DEPARTMENT OF BOTANY

Syllabus and Scheme of Examination

M. Sc. Botany

Maharshi Dayanand University

Rohtak 124001

DEPARTMENT OF BOTANY

Credit Matrix for M. Sc. Botany Program w.e.f. 2016-17

Semester	Core Paper	Discipline Specific Elective	Open Elective	Foundation Course	Dissertation	Total
I	28	-	-	-	-	28
II	20	4	3	2	-	29
III	16	8	3	-	-	27
IV	8	-	-	-	20	28
Total	72	12	6	2	20	112

REQUIRED CREDITS FOR M.SC. BOTANY TWO YEAR PROGRAM

Total Credits = 112
Core Papers Credits = 92
Discipline Specific Elective papers = 12
Open Elective = 6
Foundation Course = 2

INSTRUCTIONS FOR THE STUDENTS

- **Core Papers (C):** There are core courses in every semester. These courses are to be compulsory studied by a student as a core requirement to complete the requirement of programme in a said discipline of study.
- **Discipline Specific Elective (D):** This is a course which can be chosen from a pool of papers floated by the department. It will be supportive to the discipline of study & mandatory as per course curriculum.
- **Foundation Course (F):** The foundation course is based upon the content that leads to knowledge enhancement. It is mandatory as per course curriculum.
- **Open Elective (O):** Open elective course may be from an unrelated discipline. It is interdisciplinary/open Elective & mandatory as per course curriculum.

Programme Specific Outcomes:

PSO1 Students will have core knowledge of the taxonomy, anatomy, morphology, systematics, genetics, physiology and ecology of plants, with particular emphasis on floristic diversity and ecosystem composition

PSO2 Students will be able to demonstrate a working knowledge of the foundational concepts of Botany, including cellular, organismal and evolutionary biology.

PSO3 Students will be to integrate floristic, ecological, physiological and biotechnological principles to better understand the functioning of biological systems.

PSO4 Students will be able to make observations and collect data in laboratory and in field courses and to analyze these results, derive conclusions and report their findings in the form of research papers, project reports and dissertations.

PSO5 Students would gain basic understanding of laboratory and field safety issues.

DEPARTMENT OF BOTANY

Choice Based Credit System (CBCS)

Examination Scheme of M.Sc. Botany (Semester system w. e. f. the academic session 2016-17

1st Semester							
Sr.No.	**Course Code**	**Nomenclature of the Paper**	**Type of paper**	**No. of Credits**	**Marks**		
					Theory	**Int. Ass.**	**Total**
1	16BOT21C1	Cell and Molecular Biology	Core Course	4	80	20	100
2	16BOT21C2	Cryptogamic Botany	Core Course	4	80	20	100
3	16BOT21C3	Plant Biotechnology - I	Core Course	4	80	20	100
4	16BOT21C4	Plant Anatomy and Diversity of Gymnosperms	Core Course	4	80	20	100
5	16BOT21C5	Plant Reproduction	Core Course	4	80	20	100
6	16BOT21CL1	Lab Course-I (Based on 16BOT21C1-3)	Core Course	4	-	-	100
7	16BOT21CL2	Lab Course-II (Based on 16BOT21C4 &5)	Core Course	4	-	-	100
Sub Total Credits				**28**			
	2nd Semester						
8	16BOT22C1	Plant Biochemistry and Metabolism	Core Course	4	80	20	100
9	16BOT22C2	Taxonomy of Angiosperms	Core Course	4	80	20	100
10	16BOT22C3	Plant Development	Core Course	4	80	20	100
11	16BOT22D1 **or**	Plant Biotechnology-II **or**	Discipline specific Elective	4	80	20	100
12	16BOT22D2	Tools and Techniques		4	80	20	100
13		Open Elective*	Open Elective	3			
14		Foundation Course**	Foundation Course	2			
15	16BOT22CL	Lab Course-I (Based on 16BOT22C1& C2)	Core Course	4	100	--	100
16	16BOT22DL	Lab Course-II Based on 16BOT22C3 & D1/D2)	Core Course	4	100	--	100
Sub Total Credits				**29**			

Students will choose one discipline specific paper out of 16BOT22D1 and 16BOT22D2

*To be chosen from the pool of papers provided by the university

** To be chosen from the pool of papers provided by the university

DEPARTMENT OF BOTANY

Choice Based Credit System (CBCS)

Examination Scheme of M.Sc. Botany (Semester system w. e. f. the academic session 2016-17

	3rd Semester						
Sr.No.	**Code No.**	**Nomenclature of the Paper**	**Type of paper**	**No. of Credits**	**Theory Marks**	**Internal assessment**	**Total marks**
17	17BOT23C1	Plant Physiology	Core Course	4	80	20	100
18	17BOT23C2	Plant Ecology	Core Course	4	80	20	100
19	17BOT23DA1 **or**	Microbiology and Pathology **or**	Discipline specific course	4	80	20	100
20	17BOT23DA2	Computer Applications & Biostatistics		4	80	20	100
21	17BOT23DB1 **or**	Evolutionary and Economic Botany **or**	Discipline specific course	4	80	20	100
22	17BOT23DB2	Plant Breeding and Cytogenetics		4	80	20	100
23	-	Open Elective*	Open Elective	3			
24	17BOT23CL	Lab Course-I (Based on 17BOT23C1 & C2)	Core Course	4	100	-	100
25	17BOT23DL	Lab Course-II (17BOT23DA1/DA2 & DB1/DB2)	Core Course	4	100	-	100
Sub Total Credits				**27**			
4th Semester							
26	17BOT24C1	Plant Genetics	Core course	4	80	20	100
27	17BOT24C2	Biodiversity Conservation	Core course	4	80	20	100
28	17BOT24C3	Dissertation		20	300	-	300
Sub Total Credits				**28**			
Grand Total Credits of all the four Semesters 112							

Students will choose one discipline specific elective paper out of 17BOT23DA1 and 17BOT23DA2
Students will choose one discipline specific elective paper out of 17BOT23DB1 and 17BOT23DB2
* To be chosen from the pool provided by the university

M. Sc. Botany (Semester-I)
16BOT21C1 - Plant Cell and Molecular Biology

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will understand the structural organization of cell and intracellular organelles.
CO2 Students will understand the general principles of cellular communication and roles of different adhesion molecules
CO3 Students will have sound knowledge of replication, transcription and translation.
CO4 Students will have basic understanding of gene expression at transcription and translation level.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note:
1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT –I

Cell and Cell wall---Ultra structure of prokaryotic & eukaryotic cells. Structure organisation &function of plant cell wall. Membrane structure and function -Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport,electrical properties of membranes.

Cellular communication -Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

UNIT –II

Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility).
Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle).Mechanism of programmed cell death.

UNIT –III

Conformation of nucleic acids (Helix (A, B, Z), t-RNA, micro-RNA). **(**Operon, unique and repetitive DNA. Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons.
RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).

UNIT –IV

Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins).
Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

Suggested Laboratory Exercises

1. Separation of membrane and demonstration of permeability.
2. Isolation and demonstration of mitochondria activity.
3. Isolation of chloroplast and demonstration of chloroplast acti8vity.
4. Histochemical localization of nucleus and nucleolus.
5. Isolation quantification of RNA.
6. Isolation quantification of DNA.
7. Isolation quantification of Proteins.
8. To study chromosomal banding pattern.
9. To determine the Tm of given sample of RNA and DNA.
10. Separation of proteins through electrophoresis.

Suggested readings:

1. Brown and Berke: **Text Book of Cytology**, Blackstains Sons & Co.
2. Brachet and Mirsky (ed.): **The Cell,** Academic Press, Vols. 16.
3. Darlington, C.D. : **Recent Advances in Cytology**, Blarkstains Sons & Co.
4. Lewin, B. 2000. **Genes VII**, Oxford University Press, USA.
5. DeRobertis, E.D.P. and De Robertis, E.M.F. 2001. **Cell and Molecular Biology**, Lippineott
Williams & Wilkins, Bombay.
6. Sharma, A.K. and Sharma, A. 1980. **Chromosome Techniques**. Theory and Practice, Butterworth.
7. Stebbins, J.L. **Chromosomal Evolution in Higher Plants**, Edward Arnold Publ., London.
8. Roy, S.C. and Kumar, K.D.C. 1977. **Cell Biology**, New Central Book Agency, Calcutta.
9. Wolfe, S.L. 1993. **Molecular and Cellular Biology**, Wordsworth Publ. Co., California, USA.

