

M.Sc. Botany

Programme Code: 329

Programme Summary

Duration: 2 years

Eligibility

B Sc with CBZ with minimum 45% marks in aggregate.

Program Outcomes:

1. Understanding the general character, structure, reproduction, nutrition and phylogeny of Fungi; general history, structure, reproduction, nutrition, economic importance of bacteria, cyanobacteria, virus, phytoplasma; and structure, reactions, mechanism of antigens and antibodies.
2. To study about the general habit, thallus structure, classification, phylogeny, salient features, life cycle and alternation of generation, physiology and biochemistry, economic importance of several groups of algae, and morphology, structure, reproduction, phylogeny, ecology and fossil-general account of several bryophytes.
3. To study about history, origin, classification, distribution, morphology, life history of various pteridophyte, gymnosperms and study about the fossil plants.
4. To know about the origin of population, species concept, taxonomic hierarchy, features of ICBN, taxonomic tools, evidences, classification, herbarium, gardens, plant exploration and taxonomic study of dicotyledons and monocotyledons families.
5. To know about the seed germination, seedling growth, mobilization of food reserves, shoot development, cell division and cell communication, cambium functions, leaf growth, root development, reproduction, male gametophyte, female gametophyte development, pollination, seed development and fruit growth, latent life dormancy and senescence and programmed cell death (PCD).
6. To know about the plant resources, world centers of primary diversity domestication of plants, origin, evolution, botany, cultivation, cytotaxonomy and economic importance of food crops, forage and fodders, fibres' crops, medicinal and aromatic plants, ornamental plants, NWFPs, IPR, ethnobotany, green revolution, principles of conservation and strategies for conservation.
7. To know about the dynamic cell, plasma membrane, mitochondria and chloroplast, nucleus, chromatin organization, principles of inheritance, structural and numerical alterations in chromosomes, genetics of prokaryotes and eukaryotic organelles, gene structure and expression, genetic recombination and genetic mapping, mutations and nuclear DNA content.

8. To know about the role of plant breeding, hybridization, heterosis, breeding for resistance to diseases, physiological races, role of mutation in crop improving and evolution, plant breeding work in India, maintenance of collection, bio-statistics and its application in life science.
9. To know about functional aspects of plant cell structure, energy flow, biologically important molecules, membrane transport and translocation of water and solutes, photophysiology and photosynthesis, respiration and lipid metabolism, nitrogen fixation, and phytohormones and sensory photobiology.
10. To know about the Vegetation organization, Vegetation development, Ecosystem organization, Global biogeochemical cycles; mineral cycle, Ecosystem stability, Biological diversity, Climate and vegetation pattern of the world, soil, air, water and soil pollution, climate change, fire as an ecological factor, Ecological management, Remote Sensing, and application of remote sensing.
11. To know about the forest, forestry, man, essential elements of forest ecology, Forests and trees, Wild Life, Forest conservancy and Potential Productivity, Forest Conservation and Management, Environmental Impact Assessment.
12. To know basic procedure in diagnosis of plant diseases, Seed Pathology, Nursery disease, Plantation disease, Important disease of cash crops, Various forms and Role of Mycorrhiza in Forestry, Diseases of cereals, Millets, vegetables and fruit trees.
13. To know about the Different types of microscopes, Sources of Timber, Physical features of wood, Gross features of wood, Ultra structure of wood, Natural defects of wood, Criteria and methods of assessment of wood quality.
14. To know about the basic concept, history of conservation biology, origin and evolution of organism, Patterns of biodiversity, Uses of biodiversity, Threats to biodiversity, Global environmental problems, Extinction to species, Environmental Impact Assessment, Conservation of Biological diversity, Survey and monitoring of biological resources, Conservation of energy resources, Conservation of biological resources, Protected Area Network, Ecosystem restoration, National Forest Policy.
15. To know about the basic concepts, principles and scope of Biotechnology, Plant cell and tissue culture, Organogenesis and adventive embryogenesis, Somatic hybridization, Applications of plant tissue culture, Recombinant DNA technology, Genetic engineering of plants, Microbial genetic manipulation, Genomics and proteomics, and bioinformatics.
16. To know about the Environmental Management, EIA Planning and Significance, Environmental Management and Natural Resources, Environmental policy and environmental management system, Basic concept of ecosystem and community, Biodiversity and conservation, Protected areas concept and purpose, Renewable Energy Production and Management, Biofuel plants, oil crops and Biofuel plantation, Carbon sequestration and carbon pools.
17. To know about the introduction of seed pathology, seed borne pathogens, seed borne fungi, Nature of seed infection, Longevity of seed borne pathogens, Epiphytology of seed borne diseases, Detection of seed borne pathogens, Study of seed borne diseases of certain crops, Control of seed borne pathogens.

