PROGRAMME SPECIFIC OUTCOME OF BOTANY (MAJOR)

After graduation the students will be able to-

PSO1: Understand the basic knowledge of Thallus morphology, reproduction and evolution of lower cryptograms and plant pathology.
PSO2: Understand the basic fundamental knowledge on the structure, morphology, reproduction, alternation of generation and tissue organisation and spore dispersal mechanism in Bryophyte.
PSO3: Understand the comparative account of structural morphology, distribution, anatomy, reproduction and evolution of seed habit in higher cryptograms special emphasis.
PSO4: Understand the basic knowledge of microbiology and biotechnology in the light and recent development.
PSO5: The course is to provide fundamentals of Angiosperm, morphology and classification.
PSO6: Fundamental knowledge of structural and functional aspect of cell and cell organelles and the tools and techniques used in modern biological study.
PSO7: Fundamental knowledge of structural and functional aspect of cell and cell organelles.
PSO8: To introduce the students with the basic knowledge on plant genetic and application of genetic for improvement of crop, application of statistics in biology.
PSO9: To introduce the students the modern approaches to functional and chemical biology of plants.
PSO10: The basic principles and concepts of plant ecology, structure and function of natural plant unit, habitat degradation and role of plant on improvement of habitat, conservation of ecology phytogeography and evolution.
PSO11: Basic knowledge on major physiology aspects of plant.
PSO12: Fundamental knowledge of molecular biology and immunology.
PSO13: Tools and technique of physical and computer science used in biological studies.
PSO14: Comprehensive knowledge of usefulness of plant science for human welfare.

COURSE OUTCOME OF BOTANY (MAJOR)

COURSE CODE 101:
After completion of the course the students will be able to understand:-

CO1: General characters, classification and economic importance of algae; its phylogeny and distribution in India.
CO2: Vegetative structure: cell and thallus structure; algal chromatophores and pigments; range of thallus structure; Reproduction: Vegetative, asexual, sexual and pattern of life cycles.

CO3: A comprehensive knowledge of the following classes with special reference to the structure and life histories of the genera mentioned below:
a) Myxophyceae: *Nostoc* and *Anabaena*;
b) Cholorophyceae: *Chlorella, Volvox, Oedogonium, Coleochaete, Chara*
c) Xanthophyceae: *Vaucheria*
d) Bacillariphyceae: A general account.
e) Phaeophyceae: *Ectocarpus* and *Fucus*.
f) Rhodophyceae: *Polysiphonia* and *Batrachospermum*.
CO4: Salient features of fungi, fungal cell structure and fungal nutrition; Classification of fungi (Alexopulus, 1969 &1983) and their distribution in India
CO5: Comparative account of structure, method of reproduction and mode of spore dispersal of fungi; Economic importance of fungi.
CO6: Comprehensive knowledge of the following groups with special reference to the structure and life histories of the genera mentioned below from an evolutionary point of view.
(a) Mastigomycotina: *Myxomycetes:* a general account, *Albugo*,*Pythium.*
(b) Zygomycotina: *Rhizopus*.
(c) Ascomycotina: *Peziza*
(d) Basidiomycotina: *Pucciinia, Polyporus, Cyathus, Agaricus*
(e) Deuteromycotina: *Aspergillus, Alternaria, Penicelllium*
CO7: A general account with particular reference to types and their detail cell structure.
CO8: Mode of reproduction, symbiotic association, nutrition and economic importance.

