I B.Sc. BOTANY
SEMESTER I

COURSE TITLE: MICROBIAL DIVERSITY AND TECHNOLOGY	
Total Contact Hours:	56 Hrs
Number of Credits:	04
Formative Assessment Marks:	40
Summative Assessment Marks:	60

PO1. Skill development for the proper description using botanical terms, identification, naming and classification of life forms especially plants and microbes.

CO1. Understand the fascinating diversity, evolution, and significance of microorganisms.

CO2. Comprehend the systematic position, structure, physiology and life cycles of microbes and their impact on humans and environment.

CO3. Gain laboratory skills such as microscopy, microbial cultures, staining, identification, preservation of microbes for their applications in research and industry.

The above Cos are in alliance with the following PO:

Competency Level- C1, C2

COURSE CONTENT	
Unit-1	**15 Hrs**
Chapter 1: Microbial diversity- Introduction to microbial diversity; Methods of estimation (DMC & MPN); Hierarchical organization and positions of microbes in the living world. Whittaker's five-kingdom system and Carl Richard Woese's three domain system. Distribution of microbes in soil, air, food and water. Significance of microbial diversity in nature.	**5 Hrs**
Chapter 2: History and developments of microbiology-Microbiologists and their contributions **(**Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Dmitri Iwanowski, Sergius Winogradsky and M W Beijerinck and Paul Ehrlich**).**	**5 Hrs**

Chapter 3: Microscopy-Working principles and applications of light, dark field, phase contast and electron microscopy (SEM and TEM). Microbiological stains (acidic, basic and special) and Principles of staining. Simple, Gram's and differential staining.	**5 Hrs**
Unit-2	**15 Hrs**
Chapter 4: Culture media for Microbes-Natural and synthetic media, Routine media -basal media (Nutrient agar), enriched media, selective media, indicator media, transport media, and storage media (Types of media – PDA, MRBA, Fritsch medium).	**5 Hrs**
Chapter 5: Sterilization methods- Principle of disinfection, antiseptic, tyndallisation and Pasteurization, **Sterilization-**Sterilization by dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods of sterilization-phenolic compounds, anionic and cationic detergents.	**5 Hrs**
Chapter 6: Microbial Growth-Microbial growth and measurement. Nutritional types of Microbes- autotrophs and heterotrophs, phototrophs and chemotrophs; lithotrophs and organotrophs.	**5 Hrs**
Unit-3	**11 Hrs**
Chapter 7: Microbial cultures and preservation-Microbial cultures. Pure culture and axenic cultures, subculturing, Preservation methods-overlaying cultures with mineral oils, lyophilization. Microbial culture collections and their importance. A brief account on ITCC, MTCC and ATCC.	**5 Hrs**
Chapter 8: Viruses- General structure and classification of Viruses; ICTV system of classification. Structure and multiplication of TMV, SARS-COV-2, and Bacteriophage (T2). Cultivation of viruses. A brief account on Vaccines.	**4 Hrs**
Chapter 9: Viroids - General characteristics and structure of Potato Spindle Tuber Viroid (PSTVd); Prions - general characteristics and Prion diseases**.** Economic importance of viruses.	**2 Hrs**
Unit-4	**15 Hrs**
Chapter 10: Bacteria- General characteristics and classification. Archaebacteria and Eubacteria. Ultrastructure of Bacteria; Bacterial growth and nutrition. Reproduction in bacteria- asexual and sexual methods. Study of *Rhizobium* and its applications.	**5 Hrs**

Economic importance of Bacteria. A brief account of Actinomycetes. General Characteristics of Mycoplasmas and Phytoplasmas and diseases caused by them .	
Chapter 11: Fungi-General characteristics and C. J. Alexopoulos classification. Thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Heterothallism and parasexuality. Type study of *Albugo/Phytopthora, Puccinia, and Penicillium***.** *Neurospora* as a model organism for fungal virology; *Trichoderma* and its significance. Economic importance of Fungi.	**5 Hrs**
Chapter 12: Lichens – Structure and reproduction. Economic importance of Lichens. **VAM Fungi** and their significance. **Plant diseases-** Downy Mildew of Bajra, Grain smut of Sorghum, Sandal Spike and Citrus Canker.	**5 Hrs**

I B.Sc. BOTANY
SEMESTER I

MICROBIAL DIVERSITY AND TECHNOLOGY

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UNIT	NO. OF HOURS	NUMBER OF QUESTIONS				TOTAL NO. OF QUESTIONS UNDER EACH UNIT
		1 marks (Answer all)	2 marks (Any 4 questions)	5 marks (Any 4 questions)	8 marks (Any 3 questions) Questions can be split into two as 3+5 or 4+4	
I	15	2	1	1	1	5
II	15	2	2	1	1	6
III	11	2	1	1	1	5
IV	15	2	2	2	1	7

Question Paper Pattern
I B.Sc. BOTANY
SEMESTER I

MICROBIAL DIVERSITY AND TECHNOLOGY

Time: 3 hours Max. Marks: 70

Instructions: 1) Answer all parts
2) Draw diagrams wherever necessary

PART – A

A. Answer the following in one word/: (8x1=8)

1.
2.
3.
4.
5.
6.
7.
8.

PART – B

B. Write **any four** of the following: (4x2=8)

9.
10.
11.
12.
13.
14.

PART – C

C. Answer **any four** of the following: (4x2=8)

15.
16.
17.
18.
19.

PART – D

D. Answer **any three** of the following: (3x8=24)

20.
21.
22.
23.

I B.Sc. BOTANY
SEMESTER I

PRACTICAL COURSE TITLE: MICROBIAL DIVERSITY AND TECHNOLOGY	
Total Contact Hours:	56 Hrs
Number of Credits:	02
Formative Assessment Marks/IA:	25
Summative Assessment Marks:	25

Practical 1	Safety measures in microbiology laboratory and study of equipments/appliances used for microbiological studies (Microscopes, Hot air oven, Autoclave/Pressure Cooker, Inoculation needles/loop, Petri plates, Incubator, Laminar flow hood, Colony counter, Haemocytomer, Micrometer etc.).
Practical 2	Enumeration of soil/food /seed microorganisms by serial dilution technique.
Practical 3	Preparation of culture media (NA/PDA) sterilization, inoculation, incubation of *E. coli / B. subtilis/* Fungi and study of cultural characteristics.
Practical 4	Determination of cell count by using Haemocytometer and determination of microbial cell dimension by using Micrometer.
Practical 5	Simple staining of bacteria (Crystal violet /Nigrosine blue) / Gram's staining of bacteria.
Practical 6	Isolation and study of morphology of *Rhizobium* from root nodules of legumes.
Practical 7	Preparation of spawn and cultivation of paddy straw (Oyster) mushroom.
Practical 8	Study of vegetative structures and reproductice structures – Forms included in theory
Practical 9	Preparation of agar slants, inoculation, incubation, pure culturing and preservation of microbes by oil overlaying.

