SIES

College of Arts, Science & Commerce

RISE WITH EDUCATION

Sion (W), Mumbai – 400022

Program: M.Sc.

Course: BOTANY

Syllabus for M. Sc. Part - I

To be implemented from 2018-19

Credit Based Semester and Grading System with effect from the academic year 2018-19

PREAMBLE

The existing university syllabus of M.Sc. Botany was due for revision as per the CBSGS pattern will be implemented from the academic year 2018-2019 under autonomy.

In the revised autonomous syllabus, the committee has taken utmost care to maintain the continuity in the flow of information at M.Sc. level. Hence, some of the modules of the existing university syllabus have been upgraded with the new modules in order to introduce the learners to the recent developments in various branches of Botany.

All the papers of theory and practicals (Semester-I & Semester-II together) are compulsory to the students.

Each theory period shall be of 60 minutes duration. Theory component shall have 240 instructional periods per semester. Each practical will be of 4 periods and one period is of 60 minutes duration.

MODALITY OF ASSESSMENT:

Theory Examination Pattern

A) Internal Assessment – 40M (30M Presentation/Assignment + 10 Class participation)

B) External examination – 60M (Semester End Theory Assessment)

i. Duration - These examinations shall be of two and half hours duration.

ii. Theory question paper pattern: attached separately.

Practical Examination Pattern:

A. Internal Examination: There will not be any internal examination/ evaluation for practicals.

B. External (Semester end practical examination)

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination. In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head of the Department/ Co-ordinator of the department; failing which the student will not be allowed to appear for the practical examination.

M.Sc. Semester I and II Botany Syllabus (CBGS)
To be implemented from the Academic year 2018-2019
SEMESTER I

Course Code	UNIT	TOPIC HEADINGS	Credit	L / Week
SIPSBOT11	Paper Title: Plant Diversity :CryptogamsI (Algae and Fungi)			
	I	Algae	4	1
	II	Applied Phycology		1
	III	Fungi		1
	IV	Plant Pathology		1
SIPSBOT12	Paper Title: Plant Diversity –Spermatophyta I (Gymnosperms and Angiosperms)			
	I	Gymnosperms I	4	1
	II	Origin of Angiosperms		1
	III	Angiosperms I		1
	IV	Angiosperms II		1
SIPSBOT13	Paper Title: Plant Physiology			
	I	Photosynthesis I (Eukaryotes)	4	1
	II	Photosynthesis II (Prokaryotes)		1
	III	Proteins		1
	IV	Plant Growth Regulators		1
SIPSBOT14	Paper Title: Cytogenetics, Molecular Biology and Biotechnology			
	I	Cytogenetics	4	1
	II	Molecular Biology		1
	III	Recombinant DNA technology		1
	IV	Applications of R-DNA technology		1
SIPSBOTP11	Plant Diversity :Cryptogams I (Algae and Fungi)		2	4
SIPSBOTP12	Plant Diversity –Spermatophyta I (Gymnosperms and Angiosperms)		2	4
SIPSBOTP13	Plant Physiology		2	4
SIPSBOTP14	Cytogenetics, Molecular Biology &Biotechnology		2	4

SEMESTER II

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
SIPSBOT21	Title of the Paper: Plant Diversity : Cryptogams II (Bryophyta and Pteridophyta)			
	I	Bryophyta I	4	1
	II	Bryophyta II		1
	III	Pteridophyta I		1
	IV	Pteridophyta II		1
SIPSBOT22	Title of the Paper: Plant Diversity: Spermatophyta II (Anatomy, Developmental Botany and Palynology)			
	I	Anatomy I	4	1
	II	Anatomy II		1
	III	Developmental Botany		1
	IV	Palynology		1
SIPSBOT23	Title of the Paper: Plant Physiology and Environmental Botany			
	I	Seed Physiology	4	1
	II	Stress Physiology		1
	III	The Environment, Biogeography and Population Ecology		1
	IV	Climate Change		1
SIPSBOT24	Title of the Paper: Medicinal Botany and Dietetics			
	I	Medicinal Botany I	4	1
	II	Medicinal Botany II		1
	III	Dietetics I		1
	IV	Dietetics II		1
SIPSBOTP21	Plant Diversity: Cryptogams II (Bryophyta and Pteridophyta)		2	4
SIPSBOTP22	Plant Diversity: Spermatophyta II (Anatomy, Developmental Botany and Palynology)		2	4
SIPSBOTP23	Plant Physiology and Environmental Botany		2	4
SIPSBOTP24	Medicinal Botany and Dietetics		2	4

Course Code	Topic	Credits: 4
SIPSBOT11	Plant Diversity-Cryptogams I (Algae and Fungi)	

LEARNING OBJECTIVES

The students will be able to -

- ❖ Learn algae and fungi w.r.t. classification, general characteristics, reproduction & life cycles.
- ❖ Study culturing, preservation, cultivation & economic importance
- ❖ Understand Integrated management of diseases & study of some plant diseases.

