microscopy.

III Semester

Paper IX: Plant Ecology

- To get knowledge on major biomes and vegetation typesand environmental factorsof the world.
- To understand the Vegetation organization,mechanism and types of Ecological succession.
- To understand the structure and functions, role and application of biodiversity in ecosystem function; speciation andextinction; IUCN categories of threat, distribution and global patterns of biodiversity.
- To know brief account ofkinds; sources, quality parameters of Environmental pollution; effects on plants andecosystems and remedies.
- To get information regarding Greenhouse gases sources, trends and role; ozone layer and ozone hole;consequences of climate change (CO; sequestration, global warming, sea level rise, UVradiation).

Paper X: Cytogenetics and Plant Breeding

- To understand about the Chromatin organization,structural and numerical alterations in chromosomes,genetics of prokaryotes and eukaryotic organisms.
- To know detailed account onGene structure and expression.
- To know detailed account on mutation,DNA damage and repair mechanisms,Effect of aneuploidy onphenotypes in plants; transmission of monosomics and trisomics and their use inchromosome mapping of diploid and polyploidy species.
- To understand about the C-value paradox; cot-curves and theirsignificance; restriction mapping-concept and techniques.

Paper XI: Biotechnology

- To understand about thePrinciple and scope, bio-safety guidelines of Biotechnology.
- To know detailed account onPlant cell and tissue culture, somatic hybridizationand somaclonal variation.
- To know detailed account onRecombinant DNA technology
- To understand about theGenetic engineering of plantswith special reference to the development of transgenic plant.

Paper XII: Plant Physiology and Biochemistry

- To know detailed account onMembrane transport and translocation of water and solutes.
- To understand about theSignal transduction and sensory photobiology.
- To understand about thephotosynthesis and respiration.
- To understand about thenitrogen fixation and metabolism andplant growth regulators.
- To know detailed account onStress physiology,Carbohydrates, Lipids and Alkaloids.

Semester IV

Paper XIII: Plant Resource Utilization and Conservation

- To know detailed account onSustainable development,World centres of primary and secondary diversity of domesticated plants.

- To understand about theUses of important plantsfood, forage, fodder, fibre crops, Medicinal&aromatic plants and vegetable oil yielding plants.
- To understand about theConservation of plant biodiversity, Principles of conservation, extinction, environmentalstatus of plants based on international Union for conservation of Nature (IUCN).
- To know detailed account onStrategies for *in-situ* conservation and for *ex-situ* conservation.

Elective Course/ Special Paper XIV (ii) Plant Pathology

- To know detailed account onHistory of plant pathology in India.
- To know detailed account on Dissemination of pathogensandPhysiology of diseased hosts.
- To know detailed account on Seed pathology, market diseases of fruits and vegetables.
- To understand the Disease control including cultural practices, chemical methods, biological control, use of resistant varieties, quarantine and integrated management for disease control.To know detailed account on brief account, structure, importance, disease cycle and control of the fungi caused diseases.
- To know detailed account onGeneral characteristics, importance, disease cycle and control of the bacterial, viral and mycoplasma disease.

Programme Outcomes for M.Sc. (Botany)

Plant sciences is now an amalgamation of basic and applied science. Plants besides being the The unique capability of plants to trap solar energy and provide food to all cannot be replicated by any system. Conventional studies like plant identification is now being supplemented with molecular techniques like DNA Barcoding. The courses have been designed to benefit all Botany students to study various aspects of plant science including its practical applications. Keeping in mind that these students can take up teaching at different levels, research work in research institutes and or industry, doctoral work, environment impact assessment, biodiversity studies, entrepreneurship, scientific writing relevant topics have been included in the curriculum.

- Understanding the classification of plants from cryptogams to Spermatophyte. Identification of the flora in field. Study of biodiversity in relation to habitat correlate with climate change, land and forest degradation. Application of Botany in agriculture through study of plant pathology. Paleobotany to trace the evolution of plants.
- Understand the ultrastructure and function of cell membranes, cell communications, signaling, genetics, anatomy, taxonomy, ecology and plant Physiology and biochemistry. To understand the multi functionality of plant cells in production of fine chemicals. There wide spread industrial applications.
- Molecular and Physiological adaptations in plants in response to biotic and abiotic stress. Genes responsible for stress tolerance genetic engineering of plants.

Programme Specific Outcomes of M.Sc. (Botany)

Students would be benefited with knowledge of core subjects like plant diversity, physiology and biochemistry, molecular cytogenetics and application of statistics etc. which are offered in these subjects Modules on analytical techniques, plant tissue culture and phytochemistry would make them obtain skills in doing research.

- **Application of knowledge:** Maintain a high level of scientific excellence in botanical research with specific emphasis on the role of plants. Create, select and apply appropriate techniques, resources and modern technology in multidisciplinary way. Practice of subject with knowledge to design experiments, analyze and interpret data to reach to an effective conclusion.
- **Ability to covey the concept clearly:** They would identify, formulate and analyze the complex problems with reaching a substantiated conclusion. Logical thinking with application of biological, physical and chemical sciences. Learning that develops analytical and integrative problem-solving approaches.
- **Team work:** Students would perform functions that demand higher competence in national/international organizations with sporty spirits and helping each other.
- **Environmental and Sustainability:** Best problem-solving skills in students would encourage them to carry out innovative research projects thereby making them to use knowledge creation in depth.
- **Life Long learning and motivating others to learn:** They would lend the support to other students to grow with them with equal opportunities. Global thinking Knowledgeable disciplined students with good values, ethics, kind heart will help in nation building globally.

Dr. S. S. Maurya