

TEACHING AND EXAMINATION SCHEME
B. Sc. BOTANY (as one of the subject) (2017-2020)

Code	Description	Pd/Week		Exam (hours)	CIA *	ESE	Total
		Th.	Pr.				
BSBO 111	ALGAE, LICHENS AND BRYOPHYTES	3		3	20	80	100
BSBO 112	MYCOLOGY, MICROBIOLOGY AND PHYTOPATHOLOGY	3		3	20	80	100
BSBO 121	PRACTICAL		6	3	20	80	100
BSBO 211	PTERIDOPHYTES	3		3	20	80	100
BSBO 212	GYMNOSPERMS AND PALAEOBOTANY	3		3	20	80	100
BSBO 221	PRACTICAL		6	3	20	80	100
BSBO 311	ANATOMY OF ANGIOSPERMS, ECONOMIC BOTANY AND ETHNOBOTANY	3		3	20	80	100
BSBO 312	CELL AND MOLECULAR BIOLOGY	3		3	20	80	100
BSBO 321	PRACTICAL		6	3	20	80	100
BSBO 411	TAXONOMY AND EMBRYOLOGY OF ANGIOSPERMS	3		3	20	80	100
BSBO 412	CYTOGENETICS, GENETICS, PLANT BREEDING, EVOLUTION AND BIOSTATISTICS	3		3	20	80	100
BSBO 421	PRACTICAL		6	3	20	80	100
BSBO 511	PLANT PHYSIOLOGY AND BIOCHEMISTRY	3		3	20	80	100
BSBO 512	PLANT TISSUE CULTURE	3		3	20	80	100
BSBO 521	PRACTICAL		6	3	20	80	100
BSBO 611	ECOLOGY AND ENVIRONMENTAL BIOLOGY	3		3	20	80	100
BSBO 612	RECOMBINANT DNA TECHNOLOGY	3		3	20	80	100
BSBO 621	PRACTICAL		6	3	20	80	100

*CIA for practical includes marks for practical record, regularity, practical skills & viva voce (as applicable).

PAPER NOMENCLATURE IN B.Sc. BOTANY (as one of the subject) :

BSBO 111:	ALGAE, LICHENS AND BRYOPHYTES
BSBO 112:	MYCOLOGY, MICROBIOLOGY AND PHYTOPATHOLOGY
BSBO 121:	PRACTICAL
BSBO 211:	PTERIDOPHYTES
BSBO 212:	GYMNOSPERMS AND PALAEOBOTANY
BSBO 221:	PRACTICAL
BSBO 311:	ANATOMY OF ANGIOSPERMS, ECONOMIC BOTANY AND ETHNOBOTANY
BSBO 312:	CELL AND MOLECULAR BIOLOGY
BSBO 321:	PRACTICAL
BSBO 411:	TAXONOMY AND EMBRYOLOGY OF ANGIOSPERMS
BSBO 412:	CYTOGENETICS, GENETICS, PLANT BREEDING, EVOLUTION AND BIOSTATISTICS
BSBO 421:	PRACTICAL
BSBO 511:	PLANT PHYSIOLOGY AND BIOCHEMISTRY
BSBO 512:	PLANT TISSUE CULTURE
BSBO 521:	PRACTICAL
BSBO 611:	ECOLOGY AND ENVIRONMENTAL BIOLOGY
BSBO 612:	RECOMBINANT DNA TECHNOLOGY
BSBO 621:	PRACTICAL

SEMESTER – I
BSBO 111- ALGAE, LICHENS AND BRYOPHYTES

Unit I

General characters of Algae: Variety of habitats, Range of thallus structure, Structure of a typical algal cell, Modes of reproduction, types of life cycle. Classification of algae: outline of Fritsch's and Smith's classification; Economic importance of Algae; Important features of Chlorophyceae, Structure and life cycle of *Volvox*, *Oedogonium* and *Coleochaete*.

Unit II

Important features of Charophyceae, Structure and life cycle of *Chara*. Important features of Xanthophyceae, Structure and life cycle of *Vaucheria*. Important features of Phaeophyceae, Structure and life cycle of *Ectocarpus* and *Sargassum*.

Unit III

Important Features and life history of Rhodophyceae, Structure and life cycle of *Polysiphonia*. Lichens: Morphology of the two components; biological, ecological and economic importance. Vegetative multiplication methods with special reference to *Parmelia* and *Usnea*.

Unit IV

Bryophytes: General characters, alternation of generations and Classification. Characters and Classification of Hepaticopsida, Morphology and life history of *Riccia*, *Marchantia* and *Plagiochasma*.

Unit V

Characters and classification of Anthocerotopsida, Morphology and life history of *Anthoceros*; Characters and classification of Bryopsida, Morphology and life history of *Sphagnum*.

Suggested Readings:

1. Ghemawat, MS, Kapoor, JN & Narayan, HS 1976, *A Textbook of Algae*, Ramesh Book Depot, Jaipur.
2. Gilbert, M.S 1985, *Cryptogamic Botany*, Vol. I and II, 2nd edn, Tata McGraw Hill, Publishing Co. Ltd., New Delhi.
3. Pandey, SN, Misra, SP & Trivedi, PS 1972, *A Textbook of Botany: Bryophyta, Pteridophyta, Gymnosperms & Palaeobotany*, Vikas Pub. House Pvt. Ltd., New Delhi.
4. Parihar, NS 1961, *Bryophyta*, Vol. 1, Central Book Depot, Allahabad.
5. Puri, P 2002, *Bryophytes*, 2nd edn, Atmaram and Sons, New Delhi..
6. Rashid, A 1998, *An Introduction to Bryophyta: Diversity, Development & Differentiation*, Vikas Pub. House Pvt. Ltd., New Delhi.
7. Sharma, OP 1986, *Textbook of Algae*, Tata McGraw Hill Education (India) Pvt. Ltd.
8. Sharma, OP 2014, *Series on Diversity of Microbes & Cryptogams: Bryophyta*, Tata McGraw Hill Education (India) Pvt. Ltd.
9. Singh, V, Pande, PC & Jain, DK 2014, *A Textbook of Botany*, 4th edn, Rastogi Publications, Meerut.
10. Vashishta, BR, Sinha, AK & Singh, VP, 2010, *Botany for Degree Students- Algae*, S. Chand and Co. Ltd., New Delhi.
11. Vashishta, BR, Sinha, AR & Kumar, A 2011, *Botany for Degree Students - Bryophyta*, S. Chand and Co. Ltd, New Delhi.

BSBO 112- MYCOLOGY, MICROBIOLOGY AND PHYTOPATHOLOGY

Unit I

General characters, classification and economic importance of fungi. Important features and life history of Mastigomycotina- *Albugo*, Zygomycotina- *Rhizopus*, Ascomycotina - *Saccharomyces* and *Aspergillus*.

