

**M.Sc. PLANT SCIENCE (Self Financing Course)**  
**(Two Year) Four Semester Programme under Choice Based Credit System**  
**(Applicable for students admitted in July, 2018 & onwards)**

<b>Semester I:</b>		<b>Max Marks</b>
Paper I:	Microbiology (Bacteriology, Virology) and Microbial Biotechnology	100 (04 credits)
Paper II:	Mycology & Plant Pathology	100 (04 credits)
Paper III:	Algology, Lichenology, Microscopy & Culture Techniques	100 (04 credits)
Paper IV:	Bryology	100 (04 credits)
Practical:	Based on Papers I – IV	<u>100</u> (04 credits)
Total		<u>500</u> (20 credits)
<b>Semester II:</b>		
Paper V:	Pteridophytes	100 (04 credits)
Paper VI:	Gymnosperms and Palaeobotany	100 (04 credits)
Paper VII:	Plant Development and Reproduction	100 (04 credits)
Paper VIII:	Plant Systematics 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)
<b>Semester III:</b>		
Paper I:	Cytology, Genetics & Molecular Genetics	100 (04 credits)
Paper II:	Crop Improvement and Biostatistics	100 (04 credits)
Paper III:	Environment, Ecology and Plant Soil Relationship	100 (04 credits)
Paper IV:	Experimental Techniques and Computer application	100 (04 credits)
Practical:	Based on Papers I – IV	<u>100</u> (04 credits)
Total		<u>500</u> (20 credits)
<b>Semester IV:</b>		
Paper V:	Plant Physiology	100 (04 credits)
Paper VI:	Cell Biology & Plant Biochemistry	100 (04 credits)
Paper VII:	Biotechnology and Human welfare	100 (04 credits)
Paper VIII:	Elective - Project work (Review based on all Papers from Semester I - IV)	100 (04 credits)
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)
<b>Total</b>		<b>2400 (92 credits)</b>

**M.Sc. PLANT SCIENCE (SEMESTER –I)****PAPER - I****MICROBIOLOGY: (BACTERIOLOGY, VIROLOGY) & MICROBIAL BIOTECHNOLOGY: 05 Credits**  
(w.e.f. July 2018)**Total: 40 Hours**

<b>Unit–I BACTERIA: HISTORY, CLASSIFICATION, STRUCTURE, METABOLISM :01 Credit</b>	<b>Hrs</b>
History of microbiology	2
Classification of Bacteria and Archaea	2
Bacterial cell structure and function of cell components	3
Bacterial nutrition and metabolism, including Nitrogen fixation	3
<b>Unit – II BACTERIAL GENETICS, BIOTECHNOLOGICAL APPLICATIONS:01 Credit</b>	
Genetics of Bacteria (genome structure, replication, expression, recombination etc.	3
Role of microbes in recombinant DNA technology	2
Biotechnological applications of microbiology	2
Antibiotics and their mode of action	2
Biopesticides	1
<b>Unit–III PLANT VIRUSES: CLASSIFICATION, STRUCTURE, REPLICATION, DETECTION:01 Credit</b>	
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)	2
Genome expression strategies in plant viruses	2
Replication of RNA and DNA plant viruses (TMV, CaMV)	2
Purification and electron microscopy of Viruses	1
Virus detection by serological and nucleic acid hybridization methods	2
<b>Unit – IV PLANT VIRUS SYMPTOMS, TRANSMISSION, CONTROL, VIROIDS, BACTERIOPHAGE: 01 Credit</b>	
Morphological, anatomical, and biochemical changes in virus-infected plants	2
Molecular aspects of virus vector relationship in transmission	2
Modern methods of plant virus control	2
Structure, replication and pathogenicity of viroids	2
Structure and replication of bacteriophages	2

**Practical based on Unit I-IV: 01 Credit**

**M.Sc. PLANT SCIENCE (SEMESTER - I)**  
**PAPER - II**  
**MYCOLOGY & PLANT PATHOLOGY: 05 Credits**  
**(w.e.f. July 2018)**