M. Sc. Botany (Semester-I)
16BOT21C2 - Cryptogammic Botany

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will be conversant with general characters, silent features and life cycles of lower plants viz. algae, bryophytes and pteridophytes.
CO2 Students will be able to understand and collect the diversified habitats of algae, bryophytes and pteridophytes.
CO3 Students will be able to and identify algae, bryophytes and pteridophytes from local habitats.
CO4 Students will have basic understanding of evolution of stelar system and seed habit.
CO5 Students will learn about the ecological and economic significance of different lower plants.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Phycology: Algae in diversified habitats (terrestrial, freshwater, marine); thallus organization; cell ultra structure; reproduction (vegetative, asexual and sexual).

Classification of algae; criteria for classification; pigments, reserve food and flagella.

UNIT-II

Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.

Algal blooms; algal biofertilizers; Economic importance of algae as food, feed, in medicine and industry.

UNIT-III

Bryophyta: Morphology, structure, reproduction and life history; distribution; economic and ecological importance.

Classification of bryophytes; general account of Marchantiales, Jungermaniales, Anthoceratales, Sphagnales, Funariales and Polytrichales

UNIT-IV

Pteridophyta: General characteristics, morphology, anatomy, reproduction and classification of Pteridophytes.

Evolution of stele and stelar system; hetrospory and origin of seed habit; general account of fossil pteridophyta; introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

Suggested Laboratory Exercises

1. Morphological study of representative members of Algae, Bryophytes and Pteridophytes.
   - Algae: *Volvox, Hydrodictyon, Cladophora, Coleochaete, Oedogonium, Zygonema, Spirogyra, Chara, Vaucheria, Pinularia, Ectocarpus, Fucus, Sargassum, Polysiphonia, Batrachospermum, Oscillatoria, Nostoc, Scytonema, Euglena, Peridinium.*
   - Bryophytes: *Marchantia, Anthoceros, Funaria, Polytrichum, Pellia, Porella, Sphagnum*.
   - Pteridophytes: *Lycopodium, Selaginella, Psilotum, Equisetum, Adiantum, Marsilea, Azolla, Pteris, Ophioglossum, Dryopteris, Nephrolepis*.
2. To study permanent slides of Algae, Bryophytes and Pteridophytes.
3. Collection and submission of locally available Cryptogammic plant species.

Suggested readings

- Bold, H.C. and Wynne, M.J. 1978. Introduction to the Algae. Prentice-Hall of India,
- Puri, P. 1980. **Bryophytes**. Atma Ram & Sons, New Delhi.
- Morris, I. 1986. **An Introduction to the Algae**. Cambridge University Press, U.K.
- Round, F.E. 1986. **The Biology of Algae**. Cambridge University Press, U.K.
- Kumar, H.D. 1988. **Introductory Phycology**. EastWest Press Ltd., New Delhi.
- Sporne, K.R. 1991. **The Morphology of Pteridophytes**. B.I. Publ. Pvt. Ltd.
- Parihar, N.S. 1991. **Bryophytes**. Central Book Depot, Allahabad.
- Parihar, N.S. 1996. **The Biology and Morphology of Pteridophytes**. Central Book Depot, Allahabad.

M. Sc. Botany (Semester-I)
16BOT21C3 - Plant Biotechnology -1

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students would be able to know with theoretical information and practical experience in plant tissue culture.
CO2 Diagnostic skills would be introduced as tools for determining the sources of *in vitro* plantlet regeneration problems.
CO3 Discussions pertaining to the problems of contamination would be an active part of this program.
CO4 Students would be able to understand the importance of haploid and hybrid plants.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Plant Tissue Culture: General introduction, History and Scope and basic concepts ,laboratory Organization; media preparation and sterilization techniques, Nutrition of plant tissues-Growth limiting Factor, Concept of cellular differentiation and totipotency, Types of culture, Embryo and Endosperm culture, Induction and maintence of Callus and suspension Cultures

UNIT-II

Fundamental aspect of Morphogenesis, Study of differentiation through Organogenesis and Embryogenesis, Somatic embryogenesis, Zygotic vs. Somatic embryogenesis, micropropagation advances and encapsulation of somatic embryo & shoot tip for artificial seeds and its applications, *In vitro* production of haploids, techniques and utility, Haploid for breeding and selection of mutants

UNIT-III

Protoplast isolation, fusion, culture, hybrid selection and regeneration possibilities with special reference to crop plants, Limitations of protoplast research, Somatic hybridization and selection mechanism for hybrids and cybrids, cell line selection through callus/ suspension culture for the production of stress resistant plants, their application in crop improvement

UNIT-IV

Somaclonal & gametoclonal variations, Large scale clonally propagation of plants, Cryopreservation and germplasm storage, embryo/endosperm culture, Applications of plant tissue culture in Forestry, Ornamental Plants, Disease free plants and in the production of secondary metabolites/natural products.

Suggested Books

- Bajaj, Y.P.S. 1986. Biotechnology in Agriculture and Forestry Vol.2 Crops. Springer Verlag
- Vasil, I. K. and T.A. Thorpe 1994. Plant Cell and Tissue Culture. Kluwer Academic Press.
- Owen and Pen, 1996. Transgenic Plants- A Production System for Industrial and Pharmaceutical Proteins, Wiley
- Bhojwani S.S. & Razdan M. K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science.
- Butenk, R.G. 2000 Plant Cell Culture, University Press of Pacific
- Hammound, J. McGarvey, P. and Yusiboy V. 2000. Plant Biotechnology, Springer and Verlag.
- Slater, A. Scot, N. and Fowler M. 2003. Plant Biotechnology: The genetic manipulation of plants. Oxford University Press,
- Chawla H.S. 2009. Introduction to Plant Biotechnology Oxford and IBH Publishing
- Newmann K. H. 2009 Plants Cell and Tissue Culture Springer-Verlag Berlin Heidelberg
- Sterwat C.N. 2016. Plant Biotechnology and Genetics: Principles Techniques and Applications John Wiley

Suggested laboratory exercise:

1. Preparation of germination medium
2. Inoculation of seeds on germination medium
3. Determination of fresh and dry weight of *in vitro* seedling
4. Preparation of culture medium (MS/B5 medium)
5. Culture of explants on MS medium
6. Establishment and maintenance of callus & suspension culture
7. Organogenesis and Somatic embryogenesis using appropriate explants
8. Multiple shoots induction and calli regeneration
9. *In vitro* induction of roots and transplantation in soil.
10. Raising of haploids by tissue culture
11. Protoplast isolation from various tissues and testing their viability
12. Demonstration of fusion technique

M. Sc. Botany (Semester-I)
16BOT21C4 - Plant Anatomy and Diversity of Gymnosperms

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Describe the variations in structural components amongst plants at different stages of growth.
CO2 Relate the plant structure with the function, taxonomy, archaeology and climate change studies.
CO3 Appreciate the recovery of fossils and engage in evidence based reconstruction and identification of gymnosperms.
CO4 Understand the distribution and diversity of gymnosperms, their vegetative and reproductive growth and their significance in the present context.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.

2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Plant tissue system, tissue types and functions. Meristems, their classification, functions, organization of root and shoot apices. Structure of xylem and phloem. Anatomy of dicot and monocot stem, root, leaves and wood. Transition from root to stem. Primary and secondary growth, anomalous structure and abnormal secondary growth in stems. Application of anatomy in systematic, archaeology and climate change studies.

UNIT-II

Introduction to gymnosperms, general characters, life cycle, diversity and origin and classification of gymnosperms. Evolution of gymnosperms. Distribution of gymnosperms in India. Economic and ecological importance of gymnosperms.

UNIT-III

Paleobotany: fossils, types of rocks, types of fossils and fossilization. Techniques for study of fossils. Notable paleobotanists of India. General account of the few fossil gymnosperm families (Lyginopteridaceae, Medullosaceae, Glossopteridaceae and Caytoniaceae) and orders (Cycadeoidales, Pentoxylales and Cordaitales).

UNIT-IV

Comparative account of the morphology, anatomy and reproduction in the following orders: Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.

Suggested Laboratory Exercises

1. Study of various meristems and plant tissues by permanent and temporary slides.
2. Identification of plant organs on the basis of anatomy
3. Study of anatomy of root, stem and leaves by double staining method
4. Comparative study of anatomy of vegetative and reproductive parts of *Cycas, Pinus, Ginkgo, Cedrus, Aracaria, Cryptomeria, Ephedra, Gnetum* and *Taxus.*
5. To study permanent slide of various Gymnosperms

Suggested readings:

1. Biswas, C. and Johri, B.M. 1999. The Gymnosperms. Narosa Publishing House, New Delhi.
2. Chamberlain, C.J. 1955. Gymnosperms. Structure and Evolution.
3. Chamberlain, C.J. 2000. Gymnosperms. C B S Publishers and Distributors, New Delhi.
4. Sporne, K.R. 1986. Morphology of Gymnosperms. Hutchinson University Press.
5. Vashishta, P.C. 1999. Gymnosperms, S. Chand & Company Ltd. New Delhi.
6. David F. Cutler *et. al.* 2007. Plant Anatomy: An Applied Approach, Wiley-Blackwell.
7. William C. Dickison 2000. Integrative Plant Anatomy, Academic Press.

