

M.Sc. BOTANY
(Two Year) Four Semester Programme under Choice Based Credit System
(Applicable for students admitted in July, 2017 & onwards)

Semester I:		Max Marks
Paper I:	Microbiology: Plant Virology and Bacteriology	100 (04 credits)
Paper II:	Fungi and Plant Pathology	100 (04 credits)
Paper III:	Algae, Lichens, Microscopy and Culture Techniques	100 (04 credits)
Paper IV:	Bryophytes	100 (04 credits)
Practical:	Based on Papers I - IV	<u>100</u> (04 credits)
Total		<u>500</u> (20 credits)

Semester II:		
Paper V:	Pteridophytes	100 (04 credits)
Paper VI:	Gymnosperms and Palaeobotany	100 (04 credits)
Paper VII:	Angiosperms - Plant Development and Reproduction	100 (04 credits)
Paper VIII:	Angiosperms: Taxonomy and Economic Botany	100 (04 credits)
Practical:	Based on Papers V - VIII (including local excursion)	<u>100</u> (04 credits)
Total		<u>500</u> (20 credits)

Semester III:		
Paper I:	Cytogenetics and Molecular Genetics	100 (04 credits)
Paper II:	Plant Breeding and Biostatistics	100 (04 credits)
Paper III:	Environment, Ecology and Plant-Soil Relationship	100 (04 credits)
Paper IV:	Experimental Techniques and Computer Applications	100 (04 credits)
Practical:	Based on Papers I - IV	<u>100</u> (04 credits)
Total		<u>500</u> (20 credits)

Semester IV:		
Paper V:	Plant Physiology	100 (04 credits)
Paper VI:	Cell Biology and Plant Biochemistry	100 (04 credits)
Paper VII:	Biotechnology and Human Welfare	100 (04 credits)
Paper VIII:	Project (Review/Literature survey based on all Papers From Semester I to IV)	100 (04 credit)
Practical:	Based on Papers V and VII (including Lab Visit)	<u>100</u> (04 credits)
Total		<u>500</u> (20 credits)

Total Maximum Marks for all 4 Semesters:	2000 (80 credits)
+ 1 Elective Course / semester: 03 credits - 100 marks	<u>400</u> (12 credits)
Total	2400 (92 credits)

M.Sc. BOTANY (SEMESTER –I)
PAPER - I
MICROBIOLOGY: PLANT VIROLOGY AND BACTERIOLOGY: 05 Credits

Total: 48 Hours

Unit–I PLANT VIRUSES: CLASSIFICATION, STRUCTURE, TRANSMISSION, DETECTION: 01 Credit	
Nomenclature and classification of plant viruses	1
Particle morphology and genome organization of tobacco mosaic tobamovirus (TMV), brome mosaic bromovirus (BMV), and cauliflower mosaic caulimovirus (CaMV)	3
Morphological, anatomical, and biochemical changes in virus infected plants	2
Molecular aspects of virus vector relationship in transmission	2
Purification and electron microscopy of viruses	2
Virus detection by serological and nucleic acid hybridization methods	2
Unit–II PLANT VIRUS REPLICATION, CONTROL, VIROIDS, BACTERIOPHAGE: 01 Credit	
Infection and replication of plant viruses	2
Gene expression strategies in plant viruses	2
Modern methods of plant virus disease control	3
Structure, replication and pathogenicity of viroids	2
Structure and replication of viruses infecting bacteria	3
Unit–III BACTERIA: HISTORY, CLASSIFICATION, STRUCTURE, GENETICS: 01 Credit	
History of microbiology	3
Classification of bacteria and archaea	3
Bacterial cell structure and function of cell components	2
Bacterial genome structure, replication, expression and recombination, and plasmids	4
Unit–IV BACTERIAL METABOLISM, BIOTECHNOLOGICAL APPLICATIONS: 01 Credit	
Bacterial nutrition and metabolism, including Nitrogen fixation	4
Introduction to recombinant DNA technology	3
Biotechnological applications of microbiology	2
Antibiotics and their mode of action	2
Biopesticides	1