Course outcome:

S.No.	Course code	Course name	Credits	Course outcomes
1st Semester				
1	SLS/BOT/C001.	Mycology and Microbiology -Theory	03	<ol style="list-style-type: none"> 1. To know about the History of Mycology in India and abroad, General characters of Fungi: Substrate relationship in fungi; Cell ultra structure; unicellular and multicellular organization, nutrition (saprobic, biotrophic, symbiotic); reproduction (vegetative, asexual, sexual); Recent trends in the classification. 3. To know about the Phylogeny of Fungi; General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; Fungi in industry, medicine and as food. Mycorrhizae; Fungi as biocontrol agents. 4. To know about the Symptoms, causal organisms of plant phogens belonging to various fungal classes i.e. Mastigomycotina, Zygomycotina, acomycotina, basidiomycotina and deuteromycotina. 5. To know about the brief history of Microbiology, the diversity of micro-organisms, microbial growth, Archaeobacteria and Eubacteria: General account; ultra structure, nutrition and reproduction; biology and economic importance; cyanobacteria- classification, salient features and economic importance. 7. To know about the Viruses: Characteristics; isolation and purification of viruses; chemical nature, replication, Transmission of viruses; economic importance, Phytoplasma: General characteristics and role in causing plant diseases. (e.g. sandal spike disease, sesamum phyllody, little leaf of brinjal). 8. To know about the Immunology: Structure of antigens and antibodies, antigen- antibody reaction, Mechanism of antigen-antibody reactions. Vaccines and toxoids, Hypersensitivity.
2	SLS/BOT/C002	Phycology and Bryology - Theory	03	<ol style="list-style-type: none"> 1. To know about the, morphology, structure and Economic Importance and life cycle pattern of Algae. 2. To know about the general characters, classification morphology, anatomy and Economic Importance and life cycle pattern of Bryophytes, 3. To learn about the ecology and significance of lower plants.
3	SLS/BOT/C003	Pteridology, Gymnosperms and Palaeobotany - Theory	03	<ol style="list-style-type: none"> 1. To Know about the ecology and significance of pteridophytes and gymnosperms. 2. Study and impart knowledge about the history, origin, classification of past and present distribution, economic importance, morphology and anatomy of syllabus mentioned pteridophytes and gymnosperms plants. 3. To Know about the some fossil plants related to pteridophytes and gymnosperms. 4. To Know about the different types of fossil and their mode of preservation.
4	SLS/BOT/C004.	Taxonomy and Diversity of flowering plants - Theory	03	<ol style="list-style-type: none"> 1. Origin of intra- population variation: Population and the environment; ecads and ecotypes; Evolution and differentiation of species- various models. 2. The species concepts; taxonomic hierarchy, species, genus, family and other categories; principles used in assessing relationship, delimitation of taxa and attribution of rank. 3. Salient features of the International Code of Botanical Nomenclature. 4. Taxonomic evidences and Taxonomic tools: anatomy, palynology, embryology, phytochemistry, histological,