M. Sc. Botany (Semester-I)
16BOT21C5 - Plant Reproduction

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will have thorough knowledge of male and female gametophytes, sperm dimorphism, microsporogenesis and megasporogenesis.
CO2 Students will have basic understanding of pollen-pistil interaction, male sterility, self incompatibility and pollen allergy
CO3 Students will have training in collection of pollen material and their identification.
CO4 Students will have knowledge about dynamics of fruit development, seed formation and methods to overcome seed dormancy.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Male gametophyte: Structure of anther; microsporogenesis; role of tapetum; pollen development and gene expression; male sterility, sperm dimorphism; pollen germination; pollen tube growth and guidance, pollen storage; pollen allergy.

UNIT-II

Female gametophyte: Ovule development; megasporogenesis; organization of embryo sac; structure and functions of embryo sac cells.
Pollination: Floral characteristics, mechanisms and vectors.
Pollen-pistil interaction and fertilization: structure of the pistil; pollen stigma interactions, Self incompatibility- SSI and GSI (cytological, biochemical and molecular aspects); Double fertilization; *in-vitro* fertilization.

UNIT-III

Seed Development: Endosperm development during early maturation and desiccation stages; embryogenesis- ultra structure and nuclear cytology. Storage proteins of endosperms and embryo; Polyembryony; Apomixis; Embryo culture.

UNIT-IV

Fruit Growth: Dynamics of fruit growth; Biochemistry and molecular biology of fruit maturation.

Dormancy: Importance and types of dormancy; seed dormancy; methods of overcoming seed dormancy.

Suggested Laboratory Exercises

1. Study of microsporogenesis and gametogenesis in sections of anthers.
2. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa, Tradescantia, Crotolaria, Brassica, Petunia, Solanum melongena*, etc.).
3. Tests for pollen viability using stains and *in vitro* germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface cultures.
4. Estimation of percentage and average pollen tube length *in vitro.*
5. Role of transcription and translation inhibitors on pollen germination and pollen tube growth.
6. Estimation of proteins present in pollen wall.
7. Study of ovules in cleared peparations; study of monosporic, bisporic and tetrasporic type of embryosac development through examination of permanent, stained serial sections.
8. Field study of several types of flowers with different pollination mechanisms (wind pollination, thrips pollination, bee/butterfly pollination, bird pollination).
9. Study of nuclear and cellular endosperm through permanent slides.
10. Isolation of zygotic globular, heart shaped, torpedo stage and mature embryos from suitable seeds.
11. To study polyembryony in citrus, jamun, etc. by dissections.
12. Study of seed dormancy and methods to break dormancy.

Suggested readings

1**.** Bhojwani, S.S. and Bhatnagar, S.P. 2000 **The embryology of Angiosperms. (4th revised and enlarged edition), Vikas publishing house, New Delhi.**

2. Maheswari, P. **An Introduction to Embryology of Angiosperms**, 1950.

3. Shivanna, K.R. and Johri, B.M. **The Angiosperm Pollen: structure and Function**, Wiley Eastern Ltd., Publications, 1989.

4. Johri, B.M., Ambegaokar, K.B. and Srivastava, P.S. **Comparative Embryology of Angiosperms**, Vol. I & II, SpringerVerlag publication.

5. Bhojwani, S.S.and Bhatnagar,S.P.1999.The Embryology of Angiosperms.Vikas. publishing House, New Delhi.

6. Raghwan,V.1997.Developmental biology of flowering plants. Springeverlag,New York.

7 Salisbury, F.B.and Ross,C.w.1992.Plant physiology(4th edn.).Wadsworth publishing, Belmont, Callifornia.

8. Shivanna, K.R.and Sawhney,V.K.1997.Pollen biotechnology for crop production and improvement. Cambridge University press, Cambridge.

M. Sc. Botany (Semester-I)
Lab Course-I
(16BOT21CL1)

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will be able to demonstrate the cell membrane permeability and mitochondria activity.

CO2 Students will be able to isolate and quantify RNA, DNA and Proteins.

CO3 Students will be able to collect, identify and describe the local algae, bryophytes and pteridophytes.

CO4 Students will be able to explore and document the diversity of lower plants.

CO5 Students will become familiar in the techniques of Plant Tissue Culture and micropropagation.

CO6 Students will learn sample collection, media preparation, sterilizations and get familiarity with the mechanism of regeneration of complete plantlets via *in vitro* techniques and other processes like Androgenesis, gynogenesis, somatic hybridization, protoplast fusion and embryo rescue etc.

M. Sc. Botany (Semester-I)
Lab Course-II
(16BOT21CL2)

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will become familiar with basic techniques for study of plant anatomy

CO2 Students will be able to describe the anatomical features of stems and roots of higher plants.

CO3 Students will be able prepare the temporary and permanent slides alongwith the process of staining and mounting.

CO4 Students will be able to comprehend the general characters, diversity, classification and economic importance of gymnosperms.

CO5 Students will be able to study the characters of living and fossil gymnosperms.

CO6 Students will understand the process of fossilization and appreciate the contribution of Indian paleobotanists.

M. Sc. Botany (Semester-II)
16BOT22C1 - Plant Biochemistry and Metabolism

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1	Learn about the molecular bonding of bio molecules and contribution of enzymes to cellular metabolism
CO2	Explain fundamental thermodynamic properties and laws
CO3	Understand about the ways plants use light to assimilate atmospheric carbon dioxide to support life on this planet
CO4	Describe the structure, function, synthesis and degradation of carbohydrates and lipids within plants
CO5	Understand the dynamics of protein structure, function and interaction.
CO6	Understand the ability of plants to uptake, transport and assimilate nitrogen and sulphur.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Principles of Biochemistry: Structure of atom, molecules, forces stabilizing macromolecules, weak bonds and covalent bonds, buffers and p*K*a values.
Fundamentals of enzymology: General aspects, nature of enzyme catalysis, enzyme kinetics, enzyme regulation and inhibition, isozymes, vitamins and cofactors.

UNIT-II

Bioenergetics: Principles of thermodynamics, free energy, chemical and redox , potential, structure and function of ATP.
Photobiology and Photosynthesis: Nature of light, photoreceptors and photosynthetic pigments, light harvesting complexes, PSI and PSII, photooxidation of water, photophosphorylation and photoinhibition. RubisCo – structure & function, CO_2 assimilation in C3 and C4 plants, CAM pathway, biosynthesis of starch and sucrose, bacterial photosynthesis.

UNIT-III

Carbohydrates: Structure and classification. Metabolism of carbohydrates: Glycolysis, Pentose Phosphate Pathway, gluconeogenesis, TCA, glyoxylate cycle (C_2), electron transport and oxidative phosphorylation, alternative oxidase. Photorespiration versus dark respiration.

Lipids: Composition, structure and classification. Biosynthesis and oxidation of structural and storage lipids.

UNIT-IV

Proteins: Composition, classification and structure. Conformation of proteins: Ramachandran plot, secondary, tertiary and quaternary structure, domains, motifs and folds. Amino acid biosynthesis and catabolism. Introduction to Proteomics, protein – protein interactions and practical applications of proteomics.

Nitrogen fixation and N & S metabolism: Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation. Sulfate uptake, transport and assimilation.

Suggested References:

1. Campbell, M.K. 1999. Biochemistry. Saunders College Publishing, New York.
2. Conn, E.E. and Stumpf P.K. et al., 1999. Biochemistry. John Wiley and Sons. New Delhi.
3. David T. Dennis and David H. Trurpin (Eds.) 1993. Plant Physiology. Biochemistry and Molecular Biology. Longmann Scientific and Technical, Singapore.
4. Fisher J. et. al., 1999. Instant notes in Chemistry for Biologists. Viva Books Pvt. Ltd. New Delhi.
5. Goodwin and mercer 1996. Introduction to plant Biochemistry. CBS Publishers and Distributors, New Delhi.
6. Hames, B.D. et al., 1999. Instant notes in Biochemistry. Viva books Pvt. Ltd. New Delhi.
7. Harborne, J.B. 1999. Plant Biochemistry. Chapmann & Hall, New Delhi.
8. Jain, J.L. 2000. Fundamentals of Biochemistry. S. Chand & Co. New Delhi.
9. Plummer, D.T. 1996. An Introduction to practical Biochemistry. McGraw Hill
10. Satyanarayana, U. 1999. Biochemistry. Books and Allied (P) Ltd. Calcutta.
11. Wilson and Goulding. 1992. Biologists Guide to Principles and Techniques of Practical Biochemistry.

