Learning Outcomes based Curriculum Framework (LOCF)

for (Botany)

Post Graduate Programme

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	I	BOT-CC-121	Biology and Diversity of Viruses, Bacteria & Fungi	Mid Sem 40 End Sem 60	04

Course Objectives: The major objective of this paper is to build a strong foundation about the knowledge about archebacteria, eubacteria, virus, phytoplasma and fungi. A detailed description of Mycology and phylogeny of fungi.

Course Structure:

Unit I: Archaebacteria and Eubacteria: General account; ultra structure, nutrition and reproduction; biology and economic importance; cyanobacteria - salient features and biological importance.

Unit II: Viruses: Characteristics and ultra-structure of virions; isolation and purification of viruses; chemical nature, replication, transmission of viruses; economic importance.

Unit III: Phytoplasma: General characteristics and role in causing plant diseases.

Unit IV: Mycology: General characters of fungi; substrate relationship in fungi; cell ultra-structure unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotrophic, symbiotic); reproduction (vegetative, asexual, sexual); heterothallism; heterokaryosis, parasexuality; recent trends in classification.

Unit V: Phylogeny of fungi: general account of Mastigomycotina, Zygomycotina, Ascomycotina Basidiomycotina, Deuteromycotina; fungi in industry, medicine and as food; fungal diseases in plants and humans; Mycorrhizae; fungi as biocontrol agents.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: To understand the general characteristic structure, nutrition, reproduction and economic importance of archebacteria, eubacteria and cyanobacteria.

Unit II: To understand the general characters, ultra-structure, isolation , chemical nature, replication, transmission and economic importance of viruses.

Unit III: To understand the general characters and role in causing plant diseases by phytoplasma.

Unit IV: To understand general characters, ultrastructure, nutrition, reproduction, classification and other attributes of fungi.

Unit V: To understand the general account of different groups of fungi and their uses in industry, food, medicine etc and also role in causes various diseases in plants and humans.

Keywords: Archebacteria, Eubacteria, Virus, Phytoplasma, Fungi

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	I	BOT CC 123	Biology and Diversity of Algae, Bryophytes & Pteridophytes	Mid Sem 40 End Sem 60	04

Course Objectives: The major objective of this paper to build up a strong foundations of lower plants growing in different habitats.

Course Structure:

Unit I: Phycology: Algae in diversified habitats (terrestrial, freshwater, marine); thallus organization; reproduction (vegetative, asexual, sexual); criteria for classification: (algal pigments, reserve food, flagella); Classification of algae.

Unit II: Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta. Bacillariophyta, Phaeophyta, Rhodophyta; algal blooms, algal biofertilizers; algae as food, feed and uses in industries; economic importance.

Unit III: Bryophyta: Morphology, structure, reproduction and life history; distribution; classification; general account of Marchantiales, Jungermanniales, Anthoceratales, Sphagnales, Funariales and Polytrichales; economic and ecological importance.

Unit IV: Pteridophyta: Morphology, anatomy and reproduction; classification; evolution of stele; heterospory and origin of seed habit.

Unit V: General account of fossil pteriodophyta; introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

Course Learning Outcomes: Upon the completion of the course the students:

Unit I: Will able to understand biology of lower plants particularly algae. Now days one can a use algal pigments as potential. Start up and entrepreneurship.

Unit II: Will be able to understand and develop the skill of algal identification and application of various algal form in biofertilizer and food industry. It provide not only skill based training but also employability too.

Unit III: 3Will be able to understand basic structure and potential of various group of bryophytes, can develop consultancy for identification.

Unit IV: Will able to understand basic importance of structural and functional aspects of the group. Can develop skill for identification and exploration for environmental management.

Unit V: Will able to understand fossil forms of Pteridophytes this given an opportunity to trace the linkage of evolution of plants.

Keywords: Algae, Identification Biofertilizer entrepreneurship, cansultancy.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	I	BOT –CC-125	Biology and Diversity of Spermatophytes	Mid Sem 40 End Sem 60	04

Course Objectives: The major Objectives of this paper is to build a strong foundation in the characteristics and classification of Gymnosperm and Angiosperm

Course Structure:

Unit I: General characteristics of Gymnosperm; classification and distribution of Gymnosperm in India.

Unit II: Economic Importance of Gymnosperms. General Account of pteridospermales, Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales. Life history of *Cycas, Pinus, , Ginkgo* and *Gnetum*.

Unit –III Taxonomic hierarchy, species, genus, family and other categories; Salient features of the International Code of Botanical nomenclature.

Unit- IV Classification of angiosperm artificial and natural and phylogenetic systems merits and demerits Recent trends in Taxonomy, Herbarium, FLORA, Botanical Garden.

Unit- V Morphological nature of flower, stamen & carpel. Range of floral variation and trends of evolution in order- Ranales, Amentiferae, Tubiflorales, Santales and Helobiales. Study of various families of local flora.

Course Learning Outcomes:

Upon the completion of the course the students:

Unit 1: will be understand about characteristics, classification and distribution of Gymnosperm.

Unit 2: will get knowledge about the life cycle of some important species of gymnosperm.

Unit 3: will be understand about taxonomic hierarchy and ICBN.

Unit 4: will get knowledge about classification of angiosperm, Herbarium techniques and modern trend in taxonomy.