**Total: 40 Hours**

<b>Unit-I GENERAL ASPECTS OF STRUCTURE, REPRODUCTION, SYSTEMATICS &amp; PHYLOGENY:01 Credit</b>	<b>Hrs</b>
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.	3
Fungal systematics, phylogeny, fossil fungi.	2
Fungal biotechnology & IPR; Medicinal Fungi	2
<b>Unit- II COMPARATIVE STUDY OF FUNGAL GROUPS:01 Credit</b>	
<b>Myxomycota</b> (i) Myxomycetes- <i>Stemonitis</i> , <i>Arcyria</i> .; (ii) Plasmodiophormycetes- <i>Plasmodiophora</i>	1
<b>Eumycota</b> <b>(i) Mastigomycotina</b> <b>Chytridiomycetes-</b> <i>Synchytrium</i> , <i>Allomyces</i> , <i>Monoblepharis</i> . <b>Oomycetes-</b> <i>Saprolegnia</i> , <i>Achlya</i> . <i>Pythium</i> , <i>Phytophthora</i> , <i>Sclerospora</i> , <i>Peronospora</i>	2
<b>(ii) Zygomycotina-</b> <i>Zygorhynchus</i> , <i>Pilobolus</i> , <i>Choanophora</i> , <i>Entomophthora</i> .	1
<b>(iii) Ascomycotina-</b> <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> .	2
<b>(iv) Basidiomycotina-</b> <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> .	3
<b>(v) Deuteromycotina-</b> <i>Colletotrichum</i> , <i>Helminthosporium</i> , <i>Alternaria</i> , <i>Cercospora</i> , <i>Rhizoctonia</i> .	1
<b>Unit – III PRINCIPLES OF PHYTOPATHOLOGY:01 Credit</b>	
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.	1.5
Dissemination of plant disease; disease forecasting and management plant disease.	1.5
Post harvest diseases and mycotoxins.	1
<b>Unit – IV PLANT DISEASES CAUSED BY FUNGI, NEMATODES, ABIOTIC FACTORS &amp; THEIR CONTROL:01 Credit</b>	
Epidemiology, symptoms, etiology, perennation and control of following diseases: <b>Fungal diseases:</b> 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 deformans</i> , Ergot of rye- <i>Claviceps purpurea</i> , Rust of gram- <i>Uromyces ciceris – aurientinii</i> .	1.5
Rust of linseed- <i>Melampsora lini</i> ., Rust of wheat- <i>Puccinia recondita</i> , <i>P. striiformis</i>	1.5
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>	1.5
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>	1.5
<b>Diseases caused by nematodes:</b> (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
<b>Abiotic/Non pathogenic diseases:</b> (i) Black tip of mango (ii) Black heart of potato	1

**Practical based on Units I-IV : 01 Credit**

**M.Sc. PLANT SCIENCE (SEMESTER – I)**  
**PAPER - III**  
**ALGOLOGY, LICHENOLOGY, MICROSCOPY AND CULTURE TECHNIQUES : 05 Credits**  
**w.e.f. July 2018**

**Total: 40 Hours**

<b>Unit - I ALGAE : 01 Credit</b>	<b>Hours</b>
Detailed study of the classifications by Fritsch, Smith, Lee; modern trends for algal classifications (molecular & chemotaxonomy); range of thallus organization.	3.5
Chief cell organelles: cell wall, flagella, nucleus, eye-spot, pigments, reserve food products, pyrenoid.	2
Symbiotic algae; algal blooms	1
Fossil algae.	1.5
Ecological and economic importance of algae.	2
<b>Unit – II ALGAE: 01 Credit</b>	
A comparative study of range of thallus organization, cell structure, reproduction (asexual & sexual), phylogeny and interrelationship of following divisions: <b>CYANOPHYTA :</b>	
<b>Cyanophyceae</b> – <i>Microcystis, Oscillatoria, Nostoc, Spirulina, Stigonema</i>	2.5
<b>CHLOROPHYTA:</b>	
<b>Charophyceae</b> – <i>Cosmarium, Closterium, Coleochaete, Chara;</i>	2.5
<b>Ulvophyceae</b> – <i>Ulva, Cladophora, Caulerpa; Acetabularia</i>	2.5
<b>Chlorophyceae</b> – <i>Volvox, Stigeoclonium, Oedogonium.</i>	2.5
<b>Unit - III ALGAE: 01 Credit</b>	
A comparative study of range of thallus organization, cell structure, reproduction (asexual & sexual), phylogeny and interrelationship of following divisions: <b>RHODOPHYTA :</b>	
<b>Rhodophyceae</b> – <i>Poysiphonia, Gelidium, Corallina, Mesophyllum</i>	2.5
<b>EUGLENOPHYTA:</b>	
<b>Euglenophyceae</b> – <i>Euglena</i>	0.5
<b>DINOPHYTA:</b>	
<b>Dinophyceae</b> – <i>Gymnodinium</i>	1
<b>CRYPTOPHYTA:</b>	
<b>Cryptophyceae</b> – <i>Cryptomonas</i>	1
<b>HETEROKONTOPHYTA:</b>	4
<b>Chrysophyceae</b> - <i>Dinobryon</i>	
<b>Bacillariophyceae</b> – <i>Navicula, Melosira</i>	
<b>Xanthophyceae</b> – <i>Vaucheria, Botrydium</i>	
<b>Phaeophyceae</b> – <i>Padina, Sargassum, Dictyota</i>	
<b>PRYMNESIOPHYTA:</b>	
<b>Prymnesiophyceae</b> <i>Hymenomonas</i>	1
<b>Unit - IV Lichens, Microscopy &amp; Culture Techniques: 01 Credit</b>	
<b>Lichens –</b>	
A general account classification and distribution of Lichens.	2
A comparative study of thallus organization, cell structure, physiology and reproduction.	2
Chemotaxonomy of Lichens.	1
<b>Microscopy:</b>	
Compound (Bright and Dark field), Phase contrast, Fluorescence, Ultra violet and Infra Red, Stereoscopic microscopes.	2
Electron Microscopy: (Scanning and Transmission)	1.5
<b>Culture techniques:</b> Isolation and synthesis of Lichen and Algae.	1.5