Suggested Practical:

1. Preparation of buffers.
2. Preparation of standard solutions of BSA, Glucose, Catechol.
3. Extraction and estimation of soluble proteins by Bradford method.
4. Estimation of reducing sugars.
5. Separation of pigments by paper chromatography.
6. Isolation, assay and determination of specific activity of plant enzymes of germination, growth and fruit ripening, viz amylase, lipase, protease, peroxidase, polyphenol oxidase.
7. Ammonium sulphate precipitation – dialysis and kinetics of anyone of the above enzyme.
8. Isolation and quantification of plant lipids.
9. Isolation of chloroplast from fresh leaves and estimation of chlorophyll proteins.
10. Chlorophyll survey of five plants. Quantification, absorption spectra of chlorophyll and carotenoids using different solvents.
11. Hill activity by DCPIP/ ferricyanide reduction.
12. Extraction and estimation of total phenols.
13. Determination of antioxidants in plant tissues – ascorbic acid, tocopherol, β – carotene.

M. Sc. Botany (Semester-II)
16BOT22C2 - Taxonomy of Angiosperms

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will have sound knowledge about origin and evolution of flowering.
CO2 Students will have thorough understanding of speciation and various species concepts.
CO3 Students will be conversant with the rules and regulation of International Code of Botanical Nomenclature and Phylocode.
CO4 Students will be understood the silent features, merits and demerits of different systems of angiosperm classification.
CO5 Students will also have basic understanding of modern techniques and tools of plant taxonomy
CO6 Students will be able to collect the plant specimens, record field notes, prepare herbaria and will be able to use flora and manuals for plant identification.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Origin and evolution of angiosperms; general principles of angiosperm phylogeny, evolutionary trends in angiosperms, ecads and ecotypes; speciation; various species concepts, adaptive radiation, adaptive modifications; concept of taxonomic characters; character weighting; taxonomic hierarchy and different taxonomic categories

UNIT-II

Principles of taxonomy, characters considered before plant identification; identification keys, computer aided identification, floral formula and floral diagram. Salient features of the International Code of Botanical Nomenclature (ICBN); some important rules of nomenclature; brief idea about phylocode as a new system of nomenclature

UNIT-III

Systems of angiosperm classification: Phenetic versus phylogenetic systems; cladistics in taxonomy; Relative merits and demerits of major systems of classification. Taxonomic evidence: Morphology, anatomy, palynology, embryology, cytology; Modern trends in plant taxonomy: Numerical taxonomy, Chemotaxonomy, molecular taxonomy.

UNIT-IV

Herbarium and botanical garden: purpose of modern herbarium, techniques of herbarium preparation, description of flowering plants in different types of herbaria, major Indian herbaria and botanical gardens, importance of herbarium and botanical gardens in botanical research; Relevance of taxonomy to conservation, sustainable utilization of bio-resources and ecosystem research.

Suggested Laboratory Exercises

1. Description of a specimen from representative, locally available families such as Apiaceae, Asclepiadaceae, Asteraceae, Apocynaceae, Brassicaceae, Chenopodiaceae, Convolvulaceae, Cryophyllaceae, Cucurbitaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Liliaceae, Malvaceae, Myrtaceae, Poaceae, Ranunculaceae, Rosaceae, Rubiaceae, Solanaceae, Verbenaceae etc.
2. Location of key characters and use of keys at family level.
3. Description of various species of a genus, location of key characters and preparation of keys at generic level.
4. Preparation of herbarium of locally available wild plants.
5. Training in using floras and herbarium for identification of specimens described in class.
6. Field trips / excursion, compilation of field notes and preparation of herbarium specimens of wild plants.

Reference Books

- Davis, P.H. and Heywood, V.M. 1973. **Principles of Angiosperm Taxonomy**. Robert E. Kereiger Publ. New York.
- Grant, W.F. 1984. **Plant Biosystematics**. Academic Press, London.
- Heywood, V.H. and Moore, D.M. 1984. **Current Concepts in Plant Taxonomy**. Academic Press. London.
- Radford, A.E. 1986. **Fundamentals of Plant Systematics**, Harper & Row Publ. USA.
- Stace, C.A. 1989. **Plant Taxonomy and Biosystematics** (2nd ed.) Edward Arnold Ltd. London.
- Takhtajan, A.L. 1997. **Diversity and Classification of Flowering Plants**. Columbia Univ. Press, New York.
- Nordenstam, B., El Gazaly, G. and Kassas, M. 2000. **Plant Systematics for 21st Century**. Portland Press Ltd. London
- Singh, G. 2005. **Plant Systematics: Theory and Practices** (2nd Ed.) Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi
- Sambamurty, A.V.S.S. 2005. **Taxonomy of Angiosperms**. I.K. International Pvt. Ltd., New Delhi.
- Naik, V.N. 2006. **Taxonomy of Angiosperms**. Tata McGraw Hill Education Pvt. Ltd. New Delhi.
- Sharma, O.P. 2009. **Plant Taxonomy**. Tata McGraw Hill Education Pvt. Ltd. New Delhi.
- Verma, B.K. 2011. **Introduction to Taxonomy of Angiosperms**. PHI Learning Pvt. Ltd. New Delhi

M. Sc. Botany (Semester-II)

16BOT22C3 - Plant Development

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1	Students will understand about various developmental processes in plants *viz*. shoot, leaf and flower.
CO2	Students will become familiar in cytological and molecular analysis of development of root apical meristem and shoot apical meristem.
CO3	Students will understand the genetics of floral organ differentiation.
CO4	Students will understand various physiological and biochemical aspects of seed germination and seedling growth.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Introduction: Unique features of plant development; differences between animal and plant development.
Shoot Development: Organization of shoot apical meristem (SAM); Cytological and molecular analysis of SAM; Cell to cell communication, secretory ducts and laticifers.

UNIT-II

Root Development: Organization of root apical meristem (RAM); cell fate and lineages, lateral roots; root hair development; root-microbe interactions.

UNIT-III

Leaf growth and differentiation: Determination; phyllotaxy; differentiation of epidermis (with special reference to trichomes) and mesophyll.
Flower Development: Vegetative options and sexual reproduction, Genetics of floral organ differentiation- ABC model; mechanism of Class B gene activity, Homeotic mutants in *Arabidopsis*.

UNIT - IV

Seed development, Physiological and Biochemical aspects, seed germination and seedling growth: mobilization of food reserves; tropisms; hormonal control of seedling growth; use of mutants in understanding seedling development.

Suggested Laboratory Exercises:

1. Effect of gravity, light and plant growth regulators on the growth of young monocot and dicot seedlings.
2. To study the phenomenon of tropism.
3. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla*.
4. Study of cytohistological zonation in the shoot apical meristem(SAM) in sectioned and double-stained permanent slides of a suitable plant such as *Coleus, Kalanchoe, Tobacco.* Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
5. Study of alternate and distichous; alternate and superposed; opposite and superposed; opposite and decussate leaf arrangement. Examination of rosette plants (Launaea*, Mullugo, Raphanus, Hyoscyanus, etc.*) and induction of bolting under natural conditions as well as by GA treatment.
6. Microscopic examination of vertical sections of leaves such as *Cannnabis, Nicotiana, Nerium, Zea mays* and *Triticum to* understand the internal structure of leaf tissues and trichomes, glands, lenticels, etc. Also study the C3 and C4 leaf anatomy of plants.
7. Study of epidermal peels of leaves such as *Coccinia, Gaillardia, Tradescantia, Notonea,* etc. to study the development and final structure of stomata and prepare stomatal index. Demonstration of the effect of ABA on stomatal closure.
8. Study of whole roots in monocots and dicots. Examination of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives (use maize,aerial roots of banyan, *Pistia, Jussieua,*etc.). Origin of lateral roots. Study of leguminous roots with different types of nodules.
9. Estimation of total proteins and carbohydrates from seeds of cereals and legumes by different methods.
10. Study of permanent tissues.

Suggested readings:

Burgess, J. 1985. **An Introduction to Plant Cell Development**, Cambridge University Press,.

Fosket, D.E. 1994. **Plant Growth and Development – A Molecular approach**, Academic Press, Oxford.

Lyndon, R.F. 1990. **Plant Development – The Cellular basis**, Unnin Hyman, London.

Raghavan, V. 1999. **Developmental Biology of Flowering Plants**, Springer, New York.

Steeve, T.A. and Sussex, I.M. **Patterns in Plant Development** (2nd Ed.), Cambridge University Press, Cambridge.

Leyser,O. and Day.S. 2003. **Mechanism of Plant Development.** Black well Publishing Co.