Unit I: Algae • Classification of Algae up to orders, according to the system proposed by G.M Smith. • General account of the chloroplasts and chromatophores in different groups of algae • Asexual and Sexual spore bearing structures in various groups of algae • Life cycle of *Scytonema*, *Nitella* and *Padina*	1
UNIT 2: Applied Phycology • Culturing of algae and preservation • Contributions of Eminent Algologists in India: M. O. P. Iyengar and T. V. Desikachary. • Economic importance of algae with reference to: Food, Agriculture - Fodder, Biofuel, Biofertilizers, Industry: Agar agar, Medicine, Sewage disposal, Water pollution, Energy production. • Cultivation of algae with special reference to *Chlorella* and *Spirulina*	1
UNIT 3: Fungi • Classification of fungi upto orders, according to the system proposed by Alexopoulos (1962). • General account of vegetative structure of unicellular and multicellular Mycelia, Septa, Hyphal modifications in various groups of fungi • General account of spore bearing organs and their arrangements in various groups of fungi. • Spore release and dispersal – with special reference to Basidiomycotina, Deuteromycotina • Life cycle of *Stemonitis*, *Phytophthora* and *Peziza.* • Mycorrhiza: type, distribution and significance with reference to agriculture and forestry	1

UNIT 4: Plant Pathology • Integrated management of diseases • Study of the following diseases with reference to occurrence, symptoms, causal organism, disease cycle, predisposing factors and control measures of the following diseases: ▪ Red rot of Sugarcane (*Colletotrichum falcatum*) ▪ Blast of Rice (*Pyricularia oryzae*) ▪ Wilt of Arhar/ Tur (*Fusarium oxysporum*) ▪ Green ear of Bajra (*Sclerospora graminicola*) ▪ Angular leaf spot of Cotton (*Xanthomonas axonopodis*)	1

SIPSBOTP11	**Plant Diversity :Cryptogams I (Algae and Fungi)**	**2**
• Study of following type with reference to their systematic position, thallus and reproductive structures: *Scytonema, Lyngbya, Anabaena, Volvox, Scenedesmus, Ulothrix, Enteromorpha, Pithophora, Closterium, Nitella, Padina and Gracilaria.* • Extraction of algal pigments and their separation by paper chromatography. • Culturing of *Chlorella* and *Spirulina* algae • Culturing of *Penicillium* by streak method • Study of the following types with reference to their systematic position, thallus and reproductive structures: *Stemonitis, Saprolegnia, Phytophthora, Penicillium, Peziza, Polyporus, Daedalea, Fusarium and Trichoderma*. • Study of the disease mentioned in the syllabus (theory) with reference to the symptoms, Causal organisms, Disease cycle and Control measures.		

Course Code	Title	Credits
SIPSBOT12	**Plant Diversity – Spermatophyta I (Gymnosperms and Angiosperms)**	4

LEARNING OBJECTIVES

The students will be able to-

- ❖ Learn gymnosperms w.r.t. classification, general characteristics, affinities & life cycles.
- ❖ Study various theories of origin and different systems of classification of angiosperms
- ❖ Understand general characteristics and economic importance of angiospermic families.

Unit I: Gymnosperms I — 1

1. **Classification** of Gymnosperms upto orders according to the system proposed by C. J. Chamberlain.
2. Characters of Gymnosperms which resemble and differ from Pteridophytes, Angiosperms.
3. General characters; affinities and interrelationships of Cycadofilicales, Bennettitales, Cordaitales and Ginkgoales.
4. Life cycle of *Zamia* and *Araucaria*

Unit II: Origin of Angiosperms — 1

1. **Nature of probable ancestors of angiosperms**
   - Isoetes monocotyledon theory
   - Coniferales amentiferae theory
   - Gnetales angiosperm theory
   - Bennettitalean theory
   - Caytonialean theory
   - Pentoxylales theory
2. **Primitive and advanced character in angiosperms.**

Unit : III Angiosperms I — 1

1. Study of following families with reference to its systematic position, distribution, floral formula, floral diagram, affinities, morphological peculiarities, economic important plants and their uses: Menispermaceae, Brassicaceae, Portulacaceae, Sterculiaceae, Meliaceae, Celastraceae, Sapindaceae, Crassulaceae, Lythraceae, Gentianaceae, Boraginaceae, Chenopodiaceae, Cyperaceae

Unit : IV Angiosperms II — 1

1. **International Code of Nomenclature for Algae, Fungi and Plants (I.C.N.)** Principles and Rules and recommendation.

2 Systems of classification

- Introduction to Artificial, Natural and Phylogenetic System of classification
- Bentham and Hooker's system of classification upto orders
- Introduction to A. P. G. systems.

3 Taxonomy as synthetic branch- Introduction, type function values of taxonomic characters- numerical taxonomy, Molecular systematics.

SIPSBOTP12	**Plant Diversity – Spermatophyta I (Gymnosperms and Angiosperms)**	**2**

Gymnosperms: A study of following types

- *Cycadeoidea* (Fossil)
- *Williamsonia* (Fossil)
- *Araucaria*
- *Cupressus*
- *Podocarpus*
- *Zamia*

Angiosperms:

- A study of the angiosperm families mentioned in theory with reference to their morphological peculiarities and economic importance of its members.
- Identification of genus and species with the help of flora (In addition to the above mentioned families, all families studied in undergraduate classes are included)

SEMESTER I

Paper III

Course Code	**Title: Plant Physiology**	**Credits**
SIPSBOT13		**4**

LEARNING OBJECTIVES

The students will be able to-

- ❖ Learn process of photosynthesis in prokaryotes and eukaryotes.
- ❖ Study structural features analysis and folding of proteins.
- ❖ Understand biosynthesis, storage, breakdown, transport and physiological responses PGRs.