Practical based on Units I-IV: 01 Credit

M.Sc. BOTANY (SEMESTER - I)
PAPER - II
FUNGI & PLANT PATHOLOGY: 05 Credits

Total: 48 Hours

Unit-I GENERAL ASPECTS OF STRUCTURE, REPRODUCTION, SYSTEMATICS & PHYLOGENY: 01 Credit	Hrs
Historical account, thallus organization and cell structure.	2
Nutritional types of fungi: biotrophs, hemibiotrophs, symbionts and necrotrophs.	1
Reproduction, hormonal mechanism of sexual reproduction, parasexuality, life cycles.	4
Fungal systematics, phylogeny, fossil fungi.	3
Fungal biotechnology & IPR; Medicinal Fungi	2
Unit- II COMPARATIVE STUDY OF FUNGAL GROUPS: 01 Credit	
Myxomycota (i) Myxomycetes- <i>Stemonitis</i> , <i>Arcyria</i> .; (ii) Plasmodiophormycetes- <i>Plasmodiophora</i>	1
Eumycota (i) Mastigomycotina Chytridiomycetes- <i>Synchytrium</i> , <i>Allomyces</i> , <i>Monoblepharis</i> . Oomycetes- <i>Saprolegnia</i> , <i>Achlya</i> . <i>Pythium</i> , <i>Phytophthora</i> , <i>Sclerospora</i> , <i>Peronospora</i>	2
(ii) Zygomycotina- <i>Zygorhynchus</i> , <i>Pilobolus</i> , <i>Choanophora</i> , <i>Entomophthora</i> .	1
(iii) Ascomycotina- <i>Yeasts</i> , <i>Aspergillus</i> , <i>Taphrina</i> , <i>Protomyces</i> , <i>Emericella</i> , <i>Penicillium</i> , <i>Erysiphe</i> , <i>Phyllactinia</i> , <i>Chaetomium</i> , <i>Sordaria</i> , <i>Claviceps</i> , <i>Morchella</i> , <i>Capnodium</i> .	3
(iv) Basidiomycotina- <i>Auricularia</i> , <i>Puccinia</i> , <i>Phragmidium</i> , <i>Uromyces</i> , <i>Melampsora</i> , <i>Tolyposporium</i> , <i>Ustilago</i> , <i>Tilletia</i> , <i>Urocystis</i> , <i>Graphiola</i> , <i>Clavaria</i> .	4
(v) Deuteromycotina- <i>Colletotrichum</i> , <i>Helminthosporium</i> , <i>Alternaria</i> , <i>Cercospora</i> , <i>Rhizoctonia</i> .	1
Unit – III PRINCIPLES OF PHYTOPATHOLOGY: 01 Credit	
Historical development and present status of phytopathology.	1
Concept of plant disease, Classification of plant diseases.	1
Pathogenesis and disease development; role of enzymes and toxins in pathogenesis. Host-pathogen interaction.	2
Plant disease diagnosis; Koch's postulates with special reference to parasitism.	2
Defense mechanism in host, effect of infection on host physiology.	2
Dissemination of plant disease; disease forecasting and management plant disease.	2
Post harvest diseases and mycotoxins.	2
Unit – IV PLANT DISEASES CAUSED BY FUNGI, NEMATODES, ABIOTIC FACTORS & THEIR CONTROL: 01 Credit	
Epidemiology, symptoms, etiology, perennation and control of following diseases: Fungal diseases: Green ear disease of bajra- <i>Sclerospora graminicola</i> , Damping off of seedling and fruit rot- <i>Pythium</i> , Stem gall of coriander- <i>Protomyces macrospores</i> .	2
Peach leaf curl- <i>Taphrina deforman</i> , Ergot of rye- <i>Claviceps purpurea</i> , Rust of gram- <i>Uromyces ciceris – aurientinii</i> .	2
Rust of linseed- <i>Melampsora lini</i> ., Rust of wheat- <i>Puccinia recondita</i> , <i>P. striiformis</i>	2
Covered smut of barley- <i>Ustilago hordei</i> , Loose smut of oats- <i>Ustilago avenae</i> , Loose smut of bajra- <i>Tolyposporium penicillariae</i> , Red rot of sugarcane- <i>Colletotrichum falcatum</i>	2
Leaf spot and shot holes- <i>Alternaria spp.</i> , Tikka disease of groundnut- <i>Cercospora spp.</i> , Foot rot of gladioli- <i>Fusarium spp.</i>	2
Diseases caused by nematodes: (i) Ear cockle of wheat- <i>Anguina tritici</i> , (ii) Root knot of vegetables- <i>Meloidogyne incognita</i> , <i>M. javanica</i> , <i>M. arenaria</i>	1
Abiotic/Non pathogenic diseases: (i) Black tip of mango (ii) Black heart of potato	1

Practical based on Units I-IV : 01 Credit

M.Sc. BOTANY (SEMESTER – I)
PAPER - III
ALGAE, LICHENS, MICROSCOPY AND CULTURE TECHNIQUES : 05 Credits

Total: 48 Hours

Unit - I ALGAE : 01 Credit	Hours
Detailed study of the classifications by Fritsch, Bold and Wynne, Lee; modern trends for algal classifications (molecular & chemotaxonomy); range of thallus organization.	4
Chief cell organelles: cell wall, flagella, eye-spot, pigments, reserve food products, pyrenoid.	3
Symbiotic algae; algal blooms	2
Fossil algae (Cyanophyceae, Chlorophyceae and Rhodophyceae).	2
Ecological and economic importance of algae.	2
Unit – II ALGAE: 01 Credit	
A comparative study of range of thallus organization, cell structure, reproduction (asexual & sexual), phylogeny and interrelationship of following divisions: CYANOPHYTA :	
Cyanophyceae – <i>Microcystis, Oscillatoria, Nostoc, Spirulina, Stigonema</i>	3
CHLOROPHYTA:	
Charophyceae – <i>Cosmarium, Closterium, Coleochaete, Chara;</i>	3
Ulvophyceae – <i>Ulva, Cladophora, Caulerpa;</i>	3
Chlorophyceae – <i>Volvox, Stigeoclonium, Oedogonium.</i>	3
Unit - III ALGAE: 01 Credit	
A comparative study of range of thallus organization, cell structure, reproduction (asexual & sexual), phylogeny and interrelationship of following divisions: RHODOPHYTA :	
Rhodophyceae – <i>Poysiphonia, Gelidium, Corallina, Mesophyllum</i>	2.5
EUGLENOPHYTA:	
Euglenophyceae – <i>Euglena</i>	0.5
DINOPHYTA:	
Dinophyceae – <i>Gymnodinium</i>	1
CRYPTOPHYTA:	
Cryptophyceae – <i>Cryptomonas</i>	1
HETEROKONTOPHYTA:	6
Chrysophyceae – <i>Dinobryon</i>	
Bacillariophyceae – <i>Navicula, Melosira</i>	
Xanthophyceae – <i>Vaucheria, Botrydium</i>	
Phaeophyceae – <i>Padina, Laminaria, Sargassum</i>	
PRYMNESIOPHYTA:	1
Prymnesiophyceae – <i>Hymenomonas</i>	
Unit - IV Lichens, Microscopy & Culture Techniques: 01 Credit	
Lichens –	
A general account classification and distribution of Lichens.	2
A comparative study of thallus organization, cell structure, physiology and reproduction.	3
Chemotaxonomy of Lichens.	1
Microscopy:	
Compound (Bright and Dark field), Phase contrast, Fluorescence, Ultra violet and Infra Red, Stereoscopic microscopes.	2.5
Electron Microscopy: (Scanning and Transmission)	1.5
Culture techniques: Isolation and synthesis of Lichen and Algae.	2