Unit 5: will get knowledge about morphology of flower and taxonomic description of the different families of angiosperm.

Keywords: Spermatophytes, Gymnosperms, Angiosperms, Morphology, Taxonomy, Classification.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	I	BOT-CC-127	Field Study	Mid Sem 40 End Sem 60	04

Course Objectives: The major objective of the paper is to develop skill towards identification of plant species, recorded their occurrence and digitized it.

Course Structure:

Unit I: Collection of Plants identification and preservation

(a) Sagar and its environs (b) from local excursion (short) (c) Major excursion (long)

Unit II: Preparation of Herbarium.

Unit III: Preservation of collected plant species.

Unit IV: Submission of report for every field study.

Unit V: Submission of Dissertation at the time of End Sem. Exam.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Will learn the various techniques of plant identification and preservation. This skill enable them to leacy now to collect, preserve and identify the various taxa. A plant taxonomist may become a consultant also, so here is scope of employability too.

Unit II: Taxonomist will learn preparation of herbaria. Herbarium making is an art but require skill also herbaria are source of plant identification, Digitization make may provide global accesses.

Unit III: Will develop an entrepreneurship to establish biological house and online market of collected plant material from for diversified habitats.

Unit IV: Will enable student to develop writing skills this help them to write a report prepare field dath book.

Unit V: Will enable students to develop skill towards scientific photography, Editing of graphs and photographs along with details of the plants species.

Keywords: Plant identification, Herbaria, preservation, collection, field study

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	I	BOT-EC-121	Mushroom Biology	Mid Sem 40 End Sem 60	04

Course Objectives: The major objective of this paper to trained the students for skilled entrepreneur.

Course Structure:

Unit I: Mushroom definition, Characteristics of mushrooms, Categories (edible,poisonous,medicinal) Biodiversity of wild mushrooms.

Unit II: Ecological importance of Fungi in general and mushroom in particular, specially Locally growing Mushrooms.

Unit III: Classification, identification and cultivation methods of mushrooms.(*Pleurotus* , *Agaricus* and *Calocybe* and *Cordyceps* Species)

Unit IV: Diseases of mushrooms, use of spent mushroom compost as bio-control agent, secondary metabolites of mushrooms.

Unit V: Mushroom by-products (pickle, soap, medicine) Agri-business-(concept of marketing, market channels, SWOT analysis)

Course Learning Outcomes:

Upon the completion of the course the students:

Unit I Will able to learn about mushrooms get knowledge and enhanced skill about biodiversity of mushroom.

Unit II: Will able to learn ecological importance of fungi, can became guide and consultant about locally occurring mushroom. This provide a employability.

Unit III: Will able to learn cultivation techniques for various edible and medicinally important mushroom. This skill enable them gives an opportunity to became entrepreneur.

Unit IV: Will able to get complete knowledge of diseases management of mushroom. This provide a good skill towards maintaining mushroom houses

Unit V: Will able to learn how to produce value added products and market them : This enable them not only to become entrepreneur but also provide tool for creation of starts up or employment to others.

Keywords: Mushroom, Ecology, Fungi, Cultivation, Entrepreneurship

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	I	BOT EC-123	**Ecosystem Services**	Mid Sem 40 End Sem 60	03

Course Objectives:

The objective of the course is to understand the basic concept of ecosystem services and its valuation. It includes the current status of the ecosystem resources at global scale and the significance of the forest ecosystem services on human wellbeing from ecological, social and socio-economic aspects and its impact on the forest policy making at regional, national and global scale.

Course Structure:

Unit I: Introduction to Ecosystem Services: Definition and Key concept; classification; ecosystem functions and services.

Unit II: The role of biodiversity in the provision of ecosystem services.

Unit III: Valuing ecosystem services.

Unit IV: Paying for ecosystem services.

Unit V: Governing for ecosystem services

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand the basic concepts of Ecosystem Services and its valuation. Understand the significance of "nature capital" on human welfare.

Unit II: Decipher the correlation between ecosystem services and biodiversity conservation. Learn the functional tools and methods to evaluate the forest ecosystem services.

Unit III: Understand the impact of ecosystem services on the corporate sectors.

Unit IV: Understand the concept of PES and its implications from previous case studies. Identify the local forest ecosystem services.

Unit V: Understand the current status of ecosystem resources around the world under the influence of anthropogenic disturbances.

Keywords:

Ecosystem functions and services, Biodiversity, Millennium Ecosystem Assessment, Human well-being, Valuation of ecosystem services, Carbon foot print, Carbon credit, Carbon trade.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	II	BOT-CC-221	**Cytogenetics**	Mid Sem 40 End Sem 60	04

Course Objectives:

The objective of this course is to train students about the basic concept of cytology, genetics and its importance in studies of life sciences. It includes the basic understanding of cytoplasmic organelles, membrane transports, cell division, Mendelian principles of heredity, gene interaction, DNA structure, replications and role of mutation in crop improvements.

Course Structure:

Unit 1: General Introduction: Historical background of cytology; Prokaryotic and Eukaryotic cell organization, structure and function of cell wall and plasma membrane. Membrane transport (Active and passive mechanism), Cell organelles, Cytoskeleton,

Unit 2: Cell Cycle: Mitosis, Meiosis, role of cyclins in cell division, Apoptosis.