Unit II

Important features and life history of Basidiomycotina- *Ustilago*, *Puccinia*, *Agaricus*. Cultivation of mushrooms. Deuteromycotina- *Alternaria*.

Unit III

Viruses: Chemical and physical nature, structure, multiplication and transmission of plant viruses. Tobacco mosaic virus and Yellow vein mosaic virus disease. General account of AIDS.

Unit IV

Bacteria - Structure, nutrition, cell division, reproduction and economic importance; Cyanobacteria- Life history of *Nostoc* and *Oscillatoria*, Role of Blue green algae in nitrogen fixation; General account and biology of mycoplasma and phytoplasma.

Unit V

Principles of Plant Pathology, Koch's postulates; Causes, symptoms, diseases cycle and control measures of Green ear disease of bajra, Loose smut of wheat, Black rust of wheat, Citrus canker and Little leaf of brinjal; Principles of integrated plant disease management.

Suggested Readings:

1. Alexopoulos, CJ & Mims, CW & Blackwell, MM 1996, *Introductory Mycology*, 4th edn, John Wiley and Sons, New York, US.
2. Bilgrami, KS & Dube, HC 1990, *A Text Book of Modern Plant Pathology*, Vikas Publishing House, New Delhi.
3. Dube, HC 2012, *Fungi*, Rastogi Publication, Meerut.
4. Kaushik, P 2001, *Microbiology*, Emkay Publication.
5. Madahar, CL 1978, *Introduction to Plant Viruses*, S. Chand & Co. Ltd., New Delhi.
6. Mehrotra, RS & Aneja, KR, 2015, *An Introduction to Mycology*, New Age International Publishers.
7. Pelczar, MJ Jr, Chan, ECS & Kreig, NR 1993, *Microbiology*, 5th edn, Tata McGraw Hill Book Publishing Co., Ltd., New Delhi.
8. Pathak, VN 2000, *Fundamentals of Plant Pathology*, Agro Botanica.
9. Sharma, PD 2012, *Microbiology and Plant Pathology*, Rastogi Publications, Meerut.
10. Singh, V, Pandey, PC & Jain, DK 2011, *A Text Book of Botany*, Rastogi Publications, Meerut.
11. Vashista, BR & Sinha, AK 2012, *Botany for Degree Students : Fungi*, S. Chand & Co. Ltd., New Delhi.

PRACTICAL : BSBO 121

SUGGESTED LABORATORY EXERCISES:

Microscopic preparation and study of the following:

i. Material A - Algae: *Volvox, Oedogonium, Coleochaete, Chara, Vaucheria, Ectocarpus, Sargassum* and *Polysiphonia*

ii. Material B - Bryophyta: *Riccia, Marchantia, Plagiochasma, Anthoceros* and *Sphagnum*.

iii. Material C- Fungi: *Albugo, Rhizopus, Saccharomyces, Aspergillus, Ustilago (Teleutospores), Puccinia, Agaricus* and *Alternaria*

iv. Material D- Microbiology: Bacteria (Gram's staining) , *Nostoc* and *Oscillatoria*

SPOTS:

i. Slides/ photographs/ specimens/ Model of any Alga from the above mentioned list.

ii. Slides/ photographs/ specimens/ Model of any Bryophyte from the above mentioned list.

iii. Slides/ photographs/ specimens/ Model of any Fungus from the above mentioned list.

iv. Slides/ photographs/ specimens/ Model of any of the following from Microbiology:

a. Disease symptoms caused by TMV and YMV.

b. Root Nodule

c. *Nostoc* and *Oscillatoria*.

v. Lichens: Types on the basis of morphology .

vi Plant Pathology: Study of symptoms of the following diseases (specimen / photographs):

i. Green ear disease of Bajra

ii. Loose smut of wheat

iii. Citrus canker

iv. Black rust of wheat

v. Little leaf of brinjal. .

LACHOO MEMORIAL COLLEGE OF SCIENCE & TECHNOLOGY (AUTONOMOUS)
JODHPUR, RAJASTHAN
UG PRACTICAL EXAMINATION
SEMESTER- I
Botany (BSBO 121)

Time: 3 hours

Max. Marks: 80

1. Make suitable preparation of material "A", "B", "C" and "D". Identify and comment upon your preparation. Leave your preparation for inspection.

Material A 12

Material B 12

Material C 12

Material D 10

2. Identify and comment upon the spots from 'a' to 'f': 6x 4 = 24

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

3. Viva-voce 10

SEMESTER – II
BSBO 211- PTERIDOPHYTES

Unit I

General characters, life cycle pattern, affinities and classification of Pteridophytes, Important Characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida, Economic importance of Pteridophytes, Stear Systems in Pteridophyta.

Unit II

Occurrence, structure of vegetative and reproductive parts and life history of *Psilotum* and *Lycopodium*.

Unit III

Occurrence, structure of vegetative and reproductive parts and life history of *Selaginella*; Heterospory and origin of seed habit.

Unit IV

Occurrence, structure of vegetative and reproductive parts and life history of *Equisetum* and *Adiantum*.

Unit V

Occurrence, structure of vegetative and reproductive parts and life history of *Marsilea* and *Azolla*.

Suggested Readings:

1. Gifford, EM & Foster AS 1988, *Morphology and Evolution of Vascular Plants*, W.H. Freeman and Company, New York, 1988.
2. Pandey, SN, Mishra, SP & Trivedi PS 2013, *A Text Book of Botany* Vol. II, Vikas Publishing House Pvt. Ltd., New Delhi.
3. Parihar, NS 1996, *Biology and Morphology of Pteridophytes*, Central Book Depot, Allahabad.
4. Rashid, A 1999, *An Introduction to Pteridophytes*, 2nd edn, Vikas Publishing House Pvt Ltd, India.
5. Sarabhai, RC & Saxena RC 1990, *A Text Book of Botany*, Rastogi Publications, Meerut.
6. Sharma, OP 2006, *Pteridophytes*, Today and Tomorrow Publication.
7. Singh, V, Pandey, PC & Jain DK 2014, *A Text Book of Botany*, Rastogi Publications, Meerut.
8. Vashista, PC, Sinha, AK & Kumar A 2014, *Botany for Degree Students : Pteridophyta*, S.Chand and Co., New Delhi.

BSBO 212- GYMNOSPERMS AND PALAEOBOTANY

Unit I

Characteristics of seed plants; General features of Gymnosperms and their classification. Affinities of Gymnosperms with Pteridophytes and Angiosperms; Economic importance of Gymnosperms.

Unit II

Cycas: Morphology of vegetative and reproductive parts; Anatomy of root, stem, leaf and reproductive parts; Reproduction and life cycle.

Unit III

Pinus: Morphology of vegetative and reproductive parts; Anatomy of root, stem, leaf and reproductive parts; Reproduction and life cycle.