Practical 10	Study of Downy mildew of Bajra, Citrus canker, Tobacco mosaic disease, Sandal spike disease.
Practical 11	Preparation of fungal culture, Staining and identification.
Practical 12	Visit to water purification units/Composting/ microbiology labs/dairy and farms to understand role of microbes in day to day life.

(Note: Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory)

I B.Sc. BOTANY
SEMESTER I

MICROBIAL DIVERSITY AND TECHNOLOGY

Practical Question Paper

Time: 4 hrs **Max. Marks: 25**

1. Identify, classify and give the characteristics of A 1x2=2
2. Stain the given material B by Gram's staining, write the procedure and identify with reasons. Leave the preparation for evaluation. 1x3=3
3. Calculate the population of C (yeast cells) using Haemocytometer. 1x3=3
4. Comment on D 1x2=2
5. Identify, classify the specimens with reasons E & F 2x2=4
6. Identify, and classify the slides with diagram G & H 2x2=4
7. Record, Report & Viva 3+2+2=7

SCHEME OF VALUATION

1. A – one fungal culture (Identification & classification 1 mark, reasons 1 mark)
2. B – Gram's staining Root nodules/curd sample (Staining 1 mark, procedure 1 mark and result 1 mark)
3. C – Haemocytometer (Mounting 1 mark, calculation 1 mark and result 1 mark)
4. D – Instruments/Media (Identification 1 mark, comment 1 mark)
5. E & F – One fungi and One plant pathology (Identification with classification 1 mark, and reasons 1 mark)
6. G & H – Slides from fungi (Identification with classification 1 mark, and diagram 1 mark)
7. Record –3 marks + Report – 2 marks + Viva – 2 marks

References

1. Alexopoulos CJ and Mims CW. 1989. **Introductory Mycology**, Wiley Eastern Ltd., New Delhi.
2. Allas RM. 1988. Microbiology: **Fundamentals and Applications**, Macmillan publishing Co. New York.
3. Ananthnarayan R and Panikar JCK. 1986. **Text book of Microbiology**. Orient Longman ltd. New Delhi.
4. Arora DR. 2004. **Textbook of Microbiology**, CBS, New Delhi.
5. Brook TD, Smith DW and Madigan MT. 1984. **Biology of Microorganisms**, 4th ed. Eaglewood Cliffts. N.J.Prentice- Hall. New Delhi.
6. Burnell JH and Trinci APJ. 1979. **Fungal walls and hyphal growth**, Cambridge University Press. Cambridge.
7. William CG. 1989. **Understanding microbes. A laboratory text book for Microbiology**. W.H. Freeman and Company. New York.
8. Dubey RC and Maheshwari DK. 2007. **A textbook of Microbiology**, S. Chand and Company, New Delhi.
9. Jayaraman J. 1985. **Laboratory Manual of Biochemistry**, Wiley Eastern Limited. New Delhi.
10. Ketchum PA. 1988. **Microbiology, concepts and applications**. John Wiley and Sons. New York.
11. Michel J, Pelczar Jr.EC and Krieg CR. 2005. **Microbiology**, Mc.Graw-Hill, New Delhi.
12. Powar CB and Daginawala. 1991. **General Microbiology**, Vol – I and Vol – II Himalaya publishing house, Bombay.
13. Dubey RC and Maheshwari DK. 2002. **A Text book of Microbiology**, S.C.Chand and Company, Ltd. Ramnagar, New Delhi.
14. Reddy S and Ram. 2007. **Microbial Physiology**. Scientific Publishers, Jodhpur, 385pp.
15. Sullia SB and Shantharam S. 1998. **General Microbiology**. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.
16. Schlegel HG. 1986. **General Microbiology**. Cambridge. University Press. London, 587pp.

17. Sharma R. 2006. **Text book of Microbiology**. Mittal Publications. New Delhi. 305pp.
18. Sharma PD. 1999. **Microbiology and Plant Pathology**. Rastogi publications. Meerut, India.
19. Roger S, Ingrahan Y, Wheelis JL, Mark L and Page PR. 1990. **Microbial World** 5th edition. Prentice-Hall India, Pvt. Ltd. New Delhi.
20. Sullia SB. and Shantharam S. 2005. **General Microbiology**, Oxford and IBH, New Delhi.
21. Vasanthkumari R. 2007. **A textbook of Microbiology**, BI Publications Pvt. Ltd., New Delhi.

B.Sc. BOTANY: Open Elective Course (OE-1)

I Semester

Title of the Course: Plants and Human Welfare

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with economic importance of diverse plants that offer resources to human life.
2. To make the students known about the plants used as-food, medicinal value and also plant source of different economic value.
3. To generate interest amongst the students on plants importance in day today life, conservation, ecosystem and sustainability.

4.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	30	0	00

Content of Theory Course 1	30 Hrs
Unit I	
Origin of Cultivated Plants. Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions. Crop domestication and loss of genetic diversity (Only conventional plant breeding methods). Importance of plant bio- diversity and conservation.	2
Unit II	

Cereals: Wheat and Rice (origin, evolution, morphology, post-harvest processing & uses).Green revolution. Brief account of millets and their nutritional importance.	3
Unit III	
Legumes: General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean). Importance to man and ecosystem.	2
Unit IV	
Fruits: Mango,grapes and Citrus (Origin, morphology,cultivation ,processing and uses)	02
Unit V	
Cash crops: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Natural Rubber –cultivation, tapping and processing.	03.
Unit VI	
Spices: Listing of important spices, their family and parts used, economic importance with special reference to Karnataka. Study of fennel, clove, black pepper and cardamom.	03
Unit VII	
Beverages: Tea,Coffee(morphology,processing&uses)	02
Unit VIII	
Oils and fats: General description, classification, extraction, their uses and health implications; groundnut, coconut, sunflower and mustered (Botanical name, family & uses). Non edible oil yielding trees and importance as biofuel. Neem oil and	02

applications.	
Unit IX	
Essential Oils: General account. Extraction methods of sandal wood oil, rosa oil and eucalyptus oil. Economic importance as medicine, perfumes and insect repellents.	02
Unit X	
Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Aloe vera and Cannabis.	03
Unit XI	
Fibers: Classification based on the origin of fibers: Cotton and jute (origin morphology, processing and uses).	03
Unit XII	
Forests: Forest and forest products. Community forestry. Concepts of reserve forests, sanctuaries and national parks with reference to India. Endangered species and red data book.	03

Text Books and References

1. Kochhar, S.L. (2012). Economic Botany in Tropics. New Delhi, India: MacMillan & Co.
2. Wickens, G.E. (2001). Economic Botany: Principles &Practices.The Netherlands: Kluwer Academic Publishers.
3. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture.Jones& Bartlett - Publishers.