Practical based on Units I-IV : 01 Credit

M.Sc. BOTANY (SEMESTER – I)
PAPER-IV
BRYOPHYTES : 05 Credits

Total: 48 Hours

Unit-I :01 Credit	Hours
General characteristics, life cycle and classification of bryophytes	2
Ecology, Physiology and Reproductive biology of Bryophytes	5
Endemism and endemic liverwort genera of India	1
Bryophytes as indicator of mineral enrichment and environmental pollution	1
Spore- diversity, dispersal and germination	1
Moss protonema, protonemal differentiation and bud induction	2
Unit - II BRYOPSIDA:01 Credit	
Characteristic features, criteria of classification, range of gametophytic and sporophytic organization (morphology, anatomy and their distribution in India) in various orders/ families of the class:	3
Sphagnales - <i>Sphagnum</i>	2
Andreaeales - <i>Andreaea</i>	2
Takakiales - <i>Takakia</i>	2
Buxbaumiales - <i>Buxbaumia</i>	1
Bryales - <i>Physcomitrium, Fontinalis, Splachnum</i>	1
Polytrichales - <i>Polytrichum</i>	1
Unit -III HEPATICOPSIDA:01 Credit	
Characteristic features, criteria of classification, range of gametophytic and sporophytic organization (morphology, anatomy and their distribution in India) in various orders/families of the class:	2
Calobryales - <i>Calobryum, Haplomitrium</i>	2
Metzgeriales - <i>Pallavicinia, Riccardia, Metzgeria</i>	2
Jungermanniales - <i>Jungermannia, Porella, Ptychanthus, Radula</i>	2
Sphaerocarpaceae - <i>Riella, Sphaerocarpaceae</i>	1
Monocleales - <i>Monoclea</i>	1
Marchantiales - <i>Reboulia, Plagiochasma, Asterella, Lunularia, Dumortiera, Targionia, Cyathodium</i>	2
Unit-IV ANTHOCEROTOPSIDA:01 Credit	
Characteristic features, criteria of classification, range of gametophytic and sporophytic organization (morphology, anatomy and their distribution in India) in various orders/families of the class:	2
Anthocerotaceae - <i>Anthoceros, Folioceros</i>	1
Notothyladaceae - <i>Notothylas, Phaeoceros</i>	2
Dendrocerotaceae - <i>Dendroceros, Megaceros</i>	1
Origin, Evolution, Phylogeny & Fossil history of Bryophytes	6

Practical based on Units I-IV: 01 Credit

M.Sc. BOTANY (SEMESTER – II)
PAPER –V
PTERIDOPHYTES: 05 Credits

Total: 48 Hours

Unit-I: 01 Credit	Hours
Introduction & General characteristics of Pteridophytes	01
Origin & Evolution of Pteridophytes- Algal & Bryophytic origin	02
Geological concept of Fossil Pteridophytes, different types and their distribution	03
Criteria and comparative systems of Classification of Pteridophytes	03
Cytological evolution of fern flora and their taxonomical significance.	03
Unit-II: 01 Credit	
Ecological distribution & diversity of present day Pteridophytes	02
Evolution of stellar system and Telome theory	03
Heterospory & evolution of seed habitat	02
Comparative account of Apogamy & Apospory	02
Alternation of generation in Pteridophytes	02
Economic importance of Pteridophytes	01
Unit-III: 01 Credit	
Comparative study of the following: Rhyniopsida: <i>Rhynia</i> & <i>Dawsonites</i>	1.5
Psilopsida: <i>Psilotum</i> & <i>Tmesipteris</i>	1.5
Lycopsida: Asteroxylales- <i>Asteroxylon</i> & <i>Zosterophyllum</i> Protolepidodendrales: <i>Protolepidodendron</i> & <i>Cepodexylon</i> Lepidodendrales: <i>Lepidodendron</i> & <i>Sigillaria</i> Isoetales: <i>Isoetes</i> , <i>Stylitis</i> & <i>Pleuromia</i>	3.5
Equisetopsida: Hyeniales: <i>Hyenia</i> Sphenophyllales: <i>Sphenophyllum</i> & <i>Cheirostrobus</i> Calamitales: <i>Calamites</i> & <i>Asterocalamites</i> Equisetales: <i>Equisetum</i>	3.5
Primofilices: Protopteridales- <i>Protopteridium</i> Zygopteridales- <i>Zygopteris</i> Cladoxylales- <i>Cladoxylon</i>	2.0
Unit-IV: 01 Credit	
Comparative study of morphology of sporophytes, soral arrangement, sporangial characters and development of gametophytes in different major groups of Ferns: EUSPORANGIATEAE: Ophioglossales- <i>Ophioglossum</i> & <i>Botrychium</i> Marattiales- <i>Marattia</i> & <i>Marattiopsis</i>	02
PROTOLEPTOSPORANGIATEAE: Osmundales - <i>Osmunda</i> & <i>Osmundites</i>	01
LEPTOSPORANGIATEAE: Schizeales- <i>Schizaea</i> & <i>Lygodium</i>	01
Pteridales- <i>Pteris</i> , <i>Adiantum</i> , <i>Ceratopteris</i> & <i>Actionopteris</i>	02
Dicksoniales- <i>Dicksonia</i> ; Davalliales- <i>Davallia</i>	01
Hymenophyllales- <i>Hymenophyllum</i> ; Gleicheniales- <i>Gleichenia</i>	01
Cyatheales- <i>Cyathea</i> ; Polypodiales- <i>Polypodium</i>	01
Aspidiales- <i>Asplenium</i> & <i>Dryopteris</i>	01
Marsiliales- <i>Regnellidium</i> & <i>Pilularia</i>	01
Salviniales- <i>Salvinia</i> & <i>Azolla</i>	01