Unit IV

Ephedra: Morphology of vegetative and reproductive parts; Anatomy of root, stem, leaf and reproductive parts; Reproduction and life cycle.

Unit V

Geological time scale, fossilization and types of fossils; Techniques for fossil study;
Primitive land plant: *Rhynia*, Fossil Gymnosperm - *Williamsonia*.

Suggested readings:

1. Andrews, HN, Jr 1961, *Studies in Palaeobotany*, John Wiley & Sons Inc. New York.
2. Arnold, CA, 1947, *An Introduction to Palaeobotany*. McGraw Hill Book Company, New York.
3. Bhatnagar SP & Moitra A 2006, *Gymnosperms*, New Age International (P) Ltd, Publishers., New Delhi.
4. Biswas C & Johri BM 2004, *The Gymnosperms*, 2nd edn, Narosa Publishing House, New Delhi.
5. Gifford, EM & Foster, AS 1988, *Morphology and Evolution of Vascular Plants*, 3rd edn, W.H. Freeman and Company, New York.
6. Pandey, SN, Misra, SP & Trivedi, PS 2008, *A Text Book of Botany –Vol.-II*, 12th edn, Vikas Publishing House Pvt Ltd., New Delhi.
7. Singh, V, Pande, PC & Jain, DK 2011, *A Text Book of Botany*, 4th edn, Rastogi Publications, Meerut.
8. Sporne, KR 1991 *The Morphology of Gymnosperms*, B.I. Publ. Pvt., Bombay.
9. Stewart, WN & Rothwell, GW 1999, *Palaeobotany and Evolution of Plants*, 2nd edn, Cambridge University Press, U.K.
10. Taylor, TN 1981, *Palaeobotany: An Introduction to Fossil Plant Biology*. Mc Graw-Hill Book Co. Inc., New York.
11. Vashishta, PC, Sinha, AK & Kumar, A 2009, *Botany for Degree Students – Gymnosperms*, S. Chand and company Ltd., New Delhi.

PRACTICAL: BSBO 221

SUGGESTED LABORATORY EXERCISES:

Pteridophytes: (Material A- Vegetative Part, Material B- Reproductive Part)

1. *Psilotum* –External Morphology (photographs / specimen/model).
2. *Lycopodium* - External Morphology, T.S. of stem and L.S. of cone.
3. *Selaginella* - External Morphology, T.S. of stem and L.S. of cone.
4. *Equisetum* - External Morphology, T.S. of stem (internode) and T.S.& L.S of cone.
5. *Marsilea* - External Morphology, T.S. of rhizome, T.S. of petiole and H. L. S. of sporocarp .
6. *Adiantum* - External Morphology and T. S. of sporophyll .
7. *Azolla* - External Morphology.

Gymnosperms: (Material C- Vegetative Part, Material D- Reproductive Part)

1. *Cycas*: T.S. of normal root (Permanent slide only), T.S. of coralloid root, T.S. of rachis and T.S. of leaflet; microsporophyll and megasporophyll (specimens / slides).
2. *Pinus*: External Morphology, T.S. of needle, stem (slide only), W.M. of pollen grains, male and female cones (specimens / slides).
3. *Ephedra*: External Morphology, T.S. of stem, mounting of male flower and L.S. of female reproductive part.

SPOTS:

Slides/ Specimens/ Photographs of **Material-A, B, C and D**

Slide/ Specimens/ Photographs of the following fossil gymnosperms:

1. *Rhynia*
2. *Williamsonia*

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JODHPUR, RAJASTHAN
UG PRACTICAL EXAMINATION
SEMESTER- II
Botany (BSBO 221)

Time: 3 hours

Max. Marks: 80

1. Cut a T. S. of **material "A"** and make double stained temporary mount of the same. Draw labeled diagram. Identify the material, giving reasons. Leave your preparation for inspection.

Material "A" 16

2. Make a suitable preparation of the reproductive parts of the **material "B"** Draw labeled diagram. Identify and comment upon the features of interest. Leave your preparation for inspection.

Material "B" 07

3. Cut a T. S. of **material "C"** and make double stained temporary mount of the same. Draw labeled diagram. Identify the material, giving reasons. Leave your preparation for inspection.

Material "C" 16

4. Make a suitable preparation of the reproductive parts of the **material "D"** Draw labeled diagram. Identify and comment upon the features of interest. Leave your preparation for inspection.

Material "D" 07

5. Identify and comment upon the spots from 'a' to 'f': 6x 4= 24

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

6. Viva-voce 10

SEMESTER-III

BSBO 311: ANATOMY OF ANGIOSPERMS, ECONOMIC BOTANY AND ETHNOBOTANY

Unit I

Anatomy of Angiosperms: Root system; Root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.

Unit II

Shoot system : The shoot apical meristem and its histological organization; vascularization of primary shoot in monocotyledons and dicotyledons; cambium and its functions; Characteristics of normal secondary growth, differentiation of secondary xylem, characteristics of growth rings, sapwood and heart wood ; differentiation of secondary phloem-structure, function relationship; Periderm.

Unit III

Abnormal structure in stem: primary anomalous in Dicot and Monocot stem; Secondary growth in *Dracaena* Stem; Abnormal origin and activity of cambium in Dicot stem.
Leaf: Internal structure in relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.

Unit IV

Economic Botany: Food plants - rice, wheat, sugarcane; Fibers - cotton; Vegetable oils- groundnut, mustard and coconut; General account of sources of firewood, timber and bamboos; Beverages- Tea and coffee; Rubber.

Unit V

Spices and Condiments- General account; Medicinal plants with special reference to Rajasthan- *Aloe*, *Asparagus*, *Commiphora*, *Boswellia*, *Pedaliium*, *Zizyphus*, *Haloxylon*, *Tribulus*, *Vitex* and *Withania*;
Ethnobotany- Introduction, Methods of Ethnobotanical studies, and knowledge of aboriginals in Rajasthan.

Suggested readings:

1. Cutter, EG 1971, *Plant Anatomy: Experiment and Interpretation, Part II: Organs*, Edward Arnold, London.
2. Esau, K 1977, *Anatomy of Seed Plants*, 2nd edn, John Wiley & Sons, New York.
3. Fahn, A 1982, *Plant Anatomy*, 3rd edn, Pergamon Press, Oxford.
4. Jain, SK & Mudgal V 1999, *A Handbook of Ethnobotany*, BSMPS publication.
5. Jain, SK (ed.) 1995, *Manual of Ethnobotany*, Scientific Publisher, Jodhpur.
6. Kocchar, SL 1998, *Economic Botany in Tropics*, 2nd edn, Mac-Millan India Ltd., New Delhi.
7. Mauseth, JD 1988, *Plant Anatomy*, the Benjamin/Cummings Publ. Company Inc., Menlo Park, California, USA.
8. Pandey, BP 2014, *A Text Book of Botany Angiosperms*, S.Chand & Company Ltd. Ram nagar, New Delhi.
9. Sambamurthy, AVSS & Subramanyam, NS 1989, *A Text Book of Economic Botany*, Wiley Eastern Ltd., New York.
10. Sharma, OP 1996, *Hill's Economic Botany* (Late Dr. A.F. Hill, Adapted by O.P. Sharma), Tata McGraw Hill Co., Ltd., New Delhi.
11. Simpson, BB & Conner-Ogorzaly, M 1986, *Economic Botany Plants in Our World*, McGraw Hill, New York.
12. Singh, V, Pande, PC & Jain, DK 2014, *A Text Book of Botany Angiosperms*, 4th edn, Rastogi Publications, Meerut.