Murphy, T.M and Thompson, W.F. 1988 Molecular plant development. Prentice hall,New jersey

Atwell, B.J. Kriederusann, P.E. and Jumbull, C.G.N. (Eds.), 1999. **Plant in action: Adaptation in nature, Performance in cultivation**, MacMillan Education, Sydney..

Bewley,J.D. and Black, M. 1994. **Seeds**: **Physiology of Development and Germination,**Plenum Press, New York.

Fahn, A. 1982. **Plant Anatomy** (3 rd Ed.), Pergamon Press, Oxford.

Fosket, D.E. 1994. **Plant Growth and Development – A Molecular approach**, Academic Press, Oxford.

Lyndon, R.F. 1990. **Plant Development – The Cellular basis**, Unnin Hyman, London.

Raghavan, V. 1999. **Developmental Biology of Flowering Plants**, SpringerVerlag,New York.

Steeve, T.A. and Sussex, I.M. **Patterns in Plant Development** (2 nd Ed.), Cambridge University Press, Cambridge.

M. Sc. Botany (Semester-II)
16BOT22D1- Plant Biotechnology-II

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students would get the ability of the explanation of the concept, principle usage of the acquired knowledge of basic biotechnology for pharmaceutical, medical and agriculture application

CO2 Students would be able to explain the principle that used for basis for recombinant DNA Technology

CO3 Students would be able to describe the methods of transformation of plants and plant cells including with specific advantages and applications

CO4 Students would be able to make decision about the most appropriate method for use in gene discovery analysis and develop skill in a wide range of genomics and biotechnological methods

CO5 Students would be able to describe the current regulations regarding the production of GMO's

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Tools of Genetic engineering - Enzymes, Cloning vectors (Plasmids, Bacteriophages, Cosmids, Phagemids, Shuttle vectors, transposons vectors, artificial chromosomes as vector and eukaryotic vectors) Constriction of genomic library , and cDNA library, Staggered cleavage, addition of oligopolymer tailing ,blunt end ligation, Polymerase Chain Reaction (PCR) Principals, technique and modifications, Gene cloning Vs PCR, application , Applications of PCR.

UNIT-II

DNA synthesis and gene sequencing, Aims, strategies for the development of transgenic - Transformation vectors, Promoters from heterologous sources and its utility, Terminators, Markers and Reporter genes, *Agrobacterium* mediated gene transfer, Molecular genetics of T- DNA transfer from *Agrobacterium* to plants, Direct gene transfer methods, Comparison of vector – mediated & vector free methods, Gene tagging in transgenic plants, Uses of transgenes for herbicide Salinity and drought tolerance

UNIT-III

Chloroplast and Mitochondrial Transformation, Mechanism and Genetics of nitrogen fixation, *nif* & *nod* gene cluster, Fermentation Technology, Genetic improvement of industrial microbes & N_2 fixer, Biofertilizer, Nutritional quality improvement - Golden rice and other development

UNIT-IV

Molecular markers for introgression of useful traits in plants, Genomics and Proteomics: Genome project, Microarray, protein profiling and its significance, Applications of G.E. to Health, Industry & Agriculture, including gene therapy, IPR and regulatory requirements

References

- Adrian S, Nigel WS, Mark RF 2008. Plant Biotechnology: The genetic manipulation of Plants, Oxford University Press.
- Halford, N. 2006. Plant Biotechnology - Current and Future Applications of Genetically Modified Crops, John Wiley and Sons, England.
- David P. Clark, 2015. Biotechnology: Applying the Genetic Revolution I.K. International
- Chauhan, A.K. 2009. A Textbook of Molecular Biotechnology I.K. International
- Watson, J.D**.** 2007. Recombinant DNA: Genes and Genomes: A Short Course. (Third edition), W.H. Freeman and Company
- Foster and Twell. 1997. Plant Gene Isolation: Principles and Practice
- Owen and Pen 1997.Transgenic plants :(a production system for industrial and pharmaceutical proteins)
- Kung and Wu 1993.Transgenic Plants: Vols 1&2
- Potrykus and Spangenberg 1995.Gene Transfer to Plants Brown, T.A. 1995. Gene Cloning an Introduction. (3rd edition). Chapman Hall, U.K.
- Old and Primrose 1984.Principles of Gene Manipulation. Blackwell
- Slater, 2008. Plant Biotechnology: The Genetic Manipulation of Plants Oxford
- Rissler and Mellon 1996.Ecological risks of transgenic crops

Suggested laboratory exercises:

1. Growth characteristics of bacteria using planting & turbidimetric methods
2. Isolation of plasmids from bacteria by alkaline lysis and its quantification spectrophotometrically
3. Co-cultivation of plant material with *Agrobacterium* and study GUS activity histochemically
4. Isolation of DNA from suitable plant material
5. Spectrophotometer demonstration of DNA/RNA
6. Study of PCR

M. Sc. Botany (Semester- II)
16BOT22D2 - Tools and Techniques

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Use of different chromatographic techniques and handling of sophisticated instruments
CO2 Principles and handlings of different techniques such as RT-PCR, AFLP, electrophoresis and sequence of nucleic acid etc. used in molecular biology
CO3 Various techniques in field botany, preparation of herbarium and identification of plant materials
CO4 The database and its efficient use in bioinformatics.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note:
1. Nine questions will be set in all.
2. Question No.1 which will be objective covering the entire syllabus, will be compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, scanning and transmission electron microscopes.
Fixation and staining; cytophotometry and flow cytometry.

UNIT-II

Chromatography: Principles and applications of gel filtration, ion-exchange, affinity, thin layer, gas chromatography and high pressure liquid chromatography (HPLC).
Electrophoresis and centrifugation: Principles and applications of agarose and polyacrylamide gel electrophoresis; ultracentrifugation (velocity and buoyant density).

UNIT-III

Molecular biology techniques: southern, northern and western blotting techniques, polymerase chain reaction (PCR), ELISA.
Methods for measuring nucleic acid and protein interactions; DNA fingerprinting; Molecular markers (RFLP, AFLP, RAPD).

UNIT-IV

Spectroscopy: Fluorescence, UV, visible, NMR and ESR spectroscopy; X-ray diffraction.
Tracer Biology: Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography.

Suggested Laboratory Exercises

1. Demonstration of working of different types of microscopes.
2. Demonstration of Chromatography i.e. TLC, HPLC, GC.
3. To demonstrate the separation of proteins with the help of electrophoresis.
4. To study various molecular biology techniques i.e. PCR, ELISA.
5. To demonstrate the use of spectrophotometer.
6. Purification of protein by column chromatography.
7. Visit of various laboratories in the university, preparation and submission of report.
8. Principles of Calorimetry, Spectrophotometry and Fluorimetry.

M. Sc. Botany (Semester- II)
Lab Course-I
(16BOT22CL1)

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Carry out quantitative analysis of the important biomolecules such as proteins, sugars and lipids.
CO2 Perform experiments on enzyme kinetics.
CO3 Purify proteins/enzymes from plants sources using the techniques of precipitation and gel filtration.
CO4 Determine the content of photosynthetic pigments and study their absorption spectra.
CO5 Demonstrate Hill activity
CO6 Describe a specimen from the locally available angiospermic families.

M. Sc. Botany (Semester- II)
Lab Course-II
(16BOT22DL)

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will understand about physiological and biochemical aspects of seed germination and seedling growth.
CO2 Students will be able to study epidermal peels of leaves and trained in microscopic examination of vertical/transverse and longitudinal sections of different reproductive parts of plants.
CO3 Students will be able to estimate the total proteins and carbohydrates from seeds of cereals and legumes by different methods.
CO4 Students will be able to perform the experiments of seed and pollen tube germination.
CO5 Students will be able to isolate and co-cultivate plasmids from bacteria and able to quantify it spectrophotometrically.
CO6 Students will be able to use the basic botanical and biotechnological tools to study the concepts of plant development and molecular biology of plants.

M. Sc. Botany (Semester-III)
17BOT23C1 - Plant Physiology

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1	Explore the plant-water relations, mineral nutrition and solute transport.
CO2	Learn about the sequence of events triggered by the binding of ligands to their receptor.
CO3	Understand the growth and development of plants as influenced by the light.
CO4	Understand the nature, function and mode of action of plant growth regulators.
CO5	Learn about the resilient nature of plants and physiological aspects of their ability to withstand and grow under the unfavourable conditions
CO6	Learn about the importance of plant hormones and secondary metabolites to plant growth and development.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

UNIT I

Water: Structure, properties and movement, osmosensors. Water absorption and conduction. Loss of water from plants, stomatal physiology. Beneficial nutrient elements, their functions and deficiency symptoms. Toxic effects of minerals. Antagonistic and synergistic relationship amongst ions. Nutrient uptake by roots. Root microbe interactions for nutrient uptake.
Comparison of xylem and phloem transport, molecular mechanism of phloem loading and unloading, passive or active solute transport.