Practical based on Unit I – IV: 01 Credit

M.SC. BOTANY (SEMESTER – II)
PAPER-VI
GYMNOSPERMS AND PALAEOBOTANY: 05 Credits

Total: 48 Hours

UNIT – I GENERAL ACCOUNT:01 Credit	Hours
Evolutionary tendencies in Gymnosperms	3
Classification & distribution with special reference to India.	3
Origin, relationships and their economic importance.	3
Embryological variations and their relevance to silviculture, forest genetics and taxonomy	3
UNIT - II CYCADOPSIDA:01 Credit	
Morphological, anatomical and structural variations, phylogeny ,affinities and interrelationship within families of various orders - a)Pteridospermales - families -(i) Lyginopteridaceae ; (ii) Medullosaceae ; (iii) Glossopteridaceae; (iv) Croystospermaceae; (v) Peltaspermaceae; (vi) Caytoniaceae	6
b)Cycadales - General account; Geographical distribution; Evolutionary tendencies c)Nilssoniales - A general account.	3
d)Bennettitales (Cycadeoideales) —General account affinities and interrelationships among the families (i) Williamsoniaceae; (ii) Wielandiellaceae; (iii) Cycadeoideaceae	2
e)Pentoxylales - General account; Evolutionary tendencies	1
UNIT - III CONIFEROPSIDA:01 Credit	
a) Cordaitales - A general account of the order with reference to families- (i) Eristophylaceae; (ii) Cordaitaceae (iii) Poroxyaceae	2
b) Ginkgoales –A general account with special reference to family; (i) Ginkgoaceae	2
c) Coniferales - Distribution of conifers with special reference to India. Evolutionary trends, evolution of megastrobilus and seed-scale complex in various families. Study of various fossil genera, their reported structures with reference to families- (i)Lebachaceae (ii) Voltziaceae (iii) Palissyaceae Comparative morphological anatomical and reproductive studies in living genera with reference to families- (i) Pinaceae (ii) Araucariaceae (iii) Taxodiaceae (iv) Cupressaceae (v) Cephalotaxaceae (vi) Podocarpaceae.	7
d) Taxales - Comparative account of genera- <i>Taxus</i> , <i>Torreya</i> , <i>Palaeotaxus</i> , <i>Autrotaxus</i> , <i>Pseudotaxus</i> , <i>Amentotaxus</i>	1
UNIT- IV GNETOPSIDA & PALAEOBOTANY:01 Credit	
A general comparative account with reference to <i>Ephedra</i> , <i>Gnetum</i> and <i>Welwitschia</i>	6
Study of fossils- their methods of preservation, investigation and importance in stratigraphy.	2
Economic geology	2
A study of the standard stratigraphic scale and the succession of representative floras in various geological epochs and their bearing on plant evolution.	2