COURSE CODE-201:
After completion of the course the students will be able to understand:-

CO1: Principles of plant pathology with special reference to systematic and localised diseases and symptoms.
CO2: Host parasite interaction, (toxins, enzymes, resistant).
CO3: Plant disease management through physical, chemical, biological, regulatory and cultural methods, and post harvest management.
CO4: Study of the following diseases and their methods of control: late blight of potato, ergot of rye, loose smut of wheat, rust of wheat, red rot of sugarcane, grey blight of tea, citrus canker and mosaic disease of tobacco.
CO5: General account, classification and distribution in India
CO6: Evolution of saprophytes and spore dispersal mechanism Comparative account of the gametophyte
CO7: A comparative knowledge of the structure and life history of the following types from the evolutionary point of view and their ecology and economic importance. *Riccia, Marchantia, Anthoceros, Sphagum, Polytrichum*

COURSE COD 301:
After completion of the course the students will be able to understand:-

CO1: General classification, organisation and affinities, distribution in India and economic importance.
CO2: Stelar organisation in Pteriodophytes; Evolution of sporophytes and sporophylls in Pteriodophytes; Homospory and Heterospory and its importance in evolution of seed habit
CO3: Comparative study of morphology and life history of *Psilotum, Lycopodium, Selaginella, Equisetum, Marsilea.*
CO4: Classification, distribution and economic importance.
CO5: Comparative and evolutionary study of morphology, anatomy and reproduction of *Cycas,Pinus, Ginkgo, Gnetum.*
CO6: An elementary knowledge of paleobotany – process and the theory of fossilization, geological periods and importance of Paleobotany.
CO7: General account of anatomy and reproduction of the following types: 32
(a) Pteridophytes – *Rhynia, Hornea, Psilophyton, Sphenophyllum*
(b) Gymnosperms – Cycadefilicales(Lyginopteris), Bennettitales(Willimasonia) and Cordaitales(Cordaites).

COURSE CODE-303:
After completion of the course the students will be able to understand:-

CO1: Contribution of scientists for development of microbiology.
CO2: Classification of micro-organisms and characteristic features of different groups of microorganisms, brief knowledge of bacteria, cyanobacteria, virus, bacteriophage, mycoplasma (Structure, reproduction and importance).
CO3: Elementary principles of isolation, and cultivation of micro-organisms and pure culture concept; General ecology of soil microflora, mycorrhiza and bacteriorrhiza.
CO4: Microbiology of food, milk and water.
CO5: Importance of micro-organisms for human welfare, elementary knowledge of disease caused by microbes to man, and plants (only two diseases from each group, mentioning causal organism, symptoms and control measures).
CO6: Introduction, scope of biotechnology, recent advances in biotechnology, application of biotechnology in agriculture and industry, concepts pertaining to biofertilizers.
CO7: Genetic Engineering and its merits and demerits.
CO8: Tissue culture: basic principle, medium, protoplast fusion and somatic hybridization.
CO9: Basic knowledge of industrial microbiology with reference to production of Alcohol, Vinegar and Antibiotic.

COURSE CODE 401:
After completion of the course the students will be able to understand:-

CO1: Detail study of Morphological characters:-
(i) Carpel polymorphism
(ii) Origin of angiosperms
(iii) Evolution of inflorescence
(iv) Role of morphology in the classification of the flowering plants.
CO2: History of plant classification, its aims and objectives, outlines of the main classifications (systems of classification) – Artificial, Natural, Phylogenetic and Modern with special reference to Linnaeus, Bentham and Hooker, Engler and Prantl, Hutchinson and Takhtajan's classification.
CO3: Generic names, specific epithets, citation and authority, binomial nomenclature, taxonomic keys; typification and priority; importance of herbarium specimens and their preparations; role of herbaria and botanical gardens; documentation (floras, monographs, manuals, journals, abstracts, indices and dictionaries).
CO4: Details on Cytotaxonomy, Chemotaxonomy, Numerical Taxonomy and Biosystematics.
CO5: A detailed knowledge of the following families and their phylogenetic affinities and economically important plants:
Dicotyledons: *Magnoliaceae, Malvaceae, Rubiaceae, Fabaceae, Rosaceae, Solanaceae, Cucurbitaceae, Apiaceae, Asteraccae, Lamiaceae, Theaceae, Apocynaceae and Euphorbiaceae* Monocotyledons : *Orchidaceae, Musaceae, Zingiberaceae, Arecaceae* and *Poaceae, Commelinaceae, Cyperaceae.*