Unit 3: Introduction of Genetics**:** Overview. Pre-Mendelian theory concerning Heredity and Evolution; Mendelian concept of Heredity. Extension of Mendelism: Gene Interactions, Multiple Allelism, Polygenic Inheritance. Chromosomal Theory of Inheritance, Sex-Linkage, Linkage, Crossing over, Chromosomal Mapping. Extra-chromosomal Inheritance. Population Genetics.

Unit 4: DNA structure and Replication: DNA as genetic material, Structure and different types of DNA, Topology, Chromatin, Nucleosome model, Heterochromatin and Euchromatin, Special type of chromosomes (Lampbrush and polytene chromosome). DNA replication in prokaryotes, different proteins and enzymes involved.

Unit 5: Mutation: DNA damage and repair, Mutation, Type of Mutation, Mechanism of mutation, Polyploids and haploids in crop improvements, Transposable Genetic elements, Mechanism of Transposition.

Course Learning Outcomes: Upon the completion of the course the students will be able to:

Unit I: Understand the basic concepts of prokaryotic and eukaryotic cell organisation, different cell organelles and membrane transport.

Unit II: Understand the process of cell division, different stages of meiosis and mitosis, apoptosis and role of cyclin in cell division.

Unit III: Understand the Mendelian concept of heredity, gene interactions, multiple allelism, polygenic inheritance, chromosomal theory of inheritance, linkage, crossing over, extra-chromosomal inheritance and population genetics.

Unit IV: Understand the structure of DNA, its replications in prokaryotes and eukaryotes, special types of chromosomes.

Unit V: Understand the mechanism of mutation and its types, role of polyploids and haploids in crop improvements and mechanism of transposition.

Keywords: Cytology, Membrane transport, Cell division, Mendelism, Gene interaction, Population Genetics, Linkage and crossing over, DNA structure, Replications, Mutations, Transposition.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	II	BOT-CC-223	Plant Physiology	Mid Sem 40 End Sem 60	04

Course Objectives: The major objective of this paper is to develop understanding forwards vital function carried out by the plants.

Course Structure:

Unit I: Plant water relations: Physical properties of water; diffusion, osmosis, translocation of water, concept of water potential, Transpiration, Physiology of stomata, plant-water relations, mechanism of water transport through xylem. Plants and inorganic nutrient: Essential nutrient, nutrient role and deficiency symptoms, Toxicity of micro nutrient, root-microbe interactions in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins.

Unit II: Light and pigment: physical nature of light, natural radiation, photoreceptor. Photosynthesis: Bioenergetics, Photophosphorylation, light harvesting, Complexes, photosynthetic carbon reduction, (PCR) C4 syndrome, Crassulacean acid, metabolism (CAM) Translocation of xenobiotic chemical.

Unit III: Signal transduction: Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascade. Sensory photobiology: History of discovery of phytochromes and cryptochromes, and their photochemical and biochemical properties, photophysiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.

Unit IV: Plant growth regulators and elicitors: Physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid, brassinosteroids, polyamines, jasmonic acid and salicylic acid. The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development - genetic and molecular analysis, role of vernalization.

Unit V: Stress physiology: Plant responses to biotic and abiotic stress, mechanisms of biotic and abiotic stress tolerance, HR and SAR, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.

Course Learning Outcomes:

Upon the completion of the course the students:

Unit I: Will able to get understanding regarding water and water relationship. Generate awareness about importance of nutrients. Movements of water and Plant water relations, this skill helped them for plantation of plants.

Unit II. Will able to understand role of light and light harvesting complexes. Photo synthetic response of C3, C4 plants and xenobiotic. This provide skill enable them to understand metabolic pathways occurs in plants.

Unit III.Will able to understand important physiological pathways and their importance for sustainable development of plant based commercial business.

Unit IV.Will able to learn importance of plant growth hormones and their biosynthesis this provide a skill to students who wishes to establish entrepreneurship in floriculture and seed development.

Unit V: Will able to learn how to keep plant griming under biotic and abiotic stresses. This also helps the student to select the plants cultivation as per the habitat and climate conditions.

Keywords: Physiology, Nutrients, Photosynthesis, Photophosphorylation, Stress.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	II	BOT-CC-225	Plant Anatomy and Embryology of Angiosperm	Mid Sem 40 End Sem 60	04

Course Objectives: The major Objectives of this paper is to build a strong foundation in the anatomy and cellular structure of different types of plants tissues as well as different plants organs. Development of sporophyte and gametophyte of plants.

Course Structure:

Unit I: Meristematic Tissue: Classification based on stage or methods of development, position in plant body. Theories of SAM and RAM. Permanent Tissue: Simple (Parenchyma, Collenchyma, Sclerenchyma); The complex tissue (Xylem, Phloem)

Unit-II Cambium: origin of cambium fascicular and interfascicular cambium, structure and function of cambium. Periderm: structure and function, phellogen, phellem, phelloderm, commercial cork. Anomalous anatomical structure in Angiosperm.

Unit-III: Flower: Morphological nature of stamen and carpel. Male gametophyte: Structure of anthers; microsporogenesis, role of tapetum; pollen development, male sterility

Female gametophyte : Ovule development; Types of ovule, megasporogenesis: organization of the embryo sac, types and structure of the embryo sac.

Unit-IV Pollination, pollen-pistil interaction and fertilization: Pollination mechanisms and vectors; structure of the pistil; pollen-stigma interactions, self-incompatibility; double fertilization; in vitro fertilization.