BSBO 312: CELL AND MOLECULAR BIOLOGY

Unit I

Cell theory, Prokaryotic and eukaryotic cell; Cell organization: structure of a plant cell; cell wall, plasmodesmata, plasma membrane; Mitosis, Meiosis and cell cycle regulation.

Unit II

Structure and function of cell organelles: Plastid, Mitochondria, Endoplasmic reticulum, Golgi body, Ribosomes, Peroxisomes, Vacuoles; Nucleus: Structure, nuclear pore complex, nucleolus and chromatin network.

Unit III

DNA the genetic material: Structure and different forms of DNA; Replication of DNA: Mode of replication, Enzymes and proteins involved, Replication fork, Leading and lagging strand, Okazaki fragments; Differences between prokaryotic and eukaryotic DNA replication; DNA damage and repair mechanisms.

Unit IV

Gene: definition and structure (Promoter, coding sequences, terminator). Prokaryotic and eukaryotic transcription: Transcriptional factors and machinery, RNA polymerases, regulatory elements; mechanism of transcription -formation of initiation complex, elongation, and termination, RNA processing (brief account).

Unit V

Translation: Prokaryotic translation; translational machinery; aminoacylation of t-RNA, formation of initiation complex, elongation and termination of translation; Regulation of gene expression in prokaryotes (operon concept) and basics of gene expression in eukaryotes.

Suggested readings:

1. Alberts, B, Johnson, A, Lewis, J, Raff, M., Roberts, K & Walter, P 2007, *Molecular Biology of the Cell*, 5th edn, Garland Publishing Inc, New York.
2. Buchanan, BB, Gruissem, W, & Jones, RL (eds.) 2015, *Biochemistry and Molecular Biology of Plants*, American Society of Plant Physiologists, Maryland, USA and Wiley Blackwell.
3. Cooper, GM & Robert EH 2007, *The Cell: A Molecular Approach*, 4th edn, ASM Press and Sinauer Associates Inc, USA.
4. De, DN 2000, *Plant Cell Vacuoles: An Introduction*, CSIRO Publication, Collingwood, Australia.
5. Gunning, BES & Steer, MW 1995, *Plant Cell Biology: Structure and Function*, Jones and Bartlett Publishers, Boston, Massachusetts.
6. Gupta, PK 2014, *A Textbook of cell and Molecular Biology*, 4th edn, Rastogi Publications, Meerut
7. Harris, N & Oparka, KJ 1994, *Plant Cell Biology: A Practical Approach*, IRL Press, Oxford University Press, Oxford, UK.
8. Karp G Iwasa, I & Marshall, W 2016, *Cell and Molecular Biology: Concepts and Experiments*, 8th edn, John Wiley & Sons Inc, USA.
9. Kleinsmith, LJ & Kish, VM 1995, *Principles of Cell and Molecular Biology*, Harper Collins College Publishers, New York, USA.
10. Krebs, JE, Goldstein, ES & Kilparick ST 2014, *Lewin's Genes XI*, Jones & Bartlett Learning, Burlington, Massachusetts.
11. Lodish, H, Berk, A, Zipursky, SL, Matsudaira, P, Baltimore, D, & Darnell, JE 1999, *Molecular Cell Biology* 4th edn, W.H. Freeman and Company, New York.
12. Paoletta, P 1997, *Introduction to Molecular Biology*, Tata McGraw Hill.
13. Powar, CB 2010, *Cell Biology*, Himalaya Publishing House.

14. Verma, PS & Agarwal VK 2015, *Cell Biology (Cytology, Biomolecules and Molecular Biology)*, S. Chand & Company Ltd.

PRACTICAL: BSBO 321

SUGGESTED LABORATORY EXERCISES:

Anatomy: (Material-A)

1. Dicot Stem: *Helianthus, Nyctanthes, Bignonia, Salvadora* and *Boerhavia*.
2. Monocot Stem: *Dracaena, Zea mays*.
3. Dicot Root: *Tinospora*
4. Monocot Root: *Zea mays*.
5. Dicot Leaf: *Nerium, Ficus*
6. Monocot Leaf: *Zea mays*.

Economic Botany: (Material-B)

Purity and identification test (with principle, diagram, etc.):

1. Purity test of Haldi, Mustard oil, Hing, Katha and Coriander powder.
2. Test for starch in Wheat & Rice (from pre-soaked grains) and potato.
3. Test for Cellulose in cotton and filter paper.
4. Test for lignin in coir and matchstick.
5. Test for fats & oils in seeds of Groundnut, Mustard and Sunflower.

Cell Biology: (Material-C & D)

1. Study of various stages of mitosis in onion root tip.
2. Study of cell wall using suitable chemicals.

SPOTS:

1. Slide of any anatomy plant material.
2. Different types of stomata and thickening in xylem vessels (slides/photographs).
3. Medicinal plants / Ethnobotany specimens:
 - i. Medicinal plants: *Aloe, Asparagus, Commiphora, Tribulus* and *Withania* .
 - ii. Ethnobotany: *Abrus, Leptadenia, Calotropis* and *Crotalaria*.
4. Economic botany: Wheat, Sugarcane, Cotton, Jute, Groundnut, Mustard, Coconut, Cloves, Cardamom, Black pepper, Tea leaves & Rubber.
5. Slides/Models/Photographs/Drawings: Cell structure and Cell organelles: Plasmodesmata, Plasmalemma, Chloroplast, Mitochondria, Nucleus, Nuclear Pore Complex, Peroxisome
6. Chromosome, DNA-Physical and Chemical properties.

LACHOO MEMORIAL COLLEGE OF SCIENCE & TECHNOLOGY (AUTONOMOUS)
JODHPUR, RAJASTHAN
UG PRACTICAL EXAMINATION
SEMESTER- III
Botany (BSBO 321)

Time: 3 hours

Max. Marks: 80

1. Prepare a hand section of the anatomy material provided and illustrate with (i) labelled outline and cellular diagrams, (ii) identification and (iii) characters. Submit the double stained section for evaluation.