COURSE CODE-403:
After completion of the course the students will be able to understand:-

CO1: Cell theory and its exceptions, prokaryotic and eukaryotic cells.
CO2: Cell organisation: Cell wall, its formation and growth, plasma membrane, chemical organisation and function; protoplast, Cell-sap, Plasmodesmata, ergastic substance, cell organelles, structure, origin and function of mitochondria, nucleus, chromosome – special types of chromosomes, plastids with reference to chloroplast, golgi bodies, endoplasmic reticulum, ribosome and lysosome.
CO3: Cell formation – amitosis, mitosis, and meiosis, and cell cycle.
CO4: Nucleoproteins and nature of genetic material
CO5: Cell Adhesion, Membrane Transport, Signal Transduction (G proteins).
CO6: Working principles, operations and application of the following in biological sciences:
a. Microscopy: Compound, Phase Contrast, Dark Field and Electron microscopes.
b. Separation Techniques of Biomolecules: Paper Chromatography, TLC, HPLC, Gel Filtration, Centrifuge.

c. Colorimeter and Spectrophotometer.
d. PH meter, BOD incubator, Autoclave, Laminar Air Flow, Hot Air Oven.
e. Basic knowledge of Computer and its application in biological science.

COURSE CODE- 501:
After completion of the course the students will be able to understand:-

CO1: Organisation of tissues: Types of tissues, Meristematic and permanent, their types, structures, distribution and functions; theories of differentiation of roots and shoots.
CO2: Stelar Body – origin and development, Root – stem transition, leaf traces and leaf gaps, branch gaps, abcission layer.
CO3: Secondary structures of roots and stems, intiation of cambium and its activities. 4 class hours
CO4: Anomalous secondary growth in thickness (*Amaranthus, Asparagms, Boerharia* and *Mirabilis).*
CO5: Anatomico–physiological consideration of dermal, mechanical, conducting and photosynthetic system of tissues; anatomy of C3 and C4 plants.
CO6: A general account of the following topics: Development of male and female gametophyte of angiosperms; monosporic, bisporic & tetrasporic embryosac.
CO7: Fertilization, development of embryo; Apomixis, polyembryony, Palynology.
CO8: Development of Endosperm – nuclear, cellular, helobial; haustorial structures.

COURSE CODE-503:
After completion of the course the students will be able to understand:-

CO1: Mendel's Laws, their critical appreciation, gene interactions and modified monohybrid and dihybrid ratios; concept of alleles, multiple alleles and multiple genes, Linkage, Crossing Over and basic knowledge of Gene Mapping.
CO2: Determination of Sex, Sex Linked and Sex Limited Traits, Cytoplasmic Inheritance with reference to Plastid Inheritance and Kappa Particle Inheritance.
CO3: Chromosomal (numerical and structural) and Gene Mutation, concept of Biochemical Mutation.
CO4: Basic ideas of Gene and its fine structure, Genetic Engineering and Gene Cloning, Concept Trans Gene.
CO5: Human Genetics: Karyotype, impatant Syndromes and disorders
CO6: Methods of reproduction: Sexual, Vegetative, apomixes; Principles and methods of Plant
Breeding: Introduction, Selection, Hybridization, Heterosis Breeding and concept of Mutation Breeding.
CO7: In vitro Culture: Requirements, techniques and application in Crop Improvement.
CO8: Application of statistics in Biological Science, collection and classification of data for frequency distribution.

CO9: Measurement of Central Tendency; Mean, Media, Mode, Standard Error and Standard Deviation.
C10: Test of Significance, Probability Test.