Unit I: Photosynthesis I (Eukaryotes) — **1**

1. ATP synthesis in chloroplasts (chemiosmotic hypothesis)
2. Regulation of C_3, C_4 and CAM pathways of photosynthesis:
   C_3 plants: Role of light, regulation of RUBISCO
   C_4 plants: Role of light, regulation of PEPcase, transport of metabolites, carbonic anhydrase, NADP-MDH and PPDK
   Regulation of CAM through transport of metabolites.
3. **Pentose Phosphate Pathway** and its importance, effect of glucose-6-phosphate dehydrogenase deficiency.

Unit II: Photosynthesis II (Prokaryotes) — **1**

Photosynthesis of prokaryotes:
Classification of photosynthetic bacteria**,**
Pigment systems, CO_2 fixation in bacteria and cyanobacteria,
Structure and mechanism of light harvesting complex,
Reductive TCA cycle.

Unit : III Proteins • Primary, secondary, tertiary and quaternary structural features and their analysis – Theoretical and experimental; protein folding – biophysical and cellular aspects, Role of chaperons in protein folding.	**1**
Unit : IV Plant Growth Regulators • Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid, Brassinosteroids and Jasmonic acid; Biosynthesis, storage, breakdown, transport and their physiological responses.	**1**

Practical

SIPSBOTP13	**Plant Physiology**	**2**	**4**

Major experiments

1. Enzyme kinetics: Determination of Km and Vmax of the enzyme amylase (purified amylase).
2. Extraction of cellulase from a suitable fungal culture and study of enzyme activity by DNSA method.
3. Immobilisation of yeast cells and study of invertase activity.
4. Quantitative study of diurnal fluctuation in Titratable Acid Number (TAN) in a CAM plant.
5. Extraction and estimation of GOT and GPT from suitable plant material.
6. Estimation of the total nitrogen content of a plant using Kjeldahl's method.

Minor experiment

1. Separation of organic acids by paper chromatography.
2. Separation of sugars by paper chromatography.
3. A study of the enzyme polyphenol oxidase, from potato peels.
4. Solvent extraction of chlorophyll a/b, xanthophylls and study of absorption pattern.
5. Determine the Chl a/Chl b ratio in C_3 & C_4 plants.

MSc Sem I Paper IV

Course Code	Title	Credits
SIPSBOT14	**Cytogenetics, Molecular Biology and Biotechnology**	**4**

LEARNING OBJECTIVES

The students will be able to-

- ❖ Learn Steps in cell cycle and its control.
- ❖ Study microbial Genetics w.r.t. transformation, transduction, Conjugation & fine structure of the gene.
- ❖ Understand Recombinant DNA Technology & its application in plant improvement.

Unit I: Cytogenetics Cell division and cell cycle: Steps in cell cycle and control of cell cycle.

Check points during cell cycle-G_1 to S, progression of S phase, G_2 to M phase, Anaphase check points and components involved as regulators of check points, role of cyclins and CDKs, synthesis and degradation of cyclins, structural features of CDKs and cyclins, activation and inactivation of cyclin dependent kinases; role of E2Fs, and DP proteins, P53, different types of Cyclin dependent CDKs, CDC25, CAKs, Wee1 proteins, nim-proteins, SCFs, Anaphase Promoting Complexes APC (cyclosomes), licensing factors, replication origin and replication initiation complexes.

Centrosome activation- structure, duplication of centrosomes, Role of nucleophosmins, organization of mitotic apparatus, binding of tractile fibers to kinetochore complexes, molecular motors involved in movement of chromosomes to equatorial plate and in anaphase movement; cytokinesis by cleavage and phragmoplast formation- different gene products and structures involved and the mechanisms of cytokinesis.

Unit II: Molecular Biology

Microbial Genetics: Molecular basis of transformation, transduction, Conjugation; fine structure of the gene, T4 Phage, complementation analysis, deletion mapping, cis-trans tests.

Tetrad analysis in *Neurospora:* Linkage detection (2 genes and centromere)

Unit : III Recombinant DNA Technology

General information on SV-40, Vaccinia, Baculovirus & retroviral vectors.

Use of YAC or YEp of yeast (*Saccharomyces cervisiae*) as effective cloning vectors because of their high copy numbers in production of HBsAg vaccine

Use of BAC and its advantages

Strategies to create Transgenic plants with herbicide resistance: Following strategies to be studied in detail with reference to herbicide Glyphosate resistance:

a) Overexpression of the target protein by using a strong promoter.

b) Improved plant detoxification resulting in a more and faster conversion of toxic herbicide to non toxic or less toxic compound.

c) Detoxification of herbicide by using a foreign gene.

d) Mutation of target protein

Methods of modifying the Diazotrophs (N_2 fixing bacteria) by Gene alterations in *Rhizobium* sp. to a) Improve nitrogen fixing efficiency and bacteria host plant interaction. b) Induce symbiotic relationship with non- leguminous plants such as wheat, rice and corn c) Transfer of gene for nitrogen fixation from *Rhizobium* sps. to other bacteria such as *Agrobacterium tumefaciens.*	
Unit : IV Applications of Recombinant DNA technology **Resistance to biotic stress:** a) Transgenic plants with insect resistance: Resistance genes from microbes: Gene from *Bacillus thuringenesis*, Cholesterol oxidase of *Streptomyces* culture filtrate, Isopentenyl transferase gene from *Agrobacterium tumefaciens* Resistance genes from higher plants: Genes for Proteinase inhibitors: eg. Cowpea trypsin inhibitor gene (CpTi), Genes for alpha amylase inhibitors. b) Transgenic plants with viral resistance: Employing virus encoded genes or virus coat proteins; e.g. Transgenic tobacco plants expressing tobacco mosaic virus coat protein gene were developed which express high level of resistance to TMV **Improvement of nutritional content and Quality:** a) Increase in sweetness and flavor in fruits and vegetables for e.g. Monellin gene from African plant (*Dioscorephyllum cumminsii*)- introduction in tomato and lettuce b) Increase and change in the quality oils in *Brassica* species (increase in medium chain fatty acids and converting unsaturated fatty acid to saturated fatty acids). c) Increase in starch content (potato). **Transgenics for delayed fruit ripening and extended shelf life**-Tomato. **Transgenic plants**: Plantibodies, vaccines, Biopolymers and vitamins. **Transgenic plants in floriculture**: Increase in the shelf life of cut flowers - (Carnation flowers), Genetic engineering of Orchids, Genetic manipulation of flower pigmentation. **Genetic engineering for inducing Male Sterility in plants.** **Transgenic plants for enhancing phytoremediation.**	