UNIT II

Signal transduction: Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, Ca^{+2} - calmodulin cascade. Regulation of signaling pathways.
Diversity in protein kinases and phosphatases, specific signaling mechanisms-two component system in plants.Physiology of flowering: History, discovery, properties and molecular structure of phytochromes and cryptochromes. Photoperiodism, photoinduction and endogenous rhythms.

UNIT III

Promoters and inhibitors of plant growth. Structure, bioassay, transport, storage, physiological role and mechanism of action of auxins, gibberellins and cytokinins. Peptide hormones in plants. Structure and function of ABA, ethylene, ascorbic acid, brassinosteoids, polyamines (putrescine, spermidine, spermine and cadavarin), jasmonic acid and salicylic acid.

UNIT IV

Stress physiology: Type of stresses. Plant responses and mechanism of tolerance of biotic and abiotic stress. Water, temperature, salt, heavy metal and oxidative stress. Effect of air pollutants SO_2 and O_3 and elevated CO_2 on plants. Hypersensitive reaction and systemic acquired resistance. Role of phytoalexins and phenyl propanoid pathway in plants. Secondary plant metabolites: role of terpenes, phenols and nitrogenous compounds, allelopathy.

Suggested Laboratory Exercises:

1. Demonstration of stomatal activity from suitable plant material.
2. To study plant responses to red and far-red light.
3. Bioassay of auxin, cytokinin and gibberellins.
4. Effect of plant hormones on growth.
5. To study the effect of plant hormones on enzymatic activity.
6. To study the effect of salt and water stress on seed germination and plant growth in terms of metabolites.

Suggested Readings:

1. Brett, C.T. and Waldron, K.K. 1996. Physiology and Biochemistry of Plant Cell Walls, Chapman and Hall London.
2. Conn, E.E. and Stumpf P.K. et al., 1999. Biochemistry. John Wiley and Sons. New Delhi.
3. Daphne. J. Osborne, Micheal. B. Jackson. 1989. Cell separation in plants physiology, Biochemistry and Molecular Biology. Springer – Verlag. Berlin.
4. David T. Dennis and David H. Trurpin (Eds.) 1993. Plant Physiology, Biochemistry and Molecular Biology. Longmann Scientific and Technical, Singapore.
5. Devlin and Witham, 1997. Plant Physiology. CBS Publishers and Distributors, New Delhi.
6. Fitter, A.H. and Hay R.K.M. 1987. Environmental physiology of plants. Academic Press.
7. Hall, D.O. and Rao, K.K. 1999. Photosynthesis. Cambridge University Press.
8. Hatch, M.D. et. al., 1971. Photosynthesis and Photorespiration.
9. Hess, D. 1975. Plant physiology. Narosa Publishing House, New Delhi
10. Jain, J.L. 2000 Fundamentals of Biochemistry. S. Chand & Co. New Delhi.
11. Lincoln Taiz and Eduardo Zeiger, 1991. Plant Physiology. The Benjamin/ Cummings publishing Company, Inc.
12. Noggle and Fritz, 1999. Introductory Plant physiology. Prentice hall, London.
13. Salisbury, F.B. and Ross. C. 2000, Plant physiology. John Wiley & Sons, New Delhi.
14. Strafford, G.A. 1979 Essentials of Plant Physiology. Heinemann Publishing Co. New York.
15. Wilkins, M.B. (Ed) 1984. Advanced Plant Physiology, Pitman Publishing Co. New York.
16. William G. Hopkins, 1999. Introduction to Plant Physiology. John Wiley & Sons. Inc. New York.

M. Sc. Botany (Semester-III)
17BOT23C2 - Plant Ecology

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will be to understand characteristics of plants at community, population and ecosystem levels.
CO2 Students will have sound background of ecosystem structure and function.
CO3 Students will be able to use various tools and techniques for ecological studies.
CO4 Students will able to carry out survey of ecologically unique plants and study the ecological adaptations of locally available hydrophytes and xerophytes.
CO5 Students will able to differentiate the climatic and edaphic, floral and faunal characteristics of major terrestrial biome.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT 1

Environment: Physical environment; biotic environment; biotic and abiotic interactions; climate and soil pattern of world.

Habitat ecology: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement and major habitat types of the subcontinent.

UNIT II

Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *k* selection); age structured populations.

Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis; Mechanisms of litter fall decomposition and climatic factors associated with decomposition.

UNIT III

Community ecology: Nature of communities; community structure and attributes; analysis of communities (analytical and synthetic characters); levels of species diversity and its measurement; edges and ecotones.
Ecological succession: Types; mechanisms; changes involved in succession; concept of climax; models of succession, Ecological adaptations.

UNIT IV

Ecosystem ecology: Structure and function; energy flow and biogeochemical cycles; primary production and methods of measurement, global pattern and controlling factors; ecosystem restoration,

Biomes: Distribution, climatic and edaphic, floral and faunal characteristics of major terrestrial biome.

Suggested Laboratory Exercises

1. To study the physical characteristics (temperature, colour and texture) of soil.
2. To determine water holding capacity of soils collected from different locations.
3. To determine pH and conductivity of soils collected from different locations.
4. Chemical testing of soil for phosphorus, potassium and nitrate.
5. To determine percentage organic carbon and organic matter in the soils of crop land, grassland and forest.
6. To determine the pH and conductivity of water samples collected from different locations.
7. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples.
8. To record the abiotic components i.e. pH, temperature, turbidity and light intensity of water in a pond ecosystem.
9. To determine the minimum size of the quadrat by species- area curve.
10. To study the community by quadrat method by determining frequency, density and abundance of different species present in the community.
11. Determination of species diversity index and importance value index of local vegetation.
12. To compare protected and unprotected grasslands using community coefficients (similarity index).
13. To study the species composition of an area for analyzing biological spectrum and comparison with Raunkiaer's normal biological spectrum.
14. To survey and study the ecological adaptations of locally available hydrophytes and xerophytes.
15. Field visit of any protected area and to discuss causes and impacts of biodiversity loss.

Reference Books

- Begon, M. Harper, J.L. and Townsend, C.R. 1996. **Ecology**. Blackwell Science, Cambridge, USA.
- Campman, J.L. and Reiss, M.J. 1998. **Ecology**. Principles and Applications, Cambridge University Press, U.K.
- Ludwing, J. and Reynolds, J.F. 1998. **Statistical Ecology**. John Wiley & Sons.
- Ambasht, R.S. and Ambasht, N.K. 1999. **A text book of Ecology**. CBS Publ. & Distr. New Delhi.
- Sharma, P.D. 2001. **Ecology and Environment**, Rastogi Publications, Meerut.
- Odum, E.P. and Barrett, G.W. 2005. **Fundamentals of Ecology** (5th Ed.) Brooks/Cengage Learning India Pvt. Ltd., New Delhi.
- Kormondy, E.J. 2008. **Concepts of Ecology**. Prentice Hall of India., New Delhi.
- Subrahmanyam, N.S. and Sambamurty, A.V.S.S. 2008. **Ecology** (2nd Ed.) Narosa Publishing House, New Delhi
- Singh, J.S., Singh, S.P. and Gupta, S.R. 2008. **Ecology, Environment and Resource Conservation**, Anamaya Publishers, New Delhi.
- Stiling, P. 2009. **Ecology: Theory and Applications** (4th Ed.). PHI Learning Pvt. Ltd. New Delhi.
- Rana, S.V.S. 2009. **Essentials of Ecology and Environmental Sciences** (4th Ed.) PHI Learning Pvt. Ltd. New Delhi.

M.Sc. Botany Semester (III)
17BOT23DA1 - Microbiology and Pathology

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Ultrastructure, isolation, multiplication and economic importance of viruses
CO2 General account, ultrastructure, multiplication and economic importance of bacteria
CO3 Thallus organization, nutrition and reproduction of fungi, lichens structure, reproduction and economic importance
CO4 Pathogenesis and plant defense mechanisms, different causal organism of diseases, symptoms and its management

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

UNIT-I

Viruses: Characteristics and ultrastructure of virions; isolation and purification, chemical nature, replication, transmission and economic importance of viruses.
Phytoplasma: general characteristics and role in causing plant diseases.

UNIT II

Archaebacteria and eubacteria: General account; ultrastructure, nutrition and reproduction; economic importance.
Cyanobacteria: Salient features and biological importance.