Pedagogy:

Lectures, Practicals, Field and laboratory visits,Participatory Learning, Seminars, Assignments, specimen submission etc

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
I TEST	10
II TEST	10
ASSIGNMENT	10
Total	30

Date **Course Co-ordinator** **Subject Committee Chairperson**

I B.Sc. BOTANY
SEMESTER II

THEORY

COURSE TITLE: DIVERSITY OF NON- FLOWERING PLANTS	
Total Contact Hours:	56 Hrs
Number of Credits:	04
Formative Assessment Marks:	40
Summative Assessment Marks:	60

P02. Acquisition of knowledge on structure, life cycle and life processes that exist among plant and microbial diversity through certain model organism studies.

P03: Understanding of various interactions that exist among plants and microbes; to develop the curiosity on the dynamicity of nature.

Competency Level- C1, C2

CO1. Understand the diversity and affinities among Algae, Bryophytes, Pteridophytes and Gymnosperms.
CO2. Understand the morphology, anatomy, reproduction and life cycle across Algae, Bryophytes,
CO3. Knowledge on Pteridophytes and Gymnosperms, and their ecological and evolutionary significance.
CO4.Obtain laboratory skills/explore non-flowering plants for their commercial applications.
CO5.Explore Phytoplankton and flora in nearby water body as a part of best practise.
The above Cos are in alliance with the following POs:

Course Content

Content	
Unit-1	
Chapter 1: Cyanobacteria: General Characteristics; morphology and reproduction and life-cycles of *Anabaena* and *Scytonema*. Algal blooms and toxins. Single Cell Protein-production and advantages. **Algae** – Introduction and historical development in algology. General characteristics and classification of algae.	**5 Hrs**
Chapter 2: Diversity- habitat, thallus organization, pigments, reserve food, flagella types, life-cycle and alternation of generation in Algae. Distribution of Algae. *Oedogonium, Chara, Sargassum* and *Polysiphonia*. Diatoms and their importance. Economic importance of algae.	**5 Hrs**
Chapter 3: Algal cultivation- Cultivation of microalgae-*Spirulina* and *Dunaliella;* Algal cultivation methods in India. **Algal products-** Food and Nutraceuticals, Feedstocks, food colorants; fertilizers, aquaculture feed; therapeutics and cosmetics; medicines; dietary fibres from algae and uses.	**5 Hrs**
Unit-2	
Chapter 4: Bryophytes – General characteristics and classification of Bryophytes, Diversity-habitat, thallus structure, Gametophytes and sporophytes.	**5 Hrs**
Chapter 5: Distribution, morphology, anatomy, reproduction and life-cycles of *Marchantia, Anthoceros*, and *Funaria*. Ecological and economic importance of Bryophytes.	**5 Hrs**
Chapter 6: Pteridophytes- General characeristics and Sporne system of classification; Structure of sporophytes and life-cycles. Distribution, morphology, anatomy, reproduction and life-cycles in *Psilotum*, *Selaginella*, and *Marsilea*.	**5 Hrs**
Unit-3	
Chapter 7: A brief account on heterospory and seed habit. Stelar evolution in Pteridophytes. Affinities and evolutionary significance of Pteridophytes. Ecological and economic importance of Pteridophytes.	**5 Hrs**
Chapter 8: Gymnosperms- General characteristics. Distribution and Chamberlain system of classification. Study of the habitat, distribution, habit, anatomy, reproduction and life-cycles in *Cycas*, *Pinus* and *Gnetum*.	**5 Hrs**
Chapter-9: Affinities and evolutionary significance of Gymnosperms. Economic importance of Gymnosperms - food, timber, industrial uses and medicines.	**5 Hrs**
Unit-4	
Chapter-10: Origin and evolution of Plants: Origin and evolution of plants through Geological Time Scale.	**2 Hrs**
Chapter-11: Paleobotany- Paleobotanical records, plant fossils, Preservation of plant fossils - impressions, compressions, petrifications, moulds and casts, pith casts.	**5 Hrs**
Chapter-12: Fossil taxa- *Rhynia, Cycadeoidea,* and *Calamites*. Exploration of fossil fuels. Birbal Sahni Institiue of Paleosciences.	**4 Hrs**

I B.Sc. BOTANY
SEMESTER II
DIVERSITY OF NON- FLOWERING PLANTS

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UNIT	NO. OF HOURS	NUMBER OF QUESTIONS				TOTAL NO. OF QUESTIONS UNDER EACH UNIT
		1 marks (Answer all)	2 marks (Any 4 questions)	5 marks (Any 4 questions)	8 marks (Any 3 questions) Questions can be split into two as 3+5 or 4+4	
I	15	2	2	1	1	6
II	15	2	1	2	1	6
III	15	2	2	1	1	6
IV	11	2	1	1	1	5

Question Paper Pattern
I B.Sc. BOTANY
SEMESTER II
DIVERSITY OF NON- FLOWERING PLANTS

Time: 3 hours Max. Marks: 60

Instructions: 1) Answer all parts
2) Draw diagrams wherever necessary

PART – A

A. Answer the following in one word/: (8x1=8)

1.
2.
3.
4.
5.
6.
7.
8.

PART – B

B. Write **any four** of the following: (4x2=8)

9.
10.
11.
12.
13.
14.

PART – C

C. Answer **any four** of the following: (4x2=8)

15.

16.

17.

18.

19.

PART – D

C. Answer **any three** of the following: (3x8=24)

20.

21.

22.

23.

I B.Sc. BOTANY
SEMESTER II

PRACTICAL

PRACTICAL COURSE TITLE: DIVERSITY OF NON- FLOWERING PLANTS	
Total Contact Hours:	56 Hrs
Number of Credits:	02
Formative Assessment Marks:	25
Summative Assessment Marks:	25

Practical 1	Study of morphology, classification, reproduction of *Anabaena* and *Scytonema.*
Practical 2	Study of morphology, classification, reproduction and life-cycle of algal forms included in theory.
Practical 3	Study of morphology, classification, reproduction and life-cycle of *Marchantia, Anthoceros* & *Funaria.*
Practical 4	Study of morphology, classification, anatomy, reproduction and life-cycle of *Psilotum,* and *Selaginella.*
Practical 5	Study of morphology, classification, anatomy, reproduction and life-cycle of *Marsilea.*
Practical 6	Study of morphology, classification, anatomy and reproduction in *Cycas.*
Practical 7	Study of morphology, classification & anatomy, reproduction in of *Pinus* and *Gnetum*.
Practical 8	Study of important blue green algae causing water blooms in the lakes.
Practical 9	Study of different methods of cultivation of ferns in a nursery.
Practical 10	Preparation of natural media and cultivation of *Azolla* in an artificial ponds.
Practical 11	Media preparation and cultivation of *Spirulina*.
Practical 12	Study different algal products and fossils impressions and slides.
Practical-13	Visit to algal cultivation units/lakes with algal blooms/Fern house/ Nurseries/ Geology museum/lab to study plant fossils.