MSc Sem 1 Paper IV Practical

SIPSBOTP14	**Cytogenetics, Molecular Biology and Biotechnology**	2
	1. Preparation of cytological stains, fixatives and pretreatment agents. 2. Squash preparation from pre-treated root tips (colchicines/ Paradichlorobenzene/ Aesculin. 3. Squash preparation from mutagen treated root tips for study of aberrations. 4. Smear preparation from any suitable plant material. 5. Problems based on: a. Restriction map analysis and construction of restriction maps, b. Tetrad analysis in *Neurospora* – two genes and centromere. c. Deletion mapping in Bacteriophage.	

REFERENCE BOOKS

- Alberts. B., Bray, D., Lewis, J., Raff, M., Roberts, K and Watson, J.D. (1994). Molecular Biology of the cell. Garland Publisher Inc., New York.
- Altman, A (1997), Agricultural Biotechnology. CRC Press.
- Ashwini Kumar and Sudhir K.Sopory (2008) Recent Advances in Plant Biotechnology and its applications Prof. Karl- Hermann Commemorative Volume, IK International Publishing House Pvt. Ltd.
- Benjamin L. (2004) Genes, Oxford University Press.
- Brown Terence A. (2002) Genomes, Oxford: Wiley-Liss; John Wiley sons.
- Buchnan B.B., W,Gruissem and R.L.Jones (2004) Biochemistry and Molecular biology of Plants by I.K. International Pvt., Ltd., New Delhi.
- Chamberlain C. J. and Coulter J.M., (1910), Morphology of Gymnosperms. Wentworth Press.
- Chamberlain C.J. (1935) Gymnosperms Structure and Evolution. CreateSpace Independent Publ. Platform.
- Channarayappa (2007) Molecular Biotechnology : Principles and practice , Universities Press Pvt Ltd.
- Clark,P.D. and Pazdernik, J.N. (2009). Biotechnology. Elsevier Academic press, London.
- Cole A. J. (1969), Numerical Taxonomy, Academic Press, London.
- Cooper Geoffrey M. And Hausman Robert E. (2009). The Cell – A Molecular Approach, 5th Edition, ASM Press and Sinauer Associates INC.
- Cronquist A. (1981), An integrated system of classification of flowering plants, Columbia University Press, N.Y.
- Daneil J.H and Lodish D. (1995). Molecular Cell Biology. Baltimore Scientific American

- Davis, P. H and Heywood V. H., (1963), Principles of angiosperm taxonomy, Oliver and Boyd, Edinburgh.
- De Robertis E D P, De Robertis E M F (1988), Cell and molecular biology, International Ed. Inst. Med. Ltd.
- Elliot and Elliot. (2001). Biochemistry and Molecular Biology. Oxford University Press.
- Gerald Karp. (1996). Cell and Molecular Biology. John Wiley and Sons. Inc.
- Glick B. and Pasternak J. (2003) Molecular Biotechnology: Principles and Applications of Recombinant DNA, 3rd Edition, American Society of Microbiology.
- Goodwin T. and Mercer E. (2005) Introduction to plant biochemistry, CBS publication.
- Henry A.N. and Chandrabose M.,(1980), An aid to ICBN, Today tomorrow printers and publishers.
- Heywood, V.H. (1967), Plant Taxonomy, Edward Arnold publishers, London.
- Hyde David R. (2010) Genetics and Molecular Biology, McGraw Hill Publ.
- James W. D. (2013). Molecular Biology of the Gene, Pearson Publ.
- Jeffery, C. (1973). Biological Nomenclature, Edward Arnold publishers, London.
- Jones S. (1987). Plant systematics, Tata-MacGraw Hill Publishers, Co. Ltd.
- K.R. Sporne (1965). The morphology of gymnosperms. Scientific Publ. Jodhpur.
- Lawrence G.H.M. (1967), Taxonomy of Vascular plants, Oxford and IBH publishers.
- Lewis R. (2001). Human Genetics, Concepts and applications. MacGraw Hill Publ.
- Lodish,H., Ber, A., Zipuoskry, L.S., Matsudaira, P., Bahimore, D and Damell J. (2001)
- Molecular Biology W.H Freeman G Co. 47.
- Molls M., Vaupel P., Nieder C., Anscher M.S. (2009) The Impact of Tumor Biology on Cancer Treatment and Multidisciplinary Strategies, Springer Science and Business Media.
- Mondal A.K. (2005). Advanced plant taxonomy, New Central book agency (p) Ltd, London.
- Naik V.N. (1999). Taxonomy of Angiosperms, Tata-MacGraw Hill Publishers, Co. Ltd.
- Nigg Erich A. (2004) Centrosomes in development and disease, Wiley- VCH Verlag GmbH & Co. KGaA.
- Pollard J.P. and W.C. Earnshaw. (2016). Cell Biology 3rd Ed., Elsevier Publ.
- Russell PJ (2001) iGenetics: A molecular Approach. Pearson Publ.
- Sharma O.P. (1993). Plant Taxonomy. Tata-MacGraw Hill Publ.
- Simmons M.J., Gardner E.J. and Snustad D. P. (2006). Principles of Genetics 8th Ed., John Wiley and Sons.
- Singh G., (1999), Plant Systematics, Oxford and IBH publishers.
- Sivarajan V.V. (1991), Introduction to principles of plant taxonomy, Oxford and IBH publishers, New Delhi.
- Sivarajan V.V., (1991). Introduction to Principles of plant Taxonomy, Oxford and IBH publishers.