				<p>cytological, phytochemical, serological, biochemical and molecular techniques.</p> <p>5. Systems of angiosperm classification: Phenetic versus phylogenetic systems; cladistics in taxonomy; major systems of classification (Bentham and Hooker, Hutchinson, Cronquist) and their relative merits and demerits.</p> <p>6. Herbarium and Botanical gardens: General account.</p> <p>7. Plant exploration in India with reference to North west and Uttarakhand Himalaya.</p> <p>8. Status of flowering plant diversity in Garhwal Himalaya.</p> <p>9. A study of the following families and their relationships:</p> <p>a. Dicotyledons: Magnoliaceae, Berberidaceae, Fumariaceae, Violaceae, Meliaceae, Apiaceae, Sterculiaceae, Tiliaceae, Geraniaceae, Combretaceae, Asteraceae, Campanulaceae, Ericaceae, Primulaceae, Asclepiadaceae, Convolvulaceae, Verbenaceae, Scrophulariaceae, Oleaceae, Amaranthaceae, Chenopodiaceae, Loranthaceae, Urticaceae, Juglandaceae, Fagaceae and Salicaceae.</p> <p>b. Monocotyledons: Hydrocharitaceae, Orchidaceae, Amaryllidaceae, Arecaceae, Araceae, Lemnaceae, Poaceae and Cyperaceae .</p>
5	SLS/BOT/C005	Laboratory course- I	03	Based on theory paper Mycology and Microbiology (SLS/BOT/C001) and Phycology and Bryology. (SLS/BOT/C002).
6	SLS/BOT/C006	Laboratory course- II	03	Based on theory paper Pteridology, Gymnosperms and Palaeobotany (SLS/BOT/C003) and Taxonomy and Diversity of flowering plants (SLS/BOT/C004).
2nd Semester				
7	SLS/BOT/C007.	Plant development and Reproductive biology -Theory	03	<p>1.To Know about the seed germination and seedling, hormonal control of seedling growth, seed dormancy and breaking methods of seed dormancy and bud dormancy, senescence and programmed cell death (PCD) , seed development and fruit growth.</p> <p>2. To Know about the floral parts microspogenesis and megasporogenesis, organisation of embryo sac, pollen pistil interaction, methods of pollination and fertilization, endosperm and embryogenesis and polyembryony, apomixis, embryo culture.</p> <p>3. Understand the scope & importance of anatomy.</p> <p>4. To Know about the various tissue systems root apex meristem and shoot apex meristem, secondary xylem and leaf growth.</p> <p>5. Understand about the normal and anomalous secondary growth in plants and their causes.</p>
8	SLS/BOT/C008	ResourceUtilization, IPR and Ethnobotany - Theory	03	<p>1. To know about the plant resources: Concept, status, utilization and concerns, World Centers of Primary Diversity of domesticated plants.</p> <p>2. To know about the Origin, evolution, botany, cultivation, Cytotaxonomy and uses of Cereals and millets (wheat, paddy, maize), Legumes (soybean, black gram and cowpeas), Sugar cane and starches (sugarcane, beetroot, potato, sweat potato, cassava), Forage and fodder crops, Fibre crops, medicinal and aromatic.</p>

				<p>3. To know about the Important firewood and timber yielding plants and non- wood forest products (NWFPs) such as bamboos, gums, tannins, dyes, resins, beverages.</p> <p>4. To know about the Intellectual Property Rights, Concept, History, Protection of IPR; Patent- requirements, procedures and limitations; International convention on Biological Diversity.</p> <p>5. Ethnobotany: Concept, linkage with other sciences, tools of ethnobotanical studies, world and Indian perspective with special reference to the Himalayas.</p> <p>6. To know about the Green revolution: Benefits and adverse consequences, Plants used as ornamentals and avenue trees.</p> <p>7. To know about the Principles of conservation: Extinction; Status of plants based on International Union for Conservation of Nature (IUCN) and Strategies for conservation: <i>In situ</i> conservation; Protected areas in India- sanctuaries, national parks and biosphere reserves.</p>
9	SLS/BOT/C009.	Cytogenetics and Molecular biology -Theory	03	<p>1. To know about the dynamic cell: Structural organization of the plant cell; specialized plant cell, Cell wall: structure and functions; biogenesis, growth, Plasma membrane: structure models and functions; sites for ATPases, ion carriers, channels and pumps, receptors.</p> <p>2. To know about the Mitochondria and chloroplast: Structure, genome organization, gene expression, Nucleus: structure, nuclear pores, nucleosome organization. 6. Ribosomes: Structure, cytoprotein synthesis.</p> <p>3. To know about the Chromatin organization: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, euchromatin and heterochromatin, specialized types of chromosomes; polytene, lampbrush, B-chromosomes and sex chromosomes.</p> <p>4. To know about the Principles of inheritance: Mendelian laws along with molecular explanations, Exceptions to Mendelian laws, lethal alleles and Gene Interactions.</p> <p>5. To know about the Structural and numerical alterations in chromosomes: Origin, occurrence, production and meiosis of haploids, aneuploids and euploids, induction and characterization of trisomics and monosomics.</p> <p>6. To know about the Genetics of prokaryotes and eukaryotic organelles: genetic recombination of phage; genetic transportation, conjugation and transduction in bacteria, cytoplasmic male sterility.</p> <p>7. To know about the Gene structure and expression: Genetic fine structure, cis-trans test; fine structure analysis of eukaryotes, introns and their significance, regulation of gene expression in prokaryotes and eukaryotes. DNA damage and repair mechanism, defects in DNA repair; Initiation of cancer at cellular level, proto-oncogenes and oncogenes.</p> <p>8. To know about the Genetic recombination and genetic mapping: Recombination; independent assortment and crossing over, linkage groups, genetic markers, construction of molecular maps.</p> <p>9. To know about the Mutations: Spontaneous and induced mutations; physical and chemical mutation, molecular basis of gene mutation; mutations induced by transposons, and Nuclear DNA content; C-value paradox; Cot curves.</p>