UNIT-III

Mycology: General characters of fungi, Organization of thallus, nutrition and reproduction, general account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina;.Heterokaryosis, heterothallism, parasexuality, sex hormones, mycorrhizae; Lichens: structure, reproduction and economic importance.

UNIT-IV

Pathogenesis: Penetration and entry of plant pathogens; Defense Mechanism in plants: Hypersensitivity reaction, Plant quarantine.
Plant Diseases: Casual organisms, symptoms and management of Downy mildew of grapes,Karnal bunt of wheat,Smut of Bajra,Late and early blight of potato,Yellow vein mosaic of Bhindi,Tikka diseases of groundnut, Bacterial blight of paddy, Black rust of wheat

Suggested Laboratory Exercises

1. Morphological study of some Cyanobacteria, Bacteria and Fungi.
2. Preparation of media for Fungus and Bacteria culture.
3. Preparation of different stains of bacteria.
4. To demonstrate Gram's staining of bacteria.
5. Identification of fungal cultures: *Rhizopus, Mucor, Aspergillus, Penicillium, Fusarium, Emericella, Chaetomium, Drechslera, Curvularia, Phoma, Colletotrichum,Graphium.*
6.Study of permanent slides of Bacteria and Fungi.
7.To study the symptoms and diagnostic features of causal organisms of the following plant diseases: Downy mildew of grapes; Karnal bunt of wheat; Smut of bajra; Late and early blight of potato; Yellow vein mosaic of Bhindi; Tikka disease of groundnut; Bacterial blight of paddy; Black rust of wheat

M. Sc. Botany (Semester-II1)
17BOT23DA2 - Computer Applications and Biostatistics

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1	Students will be able to use computers and internet for their study and research purposes.
CO2	Students will be able to retrieve and install various computer softwares and programmes.
CO3	Students will have basic knowledge of tools and techniques of bioinformatics viz. BLAST, FASTA etc.
CO4	Students will be able to use statistics for analysing the data and testing the hypothesis.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Computers: Components and functions; generations of computer; input and output devices; types of memory; file manager; internet and its applications.
Operating system and its evolution; system and application software; internal and external commands of DOS, UNIX, WIN 98/2000/XP; Office applications including MS-Word, MS-Excel, MS-Powerpoint.

UNIT-11

Bioinformatics: Introduction and uses of bioinformatics tools –

a. BLAST
b. FASTA
c. Multiple sequence alignment- CLUSTAL-W
d. MEDLINE & PubMED

Retrieving and installing a programme (Tree Tool); Searching Science Citation Index & current content; Accessing full text Journal.

UNIT-3

Biostatistics: Graphical representation of data; Analysis of variation; Analysis of frequencies; Measures of central tendency; coefficient of variation.
Correlation and regression; Hypothesis testing; Experimental design and sampling theories.

UNIT-4

Probabilities theory; t- test, F- test and χ^2- test; Probability distributions and their properties.Non-parametric test: Sign test; Run & Median test; Wilcoxon Signed Rank Mann-whiteney test; Kruskal Wallis test.

Suggested Laboratory Exercises

Working knowledge of Microsoft Windows.

Demonstration of on-line data-base search.

Similarity searching using BLAST/FASTA.

Demonstration to access full text journals.

Numerical problems on mean, median and mode.

Calculation of standard deviation and coefficient of variation

Applications of t and chi- square tests in real life examples

Suggested Books-

Introduction to Embedded Systems ;2011 by E.A.Lee and S.A.Seshia.

Statics , Probabilty and Game Theory; papers in honor of David Blackwell by David Blackwell, at. al.-IMS,1996.

Introducation to Probability Theory and Statics for Linguistics by Marcus Kracht-UCLA-2005.

M. Sc. Botany (Semester-III)
7BOT23DB1 - Evolutionary and Economic Botany

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 know the origin of life and evolution of economic important plants
CO2 know about the origin and diversity of agriculture and plants as a source of energy
CO3 know about the morphology and cultivation of plants used in daily life as food, fibers, spices etc.
CO4 Gain the knowledge about aesthetic and medicinal and industrial values of plants

CO5 Students will be able to learn about the uses of medicinal plants and other non wood forest products.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Evolutionary Biology: Origin of life (including aspects of prebiotic environment and molecular evolution); Concept of evolution; Theories of organic evolution; Mechanisms of speciation. Hardyweinberg genetic equilibrium, genetic polymorphism and selection, origin and evolution of economically important crops (Wheat, Rice and cotton)

UNIT-II

Origin of agriculture: World centers of primary diversity of domesticated plants; Plant introduction; Secondary centers of origin.
Plant as a source of renewable energy; Innovations for meeting world food demands.

UNIT-III

Botany, cultivation and uses of –

a. Food, forage and fodder crops (cereals, pulses, vegetables and fruits)
b. Fiber yielding plants

Botany, cultivation and uses of-

c. Medicinal plants
d. Aromatic plants
e. Oil yielding plants

UNIT-IV

Important fire-wood, timber-yielding plants and Non-wood forest products (NWFPs) such as- Bamboos, rattans, raw materials for paper-making, gums, tannins, dyes and resins.
Plants used as avenue trees for shade, pollution control and aesthetics.

Suggested Laboratory Exercises

The practical course is divided into three units:

i) Laboratory Work

Food Crops: Wheat, Rice, Maize, Potato, Chickpea(Bengal gram), Sugarcane. Morphology, anatomy, microchemical tests for stored food materials.

Fodder Crops: Sorghum, Bajra, Berseem, Guar, Oat.

Plant Fibres: Cotton, Jute, Sun hemp, Coir.

Medicinal and Aromatic Plants: Study of live or herbarium specimens or other visual materials to become familiar with following plants:

Papaver somniferum, Atropa belladona, Catharanthus roseus, Adhatoda zeylanica, Allium sativum, Rauwolfia serpentine, Withania somnifera, Phyllanthus niruri, Andrographis paniculata, Aloe barbadensis, Mentha arvensis, Ricinus communis, Abutilon indicum, Datura sp., Artemisia sp., Pedalium murex, Ocimum sanctum, Vetiveria zizanoides, Cymbopogon maritini.

Gums, Resins, Tannins, Dyes: *Acacia, Terminalia, Tea, Turmaric, Bixa orellana, Indigo, Butea monosperma, Lawsonia inermis.*

ii) Field Survey

Prepare a list of important courses of firewood and timber in your locality. Give their local names, scientific names and families to which they belong.

iii) Scientific visits

Students should be taken to any protected area, a recognized botanical garden or museum(such as FRI, BSI, NBRI), to a CSIR laboratory doing research on plants and their utilization and an ICAR research institute or a field station dealing with crops.

Suggested readings:

Swaminathan, M.N. & Jain, R.S. **Biodiversity: Implications for global security**, Macmillan,1982.

CSIR 1986. **The Useful Plants in India**.

Kothari, 1987. **Understanding biodiversity, life sustainability and equity**, Orient Longman.

Sharma, O.P. 1996. **Hills Economic Botany.**

Thakur, R.S. *et al.,* **Major Medicinal Plants.**

Kocchar, S.L. 1998. **Economic Botany of Tropics..**

Richard B. Primack. 1993. **Essentials of Conservation Biology.**

Heywood, V.H. & Watson, R.T. 1995. **Global Biodiversity Assessment.**

Peter B. Kaufman *et al*., 1999. **Natural Products from Plants.**

Negi, S.S. 1993. **Biodiversity and its Conservation in India.**

M. Sc. Botany (Semester- III)

17BOT23DB2 - Plant Breeding and Cytogenetics

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will acquire basic knowledge of conventional and non-conventional methods of plant breeding.

CO2 Students will have understand principles of molecular cytogenetics viz. C- value paradox; Cot curve; multigene families and their evolution

CO3 Students will have in-depth knowledge about classical and latest developments in the science of genetics and plant breeding

CO4 Students will be to transfer alien gene through chromosome manipulation for improving existing varieties of crops.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.

2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Plant Breeding: Principles of plant breeding; Important conventional methods of breeding self, cross pollinated and vegetatively propagated crops.

Non-conventional methods of plant breeding; evolution of major crops (wheat, maize, mustard).

UNIT-II

Origin, occurrence, production, meiosis and breeding behavior of haploids, aneuploids, euploids, autopolyploids and allopolyploids; induction and characterization of trisomics and monosomics.

Molecular Cytogenetics: C- value paradox; Cot curve and its significance; multigene families and their evolution.

UNIT-III

Alien gene transfer through chromosome manipulation: Transfer of whole genome, examples from wheat, *Arachis* and *Brassica*; transfer of individual chromosomes and chromosome segments. Methods for detecting alien chromatin; Production, characterization and utility of alien addition and substitution lines.