Unit-V: Seed development and fruit growth: Endosperm development; embryogenesis, polyembryony; apomixes; embryo culture; seed dormancy, fruit dehiscence.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit 1: will be understand about different types of tissues in the plant body and development of different body parts.

Unit 2: will get knowledge about secondary growth and anomalous structures in plants.

Unit 3: will be understand concept of development of floral parts as well as male and female gametophytes in angiosperms.

Unit 4:will get knowledge about pollination, fertilization and self-incompatibility.

Unit 5: will get knowledge about endosperm, embryogenesis, seed, and fruit development

Keywords: Anatomy, Embryology, Pollination, Development, Gametophyte, Sporophyte.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	II	BOT EC-221	Forest Ecology	Mid Sem 40 End Sem 60	03

Course Objectives:

Principal objective of the course is to impart the details of global distribution of different types of forests in relation to climatic conditions. Dependency of humans on forests and needs for conservation. Ecological concepts pertaining to the management and growth and development of forests in general and Indian forests in particular.

Course Structure:

Unit I: Introduction, Importance of forest resources, forest communities of different climatic zones, Methods of studying structure and composition of forest communities. Forest types of India and M.P.

Unit II: Classification of forest biomes, World distribution, Classification of forests of India, Tropical Forest, Subtropical forests, Temperate Forest, Alpine vegetation of Himalayas. Differences between true temperate and Indian temperate forests.

Unit III: Phenomenon of succession in forest, Nature of climax, Role of grazing and anthropogenic factors, Forest environment, climatic factors governing forest distribution, Methods of studying environmental factors in forests.

Unit IV: Microclimate of forest, Forest soils of India, Forest Natural regeneration, Joint Forest management concept and practice.

Unit V: Wildlife conservation and related legislation, Seed biology, Forest Influences, Organic matter dynamics and annual budget sheets.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand the importance of forest resources.

Unit II: Learn the structure and functions of forests as ecosystems.

Unit III: Have the in-depth knowledge of distribution of forests globally and regionally.

Unit IV: Understand the forest succession in relation to climate and soils.

Unit V: Learn the conservation policies for wildlife conservation in India.

Keywords: Forest resources, Forest biomes, Forest classification, Microclimate, Forest regeneration, Forest soil, Forest management, Wildlife conservation.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	II	BOT-EC-223	Fungal Biosystematics	Mid Sem 40 End Sem 60	04

Course Objectives: To understand the basic concepts of fungi their history status and importance in causing several plant diseases and their beneficial utilization in various ways. This course is to popularize the field mycology so as to trained the students for survey, collection and study the fungal organisms from natural environment.

Course Structure:

Unit I: An introduction to Fungal Biosystematics and its development in Indian sub-continent. General introduction to history of Mycology, fungal characteristics and their biological status.

Unit- II: Broad classification of fungi. An introduction to field mycology- survey, collection, conservation, nomenclature and identification.

Unit III: Symptomatology- various types with examples. Broad categories of fungal diseases- leaf spots, powdery mildews, black mildews, damping off, cankers and root rots.

Unit IV: Recent terminologies used in the fungal biosystematics. Dried reference collection as important resources in fungal biosystematics.

Unit V: Beneficial fungi and their utilization. Different fungal diseases found in the area.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Will be able to understand the importance of fungal biosystematics, the historical perspective and their biological status in living organisms

Unit II: Will able to know the nature with curious and keen eyes for survey, collection and study of the fungi i.e. field Mycology.

Unit III: Will be able to understand the various types of symptoms found in the forest area, crop fields, Vegetable field and other diversified area.

Unit IV: Will be able to understand the recent terminologies used for fungal organisms, their forms, and the importance of dried reference collection as important resource for fungal biosystematics.

Unit V: Will be able to know about various beneficial fungi and their utilization to look at the different plant diseases occurring in the area

Keywords: Field Survey, Biosystematics, Mycology, Diseases, Beneficial organisms.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	III	BOT-CC-321	**Molecular Biology**	Mid Sem 40 End Sem 60	04

Course Objectives:

The objective of this course is to train students about the basic concept of molecular biology including gene expression (transcription and translation), genetic code and its elucidation, and most importantly the control of gene regulation in prokaryotes and eukaryotes.

Course Structure:

Unit 1: Introduction, Overview, Origin of Molecular Biology and its impact on Biological Sciences.Nature of Gene: Bacterial and Viral Genetics, Pre-DNA concepts, Gene-Protein relationships.

Unit 2: Gene Expression: Transcription, Mechanism of Transcription in Prokaryotes and Eukaryotes, General Transcription factors, Types of genes, RNA processing, Capping, Splicing, Polyadenylation and Termination, RNA as Enzyme.

Unit 3: Gene Expression: Translation, Structure and function of Ribosomes, Adaptor Hypothesis, Messenger Hypothesis, Discovery and Structure of different RNAs involved in Protein Biosynthesis.

Unit 4: Genetic Code and its Elucidation, Central Dogma, Contributions of Francis Crick, Hargobind Khorana, Marshal Nierenberg, Sydney Brenner.