10	SLS/BOT/C010.	Plant breeding and Biostatistics -Theory	03	<ol style="list-style-type: none"> 1. To know about the role of plant breeding - historical aspects and genetic basis: mode of reproduction in relation to breeding methods, breeding techniques; method of plant breeding in relation to self-pollinated and cross pollinated plants. 2. To know about the Hybridization: Interspecific and inter generic; pure line; back cross hybridization; self-incompatibility system. 3. To know about the Heterosis: Its genetic and physiological basis, Breeding for resistance to diseases, physiological races, Role of mutation in crop improving and evolution. 4. To know about the Plant breeding work done in India with special reference to potato, paddy, wheat and sugarcane, Maintenance of collection, registration of varieties, seed production, testing, certification and distribution 5. To know about the Bio-statistics and its application in life sciences, Methods of representation of statistical data and measurements of central tendencies, correlation, regression, curve fitting and ratio of variation, Probability and use of binomial trials.
11	SLS/BOT/C011.	LABORATORY COURSE- I	03	Based on theory paper Plant development and Reproductive biology (SLS/BOT/C007) and Resource Utilization, IPR and Ethnobotany (SLS/BOT/C008).
12	SLS/BOT/C012	LABORATORY COURSE - II	03	Based on paper Cytogenetics and Molecular biology (SLS/BOT/C009) and Plant breeding and Biostatistics (SLS/BOT/C010).
3rd Semester				
13	SLS/BOT/C013	Plant physiology and Biochemistry -Theory	03	<ol style="list-style-type: none"> 1.To know about the metabolic activity and life cycle of the plant from germination through growth and development. 2. Know importance and scope of plant physiology. 3.Understand the plants and plant cells in relation to water-osmosis, imbibition, guttation, diffusion and water potential and the movement of sap and absorption of water in plant body, transpiration-structure and function of stomata, plant nutrition and essentiality and mechanism of absorption. 4. Understand the process of photosynthesis particular light and dark reaction, photorespiration, respiration particular emphasis on aerobic and anaerobic respiration. 5. to learn about enzymes structures, properties and their mechanism, nitrogen metabolism, plant growth regulators, photoperiodism and vernalization.
14	SLS/BOT/C014	Ecology and Remote Sensing-theory	03	<ol style="list-style-type: none"> 1. To understand the principles and dynamics of community and population ecology. 2. To learn interspecies and intraspecies relations. 3. To find out the linkages in biogeochemical cycles. 4. To be able to cope with the impacts of climate change and global efforts. 5. To understand plant response to different pollution. 6. To understand the concepts, methodologies and applications of Remote Sensing in natural resource management 7. To prepare the students for National and Global Employability.