(Note: Botanical study tour to a floristic rich area for 1-2 day is compulsory)

I B.Sc. BOTANY
SEMESTER II
DIVERSITY OF NON- FLOWERING PLANTS

Practical Question Paper

Time: 4 hrs **Max. Marks: 25**

1.	Identify and classify with reasons A, B, C & D	4x2=8
2.	Micro preparation of the given material E and identify	1x2=2
3.	Identify, classify the given slides with neat labelled diagram F, G, H & I	4x2=8
4.	Record, Report & Viva	3+2+2=7

SCHEME OF VALUATION

1. A, B, C & D – One from each Algae, Bryophytes, Pteridophytes and Gymnosperms (Identification & classification 1 mark, reasons 1 mark)
2. E – (Preparation 1 mark, and identification 1 mark)
3. F, G, H, & I – One from each Cyanobacteria/Algae, Bryophytes, Pteridophytes and Gymnosperms (Identification with classification 1 mark and Labelled diagram 1 mark)
4. Record –3 marks + Report – 2 marks + Viva – 2 marks

References:

1. Agashe, S.N. 1995. **Paleobotany**. **Plants of the past, their evolution, paleoenvironment and Allied plants**. Hutchinson & Co., Ltd., London.
2. Anderson R.A. 2005. **Algal cultural Techniques**, Elsievier, London.
3. Chopra, G.L. **A text book of Algae**. Rastogi & Co., Meerut, Co., New Delhi, Depot. Allahabad.
4. Eams, A.J. 1974. **Morphology of vascular plants - Lower groups**. Tata Mc Grew-Hill Publishing Co. New Delhi, Freeman & Co., New York.
5. Fritze, R.E. 1977. **Structure and reproduction of Algae**. Cambridge University Press.
6. Goffinet B and Shaw A.J. 2009. **Bryophyte Biology**, 2nd ed. Cambridge Unversity Press, Cambridge.
7. Johri, Lata anf Tyagi, 2012, **A Text Book of Gymnosperms**, Vedam e Books, New Delhi.

8. Kakkar, R.K. and B.R.Kakkar. 1995. *The Gymnosperms (Fossils and Living)* Central Publishing House, Allahabad.
9. Kumar H. D., 1999, **Introductory Phycology**, Affiliated East-West Press, Delhi.
10. Lee, R.E., 2008, **Phycology**, Cambridge Unversity Press, Cambridge. 4th edition. McGraw Hill Publishing Co., New Delhi.
11. Parihar, N.S. 1970. **An Introduction to Embryophyta**. **Vol. I. Bryophyta.** Central Book, Allhabad.
12. Parihar, N.S. 1976. **An Introduction to Pteridophytes**, Central Book Depot, Allhabad.
13. Parihar, N.S. 1977. **The Morphology of Pteridophytes**. Central Book Depot., Allahabad. Press, Cambridge.
14. Rashid, A. 1998. **An Introduction to Pteridophyta**. II ed., Vikas Publishing House, New Delhi.
15. Sambamurty, A.V.S.S. 2005. **A Text Book of Algae.** I.K. International Private Ltd., New Delhi.
16. Sharma, O.P. 1990. **Text Book of Pteridophyta**. McMillan India Ltd. New Delhi.
17. Sharma, O.P. 1992. **Text Book of Thallophytes**. McGraw Hill Publishing Co. New Delhi.
18. Sharma, O.P., 2017, **Algae.** McGraw Hill Education.
19. Smith, G.M. 1971. **Cryptogamic Botany**. Vol. II. Bryophytes & Pteridophytes. Tata Tata McGraw Hill Publishing, New Delhi.
20. Smith, G.M. 1971. **Cryptogamic Botany**. **Vol. I Algae & Fungi**. Tata McGraw Hill Publishing. New Delhi.
21. Sporne, K.R. 1965. **The Morphology of Gymnosperms**. Hutchinson & Co., Ltd., London.
22. Stewart, W.M. 1983. **Paleobotany and the Evolution of Plants**, Cambridge University Cambridge.
23. Srivastava, H N, 2003. **Algae**, Pradeep Publication, Jalandhar, India.
24. Sundarajan, S. 1997. **College Botany Vol. I.** S Chand & Co. Ltd., New Delhi.
25. Vanderpoorten, A. and Goffinet, B. 2009, **Introduction to Bryophytes**, Cambridge Unversity Press, Cambridge.
26. Vashista, B.R. 1978. **Bryophytes**. S Chand & Co. Ltd., New Delhi.

B.Sc. BOTANY: Open Elective Course(OE-2)

II Semester

Title of the Course: Plant Propagation, Nursery management and Gardening

Paper Outcome:

On completion of this course, the students will be able to

1. To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of garden plants.

2. To get knowledge of new and modern techniques of plant propagation.

3. To develop interest in nature and plant life.

1.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	30	0	00

Content of Theory Course 1	30 Hrs
Unit I	
Nursery: Definition, objectives and scope and general practices and building up of infrastructure for nursery, planning and seasonal activities. Planting - direct seeding and transplants. Soil free/soilless/ synthetic growth mediums for pots and nursery.	04
Unit II	
Seed: Structure and types - Seed dormancy: causes and methods of breaking dormancy. Seed storage: Seed banks, factors affecting seed viability, genetic erosion Seed production technology. Seed testing and certification.	06

Unit III	
Vegetative propagation: Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings. Hardening of plants .Green house, mist chamber, shed root, shade house and glass house.	06
Unit IV	
Gardening: Definition, objectives and scope. Different types of gardening - landscape and home/terrace gardening, parks and its components. Plant materials and design. Computer applications in landscaping. Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	08
Unit V	
Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables and flowering plants: cabbage, brinjal, lady's finger, tomatoes, carrots, bougainvillea, roses, geranium, ferns, petunia, orchids etc. Storage and marketing procedures. Developing and maintence of different types of lawns. Bonsai technique.	06

Text Books and References

1. Agrawal, P.K. (1993). Hand Book of Seed Technology. New Delhi, Delhi: Dept. of Agriculture and Cooperation, National Seed Corporation Ltd.
2. Bose T.K., Mukherjee, D. (1972). Gardening in India. New Delhi, Delhi: Oxford & IBH Publishing Co.
3. Jules, J. (1979). Horticultural Science, 3rd edition. San Francisco, California: W.H. Freeman and Co.