Unit 5: Gene Regulation: Overview. Gene regulation in Prokaryotes, Lac Operon, Tryptophan Operon, Lytic and Lysogenic Growth patterns in Phage λ. Gene regulation in Eukaryotes: Levels of Gene regulation, Role of Transcription factors, Role of DNA Methylation, Histone Code hypothesis, Regulatory RNAs, RNA interference.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand the bacterial and viral genetics and key concepts in molecular biology.

Unit II: Understand the mechanism of transcription in prokaryotes and eukaryotes, and processing of mRNA in eukaryotes.

Unit III: Understand the mechanism of translation in prokaryotes and eukaryotes, and structure of different RNAs involved in protein biosynthesis.

Unit IV: Decipher the application of genetic code.

Unit V: Understand the mechanism of gene regulation in prokaryotes and eukaryotes with the help of examples.

Keywords:

Gene protein relationship, Transcription, Splicing, Post transcription processing, Translation, Genetic Code, Gene regulation, Transcription factors.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course Title**	**Marks**	**Credit**
M.Sc.	Botany	III	BOT-CC-323	Biochemistry	Mid Sem 40 End Sem 60	04

Course Objectives: The objective of the course is to understand the basic concept of Biochemistry. Structure of carbohydrates, respiration and lipid metabolism, Nitrogen fixation, amino acids and Proteins and techniques in Biochemistry.

Course Structure:

Unit I: Thermodynamics of biological system: Laws of thermodynamics; concept of free energy; energy transfer and redox potential. Basics of enzymology: classification and nomenclature of enzymes; enzymes as biocatalyst; physico-chemical properties of enzymes; cofactors and coenzymes; isozymes; kinetics of enzyme action; significance of Km; regulation of enzymes activity; factors affecting enzyme activity, e.g. Temperature; pH; allesteric modification and feedback regulation. Basics of enzymology.

Unit II: Mono, Di, Oligo and Poly saccharides, biosynthesis of Sucrose, Starch and Cellulose. Respiration and lipid metabolism: Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, altemative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids, and their catabolism Carbohydrates, Respiration and lipid metabolism.

Unit III: Nitrogen fixation, nitrogen and sulphur metabolism: Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulfate uptake, transport and assimilation.

Unit IV: Techniques in biochemistry Principles of light and electron microscopy; phase contrast and fluorescence microscopy; TEM and SEM; Cell fractionation producers; principles of various chromatography techniques- paper chromatography; TLC, GLC and HPLC; autoradiography and its applications.

Unit V: Amino acid and Proteins structure acid base properties optical and stereochemical properties. Primary, secondary, tertiary and quaternary structures.

Course Learning Outcomes: On successful completion of this course, students will be able to

Unit-I Understand the law of thermodynamics, basic concepts of enzymology, kinetics of enzyme action.

Unit-II Understand the structure of carbohydrates, Overview of plant respiration, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids, and their catabolism.

Unit- III Understand the biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation.

Unit- IV Understand the Principles and applications of of light and electron microscopy; phase contrast and fluorescence microscopy; TEM and SEM, TLC, GLC and HPLC; autoradiography.

Unit-V Understand the structure acid base properties optical and stereochemical properties of amino acids. Primary, secondary, tertiary and quaternary structures of proteins.

Key words: Thermodynamics, Enzymology, Carbohydrates, Nitrogen fixation, Microscopy, Amino acids and Proteins.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	III	BOT CC-325	Plant Ecology	Mid Sem 40 End Sem 60	04

Course Objectives:
The objective of this course is to understand the basic fundamentals of ecology and to inculcate the concepts related to structure and functions of ecosystem, community and development. Understanding of global and regional biogeochemical cycling.

Course Structure:
Unit I: History, development, definition and scope. Ecosystem Organization: Concept and definitions, kinds of ecosystem, Ecological pyramids, Food chain and Food web, Ecosystem processes.
Unit II: Ecosystem functions: Energy flow, biogeochemical cycles. Primary production: Global pattern, Methods of measurements.
Unit III: Climate, soil and vegetation patterns of the world: Major terrestrial biomes, climate types and soil types of the world.
Unit IV: Vegetation organization: Concept of community and continuum, analysis of community (analytical and synthetic characters) community coefficients, inter specific associations, concept of ecological niche.
Unit V: Vegetation development: Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic, facilitation and tolerance models); changes in ecosystem properties during succession.

Course Learning Outcomes:
Upon the completion of the course the students will be able to:

Unit I: Conceive the concepts and significance of the science of ecology

Unit II: Understand core concepts of biotic and abiotic components of ecosystems.

Unit III: Classify the soils on the basis of physical, chemical and biological components

Unit IV: Analysis of plant communities for diversity, patterns of distribution and development

Unit V: Evaluate energy sources of ecological system, Cycling of matter with reference to environmental changes

Keywords:
Ecosystem, Soil, Community, Succession, Competition, r and k selection, ecological pyramids, Climax community

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	III	BOT EC-323	Limnology	Mid Sem 40 End Sem 60	03

Course Objectives:

The objectives of the course include the significance of fresh water in the present state of changing environmental conditions, aquatic organisms and distribution of water in biosphere. Understanding of changing fresh water body status due to human impact.

Course Structure:

Unit I: Introduction: Definition and Scope of Limnology; Water in the Biosphere; Classification and origin of Lakes.

Unit II: Chemical properties: Hydrogen-ion concentration, Dissolved gases in freshwater-Nitrogen and Phosphorus cycles in freshwater lakes. Ecological classification of freshwater organisms: Nature and distribution of Phytoplankton, Macropyhytes and Zooplankton communities.