**Practicals based on Units I-IV : 01 Credit**

**M.Sc. PLANT SCIENCE (SEMESTER – I)**  
**PAPER-IV**  
**BRYOLOGY: 05 Credits**  
**(w.e.f. July 2018)**

**Total: 40 Hours**

<b>Unit - I :01 Credit</b>	<b>Hrs</b>
General characteristics of bryophytes, alternation of generation and classification	2
Life-cycle of bryophytes, asexual and sexual reproduction in various groups	3
Ecology - habitat diversity, growth forms, growth factors	1
Role of bryophytes in pollution monitoring, geobotanical prospecting, horticultural uses, economic importance	2
Spore diversity, dispersal mechanism and their germination	1
Moss protonema, protonemal differentiation and bud induction	1
<b>Unit - II BRYOPSIDA :01 Credit</b>	
Characteristic features, comparative morphological and anatomical studies of gametophytes and sporophytes in various orders of the class Bryopsida:	2
Sphagnales - <i>Sphagnum</i>	2
Andreaeales - <i>Andreaea</i>	1
Takakiales - <i>Takakia</i>	2
Buxbaumiales - <i>Buxbaumia</i>	1
Bryales - <i>Physcomitrium, Fontinalis, Splachnum</i>	1
Polytrichales - <i>Polytrichum</i>	1
<b>UNIT - III HEPATICOPSIDA: 01 Credit</b>	
Characteristic features, comparative morphological and anatomical studies of gametophytes and sporophytes in various orders of the class Hepaticopsida:	2
Calobryales - <i>Calobryum, Haplomitrium</i>	1
Metzgeriales - <i>Pallavicinia, Riccardia, Metzgeria</i>	1
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
<b>Unit - IV ANTHOCEROTOPSIDA:01 Credit</b>	
Characteristic features, comparative morphological and anatomical studies of gametophytes and sporophytes in various orders of the class Anthocerotopsida:	2
Anthocerotales - <i>Anthoceros, Folioceros</i>	1
Notothyladales - <i>Notothylas, Phaeoceros, Dendroceros, Megaceros</i>	2
Origin, Evolution, Phylogeny & Fossil history of Bryophytes	5