4. Kumar, N. (1997). Introduction to Horticulture. Nagercoil, Tamil Nadu: Rajalakshmi Publications.

Additional Resources:

1. Musser E., Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: McGraw Hill Book Co.
2. Sandhu, M.K. (1989). Plant Propagation. Madras. Bangalore: Wile Eastern Ltd.

Pedagogy:

Lectures, Practicals, Field and laboratory visits,Participatory Learning, Seminars, Assignments, specimen submission etc

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
I TEST	10
II TEST	10
ASSIGNMENT	10
Total	30

Date **Course Co-ordinator** **Subject Committee Chairperson**

B.Sc. BOTANY: Semester - III
Theory: Discipline Specific Core Course (DSCC)

COURSE TITLE: PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY	
Total Contact Hours:	56 Hrs
Number of Credits:	04
Formative Assessment Marks:	40
Summative Assessment Marks:	60

Course Outcomes:

1. Observation of variations that exist in internal structure of various parts of a plant and as well as among different plant groups in support for the evolutionary concept.
2. Skill development for the proper description of internal structure using botanical terms, their identification and further classification.
3. Induction of the enthusiasm on internal structure of locally available plants.
4. Understanding various levels of organization in a plant body with an outlook in the relationship between the structure and function through comparative studies.
5. Observation and classification of the floral variations from the premises of college and house.
6. Understanding the various reproductive methods sub-stages in the life cycle of plants
7. Observation and classification of the embryological variations in angiosperms.
8. Enthusiasm to understand evolution based on the variations in reproduction among plants.

PLANT ANATOMY

Unit 1: ANGIOSPERM ANATOMY, PLANT CELL STRUCTURE AND TISSUES

08 Hrs.

Introduction: Objective and scope of Plant Anatomy, Plant cell structure – nature of plant cell wall.

Tissue and tissue systems: Meristematic tissue, permanent tissue and secretory cells.

Classification of meristem: (apical, intercalary, and lateral), primary and secondary meristem.

Apical meristem: Theories on organization of meristem (apical cell theory, Tunica-Corpus theory, histogen theory and Korper-Kappe theory and Evolution and concept of organization of shoot apex), quiescent centre, Root cap.

Unit II: ANATOMY OF ROOTS, STEMS AND LEAVES **15 Hrs.**

Types of vascular bundles and Vascular cambium - Origin and development.

Structure of Dicot root: primary and secondary structures (*Cicer*), Structure of monocot root (Maize).
Structure of Dicot stem: Primary and secondary structures (*Tridax*), Structure of Monocot stem (Maize) and Nodal anatomy.
Structure of Dicot leaf: Primary structure (Sunflower), primary structure of Monocot leaf (Maize), stomata and its types.
Anomalous secondary growth: *Beta vulgaris* (dicot root), *Boerhaavia* (dicot stem) *Dracaena* (monocot stem).
General account: Applications in systematics, forensics and Pharmacognosy.
Wood Anatomy: Definition, types of wood, properties of wood, wood seasoning.
Dendrochronology, Indian commercial woods (any five).
General Account: Commercial uses of wood and timber identification, brief account on Plywoods.

DEVELOPMENTAL BIOLOGY

Unit III: Morphogenesis and Differentiation **14 Hrs.**

Differentiation and cell polarity in acellular (*Dictyostelium*), Unicellular (*Acetabularia*) and multicellular system (root hair and stomata formation) Shoot Apical meristem (SAM): Origin, structure and function. Organogenesis: Differentiation of root, stem, leaf and axillary buds, and bud dormancy.
Mechanism of leaf primordium initiation, development and Phyllotaxis (Diversity in size and shape of leaves)
Structure and function of root apical meristem (RAM): Root cap, quiescent centre and origin of lateral roots.
Transition from vegetative apex into reproductive apex
Developmental patterns at flowering apex: ABC model specification of floral organs. Modification of gene action by growth hormones and cellular differences between floral organs. Senescence – a general account.

Unit IV: Reproductive Biology **19 Hrs.**

Introduction, Scope and contributions of Indian embryologists: P. Maheswari, B.G.L. Swamy, M.S. Swaminathan and K.C. Mehta.
Microsporangium: Development and structure of mature anther, Anther wall layers, Tapetum - types, structure and functions and sporogenous tissue.
Microsporogenesis - Microspore mother cells, microspore tetrads, Pollinia.
Microgametogenesis – Formation of vegetative and generative cells, structure of male gametophyte. Pollen embryosac (Nemec phenomenon).
Palynology – pollen morphology – pollen wall, aperture, shape, size and architecture, NPC system, pollen wall stratification. Applied palynology – aeropalynology and melissopalynology.
Megasporangium – Structure of typical Angiosperm ovule. Types of ovules- Anatropous, Hemianatropus, Orthotropous, Amphitropous, Circinotropous.

Megagametogenesis – Types of development of Female gametophyte/embryosac- monosporic- *Polygonum* type, bisporic – *Allium* type, tetrasporic - *Fritillaria* type. Structure of mature embryosac.

Pollination and fertilization: Structural and functional aspects of pollen, stigma and style. Post pollination events; Current aspects of fertilization and Significance of double fertilization, Post fertilization changes. Pollen-Pistil interaction. Types of Styles.

Endosperm – Types and its biological importance. Free nuclear (*Cocos nucifera*) cellular (*Cucumis),* helobial types (Monocots). Ruminate endosperm (Areca and Anonaceae).

Embryogenesis – Dicot (*Capsella bursa-pastoris)* and Monocot (*Najas)* embryo development. A general account of Seed and its development.

Brief account on: Parthenocarpy and Apomixis.

II B.Sc. BOTANY
SEMESTER III

PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

BLUEPRINT

UNIT	NO. OF HOURS	NUMBER OF QUESTIONS				TOTAL NO. OF QUESTIONS UNDER EACH UNIT
		1 mark (Answer all)	2 marks (Any 4 questions)	5 marks (Any 4 questions)	8 marks (Any 3 questions)	
I	08	1	1	1	1	4
II	15	2	1	2	1	6
III	14	2	2	1	1	6
IV	19	3	2	2	1	8

Question Paper Pattern
II B.Sc. BOTANY
SEMESTER III

PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

Time: $2^1/_2$ hours Max. Marks: 60

Instructions: 1) Answer all parts
2) Draw diagrams wherever necessary

PART – A

A. Answer the following in one word/: (8x1=8)

1.
2.
3.
4.
5.
6.
7.
8.