- Slater, A., Scott, W.N. and Flower, R.M. (2008). Plant Biotechnology. 2nd edition. Oxford University Press Inc., New York.
- Sneath R.H.A. & Sokal R.R., (1973). Numerical Taxonomy, W.H. Freeman and Company, Sanfransisco.
- Taiz L. and Zeiger E. (1991) Plant physiology, Sinauer Associates
- Vashishta P.C (1983). Gymnosperms. VAS g. Publisher, New Delhi.
- Vasudevan N. R. (1997). Plant systematics, Oxford and IBH publishers.
- Voet D. and Voet J. (1998). Fundamentals of biochemistry, Wiley publishers.
- Zubay G. (1995) Biochemistry, Brown Co. USA.

M.Sc. Semester I and II Botany Syllabus (CBGS)
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SEMESTER II

Course Code	Title	Credits
SIPSBOT21	**Plant Diversity- Cryptogams II (Bryophyta and Pteridophyta)**	**4**
LEARNING OBJECTIVES The students will be able to- ❖ Learn bryophytes w.r.t. origin, evolution, classification, general characteristics, economic importance & life cycles. ❖ Study classification & lifecycles in Pteridophytes ❖ Understand the geological time scale, fossils & ethnomedicinal uses of Pteridophytes		
Unit I: Bryophyta I 1. Classification of Bryophyta, upto orders, according to the system proposed by G. M. Smith. 2. Alternation of generation in Bryophyta. 3. Contribution of Shiv Ram Kashyap and S. C. Srivastava in Bryology. 4.Type study of *Targionia* and *Pogonatum*		1
Unit II: Bryophyta II 1.Origin and evolution of Bryophyta with reference to habitat and form 2. Evolution of the Sporophyte in Bryophyta 3. Bryophytes as bioindicators 4. Economic importance of Bryophytes		1
Unit : III: Pteridophyta I 1. Classification of Pteridophyta, upto orders, according to the system proposed by G.M.Smith. 2. Heterospory and seed habit 3. Life cycle of *Psilotum*, *Pteris* and *Salvinia*		1

Unit : IV Pteridophyta II 1. The geological time scale and a study of fossil Pteridophytes *Horneophyton, Cladoxylon, Sphenophyllum, Coenopteris*) 2. Cultivation and maintenance of ornamental Ferns. 3. Abnormalities in the life cycle - Apogamy and Apospory 4. Ethnomedicinal uses of Pteridophytes	1

Practicals

Course Code	Title	Credits
SIPSBOTP21	**Plant Diversity-Cryptogams II (Bryophyta and Pterdiophyta)**	**2**
1. Study of vegetative and reproductive structures in *Targionia Plagiochasma Fimbraria, Pellia* and *Pogonatum*. 2. Study of vegetative and reproductive structures in : *Isoetes, Ophioglossum, Pteris, Angiopteris, Lygodium* and *Salvinia* 3. Study of fossils :*Horneophyton, Cladoxylon, Sphenophyllum, Coenopteris*		

Course Code	Title	Credits
SIPSBOT22	**Plant Diversity- II (Anatomy, Developmental Botany and Palynology)**	**4**
LEARNING OBJECTIVES The students will be able to- ❖ Learn plant anatomy w.r.t. Meristems, Morphogenesis and organogenesis in plants, Sensory and tactile tissue system & Wood Anatomy. ❖ Study various aspects of developmental botany. ❖ Understand pollen chemistry, palynotaxonomy & Utilization of pollens.		
Unit I: Anatomy I 1. **Meristems:** Definition type of meristems, apical cell theory, histogen theory and Tunica corpus theory 2. **Morphogenesis and organogenesis in plants**: Organization of shoot and root apical meristems; shoot and root development, leaf development and phyllotaxy; transition of flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*		1
Unit II: Anatomy II 1. **Study of Tissue system:** **Sensory and tactile tissue system**: Tactile sense organs, gravitational and optical sense organs. **Secretory Tissues:** Introduction, Glands, Digestive glands, Nectaries, Resin ducts and oils ducts, Laticiferous ducts.		1