**Practical based on Units I-IV : 01 Credit**

**M.Sc. PLANT SCIENCE (SEMESTER – II)**  
**PAPER –V**  
**PTERIDOPHYTES: 05 Credits**  
**(w.e.f. July 2018)**

**Total: 40 Hours**

<b>Unit-I: 01 Credit</b>	<b>Hrs</b>
Introduction & General characteristics of Pteridophytes	01
Origin & Evolution of Pteridophytes- Algal & Bryophytic origin	1.5
Geological concept of Fossil Pteridophytes, different types and their distribution	2.5
Criteria and comparative systems of Classification of Pteridophytes	2.5
Cytological evolution of fern flora and their taxonomical significance.	2.5
<b>Unit-II: 01 Credit</b>	
Ecological distribution & diversity of present day Pteridophytes	02
Evolution of stellar system and Telome theory	02
Heterospory & evolution of seed habitat	02
Comparative account of Apogamy & Apospory	1.5
Alternation of generation in Pteridophytes	1.5
Economic importance of Pteridophytes	01
<b>Unit-III: 01 Credit</b>	
Comparative study of the following: <b>Rhyniopsida:</b> <i>Rhynia</i> & <i>Dawsonites</i>	01
<b>Psilopsida:</b> <i>Psilotum</i> & <i>Tmesipteris</i>	01
<b>Lycopsida:</b> 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
<b>Equisetopsida:</b> Hyeniales: <i>Hyenia</i> Sphenophyllales: <i>Sphenophyllum</i> & <i>Cheirostrobus</i> Calamitales: <i>Calamites</i> & <i>Asterocalamites</i> Equisetales: <i>Equisetum</i>	3.0
<b>Primofilices:</b> Protopteridales- <i>Protopteridium</i> <i>Zygopteridales</i> - <i>Zygopteris</i> Cladoxylales- <i>Cladoxylon</i>	1.5
<b>Unit-IV: 01 Credit</b>	
Comparative study of morphology of sporophytes, soral arrangement, sporangial characters and development of gametophytes in different major groups of Ferns: <b>EUSPORANGIATEAE:</b> Ophioglossales- <i>Ophioglossum</i> & <i>Botrychium</i> Marattiales- <i>Marattia</i> & <i>Marattiopsis</i>	1.5
<b>PROTOLEPTOSPORANGIATEAE:</b> Osmundales - <i>Osmunda</i> & <i>Osmundites</i>	01
<b>LEPTOSPORANGIATEAE:</b> Schizeales- <i>Schizaea</i> & <i>Lygodium</i>	01
Pteridales- <i>Pteris</i> , <i>Adiantum</i> , <i>Ceratopteris</i> & <i>Actionopteris</i>	1.5
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>	0.5
Marsiliales- <i>Regnellidium</i> & <i>Pilularia</i>	0.5
Salviniales- <i>Salvinia</i> & <i>Azolla</i>	01

**Practical based on Unit I – IV: 01 Credit**

**M.SC. PLANT SCIENCE (SEMESTER – II)**  
**PAPER-VI**  
**GYMNOSPERMS AND PALAEOBOTANY: 05 Credits**  
(w.e.f. July 2018)

**Total: 40 Hours**

<b>UNIT – I GENERAL ACCOUNT:01 Credit</b>	<b>Hrs</b>
Evolutionary tendencies in Gymnosperms	2
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	2
<b>UNIT - II CYCADOPSIDA:01 Credit</b>	
Morphological, anatomical and structural variations, phylogeny ,affinities and interrelationship within families of various orders - <b>a)Pteridospermales</b> - families -(i) Lyginopteridaceae ; (ii) Medullosaceae ; (iii) Glossopteridaceae; (iv) Corytospermaceae; (v) Peltaspermaceae; (vi) Caytoniaceae	4
<b>b)Cycadales</b> – General account; Geographical distribution; Evolutionary tendencies <b>c)Nilssoniales</b> - A general account.	3
<b>d)Bennettitales (Cycadeoideales)</b> –General account affinities and interrelationships among the families (i) Williamsoniaceae; (ii) Wielandiellaceae; (iii) Cycadeoideaceae	2
<b>e)Pentoxylales</b> - General account; Evolutionary tendencies	1
<b>UNIT - III CONIFEROPSIDA:01 Credit</b>	
a) <b>Cordaitales</b> - A general account of the order with reference to families- (i) Eristophylaceae; (ii) Cordaitaceae (iii) Poroxylaceae	2
b) <b>Ginkgoales</b> –A general account with special reference to family; (i) Ginkgoaceae	2
c) <b>Coniferales</b> - 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)Lebachiaceae (ii) Voltziaceae (iii) Palissyaceae <b>Comparative morphological anatomical and reproductive studies in living genera with reference to families-</b> (i) Pinaceae (ii) Araucariaceae (iii) Taxodiaceae (iv) Cupressaceae (v) Cephalotaxaceae (vi) Podocarpaceae.	5
d) <b>Taxales</b> - Comparative account of genera- <i>Taxus</i> , <i>Torreya</i> , <i>Palaeotaxus</i> , <i>Autrotaxus</i> , <i>Pseudotaxus</i> , <i>Amentotaxus</i>	1
<b>UNIT- IV GNETOPSIDA &amp; PALAEOBOTANY:01 Credit</b>	
A general comparative account with reference to <i>Ephedra</i> , <i>Gnetum</i> and <i>Welwitschia</i>	5
Study of fossils- their methods of preservation, investigation and importance in stratigraphy.	2
Economic geology	1
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. PLANT SCIENCE (SEMESTER –II)**  
**PAPER - VII**  
**PLANT DEVELOPMENT & REPRODUCTION: 05 Credits**  
**(w.e.f July 2018)**