15	SLS/BOT/E001B	FOREST ECOLOGY -Theory	03	<ol style="list-style-type: none"> 1. To know about the Forests, forestry and man: Definition, forests in geological ages, forests in prehistoric era, shifting cultivation, forests in historical time, scientific forestry, forest policy, natural forest policy, private forest policy, planned forest development, forestry education in India. 2. To know about the Essential elements of forest ecology: Extent and boundaries, physical features, geology, river system, soil, land-use pattern, role in country's economy, forests and wild lands. 3. To know about the Forests and trees: Locality factors of the forests, forest influences, forest composition, stand structure, dynamics and growth, classification, forest types and their distribution, species diversity. 4. To know about the Wild Life: Species and distribution, Sanctuaries, Biosphere reserves, wild life and recreation. 5. To know about the Forest conservancy and Potential Productivity: Soil, Water relation and nutrition, soil erosion and conservation, potential productivity of forests, site quality evaluation. 6. To know about the Forest Conservation and Management: Impact of deforestation on soil and water, Role of fire: type, extent and cause of fire, fuel load, fire and different forest types of Himalaya, Forest resource management and forest resource information system, Forest cover in India-State of Art, Ground inventory. Application of Remote Sensing and Geographic Information System (GIS) in Land cover mapping. Vegetation and forest type maps. 7. To know about the Environmental Impact Assessment: Maintenance and conservational policies such as Joint Forest Management (JFM) and Agroforestry in the region.
16	SLS/BOT/E002A	PLANT HEALTH MANAGEMENT -Theory	03	<ol style="list-style-type: none"> 1. To study about Basic procedure in diagnosis of plant diseases, Significance of plant diseases, Seed Pathology, Seed borne fungi. Disease transmitted through seeds. 2. To know about the Biodeterioration of seed in storage and Control of seed borne fungi, to study about the Nursery disease: Important disease of nursery plants, to learn the Plantation disease: Plantation disease of Chir pine, Eucalyptus, Sal, Teak, Shisam, Populus, Acacia (Catechu). 3. To learn the important diseases of cash crops: Sugarcane, Potato and Ginger, how plants defend themselves against pathogen, Control of crop and forest disease. Treatment of wounds. 4. To know about Introduction and various forms of Mycorrhiza. Role of Mycorrhiza in Forestry, diseases of vegetables, fruit trees, cereals and Millets.
17	SLS/BOT/C015.	LABORATORY COURSE -I	03	Based on theory paper Plant physiology and Biochemistry (SLS/BOT/C013) and Ecology and Remote Sensing (SLS/BOT/C014).
18	SLS/BOT/E03.	LABORATORY COURSE- II (Based on elective papers)	03	LABORATORY COURSE- II: based on theory paper Forest Ecology (SLS/BOT/E001B) and Plant Health Management (SLS/BOT/E002A).
19	SLS/BOT/E002C	APPLIED PLANT ANATOMY -theory	03	<ol style="list-style-type: none"> 1. To study about the different types of microscopes, their working and utility. 2. To study about the Sources of Timber. Importance of knowledge of wood structure. 3. To study about How wood is formed: Cambium and its derivations, secondary growth, juvenile wood and mature