2. **Wood Anatomy:** Coniferous and Angiosperm wood Parenchyma: Storied and non-storied wood parenchyma, Distribution of axial parenchyma Distribution of vessels Structure of rays Characters used in identification of wood.	
Unit : III Developmental Botany 1. Male gametophyte: Pollen development and gene expression male sterility sperm dimorphism and hybrid seed production; pollen tube growth and guidance. 2. Female gametophyte; Types of embryo sacs; structure of embryo sac cells. 3. Pollination: Ultrastructural and histochemical details of style and stigma, self and interspecific incompatibility, significance of pollen-pistil interaction, role of pollen wall proteins and stigma surface proteins, barriers to fertilization, methods to overcome incompatibilities, intra-ovarian pollination; in-vitro pollination. 4. Fertilization: heterospermy, differential behavior of male gametes, discharge and movement of sperms; syngamy and triple fusion, post-fertilization metabolic & structural changes in embryo-sac. 5. **Seed development and fruit growth**; endosperm development during Early Maturation and Desiccation stages; embryogenesis, ultrastructure and nucellar cytology; cell lineage during late embryo development; storage proteins of endosperm and embryo; apomixis; embryo culture; dynamics of fruit growth; biochemistry and molecular biology of fruit maturation.	1
Unit : IV Palynology 1. Special relationships of pollen grain in pollen tetrads. 2. Pollen Chemistry: Introduction, Chemical constituents of pollen-Major metabolites (Carbohydrates, Mineral content, Callose, Organic acids, Amino acids, Pigments, Vitamins, Hormones and steroids), Chemistry of pollen wall, Pollen wall proteins. 3. Palynotaxonomy: Introduction, Systematic palynology- Palynotaxonomy of monocots (Pandanales, Glumiflorae, Principes, Liliiflorae and Scitaminae) and dicots (Centospermae, Rhoeadales, Rhamnales, Malvales, Umbelliflorae), Evolutionary trends among pollen grains based on palynotaxonomical work. 4. Utilization of pollen: Pollen as health food, Pollen as medicine, Pollen allergens for diagnosis and therapy.	1

Practicals

Course Code	Title	Credits
SIPSBOTP22	**Spermatophyta II** **(Anatomy, Developmental Botany and Palynology)**	**2**
	1. Study of wood elements in *Annona*, *Michelia*, *Sterculia* and *Thuja* & *Araucaria* using the maceration technique. 2. Study of the following leaves with respect to leaf surface characters (wax, cuticle, epidermis, stomata, epidermal outgrowth): *Pistia*, *Ficus*, *Avicennia* and *Peperomia.* 3. Study of vessels, parenchyma: Axial & Ray Parenchyma – Apotracheal: Terminal, Diffuse, Banded, Reticulate; Paratracheal: Vasicentric, Aliform, Confluent, Abaxial. Ray Parenchyma &Rays: Homogenous & Heterogenous Wood Fibres from dicotyledonous wood by temporary preparation. 4. Mounting of Glands- salt glands of halophytes- *Avicennia*, *Ipomoea biloba*, *Sesuvium/Suaeda* Nectaries- Euphorbiaceae & Combretaceae (at least 3 examples from each family) Resin ducts- Pinus Oils ducts- *Citrus*, *Eucalyptus*, *Murraya* Laticiferous ducts Apocynaceae & Asclepiadaceae. Digestive glands- From permanent slides/ photomicrograph 5. Microtomy- Processing of material, Block making & staining (5 slides for submission). 6. Camera lucida sketches of parenchyma/ rays. 7. A study of Microsporogenesis, Megasorogenesis, ovules & types of embryo sacs with the help of permanent sides/photomicrographs. 8. *In vitro* germination of pollen grains, effect of temperature on pollen viability and short-*term* storage. 9. Detection of amino-acids, sugars and lipids by paper/ Thin layer chromatography from pollen grains. 10. Study of the morphology of the pollen (using Chitale's and acetolysis method) from the families; <u>studied in sem I & II</u>	

SIPSBOT23	Plant Physiology and Environmental Botany	4

LEARNING OBJECTIVES

The students will be able to -

- ❖ Learn various aspects of seed and stress physiology of plants
- ❖ Study the causes, harmful effects & remedies for Climate Change.
- ❖ Understand the concepts in Environment, Biogeography and Population Ecology

UNIT I: **Seed physiology:** 1. Physiology and Biochemistry of seed germination, Mobilization of food reserves, Germination and growth factors. 2. Seed dormancy, Control and release of seed dormancy. 3. Factors in control for the long term storage of seeds, seed proteins.	1
UNIT II: **Stress Physiology:** 1. Biotic and abiotic stress, Response of plants to Biotic (pathogenic and insects) stress, Adaptations to eliminate and tolerate the infection, Hypersensitive reaction. 2. Response of plants to abiotic stress - Drought stress, Heat stress - Heat shock proteins, Chilling, and freezing, Salinity stress 3. Signaling pathways activated during stress.	1
UNIT III: **The Environment, Biogeography and Population Ecology**: 1. Environment: Components, Major components of physical environment, biotic and abiotic interactions, 2. Biogeography: Major terrestrial biomes, Theory of island bio-geography, Bio-geographical zones of India. 3. Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection).	1
UNIT IV **Climate Change:** 1. Global warming, carbon credits, Kyoto mechanism. 2. Factors responsible for climate change, Climate change in relation to the changes in patterns of temperature, precipitation and sea level rise, Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem. The Montreal Protocol, Paris Agreement, UNFCCC, IPCC. 3. Adaptation Strategy/ Mitigation Measures, Blue carbon initiative.	1