Unit III: Concept of Productivity: Seasonal variation, Primary productivity in freshwater lakes, Estimation of Primary Productivity.

Unit IV: Food Chains, Food webs, Trophic levels and Energy flow in freshwater ecosystems.

Unit V: Eutrophication: Causes, mechanism and significance, Management of freshwater bodies.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand of fresh water ecology with reference to water crisis.

Unit II: Apprehend the origin and development of lakes.

Unit III: Be aware of fresh water organisms and their role in ecosystem

Unit IV: Understand the seasonal variations of temperature, dissolved gases, nutrients and stratification.

Unit V: Analyse the physic-chemical properties of water. Reflect upon the process of eutrophication and management of water bodies.

Keywords:

Limnology, Plankton, Stratification, Energy flow, Nutrients, Eutrophication

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	III	BOT-EC-325	**Software's Applications in Modern Biology**	Mid Sem 40 End Sem 60	03

Course Objectives:

The objective of this course is to train students about the Applications of Software's in Modern Biology. Through this course students will be able to design their experiments, analyse the research data statistically, and to develop good quality graphs, arrange the references easily. They can serve as data analysts for various industries, and research institutions.

Course Structure:

Unit 1: Software's for biological research: Computer handling, Free online software's, downloading, installing and Troubleshooting.

Unit 2: Designing of experiments: Experimental design and optimization of media (Central Composite Design) using Design expert.

Unit 3: Statistical Analysis of Biological Data: Data collections, arrangement and management of data, One Way ANOVA, Two Way ANOVA, Correlation, Multiple correlations, Regression, by computer software.

Unit 4: Data interpretation and report/article writing: Preparing different type of graphs, designing flow charts.

Unit 5: Referencing tool: End Note and other referencing tools for managing research references/bibliography.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand the Computer handling, software's downloading, installing and Troubleshooting.

Unit II: Understand the designing of experiments with the help of design expert software.

Unit III: Analyse the experimental data with the help of SPSS program by using One Way ANOVA, Two Way ANOVA, Correlation, Multiple correlations, and Regression.

Unit IV: Prepare the different type of graphs, and designing of flow charts.

Unit V: Understand the uses of referencing tools for managing research references/ bibliography.

Keywords:

Design expert, SPSS, Excel, Graphs, End note, Mendeley, Statistical analysis.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	II	BOT-OE - 321	Economic Botany	Mid Sem 40 End Sem 60	04

Course Objectives: The major objective of the paper is to develop skill towards identification and economic importance of different cereals, pulses, spices, medicinal plants and timber.

Course Structure:

Unit – I: Cereals : Wheat, Rice, Maize

Unit – II: Pulses : Pigeon pea, Chick pea, Soybean

Unit – III: Spices and condiments : A general account

Unit – IV: Medicinal plants : Sarpagandha, Neem, Tulsi

Unit –V: Timber : Teak, Sal, Sisham

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand the basic concept of cereals and its economic importance.

Unit II: To get deep knowledge of pulses and its economic importance.

Unit III: To develop skill about spices and condiments and its economic importance.

Unit IV: To develop skill about medicinal plants identification and economic importance.

Unit V: To develop skill about timber plant identification and economic importance.

Keywords: Cereals, Pulses, Spices, Medicinal plants, Timber

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	IV	BOT-CC-421	**Genetic Engineering**	Mid Sem 40 End Sem 60	04

Course Objectives:

The objective of this course is to train students about the concept and latest tools and techniques used in Recombinant DNA technology, microbial genetic manipulation, genetic engineering, genomics, and proteomics.

Course Structure:

Unit 1: Recombinant DNA technology: An overview, Gene cloning: tools and techniques; Vectors: Plasmids and Bacteriophages. Manipulation of DNA, DNA manipulative enzymes, Restriction mapping, Gel electrophoresis, blotting, DNA sequencing, DNA libraries, PCR, Expression vectors.

Unit 2: Microbial genetic manipulation: Bacterial transformation, Selection of transformants and recombinants, Genetic improvement of microbes, Plant growth promoting bacteria: nitrogen fixation in plants, bio-control of pathogens, siderophores, Microbial insecticides.

Unit 3: Genetic engineering of plants: Aims and strategies for development of transgenics, *Agrobacterium* – the natural genetic engineer, Ti-plasmid, Ri-plasmid, T-DNA, Chloroplast transformation; alternative DNA delivery methods and its role in plant transformation.

Unit 4: Genomics and proteomics: Genetic and physical mapping of genes, Molecular markers for introgression of useful traits, Artificial chromosomes, High throughput sequencing, Genome projects, Bioinformatics, Functional genomics, Microarrays, Protein profiling and its significance.

Unit 5: Applications: Development of insect, herbicide, fungus and bacterial resistant plants, Genetic manipulation of flower pigmentation.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand the techniques of gene cloning and its various applications. They will also learn thegel electrophoresis, blotting, DNA sequencing, PCR, creation of DNA libraries.

Unit II: Understand about the genetic improvement of microbes, plant growth promoting bacteria: nitrogen fixation in plants, bio-control of pathogens, siderophores, and production if microbial insecticides.

Unit III: Understand the strategies for development of transgenics, alternative DNA delivery methods and its role in plant transformation.