Material "A" 16

2. Perform the phytochemical / purity test of the given material and report the result.

Material "B" 07

3. Prepare a suitable smear of the onion root tip . Draw a labelled diagram of the same. Submit the smear for evaluation.

Material "C" 16

4. Study the cell wall of given material using suitable chemicals.

Material "D" 07

5. Identify and comment upon the spots from 'a' to 'f': 6 x 4= 24

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____
- f. _____

6. Viva-voce 10

SEMESTER-IV
BSBO411: TAXONOMY AND EMBRYOLOGY OF ANGIOSPERMS

Unit I

Angiosperms: Angiosperm Taxonomy- Alpha, Omega and Holotaxonomy, Taxonomic Literature, Botanical Nomenclature, Principles and Rules, Taxonomic Ranks, Type Concept, Principle of Priority.

Classification of Angiosperms –Natural, Artificial and Phylogenetic, Salient Features of Systems proposed by Bentham and Hooker and Engler and Prantl.

Unit II

Flower- Modified Shoot, Structure and Development of Flower, Inflorescence-Types of inflorescence. Diversity of Flowering Plants as illustrated by members of families – Ranunculaceae, Papaveraceae, Caryophyllaceae, Apiaceae.

Unit III

Diversity of Flowering Plants as illustrated by members of families: Asteraceae, Acanthaceae, Apocynaceae, Asclepiadaceae, Scrophulariaceae, Lamiaceae, Euphorbiaceae and Poaceae.

Unit IV

Structure of Anther, Microsporogenesis, Tapetum-Types and Function, Development of Male Gametophyte, Structure of Pollen Grains, Types of Ovules, Megasporogenesis, Structure and Development of Female Gametophyte (Embryo sac), Types of Embryo Sacs- Monosporic, Bisporic and Tetrasporic.

Unit V

Pollen- Pistil Interaction, Self Incompatibility, Double Fertilization, Endosperm: Types of Endosperm, Development of Monocot and Dicot Embryo, Polyembryony, Apomixis, Parthenogenesis and Parthenocarpy; A brief account of Genomic Imprinting.

Suggested Readings:

1. Bhojwani, SS & Bhatnagar, SP 2009, *The Embryology of Angiosperms*, Vikas Publ., New Delhi.
2. Davis, PH & Heywood, VH 2011, *Principles of Angiosperm Taxonomy*, Scientific Publishers, Jodhpur.
3. Davis, PH & Heywood, VH 1991, *Principles of Angiosperm Taxonomy*. Today and Tomorrow Publications, New Delhi.
4. Jeffery, C 1982, *An Introduction to Plant Taxonomy*, Cambridge University Press, Cambridge, London.
5. Jones, SD Jr. & Luchsinger, AE 1986, *Plant Systematics*. McGraw- Hill Book Co., New York.
6. Lawrence, GHM 1951, *Taxonomy of Vascular Plants*. The Macmillan Company. New York.
7. Mondal, AK 2011, *Advanced Plant Taxonomy*. New Central Book Agency (P) Limited.
8. Pandey, SP & Misra SP 2008, *Taxonomy of Angiosperms*, Ane Books Pvt Ltd.

9. Sambamurty, AVSS 2005, *Taxonomy of Angiosperms*, I K International Pvt Ltd
10. Sharma, OP 2009, *Taxonomy*, Tata McGraw Hill Pub. Company Ltd., New Delhi.
11. Singh, G 2010, *Plant Systematics: An Integrated Approach*, Third Edition, Science Publishers.
12. Singh, V, Pandey, P C & Jain, D K 2010, *Structure, Development and Reproduction in Angiosperms*. Rastogi Publications, Meerut.
13. Sivarajan, VV 1999, *Introduction to the Principles of Plant Taxonomy*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
14. Verma, BK 2011, *Introduction to Taxonomy of Angiosperms*. PHI Learning Pvt. Ltd.

BSBO412: CYTOGENETICS, GENETICS, PLANT BREEDING, EVOLUTION AND BIOSTATISTICS

Unit I

Cytogenetics: Chromatin organization: structure of chromosomes, concept of nucleosome, types of chromosomes: Special types of chromosome (Polytene and lampbrush) and sex chromosomes. Chromosome aberrations: Structural aberrations: deletion, duplication, translocation, inversion; Numerical aberrations: aneuploidy and polyploidy.

Unit II

Genetics: Nature of inheritance: Laws of Mendelian inheritance, Mono and Dihybrid cross, test cross, back cross, extensions of Mendelian principles: incomplete dominance, codominance, multiple alleles, Complementary interaction, supplementary interaction, Epistasis, duplicate gene, polygenic inheritance, Pleiotropy, maternal inheritance; Chromosome theory of inheritance, crossing-over, linkage.

Unit III

Plant breeding: Centres of origin of crop plants and centres of diversity; Domestication, Introduction, Selection, Hybridization, Mutation breeding, breeding work done on wheat.

Unit IV

Evolution: origin of life (Haldane/A.I. Oparin Hypothesis), Lamarck's theory, Darwin's theory, Evidences of organic evolution, Natural selection, origin of species; Population genetics: Allele and genotype frequency, Hardy-Weinberg principle.

Unit V

Biostatistics: Definition and Applications, Collection and representation of data (Tabular, graphical and diagrammatic representation), Mean (Arithmetic, geometric, harmonic mean), Median (for grouped and ungrouped data), Mode, Standard deviation: computation for grouped and ungrouped data, merits and demerits.

Suggested readings:

1. Atherly, AG, Girton, JR & McDonald, JF 1999, *The Science of Genetics*, Saunders, College Publishing, Fort Worth, USA.
2. Burnham, CR 1984, *Discussions in Cytogenetics*, 7th edn, University of Minnesota, St. Paul.
3. Chaudhary, HK 1983, *Elementary Principles of Plant Breeding*, Oxford IBH Publishing, New Delhi.
4. Gupta, PK 2010, *Cytology, Genetics, Evolution and Plant Breeding*, 2nd edn, Rastogi Publications, Meerut.
5. Hartl, DL & Jones, EW 2002, *Essential Genetics: A Genomic Perspective*, Jones & Bartlett Publishers, Massachusetts, USA.
6. Khush, GS 1973, *Cytogenetics of Aneuploids*, Academic Press, New York, London.
7. Prasad, S 2006, *Elements of Biostatistics*, 2nd edn, Rastogi Publications, Meerut.
8. Pierce, BA 2013, *Genetics: A Conceptual Approach*, 5th eds, W. H. Freeman
9. Shukla, RS & Chandel, PS 2013, *Cytogenetics, Evolution and Plant Breeding*, S. Chand and Co. Ltd, New Delhi.
10. Singh, BD 2007, *Fundamentals of Genetics*, Kalyani Publishers, Ludhiana.
11. Singh, BD 2012, *Plant Breeding: Principles and Methods*, Kalyani Publishers, Ludhiana.