**Total: 40 Hours**

<b>Unit –I : 01 Credit</b>	<b>Hrs</b>
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
Root-shoot Transition; Stem-Node-Leaf continuum.	0.5
Origin, differentiation and growth: Leaf, Mesophyll, Epidermis (including cuticle, stomata and trichomes) and Venation.	2
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.	1.5
<b>Unit – II : 01 Credit</b>	
General Morphology of floral parts, floral meristem.	2
Formation of floral organs and their development.	2
Genetics of floral organ differentiation, Homeotic mutants in <i>Arabidopsis</i> and <i>Antirrhinum</i> .	2
Accessory floral organs: Epicalyx, Involucre; Cupule; Corona; Nectaries.	1
Epigyny	1
Origin, History and Evolution of Angiosperm flower.	2
<b>Unit – III : 01 Credit</b>	
Microsporogenesis: Structure, development, function; Microsporogenesis, Male gametophyte.	2
Megasporangium (Ovule): Types, evolution and ontogeny; Megasporogenesis: organization of embryo sac, Gene function during Megagametogenesis.	2.5
Sexual incompatibility; methods of overcome; barriers to fertilization, Pollen tube; structure and growth, Sexual dioecism.	1.5
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.	1
<b>Unit – IV : 01 Credit</b>	
Polyembryony, Apomixis: Classification, causes and application.	1.5
Structure and growth of fruit and seed.	1.5
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	1

**Practical based on Units I-IV :01 Credit**



**M.Sc. PLANT SCIENCE (SEMESTER –II)**  
**PAPER – VIII**  
**PLANT SYSTEMATICS & ECONOMIC BOTANY: 05 Credits**  
**(w.e.f.July 2018)**

**Total: 40 Hours**

<b>Unit –I :01 Credit</b>	<b>Hrs</b>
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.	7
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
<b>Unit – II:01 Credit</b>	
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.	10
<b>Unit – III:01 Credit</b>	
Sexual dioecism; Interesting taxonomic features and interrelationships of following Dicot and Monocot families: <b>Dicots:</b> Acanthaceae, Aizoaceae, Amaranthaceae, 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. <b>Monocots:</b> Alismataceae, Arecaceae, Commelinaceae, Cyperaceae, Liliaceae, Orchidaceae, Poaceae, and Zingiberaceae. Special features of Insectivorous / Parasitic and Saprophytic families.	10
<b>Unit – IV:01 Credit</b>	
Origin, Cultivation and improvement of major crops viz. Wheat, Rice, Maize, Pearl Millet and Sorghum.	2
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)	2
Ethnobotany- Its concepts, relevance and ethnic use.	1

**Practical based on Units I-IV: 01 Credit**

**M.Sc. PLANT SCIENCE (SEMESTER – III)**  
**PAPER-I**  
**CYTOLOGY, GENETICS & MOLECULAR GENETICS: 05 Credits**  
**(w.e.f. July 2018)**