Practical based on Units I-IV : 01 Credit

M.Sc. BOTANY (SEMESTER –II)
PAPER - VII
ANGIOSPERMS: PLANT DEVELOPMENT & REPRODUCTION: 05 Credits

Total: 48 Hours

Unit –I : 01 Credit	Hours
Development of Root: Organization of RAM, cell fates, Differentiations of vascular tissue, Formation of aerial roots, root hairs.	2
Development of Shoot: Cytological analysis of SAM, Growth and differentiation of shoot.	2
Tissue differentiation: Cambium, Xylem, Phloem their function, factors and development.	1.5
Root-shoot Transition; Stem-Node-Leaf continuum.	1
Origin, differentiation and growth: Leaf, Mesophyll, Epidermis (including cuticle, stomata and trichomes) and Venation.	2.5
Secretory ducts, Laticifers: Structure and Formation	1
Plant Surface – Structure and Function of Lenticells, Hydathodes, Domatia, Epiphyllus branches, Epicuticular waxes, Extra floral nectaries and Hydropoten.	2
Unit – II : 01 Credit	
General Morphology of floral parts, floral meristem.	2
Formation of floral organs and their development.	2.5
Genetics of floral organ differentiation, Homeotic mutants in <i>Arabidopsis</i> and <i>Antirrhinum</i> .	2.5
Accessory floral organs: Epicalyx, Involucre; Cupule; Corona; Nectaries.	1.5
Epigyny	1
Origin, History and Evolution of Angiosperm flower.	2.5
Unit – III : 01 Credit	
Microsporogenesis: Structure, development, function; Microsporogenesis, Male gametophyte.	2
Megasporangium (Ovule): Types, evolution and ontogeny; Megasporogenesis: organization of embryo sac, Gene function during Megagametogenesis.	3
Sexual incompatibility; methods of overcome; barriers to fertilization, Pollen tube; structure and growth, Sexual dioecism.	2
Double Fertilization, Post fertilization metabolic and structural changes in embryo sac; Endosperm: structure, development; Polyploidy in reproductive organs and tissues	3
Embryogenesis; Physiological and morphogenetical relationship of endosperm and embryo.	2
Unit – IV : 01 Credit	
Polyembryony, Apomixis: Classification, causes and application.	2
Structure and growth of fruit and seed.	2
Experimental and applied embryology.	1
Morphogenetic Phenomenon- Symmetry, Polarity, Correlation, Differentiation Totipotency and Regeneration and Phyllotaxy.	5
Factors affecting Morphogenetic Phenomenon: Genetic, Physical and Chemical	2

Practical based on Units I-IV :01 Credit

M.Sc. BOTANY (SEMESTER –II)
PAPER – VIII
ANGIOSPERMS: TAXONOMY & ECONOMIC BOTANY: 05 Credits

Total: 48 Hours

Unit –I :01 Credit	Hours
Principles of systematics, Relevance and role of Systematics; Approches to classification- Phenetic, Phylogenetic and cladistics; Relative merits and demerits of major systems of classification viz. Bentham and Hooker, Engler and Prantl, Hutchinson, Cronquist, Dahlgren and Thorne; APG system; Origin and Evolution of Angiosperms; Treatment of monocots in evolutionary systems of classification; GIS and Phylocode, Herbarium & Botanical Gardens.	9
ICN (History, Principles and Applications), Protologue and Botanic literature (Monographs, Icones, Floras and Taxonomic literature)	1
Species Concept: Various models; Speciation and Variation.	1
Phytogeography with special reference to discontinuous areas, endemism, Hotspots and hottest hotspots; Biodiversity and its conservation	1
Unit – II:01 Credit	
Modern tools and evidence of taxonomy viz: Morphology and Anatomy: Epidermis and other structures associated with it, Node, Leaf, Flower Embryology, Palynology, Reproductive Biology, Ovular morphology and Seed Coat; Cytotaxonomy, Phytochemistry, Sieve Elements Plastids and Ecology.	12
Unit – III:01 Credit	
Sexual dioecism; Interesting taxonomic features and interrelationships of following Dicot and Monocot families: Dicots: Acanthaceae, Aizoaceae, Amaranathaceae, Asclepiadaceae, Asteraceae, Betulaceae, Bombaceae, Cactaceae, Caesalpiniaceae, Capparaceae, Caryophyllaceae, Casurinaceae, Cucurbitaceae, Ericaceae, Euphorbiaceae, Fagaceae, Fumariaceae, Malvaceae, Mimosaceae, Nelumbonaceae, Nymphaeaceae, Papaveraceae, Papilionaceae, Passifloraceae, Polygonaceae, Primulaceae, Ranunculaceae, Rosaceae, Rubiaceae, Scrophulariaceae, Tiliaceae and Trochodendraceae. Monocots: Alismataceae, Arecaceae, Commelinaceae, Cyperaceae, Liliaceae, Orchidaceae, Poaceae, and Zingiberaceae. Special features of Insectivorous/Parasitic and Saprophytic families.	12
Unit – IV:01 Credit	
Origin, Cultivation and improvement of major crops viz. Wheat, Rice, Maize, Pearl Millet and Sorghum.	3
General account of pulses along with their economic uses.	1.5
Sugars (Sugarcane, Potato, Sweet Potato); Starches (Potato).	1.5
Extraction and utility of Fibres (Cotton, Jute, Coir and Paper making fibres), Oils, Fats & Rubber.	2
Morphological identification & pharmacognostic/anatomical characterization of Spices & Condiments, Fumatories & Masticatories, major woods, medicinal plants, petrocrops and beverages (at least 10 examples of each class of product be given)	3
Ethnobotany- Its concepts, relevance and ethnic use	1