Unit IV: Understand about the role of molecular markers for introgression of useful traits, High throughput sequencing, Genome projects, Bioinformatics, Functional genomics, Microarrays, and Protein profiling techniques.

Unit V: Understand the mechanism of development of insect, herbicide, fungus and bacterial resistant plants using genetic engineering.

Keywords:

Recombinant DNA technology, PCR, Blotting, Natural genetic engineer, Plant growth promoting bacteria DNA delivery methods, Genomics, Proteomics, Microarray.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	IV	BOT-CC-423	**Biotechnology**	Mid Sem 40 End Sem 60	04

Course Objectives:

The objective of this course is to train students about the basic concept used in the plant tissue culture. This course enhances the skills in the students regarding to produce the whole plant by using micropropagation, protoplast culture, haploid production aseptically in the lab.

Course Structure:

Unit 1: Biotechnology: Basic concepts, principles and scope.

Unit 2: Plant Cell and Tissue Culture: General introduction, history, scope, concept of cellular differentiation, and totipotency.

Unit 3: Organogenesis and adventives embryogenesis: Fundamental aspects of morphogenesis, somatic embryogenesis and production of haploid plants, androgenesis, mechanisms, techniques and utility.

Unit 4: Somatic Hybridization: Protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitation of protoplast research.

Unit 5: Applications of plant tissue culture: Clonal propagation, artificial seed, production of hybrids and somaclones, production of secondary metabolites/natural products, cryopreservation and germplasm storage.
Intellectual property rights, ecological and ethical concerns.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand the tools and techniques used in the tissue culture of plants.

Unit II: Understand about the concept of cellular differentiation, and totipotency.

Unit III: Understand the strategies used for somatic embryogenesis and production of haploid plants

Unit IV: Understand about the Protoplast isolation, fusion and culture, hybrid selection and regeneration.

Unit V: Understand the application of tissue culture in crop improvements.

Keywords:

Totipotency, Media, Protoplast, Haploid production, Cryopreservation, Micropropagation, Organogenesis. Intellectual property rights.

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	IV	BOT CC-425	Ecology and Environment	Mid Sem 40 End Sem 60	04

Course Objectives:

The objective of the course is to understand the applied aspects of ecology. It includes the critical comprehension of environmental pollution, biodiversity conservation and climate change. An understanding of environmental impact assessment and ecosystem restoration methods.

Course Structure:

Unit I: Environmental pollution: Air, Water and Soil: Kinds, sources quality parameters, effects and control.

Unit II: Biodiversity and conservation: Levels of biodiversity, Distribution and regional patterns; Hypotheses for global patterns of distribution; Hot Spots of Biodiversity, Biodiversity Conservation; IUCN categories, strategies for conservation.

Unit III: Climate change: Greenhouse gases, global warming; Ozone layer and Ozone hole consequences of climate change.

Unit IV: Ecosystem stability: concept (resistance and resilience), Ecosystem services, ecological perturbation and their impact on plants and ecosystems, Environmental Impact Assessment (EIA).

Unit V: Ecosystem Management: Concept, sustainable development, Sustainability indicators, ecosystem restoration.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand the cause, impact and control of pollution.

Unit II: Learn the methods to assess the biodiversity of an ecosystem.

Unit III: Learn the concept of biodiversity levels, significance and conservation.

Unit IV: Perceive the gamut of climate change, its impacts globally and its mitigation.

Unit V: Analyse the ecosystem stability, degradation and restoration.

Keywords:

Environmental pollution, Level of biodiversity, IUCN categories of threatened taxa, Conservation strategies, Hotspots of biodiversity, Greenhouse gases, Ecosystem stability, Sustainable development and indicators

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	IV	BOT-EC-421	Land scaping and Garden Management	Mid Sem 40 End Sem 60	04

Course Objectives: The important objective of this paper is to develop skill, entrepreneurship and employability.

Course Structure:

Unit I: Landscaping: Principle of elements, Garden features and adornment, Garden designing, Bio-aesthetics planning, Role of plants and combatic environmental pollution, types of garden

Unit- II: Garden Management: - Soil analysis, Physio-chemico properties, Soil nutrient management, Types of soil, role of soil for plant growth and plant disease management.

Unit- III: Bio-fertilizers: - Farm yard manure (FYM), Vermicompost, Organic manure, Green manure, Role of bacteria, role of AM fungi, Bio-pesticides.

Unit- IV: Garden tools (Falcon). 1. Pruning secateurs, 2. Hedge sheer with steel handle and PVC grip, 3. Pruning saw, 4. Sickle with wooden handle, 5. Budding grafting knife, 6. Weeding towel chrome coated small and large, 7. Cultivator head three prongs with wooden handle, 8. Weeder with wooden handle, 9. Weeding fork, 10. Plant lifter with wooden handle, 11. Garden rake with steel handle 12 and 16 teeth, 12. Hoe garden type and Dutch type, 13. Khurpa high carbon steel, steel handle with PVC grip (small, medium and long), 14. Tree pruner multi-angular long reach pruner, 15. Spade with wooden handle, 16. Lawn mower manual, 17. Lawn mower electric motor. and techniques:- Spacing, compartment (for different plant groups), seeding, budding, cutting, grafting, thickets, irrigation (Automated drip irrigation).