**Total: 40 Hours**

<b>UNIT – I CHROMOSOMAL BASIS OF HEREDITY: 01 Credit</b>	<b>Hrs</b>
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.	3
Unique, moderately repetitive and highly repetitive DNA, conformation of nucleic acids. (A, B, Z DNA) sequencing and amplification, nucleic acids, nuclear DNA content, C-value paradox.	2
In situ hybridization, FISH, GISH, chromosome microdissection and microcloning, flow cytometry.	1
Allele concept, multiple alleles, isoalleles, pseudoalleles	1
Recombination and Linkage: Concept and types of Linkage, Molecular mechanism of recombination, estimation of recombination percentages and map distances, Gene mapping.	3
<b>UNIT - II QUALITATIVE AND QUANTITATIVE GENETICS: 01 Credit</b>	
Principles of inheritance and Interaction of genes. Complementary, epistasis, inhibitory, Duplicate, Polymeric, Lethal and additive interaction of genes.	3
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).	3
Polygenic Inheritance: Continuous variation, Inheritance of 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
<b>UNIT - III CHROMOSOMAL CHANGES AND INDUCTION OF MUTATION: 01 Credit</b>	
Chromosomal aberrations: Duplication, deficiency, inversion and translocation heterozygotes.	3
Numerical variation: Origin of euploids and aneuploids. production of autopolyploids, allopolyploids and haploids. Induction and characterization of trisomics and monosomics..	3
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.	4
<b>UNIT- IV MOLECULAR GENETICS: 01 Credit</b>	
Cell Cycle and programmed cell death: Role of cyclins and cdks, mechanism of cell death.	1
Genetic Code; historical perspective and properties.	1
Gene fine Structure: Organization and Structure of prokaryotic and eukaryotic genes; Genome Projects, Restriction mapping, multigene families.	2
DNA Replication: Mechanism of prokaryotic and eukaryotic DNA replication.	1
Transcription: RNA polymerases and their role, Transcription in prokaryotes and eukaryotes, Initiation, elongation and termination, RNA processing, types of RNA.	2
Regulation of gene expression in prokaryotes and eukaryotes: Operon concept (Lac, Tryptophan, Arabinose) positive and negative regulation of prokaryotic genes, eukaryotic transcription factors. transcriptional and translational control.	3

**Practical based on Unit I – IV: 01 Credit**

**M.Sc. PLANT SCIENCE (SEMESTER – III)**  
**PAPER-II**  
**CROP IMPROVEMENT AND BIOSTATISTICS: 05 Credits**  
**(w.e.f. July 2018)**

**Total: 40 Hours**

<b>UNIT – I INTRODUCTION; GENETIC RESOURCES AND REPRODUCTIVE MECHANISMS: 01 Credit</b>	<b>Hrs</b>
An introduction to plant breeding, objectives and contribution to production	2
Germplasm; in-situ and ex-situ conservation, collection, evaluation and organizations concerned with germplasm, kinds of germplasm.	2
Genetic diversity; Centres of diversity and gene banks.	2
Modes of reproduction in crop plants; sexual and asexual reproduction, applications of apomictic plants.	1
Incompatibility; basis of incompatibility, utility of self incompatibility.	1
Male sterility; genetic and cytoplasmic male sterility and its applications.	2
<b>UNIT - II BREEDING METHODS: CONVENTIONAL AND SPECIAL: 01 Credit</b>	
Plant introduction; types of introduction, procedure, benefits of plant introduction.	1
Pure line selection, mass selection, procedure and achievements.	2
Pedigree selection, recurrent selection and their applications.	2
Mutation in plant breeding and major achievements.	1
Polyploidy in crop improvement.	1
Somatic hybridization.	1
Method of gene transfer and transgenic varieties.	2
<b>UNIT - III HETEROSIS BREEDING AND STRESS BREEDING: 01 Credit</b>	
Hybridization- kinds of hybridization, hybridization procedure, types of hybridization and its utility.	2
Hybrid breeding in self- and cross-pollinated crops.	1
Back cross breeding and applications	1
Types of hybrid – single cross hybrid, three way cross hybrid, double cross hybrid, multiple crosses – synthetic and composite varieties.	1
Heterosis; theories of heterosis, inbreeding depression.	2
Breeding for disease resistance, salinity resistance.	2
Marker assisted selection.	1
<b>UNIT- IV BIOSTATISTICAL APPROACHES: 01 Credit</b>	
Importance and scope of biostatistic.	1
Statistical terms and graphical representation of data.	1
Measures of central tendency.	1
Measures of dispersion: range, mean deviation, standard deviation, variance and deviation.	3
Correlation and regression.	2
SD means, Standard error, students 't' test, Chi square test	2

**Practical based on Unit I – IV: 01 Credit**

**M.Sc. PLANT SCIENCE (SEMESTER – III)**  
**PAPER - III**  
**ENVIRONMENT, ECOLOGY AND PLANT-SOIL RELATIONSHIP: 05 Credits**  
**(w.e.f. July 2018)**

**Total: 40 Hours**

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

**Practical based on Unit I – IV: 01 Credit**

**M.Sc. PLANT SCIENCE (SEMESTER – III)**  
**PAPER-IV**  
**EXPERIMENTAL TECHNIQUES & COMPUTER APPLICATIONS: 05 Credits**  
**w.e.f July 2018**