Practical based on Units I-IV: 01 Credit

M.Sc. BOTANY (SEMESTER – III)
PAPER-I
CYTOGENETICS AND MOLECULAR GENETICS: 05 Credits

Total: 48 Hours

UNIT – I GENOME: CONCEPT AND ORGANIZATION: 01 Credit	Hrs
Chromosome structure, nucleosome, solenoid and packaging of DNA, molecular organization of centromere and telomere, nucleolus, euchromatin and heterochromatin, karyotype analysis, banding patterns, special chromosomes-polytene chromosomes, lampbrush chromosomes, B chromosomes.	4
Nucleic acids, Nuclear DNA content, C-value paradox, unique, moderately repetitive and highly repetitive DNA, conformation of nucleic acids. (A, B, Z DNA), DNA sequencing and amplification	4
Allele concept, multiple alleles, isoalleles, pseudoalleles	1
Linkage and Recombination: Concept and Types of Linkage, Three point test crosses, Molecular mechanism of recombination.	3
UNIT - II INHERITANCE GENETICS: 01 Credit	
Mendelian inheritance and Interaction of genes: Complementary, epistasis, inhibitory, Duplicate, Polymeric, Lethal and additive interaction of genes.	4
Cytoplasmic inheritance: Cytoplasmic inheritance involving chloroplast (<i>Mirabilis jalapa</i> , <i>Zea mays</i>) and Mitochondria (petite yeasts and cytoplasmic male sterility in higher plants)	4
Quantitative Inheritance: Continuous variation, Inheritance of quantitative traits like kernel colour in wheat, corolla length in <i>Nicotiana</i> , cob length in <i>Zea mays</i> .	2
Population genetics: Gene and genotype frequencies, Hardy-Weinberg law, Factors affecting Hardy-Weinberg equilibrium	2
UNIT - III STRUCTURAL, NUMERICAL VARIATIONS AND MUTATION: 01 Credit	
Structural changes in chromosomes: Duplication, deficiency, inversion and translocation heterozygotes. Cytological consequences of crossing over in inversion and translocation heterozygotes.	3
Numerical alterations in chromosomes: Origin of euploids and aneuploids. Production of autopolyploids, allopolyploids and haploids. Induction and characterization of trisomics and monosomics.	4
Mutation- Spontaneous and induced mutation, physical and chemical mutagens, molecular basis of mutations, transposable elements in prokaryotes and eukaryotes, site directed mutagenesis, DNA damage and repair mechanism.	5
UNIT- IV MOLECULAR GENETICS: 01 Credit	
Cell Cycle and apoptosis: Control mechanisms, role of cyclins and cyclin dependent kinases, mechanism of programmed cell death.	2
Genetic Code, history and properties.	1
Gene concept and structure: Organization and Structure of prokaryotic and eukaryotic genes; multigene families, structure and role of promoters, Genome Projects.	2
In situ hybridization to locate transcripts in cells-FISH, GISH, Restriction mapping, chromosome microdissection and microcloning, flow cytometry.	1
DNA Replication: Mechanism of prokaryotic and eukaryotic DNA replication, replication apparatus, Origins of replication, priming and DNA polymerases.	2
Transcription: RNA polymerases and their role, transcription in prokaryotes and eukaryotes, RNA processing, Ribonucleoproteins, structure of RNAs.	2
Gene Regulation in prokaryotes and eukaryotes: Operon concept (Lac, Tryptophan) positive and negative regulation of prokaryotic genes, eukaryotic transcription factors. transcriptional and translational control	2

Practical based on Unit I – IV: 01 Credit

M.Sc. BOTANY (SEMESTER – III)
PAPER-II
PLANT BREEDING AND BIOSTATISTICS: 05 Credits

Total: 48 Hours

UNIT – I BRIEF INTRODUCTION; GENETIC RESOURCES AND REPRODUCTIVE SYSTEMS: 01 Credit	Hrs
Importance, scope and major achievements of plant breeding.	2
Germplasm; kinds of germplasm, collection, evaluation and organizations concerned with germplasm, in-situ and ex-situ conservation.	2
Genetic diversity; Centres of diversity and gene banks.	2
Modes of reproduction in crop plants; sexual and asexual reproduction, apomixis, identification of apomictic plants.	2
Incompatibility; genetic, physiological and biochemical basis of incompatibility, utility of self incompatibility.	2
Male sterility; genetic and cytoplasmic male sterility and its applications.	2
UNIT - II CONVENTIONAL AND MODERN METHODS OF BREEDING: 01 Credit	
Plant introduction; types of introduction, procedure, uses of plant introduction and organizations associated with introduction.	2
Pure line selection, mass and progeny selection, procedure and achievements.	2
Pedigree selection, recurrent selection and their applications.	1
Role of mutation in plant breeding, isolation of useful mutants and major achievements.	2
Role of polyploidy in crop improvement.	1
Protoplast fusion and somatic hybrids.	1
Method of gene transfer and transgenics.	2
Marker assisted selection.	1
UNIT - III HETEROSIS BREEDING, BREEDING FOR STRESS AND QUALITY TRAITS: 01 Credit	
Hybridization- kinds of hybridization, procedure of hybridization, types of hybridization and utility of hybridization.	2
Hybrid breeding in self- and cross-pollinated crops.	2
Back cross breeding	1
Types of hybrid – single cross hybrid, three way cross hybrid, double cross hybrid, multiple crosses – synthetic and composite crosses.	2
Heterosis; theories of heterosis , inbreeding depression.	2
Breeding for disease resistance, salinity tolerance and quality traits.	3
UNIT- IV BIOSTATISTICS: 01 Credit	
Importance and scope of biostatistics in biological studies.	2
Statistical terms and graphical representation of data.	1
Measures of central tendency.	1
Measures of dispersion: range, mean deviation, standard deviation, variance and deviation.	2
Correlation and regression and their role in selection.	2
Tests of significance: differences in means, standard error of mean, standard error of SD , students 't' test.	3
Heritability and its predictive role in selection.	1