Unit- V: Floriculture: - History of Ornamental plants, Floriculture as carrier, Commercial floriculture, flowers & Industries, floriculture business competition, World scenario floriculture.

Course Learning Outcomes:

Upon the completion of the course the students:

Unit I: Will be able to design landscape for various gardens and can give consultancy

Unit II: Will be able understand soil quality according to landscape so that proper plants can be planted accordingly also, learn now to manage the plant diseases. This sill helped the student is various ways.

Unit III: Will be able to develop various bio-fertilizer and later on establish entrepreneurship.

Unit IV: Will be able to use the modern tool of Garden management and learn now to do planting pruning, budding and designing of modern garden, it will generate employability.

Unit V: Will be able to establish carrier as a floriculturist and can provide job to other also.

Keywords: Landscape, Gardening Biofertilizer, floriculture

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	IV	BOT EC-423	Biodiversity & Conservation	Mid Sem 40 End Sem 60	03

Course Objectives:

The objective of the course is to understand the concept of biological diversity and its current status under the threat of anthropogenic disturbances. It includes he significance of India as a mega biodiversity region and its current scenario, different biodiversity hotspots around the world, different conservation strategies taken to prevent the degradation of biodiversity at global scale, the concept and implications of sustainable development.

Course Structure:

Unit I: Biodiversity: basic concepts, types and levels of biodiversity, biodiversity distribution, biodiversity assessment, inventory and sampling strategies, biodiversity hotspots.

Unit II: Biodiversity as resource, direct and indirect values, ecological benefits and services provided by biodiversity.

Unit III: Threat to biodiversity, losses of biodiversity, endemism, species loss, Invasive Alien species, biodiversity and rarity, IUCN classification of threatened category of species, extinction of species.

Unit IV: Biodiversity conservation, *Ex-situ* and *in-situ* conservation measures, Conservation measures taken in India, International efforts for biodiversity conservation, Habitat and ecosystem management, Ecological restoration.

Unit V: Conservation of natural resources (hotspot areas, WLS, NPs, BRs), Sustainable development, Role of Institutions and policy making in conservation, International conservation laws, Intellectual property rights, CBD / National Biodiversity Authority etc.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Understand the vast concept of biodiversity in genetic, species and ecological level

Unit II: Learn the methods to assess the biodiversity of an ecosystem.

Unit III: Understand different types of conservation and their impact on the ecosystem. Be aware about the magnitude of current biodiversity loss under the influence of anthropogenic disturbances.

Unit IV: Decipher the correlation between biodiversity conservation, climate change and ecosystem services. Learn about the different national projects to save threatened species.

Unit V: Learn about the national and international strategies for the conservation and sustainable use of essential ecological diversity to preserve the continuity of the food chains. Learn about different traditional biodiversity conservation approaches in Indian subcontinent.

Keywords:

Biodiversity, Level of biodiversity, IUCN categories of threatened taxa, Conservation strategies, Hotspots of biodiversity, UNESCO conservation heritage sites

Department of Botany						
Class	**Subject**	**Semester**	**Course Code**	**Course title**	**Marks**	**Credit**
M. Sc.	Botany	IV	BOT EC-425	Climate change and current issues	Mid Sem 40 End Sem 60	03

Course Objectives:

The main objective of the present course is to make the students aware in depth about the climate change and issues and global problems. Understanding the origin and dynamics of gaseous composition of atmosphere, GHGs and global warming and related issues. National and international efforts and strategies for mitigating the climate change.

Course Structure:

Unit I: Climate Change: Origin and evolution of the earth's atmosphere, Overview of key concepts- weather and climate.

Unit II: Climatic classification – Koppen's climatic classification; Climatic variability – temperature, rainfall, wind speed & direction El-Nino, La Nino and their impacts. Effect of various anthropogenic activities on earth's atmosphere.

Unit III: Greenhouse Effect: Global warming and greenhouse effect – major greenhouse gases, sources and sinks of greenhouse gases; Urban Heat Islands; Ozone layer depletion, issues and advance research to protect the Ozone layer and consequences; sea level rise and its impact; Heat and cold waves; global dimming; Implication of climate change, monitoring and assessment.

Unit IV: Climate change and policy frameworks– History of international climate change policies, United Nation Frameworks Convention of climate change (UNFCCC)- Key Provisions of the UNFCCC, its structure, and different party groups the convention. The Kyoto protocol and its associated bodies, Overview of Conference of Parties (CoP). Main climate change negotiations evolved over the past years and highlights of some key issues relevant to future climate change regime.

Unit V: Climate change adaptation and mitigation: The concept of climate change adaptation; Linkage between climate change adaptation and development, international adaptation initiatives and programs. Integrated mitigation for development and planning through low Emission development strategies.

Course Learning Outcomes:

Upon the completion of the course the students will be able to:

Unit I: Comprehend the climate variability on global scale.

Unit II: Learn the atmospheric development over the ages.

Unit III: Understand different types of conservation and their impact on the ecosystem. Be aware about the magnitude of current biodiversity loss under the influence of anthropogenic disturbances.

Unit IV: Understand the impacts of climate change on productivity, diversity and human environment.

Unit V: Inculcate the knowledge about policies for mitigation and adaptations of climate change.

Keywords:

Climate change, Classification of climate change, Greenhouse effect, Ozone layer, Sea level rise, Kyoto protocol, UNFCCC framework, Climate change and productivity