Practicals

SIPSBOTP23	Plant Physiology and Environmental Botany	2
	• Practical exercises are planned for better understanding of the state of environment, rather than 5-hour units. • Field exercises are expected to be completed during excursion and field diaries are to be maintained for submission during tests. • Other practical work can be carried out in the laboratory with help of plant and soil samples collect from the field. **Major experiments** 1. Breaking of seed dormancy by Physical and Chemical methods 2. Assessing seed viability by TTC method 3. Determination of Nygard index of algae in a water body. 4. Determination of dust load on lives of roadside plant. 5. Comparison of two population of a species collected from two areas. 6. Determination of primary production of an area by harvest method. 7. Determination of primary production of an area by chlorophyll method. 8. Determination of primary aquatic production by harvest method. 9. Determination of mechanical composition of soil by international pipette method. **Minor experiments** 1. Effect of water and salinity stresson chlorophyll content of leaves. 2. Effect of water and salinity stress on Proline content of leaves. 3. Determination of Stomatal Index of leaves 4. Determination of epidermal architecture of leaves. 5. Determination of LAI of different types of trees. 6. Assessment of pollution in ambient air, on the basis of injured leaf area. **Field exercises** 1. Assessment of erosion status of land along a 'stream' on a slope or on flat land. 2. Assessment of status of waste land, on the basis of its appearance and visible plant growth. 3. Assessment of degradation of a forest on the basis of its canopy cover, height, strata & species diversity.	

SEMESTER – II, PAPER – IV

Course Code	Title	Credits
SIPSBOT24	**Medicinal Botany and Dietetics**	4

LEARNING OBJECTIVES

The students will be able to-

- Learn herbal medicines & crude drugs.
- Study Nutraceuticals w.r.t. Role in health benefits, Current trends and future prospective of nutraceuticals.
- Understand Plant food in the treatment of diseases & source of antioxidants.

Unit I: Medicinal Botany I

Monograph of drugs with respect to Biological source, Geographical distribution, macro and microscopic characters, chemical constituents and therapeutic uses of the following drugs:

Root: *Withania somnifera* (Ashwagandha)
Rhizome: *Zingiber officinale* (Ginger)
Stem bark: *Cinnamom zeylanicum* (Cinnamom) and *Holarrhena antidysenterica* (Kurchi)
Leaf: *Azadirachta indica* (Neem)
Fruit: Foeniculum vulgare (Fennel)
Seed: *Plantago ovata* (Isabgol*)*

Unit II: Medicinal Botany II

Introduction to Pharmacopeia: Indian pharmacopeia and Ayurvedic pharmacopeia

Quality control of crude drugs:

- Morphological examination – Exomorphic characters
- Microscopical evaluation – Anatomical characters
- Preliminary phytochemical tests.
- Development of standardization parameters – Moisture content, Ash values, Solvent extraction value, bitterness value, foaming index, swelling index and heavy metal.

Unit III: Dietetics I

Nutraceuticals:

- Definition and Introduction, classification (Dietary supplements, functional foods, Medicinal food, Pharmaceuticals)
- Role of plant nutraceuticals in health benefits (onion, garlic, tomato, carrot, beet, turmeric).
- Current trends and future prospective of nutraceuticals.

Unit IV: Dietetics II Plant Food as medicine

- Plant food in the treatment of diseases – arthritis, constipation, diarrhoea, diabetes, hypertension, cancer, jaundice, memory and piles
- Concept of Antioxidants, their significance, Plants as a source of antioxidants.

Course Code	Title	Credits
SIPSBOTP24	**Medicinal Botany and Dietetics**	2

Medicinal Botany –I

1. A study of the macroscopic and microscopic characters and identification of active ingredients of drugs mentioned in the syllabus for theory by means of chemical tests.

- Root: *Withania somnifera* (Ashwagandha)
- Rhizome: *Zingiber officinale* (Ginger)
- Stem bark: *Cinnamom zeylanicum* (Cinnamom) and *Holarrhena antidysenterica* (Kurchi)
- Leaf: *Azadirachta indica* (Neem)
- *Fruit: Foeniculum vulgare* (Fennel)
- Seed: *Plantago ovata* (Isabgol*)*

Medicinal Botany -II

2. Determination of Moisture content of Ash values, Solvent extraction value of the given sample.

3. Determination of foaming index of the given sample.

4. Determination of swelling index of the given sample.

Nutraceuticals

1. Estimation of lycopene by TLC
2. Amino acid profile of a plant/plant product
3. Identification of plants Nutraceuticals for health benefits (As per theory topics)

REFERENCES BOOKS

- Bhowmik D., Gopinath H., Pragati Kumar B., Duraivel S., Sampath Kumar K. P. (2013), Nutraceutical –A Bright Scope and Opportunity of Indian Healthcare Market, The pharma innovation Vol. 1 (11), pp. 29- 41.
- Brain K.R. & Turner T. D. The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol.
- Brain K.R. & Turner T. D.: ThePractical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol.
- Broin Deiric and Kirby Peader (2016) Adapting to Climate Change: Governance Challenges,
- Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited.
- Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited.
- Chapman, J and Reiss M. (2005) Ecology Principles and Applications, Cambridge
- Conn & Stump f. (1987) Outlines of Biochemistry, John Willey and Co.
- Dakshini K.M.M. (1999) Principle and Practices in Plant Ecology, CRC, Boston.
- Dam Jan (2003), Impacts of Climate Change and Climate Variability on Hydrological Regimes, Cambridge University Press.
- Dash M.C. (1994) Fundamentals of Ecology, Tata McGraw Hill, New Delhi.
- Dash Sushil Kumar (2007), Climate Change – An Indian Perspective, Cambridge University Press India Pvt. Ltd.
- Dennis and Turnip (1990) Plant Physiology, Biochemistry and Molecular Biology, Longman
- Dubash N. (2011) Handbook on Climate Change and India: Development, Politics and Governance, Oxford Publications.