Practical based on Unit I – IV: 01 Credit

M.Sc. BOTANY (SEMESTER – III)
PAPER - III
ENVIRONMENT, ECOLOGY AND PLANT-SOIL RELATIONSHIP: 05 Credits

Total: 48 Hours

Unit - I ENVIRONMENTAL BOTANY	Hours
Environmental Pollution, the problems and its causes and prevention	4
Indicator Plants (pollution of air, water and soil, radioactivity and noise)	4
Modern Environmental problems- Acid rain, Ozone depletion, Green house effect and Climate change.	4
Unit – II PLANT ECOLOGY	
Plant responses to environmental factors (climate, edaphic, Biotic, topographic and geographic factors).	3
Ecosystems- The concept, ecosystem component and major ecosystem of the world.	5
Ecosystem functioning (Tropic organization & Ecological efficiency), Community dynamics - successional changes.	4
Unit - III STUDY OF PLANT COMMUNITIES (QUANTITATIVE AND QUALITATIVE)	
Characteristics of communities, methods of study (Life forms, growth form and biological spectrum) and classification of plant communities.	3
Population dynamics: Principles of population regulation.	2
Phytogeography: Vegetational zone, Important forest types of India.	3
Interpretative Phytogeography, Principles and concepts of plant distribution.	4
Unit - IV SOIL	
Soil and natural medium for plant growth. Origin of soil, Minerals as a source of plant nutrients.	3
Soil forming process and its impact on soil profile development, properties of soils, Soil texture & structure	3
Ion exchange, calcareousness, salinity, sodicity. Organic matter.	4
Soil fertility: Concept, basic methods of fertility evaluation and maintenance. Soil types of India.	2

Practical based on Unit I – IV: 01 Credit

M.Sc. BOTANY (SEMESTER – III)
PAPER-IV
EXPERIMENTAL TECHNIQUES & COMPUTER APPLICATIONS: 05 Credits

Total: 48 Hours

UNIT- I : 01 Credit	Hrs
Sand culture/water culture and controlled soil culture techniques.	8
Tracer techniques: Detection and measurement of isotopes and applications.	2
Microtomy, staining and differentiation techniques for cellular components and tissues.	2
UNIT - II: 01 Credit	
Centrifugation and ultracentrifugation techniques and their applications.	3
Chromatography- Paper, TLC, Column, Gel Filtration, Affinity, Ion Exchange HPLC, GC.	4
Photometry: Colorimetry and Spectrophotometry (UV- visible), Fluorescence, Spectrophotometry, IR, Raman, Mass, NMR, ESR.	5
UNIT - III: 01 Credit	
Electrophoretic techniques and their applications.	4
Amino acid analysis and protein sequencing.	3
Applications and detection of proteins and nucleic acids (Western Transfers and Immuno blots and Southern blot) MAB technology.	3
DNA chip technology and Microarray	2
UNIT - IV: 01 Credit	
Brief introduction to computers and their applications.	2
MS Office (MS Word, MS Excel, MS Power Point, MS Access)	4
Languages (Coral/Photoshop, Graphics, dBASE, Operating System, Windows	6

Practical based on Units I-IV :01 Credits

M.Sc. BOTANY (SEMESTER-IV)**Paper –V****PLANT PHYSIOLOGY: 05 Credits****Total: 48 Hours**

Unit-I: 01 Credit	Hours
Plant water relations: Cell osmotic quantities- osmosis, osmotic potential, water potential.	01
Mechanism of water uptake and translocation: Water absorption by roots, root pressure and turgor pressure. Phloem loading and unloading	01
Transpiration: Types of transpiration. Mechanism and regulation of stomatal opening and closing.	01
Photosynthesis: General aspects and historical perspective. Light energy absorption and Action spectra, organization of photosynthetic apparatus, photoreceptors and light harvesting complexes. Structure and functions of components of Photosystem I and II. Photooxidation of water.	01 02
Electron transport in chloroplastic membrane: Photophosphorylation. ETS and ATP synthesis in chloroplast- ATP synthetase.	02
Carbon assimilation: Photosynthetic Carbon Reduction Cycle and its regulation. RUBISCO. Photorespiration and Carbon Oxidation Cycle and their regulation. CAM pathway. Ecological significances of photosynthesis. Synthesis of Starch and Sucrose.	04
Unit- II: 01 Credit	
Respiration: Types of respiration. Glycolysis, Pentose Phosphate Pathway. Kreb's Cycle and their regulation. Alternate Glycolytic reaction (Gluconeogenesis). Glyoxylate cycle.	05 01
Electron transport in mitochondria and ATP synthesis: Multiprotein respiratory complexes, F ₁ -F ₀ ATPase, Alternate oxidase system. Chlororespiration.	03
Lipid Metabolism: Synthesis of fatty acids (saturated and unsaturated) and lipids (phospholipids). Fatty acid degradation- α , β and ω oxidation.	02 01
Unit- III: 01 Credit	
Plant Growth: Seed germination, Dormancy (bud and seed) and its importance, Apical dominance, Abscission and Senescence. Plant movements.	03
Control of Flowering: Floral evocation, Florigen concept, circadian rhythms, Photoperiodism and its regulation. Vernalization.	03
Phytochrome: Its structure, discovery and functions.	02
Nitrogen metabolism: Nitrogen cycle. Biochemistry of nitrogen fixation-free living and symbiotic organisms, nitrogenase enzyme complex, nodule formation and nod factors.	02
Assimilation of nitrogen: Ammonia assimilation. Nitrate and nitrite reduction.	02
Unit-IV: 01 Credit	
Plants and Inorganic Nutrients: Essential and beneficial elements. Function and deficiency disorders of essential nutrient elements.	03
Stress Physiology: Plant responses to abiotic stress. Stress Proteins (HSP, LEA). Water deficit and drought. Heat, chilling and freezing, light and anoxia stress. Oxidative stress- reactive oxygen and nitrogen species, antioxidative defense system.	02 01 02 02
Sulphur metabolism: Sulphate uptake and its assimilation.	02