PART – B

B. Write **any four** of the following: (4x2=8)

9.
10.
11.
12.
13.

14.

PART – C

C. Answer **any four** of the following: (4x2=8)

15.
16.
17.
18.
19.

PART – D

D. Answer **any three** of the following: (3x8=24)

20.
21.
22.
23.

II B.Sc. BOTANY
SEMESTER III

PRACTICAL COURSE TITLE: PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY	
Total Contact Hours:	52 Hrs
Number of Credits:	02
Formative Assessment Marks/IA:	25
Summative Assessment Marks:	25

LIST OF EXPERIMENT

Practical No. 1	i. Study of meristem (Permanent slides/ Photographs). ii. Study of Simple Tissues (Parenchyma, Collenchyma and Sclerenchyma) and Complex Tissues (xylem and phloem).
Practical No. 2	i. Maceration technique to study elements of xylem and phloem and Micrometry. ii. Study of primary structure of dicot root, stem and leaf (Sunflower) and monocot root, stem and leaf (Maize)

Practical No. 3	Study of Normal secondary growth structure in dicot stem and root (Sunflower) and Anomalous secondary growth: *Boerhaavia* (dicot stem) & *Dracaena* (monocot stem)
Practical No. 4	Study of trichomes (any three types) and stomata (any three types) with the help of locally available plant materials
Practical No. 5	i) Permanent slides of Microsporogenesis and male gametophyte. ii) Mounting of Pollen grains of Grass and *Hibiscus* and Pollinia of *Calotropis*
Practical No. 6	Pollen germination (hanging drop method) and Effect of Boron and Calcium on pollen germination.
Practical No. 7	i) Permanent slides of types of ovules, Megasporogenesis & embryosac development ii) Sectioning of ovary for the types of placentation
Practical No. 8	i) Mounting of embryo: *Tridax* and *Cyamopsis*. ii) Mounting of endosperm: *Cucumis*
Practical No. 09, 10 and 11	Mini project work in groups of 3-5 students, from the following list: a. Study of pollen morphology of different flowers with respect to shape, size, aperture etc. b. Calculating percentage of germination of one particular type of pollen grain collected from different localities/ under different conditions/different duration. c. Mellissopalynology d. Aeropalynology e. Study of placentation of different flowers. f. Any other relevant study related to Anatomy / Embryology.

II B.Sc. BOTANY
SEMESTER III

PLANT ANATOMY AND DEVELOPMENTAL BIOLOGY

Practical Question Paper

Time: 4 hrs **Max. Marks: 25**

8. Identify the given slides A, B, C & D 4x2=8
9. Identify and measure the cell E. Leave the preparation for evaluation. 1x3=3
10. Calculate the rate of pollen germination F. 1x2=2
11. Make a temporary section of the given sample G, identify and draw the Ground plan. 1x3=3
12. Mount and identify the given sample H. 1x2=2
13. Viva 2
14. Submission of Record and Field visit report 5

SCHEME OF VALUATION

1. A, B, C & D (Two from anatomy and two from embryology). Identification ½ mark; diagram ½ mark; comment 1 mark.
2. E- Maceration: Mounting 1 mark, Measurement and comment 2 marks.
3. F- Pollen germination: Preparation 1 mark, comment 1 mark.
4. G-Sectioning 1 mark and Identification & Ground plan 2 marks.
5. H-Mounting 1 mark, identification with comment 1 mark.
6. Viva 2 marks.
7. Record 5 marks. (Marks for field visit report is included in the internal assessment)

Reference:

1. Bhojwani and Bhatnagar, Introduction to Embryology of Angiosperms –Oxford & IBH, Delhi
2. Bhojwani Sant Saran, 2014.Current Trends in the Embryology of Angiosperms, Woong-Young Soh, Springer Netherlands,
3. Coutler E. G. 1969. Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London.

4. Dickison, W.C. (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA
5. Eames A. J. - Morphology of Angiosperms - Mc Graw Hill, New York.
6. Esau, K. 1990. Plant Anatomy, Wiley Eastern Pvt Ltd New Delhi
7. Evert, R.F. (2006) Esau's Plant Anatomy: Meristem, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc
8. Fahn, A.1992. Plant Anatomy, Pergamon Press, USA
9. Johri, B.M. l., 1984.Embryology of Angiosperms, Springer-Verlag, Netherlands.
10. Karp G., 1985. Cell Biology; McGraw Hill Company
11. Maheshwari,P 1950. An introduction to the embryology of angiosperms. New York: McGraw-Hill
12. Mauseth, J.D. (1988). Plant Anatomy, The Benjammin/Cummings Publisher, USA.
13. Nair P.K.K - Pollen Morphology of Angiosperms - Scholar Publishing House, Lucknow
14. Pandey S.N. 1997, Plant Anatomy and Embryology. A. Chadha, Vikas Publication House Pvt Ltd;
15. Pandey, B. P., 1997. Plant Anatomy, S. Chand and Co. New Delhi
16. Raghavan, V., 2000. Developmental Biology of Flowering plants, Springer, Netherlands.
17. Saxena M. R. – Palynology – A treatise - Oxford & I.B.H., New Delhi.
18. Shivanna, K.R., 2003. Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
19. Vashishta P.C.1984. Plant Anatomy – Pradeep Publications – Jalandhar
20. Vashishta, P.C. 1997. Plant Anatomy, Pradeep Publications

B.Sc. BOTANY SEMESTER IV

Theory: Discipline Specific Core Course (DSCC)

COURSE TITLE: ECOLOGY AND CONSERVATION BIOLOGY	
Total Contact Hours:	56 Hrs
Number of Credits:	04
Formative Assessment Marks:	40
Summative Assessment Marks:	60

Course outcomes:

- Demonstrate broad and coherent knowledge in the principles and concepts associated with the ecology.
- Understanding of physical and chemical factors that influence organisms, their physiology, and ecosystem function.
- Analysing the methods of conservation and its significance.
- Understanding the geography and its influence on the diversity of plants.
- Examining the impact of pollution on plants.