COURSE CODE- 505:
After completion of the course the students will be able to understand:-

CO1: Concept of Biomolecules, Polymeric substances in plants- A brief study of Polysaccharides, Lipids, Proteins, Nucleic Acids, Chlorophylls with special reference to their functions.
CO2: Metabolic concept- Anabolism and Catabolism.
CO3: Secondary plant products- Terpenoids, Phenols, Flavonoids, Anthocyanins, Alkaloids, Non-protein Amino Acids.
CO4: General account of – Plant Hormones and their role (Auxins, gibberellins, Cytokinins,Florigen Abssisic Acid), phytochrome, and storage products.
CO5: Mechanism of Source Sink Relationship

COURSE CODE- 507:
After completion of the course the students will be able to understand:-

CO1: Introduction: definition and scope of plant ecology, development of plant ecology in India and abroad, division of plant ecology; Edaphic factor: Soil Profile, Soil Properties(Physical & Chemical); Physiographic Factors: Types of Biotic Interactions.
CO2: Ecosystem Ecology: Ecosystem Concept, Structure & Function, Ecological Pyramids, ood Chain, Food Web, Trophic Level, Ecological Niche, Flow of Energy in an ecosystem, Productivity, Nuutrient Cycling, Biogeochemical Cycle (Water, Oxygen, Carbon Nitrogen, Sulphur and Phosphorous Cycle).
CO3: Autecology and population dynamics: definition, characteristics of population, population growth forms; Synecology and Community Dynamics: structure and classification of plant community, community characteristics, Analytic and Synthetic characters; Plant Succession: Concept, Types of Succession, causes of Succession, the Climax concept; Plant Adaptation: Hydrophytes, Xerophytes, Helophytes and Epiphytes.
CO4: Ecosystem Dynamics: Definition, Types, Structure and Function of Ecosystem, concept of Energy Flow through Ecosystem; Nutrient Cycling and Biogeochemical Cycles with special reference to water, oxygen, carbon, nitrogen, sulphur and phosphorus cycles.
CO5: Habitat degradation: Pollution of air, water, soil and its impact on our environment; control of pollution with special reference to phytoremediation, public awareness and people's participation; Global Environmental Problems(Global Warming, Ozone Depletion, Acid Rain, Global Water Crisis), Concept on EIA.
CO6: Conservation Ecology and Biodiversity: Definition and classification of Natural Resources, In-Situ & Ex-Situ Conservation in details; Biodiversity: Concept, origin, values, Hot-Spot of Biodiversity(Terrestrial & Marine), IUCN

Red List Categories, Concept on Flagship, Keystone and Endemic Species, Biodiversity & Sustainable Development, Knowledge on WWF, IUCN, CITES, NBWL, NBA.

CO7: Principles of static and dynamic phytogeography; general idea of the distribution of plants over the globe (from tropical to arctic zones) with special reference to the Phytogeographical Regions of India.

CO8: Organic evolution: mechanism of organic evolution; theories of organic evolution (a general idea).

CO9: Modern concept of evolution and origin of life in the light of chemical evolution.

COURSE CODE-601:

After completion of the course the students will be able to understand:-

CO1: Plant water relationships: Diffusion, imhibition and Osmosis; water potential and chemical potential; absorption of water; mechanism of active and passive absorption; water holding and wilting co-efficient; co-efficient; transpiration, its mechanism and significant factors.

CO2: Ascent of sap: Definition; different theories related to ascent of sap; physiological effects of water deficit and stress physiology; Mineral nutrition in plants: Role of micro and macro elements; mineral deficiency symptoms in plant growth; Translocation of Organic Solutes: Transport of Photosynthates.

CO3: Nitrogen Metabolism: Nitrogen Fixation (Symbiotic and Non-Symbiotic), nif-gene and nitrification.

CO4: Photosynthesis: Historical background and significance; mechanism a) Light Reaction- Red Drop, Emerson Effect, Photosynthetic Pigments; two pigment systems; Cyclic and Noncyclic Electron Transport; Photophosphorylation and production of Assimilatory Power, (b) Dark Reaction: Calvin Cycle (C3 pathway), Hetch-Slack Pathway (C4 pathway); differences between C3 and C4 cycle; Chotorespiration, Crassulacian Acid Metabolism (CAM) and Chemosynthesis; factors affecting photosynthesis.