12. Snustad, DP & Simmons, MJ 2012, *Principles of Genetics*, 6thedn, John Wiley & Sons Inc, Hoboken, NJ, USA.
13. Verma, PS & Agarwal VK 2015, *Cell Biology (Cytology, Biomolecules and Molecular Biology)*, S. Chand & Company Ltd.

PRACTICAL: BSBO 421

SUGGESTED LABORATORY EXERCISES:

Taxonomy:

Description of following flowers using taxonomic terms:

1. **Ranunculaceae:** *Delphinium*
2. **Papaveraceae:** *Papaver*
3. **Caryophyllaceae:** *Dianthus, Saponaria*
4. **Apiaceae:** *Coriandrum*
5. **Asteraceae:** *Helianthus, Sonchus*
6. **Acanthaceae:** *Adhatoda, Barleria*
7. **Apocynaceae:** *Catharanthus, Thevetia, Nerium*
8. **Asclepiadaceae:** *Calotropis*
9. **Scrophulariaceae:** *Antirrhinum, Linaria*
10. **Lamiaceae:** *Ocimum, Salvia*
11. **Euphorbiaceae:** *Euphorbia pulcherrima, Ricinus communis*
12. **Poaceae:** *Triticum*

Embryology:

1. Germination of pollen in control and 5 % sucrose solution
2. Translator mounting: *Calotropis*
3. Study of Placentation : Axile, Free Central, Parietal, Marginal and Basal
4. Pollen stainability(1:1 Glycerin: Acetocarmine) in *Cassia fistula* and *Datura*

Genetics/Plant Breeding/Statistics:

1. Problems related to Mendel's law of dominance, segregation and independent assortment (Seed sample).
2. Problems related to Incomplete dominance, modified ratios and multiple alleles (Seed sample).
3. Problems related to central tendency (Mean, Mode and Median- by data sheet/plant material).
4. Demonstration of Emasculation technique including bagging, tagging and labelling.

Spots

- 1 Leaf : Simple and compound;
Inflorescence : Cyathium, Verticillaster and Umbel
- 2 Fruits : Pepo, Caryopsis, Cremocarp and Hesperidium;
Endosperm : Coconut, Walnut and Custard apple.
- 3 Structure of Ovule: Orthotropus, Anatropus, Campylotropus and Amphitropus;
Study of Placentation : Axile, Free Central, Parietal, Marginal and Basal
- 4 Chart showing Pure line and mass selection;

Scientific contributions of Darwin, Lamarck, Hugo de vries, Vavilov and Mendel
(Photographs with names)

- 5 Slides/Models/Photographs/Drawings: Chromosome structure (nucleosome, solenoid model), lampbrush and polytene chromosome
- 6 Photographs/Drawings: Chromosomal aberrations- structural and numerical.

LACHOO MEMORIAL COLLEGE OF SCIENCE & TECHNOLOGY (AUTONOMOUS)
JODHPUR, RAJASTHAN
UG PRACTICAL EXAMINATION
SEMESTER- IV
Botany (BSBO 421)

Time: 3 hours

Max. Marks: 80

- 1 Describe the given flower using Taxonomic terms with floral diagram and floral formula, mentioning special features of identifications 16
- 2 Prepare and identify the given material from Embryological point of view. 07
- 3 Perform Biostatistics exercise. 09
- 4 Explain the given Genetics exercise. 07
- 5 Emasculate the given material and submit for evaluation. 07
- 6 Identify and comment upon the spots from 'a' to 'f': 6 x 4= 24

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____
- f. _____

7. Viva-voce

10

SEMESTER V
BSBO511: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Unit I

Plant-water relations: Importance of water to plant life; structure & physical properties of water; diffusion and osmosis; absorption by roots, ascent of sap and transpiration.

Mineral nutrition: Role of essential macro- and micro-elements and their deficiency symptoms.

Transport of organic substances: source-sink relationship; mechanism of phloem transport, factors affecting translocation

Unit II

Photosynthesis: Photosynthetic pigments; absorption & action spectra, enhancement and red drop effect; concept of two photosystems; Z-scheme; photophosphorylation; Calvin cycle; C₄ pathway; CAM pathway; photorespiration

Unit III

Respiration: Aerobic and anaerobic respiration; Glycolysis & Krebs cycle; electron transport mechanism, oxidative phosphorylation; pentose phosphate pathway

Basics of enzymology: Discovery, nomenclature, classification and characteristics of enzymes; concept of holoenzyme, apoenzyme, coenzyme and cofactors; mechanism of action; regulation of enzyme activity

Unit IV

Nitrogen uptake: Biological nitrogen fixation; nitrate reduction; nitrate reductase and its regulation; ammonium assimilation

Lipid metabolism: Saturated and unsaturated fatty acids, classification, structure and function of lipids; fatty acid biosynthesis; β -oxidation ; glyoxylate cycle

Unit V

Growth and development: Definitions; phases of growth and development; plant hormones viz.- auxins, gibberellins, cytokinins, abscisic acid and ethylene –their discovery & physiological roles; general mechanism of action of hormones; seed germination & dormancy; photoperiodism & vernalization; photomorphogenesis and skotomorphogenesis; phytochromes- discovery, physiological roles & mechanism of action.

Suggested readings:

1. Hopkins, WG & Huner, NPA 2009, *Introduction to Plant Physiology*, 4th edn, John Wiley and Sons, Inc., New York, USA.
2. Jain, VK 2000, *Fundamental of Plant Physiology*, 5th edn, S. Chand and Co. Ltd., New Delhi.

- Pandey, SN 2005, *Plant Physiology*, 4th edn, Vikas Pub. House Pvt. Ltd., New Delhi.
- Salisbury, FB & Ross, CW 1992, *Plant Physiology*, 4th edn, Wadsworth Publishing Co., California, USA.
- Sinha, RK 2003, *Modern Plant Physiology*. Narosa publishing Co, New Delhi.
- Srivastava, HS 2005, *Plant Physiology & Biochemistry*, Rastogi Publications, Meerut.
- Taiz, L., Zeiger, E, Moller, IM & Murphy, A 2015, *Plant Physiology and Development*, 6th edn, Sinauer Associates, Inc.USA.
- Trivedi, P. C., Atreya, A and Pathak, K 2006, *Plant Physiology, Biochemistry and Biotechnology*. Ramesh Book Depot, Jaipur.
- Verma, SK 2007, *Textbook of Plant Physiology, Biochemistry & Biotechnology*, S. Chand and Co. Ltd., New Delhi.
- Verma, V 2007, *Textbook of Plant Physiology*. Ane books, India.

BSBO512: PLANT TISSUE CULTURE

Unit I

History of plant tissue culture: Cell theory, Totipotency, Pluripotency, Contributions of Haberlandt, White, Skoog, Guha and S.C. Maheshwari, Cocking, Murashige.