- Dutta Soumya, Ghosh Soumitra, Gopalakrishnan Shankar, Bijoy C. R., Hadida Yasmin, Luxemburg Rosa Stiftung (2013) Climate Change and India, South Asia, Centre for International Co-Operation, New Delhi.
- E. Kirsten Peters (2012) The Whole Story of Climate: What Science Reveals About the Nature of Endless Change.
- Feenstra Jan F., Ian Burton, Joel B. Smith, Richard S.J. Tol, (2007) Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies, United Nations Environment Programme (UNEP), 1998 IPCC Fourth Assessment Report – The AR4 Synthesis Report, Cambridge University Press.
- Goel M. (2014) Carbon Capture, Storage and Utilization: A Possible Climate Change Solution for Energy Industry.
- Harbone J. B.: Phytochemical Methods: A guide to modern techniques Analysis: Chapman& Hall, London.
- Hensen R. (2006) The Rough Guide to Climate Change, First Edition, Rough Guides Publishers.
- Ingegnoli V. (2002) Landscape Ecology: A widening foundation, Springer, Bonn.
- IPCC Fifth Assessment Report (2014) Working Group I, II, III Report, Cambridge University Press.
- Iyengar M. A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press Manipal.
- Iyengar M. A.: Pharmacognosy of Powdered Drugs; Manipal Power Press, Manipal.
- Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune.
- Kokate C. K.: Practical Pharmacognosy; Vallabh Prakashan.
- Kokate C.K., Purohit A. P. & Gokhale S. B.: Pharmacognosy; Nirali Publications, Pune.
- Kormondi E.J. (1999) Concepts of Ecology, Prentice Hall of India, New Delhi.
- Kreb C.J. (1989). Ecological Methodology. Harper & Row, NewYork, USA
- Misra R. (1968) Ecology work book. Oxford & IBH New Delhi
- Molles M.C. Jr. (1999) Ecology- Concepts and Application, McGraw Hill, New Delhi.
- Odum E. and Barrett G. (2005) Fundamentals of Ecology, Thomson Asia Pvt. Ltd., Singapore.
- Odum E. P. (1996) Fundamentals of Ecology, Nataraj Publisher, Dehradun.
- Pachauri R. K. (2010) Dealing with Climate Change: Setting a Global Agenda for Mitigation and Adaptation.
- Pandey and Sinha (1987) Plant Physiology, Vikas Publishing House.
- Patil C. S. (2011) Current trends and future prospective of Nutraceuticals in health promotion, BIOINFO Pharmaceutical Biotechnology, Volume 1, Issue 1, pp.01-07
- Rajagopalan R. Environmental Studies from Crisis To Cure (2nd Edition),
- Rajam Parasuram (2011) Nutraceutical an area of tremendous scope, IJRAP, 2(2), pp. 410-415.
- Ramesh M. (2018) The Climate Solution: India's Climate Change Crisis and What We Can Do About It.
- Rana S.V.S. (2005) Essentials of Ecology and Environmental Sciences, Prentice Hall of India, New Delhi.
- Satapathy S., Porsché Ilona, Künkel Nana (2011) Adaptation to Climate Change with a Focus on Rural Areas and India, GIZ and Ministry of Environment and Forests, Govt. of India.
- Saxena H. (2014) Environmental Ecology, Biodiversity and Climate Change: Towards Sustainable Development.

- Smith, R.L (1996). Ecology and field biology, Harper Collins, New York
- Statistics Related to Climate Change, India (2013) Ministry of Statistics and Programme Implementation, Government of India, New Delhi.
- Taiz and Zeiger Plant Physiology, Sinauer association Inc.
- The Indian Pharmacopeia: The Controller of Publication; Delhi.
- Trease D. & Evans W. C. (2009) Text Book of Pharmacognosy: W. B. Saunders Publ.
- Trease D. & Evans W. C. Text Book of Pharmacognosy, W. B. Saunders.
- Tyler V.E., Brady L.R. & Robbers J. E. (1988) Pharmacognosy; Lea & Feibger, USA.
- Vasudevan T. N. and Laddha K. S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon
- Verma V. (2011) Plant ecology, Ane book publication.
- Wagner, Bladt & Zgainski; Plant Drug Analysis; Springer Verlag.
- Wallis T. E.; Text Book of Pharmacognosy; CBS Publishers, Delhi.
- Wilkins M., (1984) Introductory Plant Physiology Pitman Publication Ltd,

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First/Second Semester

Class: MSc Part I **Sub: Botany** **Paper: I/II/III/IV**

Day: **Date:** **Time:** **Marks: 60**

N.B.: **1) All questions are Compulsory.**

2) Figures to the right indicate marks.

3) Draw neat labelled diagrams wherever necessary.

Q.1	Unit I: Long answer question	**(12)**
	OR	
	Unit I: Long answer question	
Q.2	Unit II: Long answer question	**(12)**
	OR	
	Unit II: Long answer question	
Q.3	Unit III: Long answer question	**(12)**
	OR	
	Unit III: Long answer question	
Q.4	Unit IV: Long answer question	**(12)**
	OR	
	Unit IV: Long answer question	
Q. 5	Write notes on **any three** of the following:	**(12)**
a.	Unit I	
b.	Unit II	
c.	Unit III	
d.	Unit IV	
e.	Unit I / Unit II	
f.	Unit III / Unit IV	

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