CO5: Respiration: Glycolysis and TCA Cycle, Pentose Phosphate pathway; oxidative phosphorylation.

CO6: Growth and Development: Definitions; Phases of Growth; Kinetics of Growth; Physiology of Seed Dormancy and Germination; Photoperidism and Vernalisation; Phytohormones; Plant Movements –tropic and nastic.

COURSE CODE-603:

After completion of the course the students will be able to understand:-

CO1: Nucleic Acids, DNA as genetic material, structure and functions of DNA & RNA, Watson & Crick Model of DNA, other forms of DNA (A & Z), Genome organization in prokaryotes and eukaryotes.

CO2: Replication of DNA- prokaryotes and eukaryotes, Transcriptions in prokaryotes and eukaryotes.

CO3: Features of genetic code wobble hypothesis, protein biosynthesis in prokaryotes and eukaryotes.
CO4: Recombination in Prokaryotes; Transformation, Conjunction and Transduction; Concept of Transposons and Plasmids.
CO5: Regulation of Gene Expression in Prokaryotes- Operon concept (Lac)
CO6: Plant health management.
CO7: Immunity & resistant in mammals, principle of antigens and Antibodies reaction.
CO8: Interaction of plants with bacteria, virus and fungi; breeding for disease resistance, environment & immunity, laws in the distribution of immunity from infectious diseases in plants.

COURSE CODE-604:
After completion of the course the students will be able to understand:-
CO1: Scope and development of Biophysics. PH and buffer solution in details.
CO2: Laws of Thermodynamics, Concept of Free Energy, Redox Potential and Bioenergetics (only high energy compound).
CO3: X-ray Crystallography (XRD), Chromatography, LASER and its biological applications, Flurences and its application, Basic concept of NMR and Ultra Sound.
CO4: Isotopes, Types, their importance in biological studies, measure of radioactivity.
CO5: Fundamentals of bioinformatics: introduction, history and scope of bioinformatics; sources of information, internet world wide web and web browsers.
CO6: Biological database: introduction, basic concepts of primary and secondary databases; Nuclic acid and protein sequence database (NCBI, gene bank and SWISSPROT); Data mining and data mining tools (ENTREZ).
CO7: Database search and sequence alignment, Tools of sequence alignment – FASTA and BLAST; methods of sequence alignment.
CO8: Phylogenetic analysis: basic concept, steps in evaluation of phylogeny and constructing phylogenetic trees.

COURSE CODE- 606:
After completion of the course the students will be able to understand:-

CO1: Origin of cultivated plants, Vavilov's centre of origin of crop plants; ethnobotany and its importance in Indian context, Knowledge on Indigenous Knowledge System (IKS).
CO2: Agrotechnology of rice, wheat, mustard, sunflower, sesume, groundnut, soyabean, gram, mung, pea, tea, coffee, potato, cabbage, cauliflower, tomato and their economic utilization.
CO3: Agrotechnology of Chilli, turmeric, zinger, cardamom, black piper, jute, cotton, ramie, bamboo, teak, sal, sisoo, ajar, nahar and their economic utilization.

CO4: Medicinal importance of sarpagandha, ashwagandha, kalmegh, satmul, bos, giloi (Tinospora), bhot jalakia, amlakhi, arjun, silikha and their economic utilization.
CO5: Aromatic and Petrocrops(Cultivation and economic utilization) of patchouli, citronella, vitivar, sasi, jatropha, era.
CO6: Domestication of Plants; Germplasm Collection & Conservation, Importance of Germplasm of Wild Species: Gene Library, Gene Bank; Concept of, Biofertilizers, biopesticides and Organic farming; Useful aspect of Lower Group of Plants: Algae, Fungi, Lichen.