Contents of Theory Course		
Units	**Topics**	**Teaching Hours**
I	**Introduction to Ecology and Conservation Biology:** Definitions, Principles of Ecology, Brief History, Major Indian Contributions, Scope and importance. Ecological levels of organisation. **Ecological factors: -** **Climatic factors**: light, temperature, wind, precipitation and humidity. **Edaphic factors**: Soil and its types, soil texture, soil profile, soil formation; physico-chemical properties of soil - mineral particle, soil pH, soil aeration, organic matter, soil water, soil humus and soil microorganisms. **Biotic factor**: Positive and negative interactions **Topographic Factors**: Altitude, Latitude. **Ecological groups of plants and their adaptations:** Morphological and anatomical adaptations of hydrophytes, xerophytes, epiphytes, halophytes and parasites.	**15 hrs**

II	**Ecosystem:** Introduction, definition, types of ecosystems with examples -terrestrial and aquatic, natural and artificial. Structure of ecosystem: Biotic and Abiotic components, Estuarine and Forest ecosystem. Ecosystem functions and processes: Trophic levels, Food chain-grazing and detritus; Food web. Ecological pyramids -Pyramids of energy, biomass and number. Principles of Energy flow in ecosystem. Bio-geo chemical cycles: Gaseous cycles -carbon and nitrogen, Sedimentary cycle-Phosphorus. Ecological succession: Definition, types- primary and secondary. General stages of succession. Hydrosere and xerosere. **Community Ecology:** Community and its characteristics – frequency, density, Abundance, cover and basal area, phenology, stratifications, life-forms. Concept of Ecotone and Ecotypes. Intra-specific and Inter-specific interactions with examples. **Ecological methods and techniques:** Methods of sampling plant communities – transects and quadrates. Remote sensing as a tool for vegetation analysis, land use – land cover mapping. **Population Ecology:** Population and its characteristics – Population density, natality, mortality, age distribution, population growth curves and dispersal.	**15 hrs**
III	**Phytogeography and Environmental issues:** Theory of land bridge, theory of continental drift, polar oscillations and glaciations. Centre of origin of plant – Vavilov's concept, types. Phytogeographical regions – concept, phytogeographical regions of India. Vegetation types of Karnataka – Composition and distribution of evergreen, semi-evergreen, deciduous, scrub, mangroves, Shola forests and grasslands. An account of the vegetation of the Western Ghats. Pollution: Water pollution: Causes, effect, types; water quality indicators, water quality standards in India, control of water pollution (Wastewater treatment). Water pollution disasters – National mission on clean Ganga, Minimata, Pacific gyre garbage patch, Exxon valdez oil spill. Air pollution: Causes, effect, air quality standards, acid rain, control. Soil pollution: Causes, effect, solid waste management, control measures of soil pollution.	**11 hrs**
IV	**Biodiversity and its conservation:** Biodiversity: Definition, levels of biodiversity - habitat diversity, species diversity and genetic diversity, Global and Indian species diversity. SDGs in biodiversity conservation. Values of Biodiversity: Economic, aesthetic, medicinal and timber values. NTFPs. CBD and Climate change. Threats to biodiversity.	**15 hrs**

	ICUN plant categories with special reference to Karnataka/ Western Ghats. Concept of endemism and endemic species. Concept of Biodiversity Hotspots, Biodiversity hot spots of India. Biodiversity Conservation-Indian Forest conservation act, Biodiversity Act (2002), NBA. Conservation methods – *In-situ* and *ex-situ* methods *In-situ* methods –Nilgiris Biosphere reserves, Gulf of Mannar National parks, Sanctuaries, Sacred grooves. *Ex-situ* methods-Botanical gardens, Seed bank, Gene banks, Pollen banks, Culture collections, Cryopreservation. Brief account on Soil Conservation: Bioremediation, Soil reclamation and Water Conservation: Watershed management, Rain water harvesting.	

II B.Sc. BOTANY
SEMESTER IV
Ecology and Conservation Biology

BLUEPRINT

UNIT	NO. OF HOURS	NUMBER OF QUESTIONS				TOTAL NO. OF QUESTIONS UNDER EACH UNIT
		1 mark (Answer all)	2 marks (Any 4 questions)	5 marks (Any 4 questions)	8 marks (Any 3 questions)	
I	15	2	2	1	1	6
II	15	2	2	1	1	6
III	11	2	1	1	1	5
IV	15	2	1	2	1	6

20% of the marks should be BLOOM'S taxonomy

Question Paper Pattern

II B.Sc. BOTANY
SEMESTER IV
ECOLOGY AND CONSERVATION BIOLOGY

Time: $2^1/_2$ hours Max. Marks: 60

Instructions: 1) Answer all parts
2) Draw diagrams wherever necessary

PART – A

A. Answer the following in one word/: (8x1=8)

1.
2.

3.
4.
5.
6.
7.
8.

PART – B

B. Write **any four** of the following: (4x2=8)

9.
10.
11.
12.
13.
14.

PART – C

C. Answer **any four** of the following: (4x5=20)

15.
16.
17.
18.
19.

PART – D

D. Answer **any three** of the following: (3x8=24)

20.
21.
22.
23.

II B.Sc. BOTANY

SEMESTER IV

PRACTICAL COURSE TITLE: ECOLOGY AND CONSERVATION BIOLOGY	
Total Contact Hours:	52 Hrs
Number of Credits:	02
Formative Assessment Marks/IA:	25
Summative Assessment Marks:	25

LIST OF PRACTICALS

Experiments	
Practical No. 1	i. Determination of pH of different types of Soils. ii. Determination of water holding capacity of soil samples iii. Determination of texture of different soils iv. Estimation of salinity (Chloride) of soil/water samples.
Practical No. 2	Study of Ecological instruments – Wet and Dry thermometer, Altimeter, Hygrometer, Soil thermometer, Rain Gauge and Barometer.
Practical No. 3	i. Hydrophytes: Morphological adaptations in *Pistia, Eichhornia, Hydrilla, Nymphaea* (Any two). ii. Anatomical adaptations in *Hydrilla* (stem)/ *Nymphaea* (petiole).
	i. Xerophytes: Morphological adaptations in *Asparagus, Casuarina, Acacia, Aloe vera, Euphorbia tirucalli* (Any two). ii. Anatomical adaptations in phylloclade of *Casuarina.*
Practical No. 4	i. Epiphytes: Morphological adaptations in *Acampe, Bulbophyllum, Drynaria*. Anatomical adaptations in epiphytic root of *Acampe/ Vanda.* ii. Halophytes: study of Vivipary in mangroves, Morphology and anatomy of Pneumatophores.
Practical No. 5	i. Study of a pond/forest ecosystem and recording the different biotic and abiotic components.
Practical No. 6	i. Demonstration of different types of vegetation sampling methods – transects and quadrats. ii. Determination of Density and frequency.
Practical No. 7	Application of remote sensing to vegetation analysis using satellite imageries.
Practical No. 8	Field visits to study different types of local vegetations/ecosystems and the report to be written.
Practical No. 9	Determination of Biological oxygen demand (BOD)
	Determination of Chemical oxygen demand (COD)