**Total: 40 Hours**

<b>UNIT- I : 01 Credit</b>	<b>Hrs</b>
Sand culture/water culture and controlled soil culture techniques.	7
Tracer techniques: Detection and measurement of isotopes and applications.	2
Microtomy.	1
<b>UNIT - II: 01 Credit</b>	
Centrifugation and ultracentrifugation techniques and their applications.	2
Chromatography- Paper, TLC, Column, Gel Filtration, Affinity, Ion Exchange HPLC, GC.	3
Photometry: Colorimetry and Spectrophotometry (UV- visible), Fluorescence, Spectrophotometry, Basic features and principles of IR, Raman, Mass, NMR, ESR.	5
<b>UNIT - III: 01 Credit</b>	
Electrophoretic techniques and their applications.	4
Amino acid analysis and protein sequencing.	2
Applications and detection of proteins and nucleic acids (Western Transfers and Immuno blots and Southern blot) MAB technology.	2
DNA chip technology and Microarray	2
<b>UNIT - IV: 01 Credit</b>	
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	4

**Practical based on Units I-IV :01 Credits**

**M.Sc. PLANT SCIENCE (SEMESTER-IV)**  
**PAPER –V**  
**PLANT PHYSIOLOGY: 05 Credits**  
**(w.e.f. July 2018)**

**Total: 40 Hours**

<b>Unit-I: 01 Credit</b>	<b>Hrs</b>
<b>Water metabolism:</b> Diffusion, osmosis, osmotic potential and water potential.	01
<b>Translocation of water and solutes:</b> Water absorption by roots, transport through xylem. Phloem loading and unloading	01
<b>Transpiration and its regulation:</b> Mechanism of stomatal opening and closing.	01
<b>Photosynthesis:</b> Historical background and action spectra. Photosynthetic pigments and light harvesting complexes. Photosystem I and II. Photolysis of water.	01 02
<b>Mechanism of electron transport:</b> Photophosphorylation-cyclic non-cyclic. Proton transport and ATP synthesis in chloroplast- ATP synthetase.	01
<b>Carbon assimilation:</b> Calvin cycle, Photorespiration (C <sub>2</sub> Cycle) and C <sub>4</sub> cycle and their regulation. CAM pathway. Photosynthetic responses to light, CO <sub>2</sub> and Temperature. Synthesis of Starch and Sucrose.	03
<b>Unit- II: 01 Credit</b>	
<b>Respiration:</b> Aerobic and anaerobic respiration. Glycolysis, Pentose phosphate Pathway, Kreb's Cycle and their regulation. Substrate level Phosphorylation. Gluconeogenesis. Glyoxylate cycle.	04 01
<b>Electron Transport System and ATP synthesis:</b> NADPH DH in plant mitochondria, F <sub>1</sub> -F <sub>0</sub> ATPase, Alternate oxidase system. Chlororespiration.	02
<b>Lipid Metabolism:</b> Synthesis of fatty acids (saturated and unsaturated) and lipids (phospholipids). $\alpha$ , $\beta$ and $\omega$ oxidation.	02 01
<b>Unit-III: 01 Credit</b>	
<b>Mineral Nutrition:</b> Essential and Beneficial elements. Role and deficiency effects of essential nutrient elements.	02
<b>Stress Physiology:</b> 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 01
<b>Sulphur metabolism:</b> Sulphate uptake and its assimilation.	02
<b>Unit- IV: 01 Credit</b>	
<b>Flowering:</b> Floral evocation, Florigen concept, circadian rhythms, Photoperiodism and its regulation. Vernalization.	03
<b>Phytochrome:</b> Its structure, discovery and functions.	02
<b>Various growth and developmental phenomena:</b> Apical dominance, abscission, dormancy (bud and seed), seed germination and Senescence. Plant movements.	02
<b>Nitrogen metabolism:</b> Biological nitrogen fixation-free living and symbiotic organisms, nitrogenase enzyme complex, nodule formation and nod factors. Mechanism of nitrate reduction-nitrate and nitrite reductase. Ammonia assimilation.	02 01

**Practical based on above Unit 1-1V: 01 Credit**

**M.SC. PLANT SCIENCE (SEMESTER-IV)**  
**Paper –VI**  
**CELL BIOLOGY AND PLANT BIOCHEMISTRY: 05 Credits**  
**(w.e.f. July 2018)**