Practical based on above Unit 1-IV: 01 Credit

M.Sc. BOTANY (SEMESTER- IV)
Paper –VI
CELL BIOLOGY AND PLANT BIOCHEMISTRY: 05 Credits

Total: 48 Hours

Unit-I: 01 Credit	Hours
Plant Cell: Organization of cell, the cytoskeleton system, microtubules, microfilaments and plasmadesmata. Cell organelles: microbodies, golgi apparatus, lysosomes, endoplasmic reticulum, vacuole, ribosomes, nucleus, chloroplast and mitochondria.	02 02
Membrane Structure and Transport: Structural models and functions. Plant membrane transport. Passive uptake of ions- facilitated diffusion. Primary and secondary active transport, ion carriers, channel proteins and pumps (Na^+/K^+ and Ca^{2+} pumps). Membrane transport proteins- Plasma membrane H^+ - ATPase, vacuolar H^+ -ATPase and H^+ pyrophosphatases.	02 02 02 02
Unit-II: 01 Credit	
Macromolecules: Structures and functions of carbohydrates, Amino acids, Proteins, Lipids and Nucleic acid.	04
Nitrogen containing compounds: Non- protein amino acids, Alkaloids, Cyanogenic glycosides, Glucosinolates.	02
Secondary metabolism: Shikimic acid pathway: Shikimic acid, Phenylalanine, Tyrosine, Tryptophan.	02
Acetate Mevalonate Pathway: Terpenes, Sterols	02
Acetate Malonate Pathway- Cutins, Suberins, Lignin, Anthocyanins, Chalcones, Isoflavones, Stilbenes.	02
Unit –III: 01 Credit	
Plant Growth Hormones and Elicitors: Structure, function, synthesis, cellular and molecular mechanism of action of- Auxins- the growth hormone. Gibberellins- regulators of plant development. Cytokinins- regulators of cell division. Absciscic acid- the stress hormone, Ethylene- the gaseous hormone. Brassinosteroids, Polyamines, Jasmonic acid and salicyclic acid.	02 02 02 02 01 03
Unit- IV: 01 Credit	
Enzymology: General aspects, classification, mode of action, allosteric mechanism, regulation of enzymes Active sites, reversible and irreversible enzyme inhibition. Enzyme kinetics and Michaelis- Menton equation.	03 02 01
Signal Perception and Transduction: Protein receptors and signaling mechanism. G- proteins, Ca-calmodulin, phospholipid signaling. Cyclic nucleotides- adenylyl cyclase. Protein kinases-receptor like protein kinase (RLKs), mitogen activated protein kinase (MPAK), cyclin dependent protein kinase (CDK). Protein phosphatase, Auxin, GA and ABA signal transduction.	02 02 02

Practical based on above Unit 1-IV: 01 Credit

M.Sc. BOTANY (Semester-IV)
Paper -VII
BIOTECHNOLOGY AND HUMAN WELFARE: 05 Credits

Total: 48 Hours

Unit-I PLANT CELL AND TISSUE CULTURE:01 Credit	Hours
Plant Cell and Tissue culture: Introduction, history, scope, concept of cellular differentiation, totipotency	2
Culture media and laboratory requirements	1
Micropropagation-Organogenesis and embryogenesis, Bioreactors, Embryo rescue,	2
Endosperm, nucellus culture	1
Somaclonal variation:-applications and reasons for generation	1
Somatic hybridization -protoplast culture, regeneration and somatic hybridization, Cybrids	2
Production and uses of haploids	1
Applications of plant tissue culture	2
Unit-II GENETIC ENGINEERING: 01 Credit	
Cloning vectors (plasmid and bacteriophage vectors, cosmids BAC and YACs. And Enzymes (restriction endonucleases, polymerases, reverse transcriptase, alkaline phosphatase, polynucleotide kinase, Ligases, terminal transferases)	3
DNA cloning, preparation of plasmid DNA, Restriction and electrophoresis, ligation, transformation and analysis of recombinants.	2
Methods of direct and indirect gene transfer in plants, <i>Agrobacterium</i> , Ti and Ri plasmids,	2
Application of genetic engineering, transgenic plants for pest and disease resistance, abiotic stress tolerance, production of useful products.	3
Gene libraries and cDNA libraries, Polymerase chain reaction, DNA fingerprinting, DNA Synthesis, DNA Sequencing, Southern blotting	2
Unit-III BIOTECHNOLOGY AND HUMAN WELFARE: 01 Credit	
Applications of genetically engineered bacteria in crop production and protection, biodegradation of xenobiotics and toxic wastes, production of chemicals and fuels Biopesticides and integrated pest management, Biofertilizers, Organic farming	6
Biotechnology in pollution control and phytoremediation	2
Restoration of degraded land -Development of stress tolerant plants, microbes for improving soil fertility	4
Unit-IV BIOTECHNOLOGY- RECENT UPDATE: 01 Credit	
Introduction to Genomics and Proteomics	2
Molecular markers	2
Bioinformatics -general outline	2
Intellectual Property rights and Protection-brief introduction	2
Patenting of Biological material and its implications	2
Ethics in biotechnological research	2

Practical based on Unit I – IV: 01 Credit