		Self Study Paper (qualifying paper)		<p>wood, Physical features of wood visible on the cross surface of log, sapwood and heart wood, growth rings and growth marks, colour, luster, odour and taste, weight, grain, texture.</p> <p>4. To study about the Gross features of wood visible on longitudinal surface of wood, Ultra structure of wood and techniques: Electron microscope, ultra structure of cell wall, micro- fibril angle.</p> <p>5. To study about the Natural defects of wood: Reaction wood, Knots, Silica content and other defects due to stress, Defects of timbers to utilization.</p> <p>6. To study about the Wood structure in relation to properties and uses, Criteria and methods of assessment of wood quality in plantation grown timbers, viz: Eucalyptus and Poplar for pulp and timber.</p>
4th Semester				
0	SLS/BOT/C016	Conservation Biology (Theory)	03	<p>1. To know about the basic concept, history of conservation biology and origin, evolution of organism; genetic plasticity a factor in evolution; the invasion of unoccupied ecological niches.</p> <p>2. To know about the global and regional patterns of biodiversity, Distribution, Gradients, Magnitude of biodiversity, Hotspots, keystone species, effects of species deletion and addition on maintenance of biodiversity and uses of biodiversity, biodiversity based products and industries, wild relatives of cultivated plants, scientific role of biodiversity.</p> <p>3. To know about threats to biodiversity, Global environmental problems, Extinction to species, Red and Green Data Books.</p> <p>4. To know about Environmental Impact Assessment (EIA), Conservation of Biological diversity, Survey and monitoring of biological resources, People participation, biodiversity registers and their maintenance.</p> <p>5. To know about the Conservation of energy resources, biological resources, Strategies, Designing Networks of Protected Areas; Restoration of endangered species, Challenges for the future.</p> <p>6. To study about the Protected Area Network with special reference to Uttarakhand and India, International efforts for conserving biodiversity, Ecosystem restoration, Strategies and plans for restoration,</p> <p>7. To learn about the National Forest Policy, Wildlife (Protection) act, Forest (Conservation) Act, Environment (Protection) Act, and Biodiversity Act.</p>
21	SLS/BOT/C017.	Biotechnology and Genetic Engineering of Plants and Microbes - theory	03	<p>1. To know the genome organization in higher organisms.</p> <p>2. To know the steps involved in recombinant DNA technology.</p> <p>3. To Know the the construction of DNA and cDNA library and their applications.</p> <p>4. To Know the development of an ability to design and conduct genetic engineering experiments, as well as to analyze and interpret data.</p> <p>5. To Know the development of research aptitude and technical skills to secure a job in genetic engineering labs.</p> <p>6. To develop skills for application of tissue culture techniques in plant breeding and horticulture about the plant tissue culture and transgenic plants.</p> <p>7. To know about principles and Tools of Gene Cloning, strategies and steps of gene cloning.</p> <p>8. To gain knowledge of sequence detection, amplification and modification techniques, DNA synthesis and sequencing (Chemical, enzymatic and automated methods); Sequence assembly for whole genome analysis.</p> <p>9. To know about the principle, methods and applications of: PCR and techniques used in genome analysis, DNA fingerprinting, various molecular markers for genomics and proteomics.</p>

22	SLS/BOT/E 005B.	Environment Management with Reference to Western Himalaya -theory	03	<ol style="list-style-type: none"> 1. To understand appropriate sociological and technological measures in environment management. 2. To focus on ecosystem services and human well being and livelihoods. 3. To learn basis of problems and solutions in natural resource management. 4. To find solutions towards more sustainable societies around the globe. 5. To learn strategies for waste reduction and disposal. 6. To contribute meaningfully for analysis of environmental systems planning and management with both a local and global perspective 7. To prepare the students for national and global employability.
23	SLS/BOT/E 005D.	Seed Pathology -theory	03	<ol style="list-style-type: none"> 1. To study about Introduction, terminology and historical development, seed health and its importance, and kinds of seed borne pathogens: fungi, bacteria, viruses, viroides and nematodes. 2. To learn the types of damage caused by the seed borne fungi to seeds and crops, nature of seed infection. 3. To know about the systemic infection through flower, fruit and seed stock. Penetration through seed coat, natural openings and inflicted openings. 4. To study about longevity of seed borne pathogens, factors influencing longevity, detection of seed borne pathogens, objectives of seed health testing. testing methods for seed borne fungi, seed borne bacteria, seed borne viruses and seed borne nematodes. 5. To understand seed borne diseases of certain specific crops, cereals, millets, pulses, oil crops, fibre crops, and vegetable and timber crops. 6. To study about the control of seed borne pathogens: selection of seed production areas, crop management, seed treatment, certification, plant quarantine and disease resistance.
24	SL/BOT/C018	Laboratory Course - I	03	Based on paper Conservation Biology (SLS/BOT/C016) and Biotechnology and Genetic Engineering of Plants and Microbes (SLS/BOT/C017).
25	SLS/BOT/E006	Laboratory Course - II	03	Based on theory paper Environment Management with Reference to Western Himalaya (SLS/BOT/E 005B) and Seed Pathology (SLS/BOT/E 005D).