**Total: 40 Hours**

<b>Unit-I: 01 Credit</b>	<b>Hrs.</b>
<b>Structural organization of cell:</b> Cytoskeleton system, organization of microtubules, microfilaments and plasmadesmata.	01
Structure and function of microbodies, golgi apparatus, lysosomes, endoplasmic reticulum, vacuole, ribosomes, nucleus, chloroplast, and mitochondria.	02
<b>Structural organization and functions of :</b> Cell wall and Plasma membrane.	02
<b>Uptake of ions-</b> Passive uptake, facilitated diffusion, ion carriers, channel proteins	02
Primary and secondary active transport, ion pumps ( $\text{Na}^+/\text{K}^+$ and $\text{Ca}^{2+}$ pumps).	02
Membrane transport proteins- Plasma membrane $\text{H}^+$ -ATPase, vacuolar $\text{H}^+$ -ATPase and $\text{H}^+$ pyrophosphatases.	01
<b>Unit –II: 01 Credit</b>	
<b>Plant growth hormones:</b> Structure, function, synthesis, cellular and molecular mechanism of action of-	
Auxins.	02
Gibberellins.	02
Cytokinins.	02
Abscisic acid,	02
Ethylene.	01
Brassinosteroids, Polyamines, Jasmonic acid and salicylic acid.	01
<b>Unit-III: 01 Credit</b>	
<b>Macromolecules:</b> Structures and functions of carbohydrates, Amino acids, Proteins, Lipids and Nucleic acid.	03
<b>Secondary metabolites and their function:</b> <b>Nitrogen containing compounds-</b> alkaloids, Cyanogenic glycosides, Glucosinolates, Non- protein amino acids.	01
<b>Biosynthesis of :</b> Phenylalanine, tyrosine and tryptophan (Shikimic acid pathway)	02
Terpenes (acetate mevalonate pathway).	02
Phenylpropanoids (acetate malonate pathway). Cutins, Suberins, Lignin, Anthocyanins, Chalcones, Isoflavones, Stilbenes, terpenes, Sterols.	02
<b>Unit- IV: 01 Credit</b>	
<b>Enzymes:</b> General aspects, classification, mode of action, allosteric mechanism, regulation,	02
Active sites, reversible and irreversible enzyme inhibition.	01
Enzyme kinetics and Michaelis- Menton equation.	01
<b>Signal transduction:</b> Role of membranes, receptors and G- proteins, Ca-calmodulin cascade, phospholipid signaling.	02
Cyclic nucleotides- adenylyl cyclase.	
Protein kinases-receptor like protein kinase (RLKs), mitogen activated protein kinase (MPAK), cyclin dependent protein kinase (CDK).	02
Protein phosphatase, Auxin, GA and ABA signal transduction.	02

**Practical based on Unit 1-IV: 01 Credit**

**M.Sc. PLANT SCIENCE (Semester-IV)**  
**Paper -VII**  
**BIOTECHNOLOGY AND HUMAN WELFARE: 05 Credits**  
**(w.e.f. July 2018)**

**Total: 40 Hours**

<b>Unit-I PLANT CELL AND TISSUE CULTURE:01 Credit</b>	<b>Hrs</b>
Plant Cell and Tissue culture: Introduction, history, scope, concept of cellular differentiation, totipotency, applications	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
<b>Unit-II GENETIC ENGINEERING: 01 Credit</b>	
Cloning vectors (plasmid and bacteriophage vectors, cosmids BAC and YACs. And Enzymes (restriction endonucleases, polymerases, reverse transcriptase, alkaline phosphatase, polynucleotide kinase, Ligases, terminal transferases)	2
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.	2
Gene libraries and cDNA libraries, Polymerase chain reaction, DNA fingerprinting, DNA Synthesis, DNA Sequencing, Southern blotting	2
<b>Unit-III BIOTECHNOLOGY AND HUMAN WELFARE: 01 Credit</b>	
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	5
Biotechnology in pollution control and phytoremediation	2
Restoration of degraded land -Development of stress tolerant plants, microbes for improving soil fertility	3
<b>Unit-IV BIOTECHNOLOGY- RECENT UPDATE: 01 Credit</b>	
Introduction to Genomics and Proteomics	1
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	1

**Practical based on Unit I – IV: 01 Credit**