Basic techniques and tools of plant tissue culture: Sterilization, concept of clean area/aseptic condition, explant types, pretreatment and surface sterilization, laminar air flow bench, growth room, green house.

Culture media: Basic constituents of culture media (MS: Inorganic and organic nutrients, energy source, gelling agents, PGR's, pH).

Unit II

Micropropagation: Methods of Micropropagation (Axillary bud proliferation, Adventitious shoot bud differentiation, callus organogenesis and somatic embryogenesis). Various stages of Micropropagation: establishment of cultures, subculture of *In vitro* established cultures, rooting (*In vitro* and *ex vitro*) and hardening of plantlets.

Unit III

Protoplast culture technique: source of protoplasts, isolation techniques, enzymes, osmoticum, purification of protoplasts, viability of protoplast and various culture techniques.

Somatic hybridization: protoplast fusion. Identification and selection of hybrid cells, verification and characterization of somatic hybrids, Cybrids, Potential, problems and limitations of somatic hybridization.

Unit IV

Cell culture: Types of suspension culture, techniques for single cell culture, selection of cells for higher yield, optimization of growth conditions, bioreactors for large scale culture, types of bioreactors, immobilization of cell culture, hairy root cultures, elicitations and biotransformation.

Unit V

Application and scope of plant tissue culture: Role of shoot tip culture, haploids, soma clonal variants, synthetic seeds and cryopreservation in forestry, floriculture, agriculture and biodiversity conservation.

Suggested readings:

- Ahuja, MR (ed) 1993, *Micropropagation of Woody Plants*, Springer.
- Beyl, CA, & Trigiano, RN (eds) 2014, *Plant Propagation Concepts and Laboratory Exercises*, 2nd edn, CRC Press, Boca Raton, FL.
- Bhojwani, SS & Razdan, MK 1996, *Plant Tissue Culture: Theory and Practice*, Elsevier Science.
- Chawla HS 2009, *Introduction to Plant Biotechnology*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

5. George, EF, Hall, MA & Klerk, DG (eds.) 2008, *Plant Propagation by Tissue Culture*, Springer.
6. Lindsey K. (ed) 2007, *Plant Tissue Culture Manual Supplement 7: Fundamental and Applications*, Springer India Private Limited, New Delhi, India.
7. Mather, JP & Roberts, PE 1998, *Introduction to Cell and Tissue Culture: Theory and Technique*, Springer.
8. Purohit, SD 2013, *Introduction to Plant Cell, Tissue and Organ Culture*. PHI, Private Limited.
9. Ravishankar, GA & Venkataraman, LA (eds) 1997, *Recent Advances in Biotechnological Applications of Plant Tissue and Cell Culture*, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
10. Razdan, MK 2012, *Introduction to Plant Tissue Culture*, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
11. Singh, BD 2012, *Biotechnology: Expanding Horizons*, Kalyani Publishers, Ludhiana.

PRACTICAL: BSB0 521

PLANT PHYSIOLOGY AND BIOCHEMISTRY:

SUGGESTED LABORATORY EXERCISES:

MAJOR EXERCISES

1. Determination of osmotic potential by diffusion pressure deficit.
2. Determination of R_f value of an unknown amino acid using paper chromatography.
3. Separation of chlorophyll pigments by paper chromatography.

MINOR EXERCISES

1. Demonstration of the effect on membrane permeability by different temperature (room temperature & hot water treatment)
2. Demonstration of the effect on membrane permeability by different organic solvents (Ethanol, Methanol, Butanol).
3. Demonstration of opening and closing of Stomata (using distilled water, sucrose and KCl, independently).
4. Demonstration of plasmolysis.

SPOTS:

1. Contribution of Scientists to Physiology and biochemistry: E. Munch, M. Calvin, H.P. Hatch and C.R. Slack, E. Fischer, P. Mitchell, S.B. Hendricks and H.A. Borthwick.
2. Ripening of fruits.
3. IBA effect on rooting
4. Ethylene effect
5. Photomorphogenesis
6. Senescence
7. Chlorophyll separation
8. RQ
9. Protein structure: secondary (helix, sheets), tertiary and quaternary.
10. Root nodules.

PLANT TISSUE CULTURE :

SUGGESTED LABORATORY EXERCISES:

1. Preparation of the culture medium (mentioning PGR and each constituents in mg/L) for induction of callus; surface sterilization and inoculation of the given explant for culture initiation.
2. Preparation of the culture medium (mentioning PGR and each constituents in mg/L) for axillary shoots; surface sterilization and inoculation of the given explant for culture initiation.
3. Preparation of the culture medium (mentioning PGR and each constituents in mg/L) for *in vitro* rooting and inoculation of *in vitro* raised shoots.

4. Preparation of the culture medium (mentioning PGR and each constituents in mg/L) for haploid culture; surface sterilization and inoculation of the given explant for culture initiation.

SPOTS:

1. Contribution of Scientists to Biotechnology: Gottlieb Haberlandt, Miller and Skoog.
2. Anther culture.
3. Synthetic seeds.
4. Protoplast
5. Somatic hybridization.
6. Tools and techniques: Laminar air flow bench, Autoclave, Bioreactor.
7. *In Vitro* Production: Shikonin, Diosgenin, Ephedrin, Vinca Alkaloids

LACHOO MEMORIAL COLLEGE OF SCIENCE & TECHNOLOGY (AUTONOMOUS)
JODHPUR, RAJASTHAN
UG PRACTICAL EXAMINATION
SEMESTER- V
Botany (BSBO 521)

Time: 3 hours

Max. Marks: 80

- 1 Perform the physiology experiment allotted by lots and report the result in suitable form.
 - a. Major experiment 16
 - b. Minor experiment 07

- 2 Perform the plant tissue culture experiment allotted by lots.
 - a. Preparation of nutrient medium & reporting the constituents in mg/L 07
 - b. Pre-treatment, surface sterilization and inoculation of the explants according to the given experiment. 16

3. Identify and comment upon the spots from 'a' to 'f': 6 x 4= 24
 - a. _____
 - b. _____
 - c. _____
 - d. _____
 - e. _____
 - f. _____

4. Viva- voce 10

SEMESTER VI
BSBO611: ECOLOGY AND ENVIRONMENTAL BIOLOGY

Unit I

Plants and Environment: atmosphere (gaseous composition) water (properties of water cycle), light (global radiation, photosynthetically active radiation), temperature, soil (development, soil profile, physicochemical properties) and adaptation of plants to water, temperature, light and salinity.

Unit II

Population ecology: concept & character, growth curve, biotic potential, ecotypes and ecads. community ecology and succession: community characteristics- frequency, density, cover, life forms & biological spectrum. Succession: concept, classification, model and mechanisms; examples (hydrosere and xerosere).