UNIT-IV

Genetic basis of inbreeding and heterosis; exploitation of hybrid vigour. Immunotechniques; *In-situ* hybridization- concept and techniques; FISH, GISH; computer assisted chromosome analysis

Suggested Laboratory Exercises

1. Characteristics and behavior of B chromosome using maize or other appropriate material.
2. Induction of polyploidy using colchicines.
3. Different methods of applications of colchicines.
4. Mitotic and meiotic behavior of chromosomes in polyploidy plants
5. Effect of polyploidy on phenotype, pollen, seed fertility and fruit setting.
6. Isolation of chlorophyll mutants.
7. Orcein / Feulgen staining of the salivary gland chromosomes of *Chironomas* and / or *Drosophilla.*
8. Linear differentiation of chromosomes through G-banding / C- banding / Q- banding.
9. Study different stages of mitosis in root tips of A*llium* species.
10. Study meiotic behaviour of chromosomes in Anthers of A*llium* sp. or *Tradescantia.*
11. Isolation of DNA/ RNA from suitable plant material.
12. Quantitative estimation of DNA by diphenylamine method.

M. Sc. Botany (Semester- III)
Lab Course-I
(17BOT23CL)

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will be able to understand the effects of various biotic and factors on plant development and growth

CO2 Students will be able to perform, analyse and report on experiments and observations in plant physiology and plant ecology.

CO3 Students will be able to determine the effects of salt and water stress on seed germination and plant growth.

CO4 Students will be able to collect water and soil samples and their physico-chemical analysis.

CO5 Students will learn the methodology of community studies i.e. line transect, point and quadrat methods.

M. Sc. Botany (Semester- III)
Lab Course-II
(17BOT23DL)

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will be able to identify and classify various groups Cyanobacteria, Bacteria and Fungi.

CO2 Students will be able to prepare media for bacterial and fungal culture.

CO3 Students will be able to identify the symptoms of plant diseases and carry plant pathological experiments.

CO4 Students will be to use the applications of computers, tools of bioinformatics and statistics for botanical research.

CO5 Students will be able to analyse their experimental data by applying different statistical tools.

M. Sc. Botany (Semester-IV)
17BOT24C1 - Plant Genetics

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Structure and function of different types of chromosome and organization of genetic material

CO2 Abnormalities in chromosome, mutation and its efficient use in plant breeding

CO3 Genome mapping in bacteria and genetic transformation using vectors

CO4 Genetic recombination, construction of molecular map and correlation of genetic and physical maps

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.

2. Question No.1 which will be objective covering the entire syllabus, will be compulsory. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Cytology: Chromosome structure and packaging of DNA; molecular organization of centromere and telomere; euchromatin and heterochromatin.

Karyotype analysis; banding patterns; karyotype evolution; specialized types of chromosomes: polytene, lampbrush, B-chromosomes and sex chromosomes.

UNIT-II

Structural and numerical alterations in chromosomes: Mutations, mutagens and their molecular mechanisms of occurrence; Site directed mutagenesis; DNA repair mechanisms; Transposable elements; DNA methylation.

Origin, meiosis and breeding behavior of deficiency, duplication, inversion and translocations in chromosomes; Robertsonian and B-A translocations.

UNIT-III

Mapping of bacteriophage genome; genetic recombination in phage; genetic transformation, conjugation and transduction in bacteria.

Genetic fine structure; cis-trans test; Heterochromatization; Dosage compensation and mechanism of sex determination.

UNIT-IV

Genetic recombination and mapping: Recombination; independent assortment and crossing over; molecular mechanisms of recombination; role of RecA and RecBCD enzymes; site-specific recombination.

Chromosome mapping; linkage groups; physical mapping; construction of molecular maps; correlation of genetic and physical maps; somatic cell genetics- an alternative approach to gene mapping.

Suggested readings:

1. Russel P.J., 1998. Genetics (5th ed.). The Benjamin/Cummings Publishing Co., Inc. USA.
2. Snustad, D.P. and Simmons, M.J., 2000. Principles of Genetics (2nd ed.) John Wiley and Sons, Inc. USA.
3. Strickberger, M.W., 2008. Genetics, Phi Learning.
4. Atherly, A.G., Girton, J.R. and McDonald, J.F., 1999. The Science of Genetics. Saunders College Publishing, Frot Worth, U.S.A.
5. Hartk, D.L. and Jones, E.W., 1998. Genetics: Principles and Analysis (4th ed.). Jones and Bartlett Publishers, Massachusetts, U.S.A.
6. Lodish, H., Berk, A., Zipursky, S.L., Matudaria, P., Baltimoe, D. and Darnell, J. 2000. Molecular, Cell Biology, W.H. Freeman and Co., New York, USA.
7. Miesfeld, R. 1999. Applied molecular genetics. John Wiley and Sons, Inc. USA.
8. Ringo, J., 2004. Fundamental Genetics. Cambridge University Press.
9. Brooker, R., 2008. Genetics: Analysis and Principles. McGraw-Hill Science.
10. Hartwell, L., 2010. Genetics: From Genes to Genomes. McGraw-Hill Science.
11. Elrod, S., 2010. Schaum's outline of Genetics (5th ed.). McGraw-Hill Science.

M. Sc. Botany (Semester-IV)
17BOT24C2 - Biodiversity Conservation

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will learn about current status of biodiversity both at national and international level.
CO2 Students will learn about local plant diversity and its socio-economic importance.
CO3 Students will be able to recognize the significance of biodiversity of human well being.
CO4 Students will be able to explain the effects of habitat degradation, exotic species, overexploitation, pollution and climate change on biodiversity in general and floristic diversity in particular.
CO5 Students will become conversant in various traditional and modern approaches in biodiversity conservation.

Total Marks: 100
Semester End Exam Marks: 80
Internal Assessment Marks: 20
Time: 3 hrs.

Note: 1. Nine questions will be set in all.
2. Question No.1 will be compulsory. It will be objective type covering the entire syllabus. The remaining eight questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting one from each section.

UNIT-I

Biodiversity: concept; national & global status; endemism, speciation and extinction; levels of biodiversity, hotspots and hottest hotspots; study of Indian biodiversity hot spot, significance of biodiversity; local plant diversity and its socio-economic importance, causes of biodiversity depletion, ICUN categories of threat; Red Data Books.

UNIT-II

Principles of conservation, major approaches to management, Biodiversity Conservation strategies, Protected areas in India - Wildlife sanctuaries; National parks; Biosphere reserves; Wetlands and Ramsar convention, Role of botanical gardens, seed banks, *in-vitro* repositories and cryobanks in biodiversity conservation.

UNIT-III

Plant explorations; invasions and introductions; National Bureau of Plant Genetic Resources (NBPGR), Convention of Biological Diversity (CBD), Indian initiatives in biodiversity conservation, National Biodiversity Authority (NBA), Importance of Ethnobotany in Indian context; Farmers' Rights and Intellectual Property Rights.

UNIT-IV

Phytogeography and forest types of India - Ecological and economic importance of forests, afforestation, deforestation and social forestry; endangered plants, endemism,

invasive species; desertification and wasteland reclamation, energy plantations; Effects of global warming, climatic change and stratospheric ozone depletion on plant diversity.

Reference Books

- Odum, E.P. and Barrett, G.W. 2005. **Fundamentals of Ecology** (5th Ed.) Brooks/Cengage Learning India Pvt. Ltd., New Delhi.
- Kormondy, E.J. 2008. **Concepts of Ecology**. Prentice Hall of India., New Delhi.
- Subrahmanyam, N.S. and Sambamurty, A.V.S.S. 2008. **Ecology** (2nd Ed.) Narosa Publishing House, New Delhi
- Singh, J.S., Singh, S.P. and Gupta, S.R. 2008. **Ecology, Environment and Resource Conservation**, Anamaya Publishers, New Delhi.
- Stiling, P. 2009. **Ecology: Theory and Applications** (4th Ed.). PHI Learning Pvt. Ltd. New Delhi.
- Rana, S.V.S. 2009. **Essentials of Ecology and Environmental Sciences** (4th Ed.) PHI Learning Pvt. Ltd. New Delhi.

M. Sc. Botany (Semester-IV)
Dissertation
(16BOT24C3)

Total Marks: 300

Course outcomes:

On the completion of this course students will be able to learn the following:

CO1 Students will develop a thorough understanding of the chosen subject area.
CO2 Students will be able to frame the hypothesis and to define the research questions.
CO3 Students can recognize the importance of planning and preparation required to undertake a research project.
CO4 Students will be able to use the appropriate research tools and techniques to collate and critically assess/interpret data.
CO5 Students will be able to identifying their own area of interest; able to explore a subject in depth; manage a research project
CO6 Students will develop an ability to effectively communicate knowledge in a scientific manner.