Unit III

Ecosystem: structure, abiotic and biotic components, food chain, food web, ecological pyramids, energy flow, biogeochemical cycles of carbon, nitrogen and phosphorus.

Unit IV

Productivity: Primary productivity, its measurements and factors affecting primary productivity. Environmental biology of Indian Desert: climate, vegetation types, adaptive strategies of desert plants. Desertification: meaning, causes, critical issues. Biodiversity: meaning, levels and their importance.

Unit V

Pollution ecology: definition, classification, sources, effect and control measures of air, water and land pollution; green house effect, acid rain, eutrophication.
Biogeographical regions of India.

Suggested readings:

1. Dash, MC 1996, *Fundamentals of Ecology*, Tata McGraw Hill Publishing Co. Ltd, New Delhi.
2. Kumar, HD 1997, *General Ecology*, Vikas Publishing House, New Delhi.
3. Odum, EP 1983, *Basic Ecology*, Saunders, Philadelphia.
4. Sen, DN 1982, *Environment and Plant Life in Indian Desert*, Geobios International, Jodhpur.
5. Sharma, PD 2012, *Ecology and Environment*, Rastogi Publications, Meerut.
6. Shukla, RS & Chandel, PS 2015, *A Textbook of Plant Ecology*, S. Chand & Company Ltd., New Delhi.
7. Singh, JS, Singh, SP & Gupta, SR 2010, *Ecology, Environment and Resource Conservation*, Anamaya Publishers, New Delhi.

BSBO612: RECOMBINANT DNA TECHNOLOGY

Unit I

Basics of recombinant DNA Technology: History and definition, source of desired gene, isolation of desired gene, restriction enzymes (types and their properties), Genomic and cDNA library, Gene cloning vectors: properties of an ideal vector, carrying capacity of vectors, types of vectors (pBR322, pUC, BAC, YAC). Integration of gene into vector and transformation. selection of desired recombinant cells.

Unit II

Gene transfer methods in plants: *Agrobacterium*-mediated gene transfer in plants: molecular organization of Ti-plasmid (nopaline and octopine types), molecular organization of T-DNA, molecular biology of T-DNA transfer, integration of T- DNA into host cell. Direct methods of gene transfer: electroporation, chemical methods, biolistics, microinjection, macro injection. Marker genes: Reporter genes (e.g. Lux gene, GUS gene), Selectable markers (e.g. Antibiotic resistance markers, Herbicide resistance markers)

Unit III

Transgenic Crops :Resistance to abiotic stress (salt, temperature and drought,) and biotic stress (Insect, virus and disease). Herbicide resistance. Transgenics for improved storage, flower colour, shape, male sterility, terminator seed, protein quality, vitamin and production of edible vaccines; impact of GMO's on society and environment.

Unit IV

IPR: History of IPR, role of WTO, GATT and TRIPS. Types of intellectual property; Patent (product and process), requirement of processing of patent; Copyright, geographical indicators, trade mark, farmer's and plant breeder's rights.

Unit V

Techniques: Electrophoresis: principle, types (horizontal and vertical electrophoresis) and applications. DNA fingerprinting: principle and applications. PCR: principle, types and applications. DNA sequencing (dideoxy chain termination method): principle, method and applications.

Suggested readings:

1. Chawla, HS 2009, *Introduction to Plant Biotechnology*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Collins, GB & Shepherd RJ 1996, *Engineering Plants for Commercial Products and Applications* (Annals of the New York Academy of Sciences), New York Academy of Sciences.
3. Greene, JJ & Rao VS (eds) 1998, *Recombinant DNA–Principles and Methodologies*. Marcel Dekker, New York.
4. Hansen, E & Harper, G (eds) 1997, *Differentially Expressed Gene in Plants*, Taylor and Francis Ltd. London.
5. Primrose, SB & Twyman RM 2015, *Principles of Gene Manipulation and Genomics*, Blackwell Science, Oxford.
6. Singh, BD 2012, *Biotechnology: Expanding Horizons*, 4th edn, Kalyani Publishers, Ludhiana.

PRACTICAL: BSBO 621

ECOLOGY AND ENVIRONMENTAL BIOLOGY

SUGGESTED LABORATORY EXERCISES:

MAJOR EXERCISES

1. Determination of frequency, density and abundance from quadrat sample sheet.
2. Determination of Important Value Index from quadrat sample data.
3. Determination of diversity indices from quadrat sample data.
4. Determination of carbonate and bicarbonate from water samples.
5. Determination of chlorosity/salinity from water samples.
6. Determination of hardness from water samples.
7. Determination of dissolved oxygen content in water samples.

MINOR EXERCISES

1. Determination of relative frequency from quadrat sample data.
2. Determination of relative density from quadrat sample data.
3. Determination of relative abundance from quadrat sample data.
4. Determination of soil texture.
5. Qualitative assessment of nitrate nitrogen content in the given soil sample.
6. Qualitative assessment of available phosphorus content in the given soil sample.
7. Determination of water holding capacity of the given soil sample.

SPOTS:

1. *Opuntia, Euphorbia* – Xerophytes-Succulents
2. *Capparis, Calligonum, Leptadenia, Parkinsonia*- - True Xerophytes
3. *Atriplex, Chloris*- Halophytes – salt- secreting
4. *Suaeda, Salsola* – Halophytes – salt- accumulating
5. *Eichhornia, Nymphaea, Hydrilla*- Hydrophytes

RECOMBINANT DNA TECHNOLOGY

SUGGESTED LABORATORY EXERCISES:

1. Isolation of DNA from the given material.
2. Visualization of DNA by agarose gel electrophoresis (Demonstration only).
3. Construction of restriction map from the given data.
4. Deducing the DNA sequence from the given data/photograph by Sanger's method.

SPOTS:

1. Techniques: DNA finger printing, PCR, electrophoresis, DNA sequencing (dideoxy chain termination method), microinjection, gene gun, electroporation, genomic and cDNA library,
2. Gene cloning vectors: BAC, YAC.
3. Ti plasmid (Crown gall)
4. GM Crops (golden rice, Bt cotton).

LACHOO MEMORIAL COLLEGE OF SCIENCE & TECHNOLOGY (AUTONOMOUS)
JODHPUR, RAJASTHAN
UG PRACTICAL EXAMINATION
SEMESTER- VI
Botany (BSBO 621)

Time: 3 hours

Max. Marks: 80

- 1 Perform the Ecology experiment allotted by lots and report the result in suitable form.
 - a. Major experiment 16
 - b. Minor experiment 07

- 2 Perform the Recombinant DNA Technology experiment allotted by lots.
 - a. Major experiment 16
 - b. Minor experiment 07

- 3 Identify and comment upon the spots from 'a' to 'f': 6 x 4= 24
 - a. _____
 - b. _____
 - c. _____
 - d. _____
 - e. _____
 - f. _____

4. Viva- voce 10