II B.Sc. BOTANY

SEMESTER IV

ECOLOGY AND CONSERVATION BIOLOGY

Practical Question Paper

Time: 4 hrs **Max. Marks: 25**

15. Identify, and comment on A, B, & C	3x2=6
16. Estimate the BOD/COD/chloride of the given sample D	1x4=4
17. Identify E & F	$2x2^{1}/_{2}=5$
18. Calculate the frequency of the given sample G	1x3=3
19. Viva	2
20. Submission of Record and Field visit report	5

SCHEME OF VALUATION

1. Identification ½ mark; comment 1½ (A. Instrument, B. Ecosystem types, C. soil texture/pH of different soil samples).
2. Performance 1 mark; Procedure 1 mark; calculation 2 marks.
3. Identification and diagram 1 mark; comment 1½ marks (E. Morphological adaptation; F. Anatomical adaptation).
4. G Vegetation analysis using satellite images/Quadrat method of studying vegetation (2 marks Calculation and 1mark Explanation)
5. Viva 2 marks
6. Record 5marks (Marks for field visit report is included in the internal assessment)

REFERENCE:

1. Sharma, P.D. 2018. Fundamentals of Ecology. Rastogi Publications.
2. Odum E.P. (1975): Ecology by Holt, Rinert & Winston.

3. Oosting, H.G. (1978): Plants and Ecosystem Wadworth Belmont.
4. Kochhar, P.L. (1975): Plant Ecology. (9th edn.,) New Delhi, Bombay, Calcutta-226 pp.
5. Kumar, H.D. (1992): Modern Concepts of Ecology (7th edn.,) Vikas Publishing Co., New Delhi.
6. Kumar H.D. (2000): Biodiversity & Sustainable Conservation. Oxford & IBH Publishing Co Ltd. New Delhi.
7. Newman, E.I. (2000): Applied Ecology, Blackwell Scientific Publisher, U.K.
8. Chapman, J.L&M.J. Reiss (1992): Ecology (Principles & Applications). Cambridge University Press, U.K.
9. Malcolm L. Hunter Jr., James P. Gibbs, Viorel D. Popescu, 2020. Fundamentals of Conservation Biology, 4th Edition. Wiley-Blackwel.
10. Saha T. K., 2017. Ecology and Environmental Biology. Books and Allied Publishers.

B.Sc. BOTANY – III Semester

Open Elective Course (OEC-3)

(OEC for other students)

PAPER: Landscaping and Gardening

COURSE TITLE: LANDSCAPING AND GARDENING	
Total Contact Hours:	42 Hrs
Number of Credits:	03
Formative Assessment Marks:	40
Summative Assessment Marks:	60

Course outcomes:

- Apply the basic principles and components of gardening
- Conceptualize flower arrangements and bio-aesthetic planning.
- Design various types of gardens according to the culture and art of bonsai
- Distinguish between formal, informal and free style gardens
- Establish and maintain special types of gardens for outdoor and indoor land scaping

Keywords:

Gardening, Landscaping, Flower arrangement, Vertical gardens, Roof gardens, Computer aided designing.

Unit I **14 lectures**

Principles of gardening, garden components, adornment, lawn making, methods of designing rockery, water garden, etc. Types of gardens, trees, their design, values in, and scaping, propagation, planting shrubs and herbaceous perennial. Importance, design values, propagation, planting of climbers and creepers, palms, ferns, grasses and cacti succulents.

Unit II **14 lectures**

Flower arrangement: importance, production details and cultural operations, constraints, post-harvest practices. Bio-aesthetic planning, definition, need, round country planning, urban planning

and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, riverbanks, planting material for playgrounds.

Unit III **14 lectures**

Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens. Land scape designs, Styles of garden, formal, informal and freestyle gardens, types of gardens, Urban land scaping, Land scaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, dam sites, IT parks, corporate. Establishment and maintenance, special types of gardens, Bio-aesthetic planning, eco-tourism, indoor gardening, therapeutic gardening, non-plant components, water-scaping, xeri-scaping, hardscaping; Computer aided designing (CAD) for outdoor and indoor scaping Exposure to CAD (Computer Aided Designing).

References

1. Berry, F. and J. Kress. 1991. Heliconia: An identification Guide. Smithsonian Institution Press.
2. Butts, E. and K. Stensson. 2012. Sheridan Nurseries: One hundred years of People, Plans and Plants. Dundurn Group Ltd.
3. Russell, T. 2012. Nature Guide: Trees: The world in your hands (DK Nature Guides).

MAHARANI LAKSHMI AMMANNI COLLEGE FOR WOMEN AUTONOMOUS
END SEMESTER EXAMINATION

BLUEPRINT

Open Elective Course (OEC-3)

PAPER: Landscaping and Gardening

UNIT	NO. OF HOURS	NUMBER OF QUESTIONS				TOTAL NO. OF QUESTIONS UNDER EACH UNIT
		1 mark (Answer all)	2 marks (Any 4 questions)	5 marks (Any 4 questions)	8 marks (Any 3 questions)	
I	14	2	2	1	1	6
II	14	3	1	2	1	7
III	14	3	2	1	1	7

MAHARANI LAKSHMI AMMANNI COLLEGE FOR WOMEN, AUTONOMOUS

Open Elective Course (OEC-3)
PAPER: Landscaping and Gardening

Question paper pattern

Time: $2^{1}/_{2}$ hours **Max. Marks: 60**

INSTRUCTIONS: 1. Answer all sections
2. Draw diagrams wherever necessary

PART – A

A. Answer **all** the following in one word/: (8x1=8)

1.
2.
3.
4.
5.
6.
7.
8.

PART – B

B. Write **any four** of the following: (4x2=8)

9.
10.
11.
12.
13.
14.

PART – C

C. Answer **any four** of the following: (4x5=20)

15.
16.
17.
18.
19.

PART – D

D. Answer **any three** of the following: (3x8=24)

20.
21.
22.
23.

B.Sc. BOTANY – IV Semester

Open Elective Course (OEC - 4)

(OEC for other students)

Paper: Floriculture

COURSE TITLE: FLORICULTURE	
Total Contact Hours:	42 Hrs
Number of Credits:	03
Formative Assessment Marks:	40
Summative Assessment Marks:	60

Course outcomes:

- Develop conceptual understanding of gardening from historical perspective.
- Analyze various nursery management practices with routine garden operations.
- Distinguish among the carious Ornamental plants and their cultivation.
- Evaluate garden designs of different countries.
- Appraise the landscaping of public and commercial places for floriculture.
- Diagnoses the various diseases and uses of pests for ornamental plants.

Keywords:

Gardening, Transplanting, Mulching. Plant growth regulators, Ornamental plants. Commercial floriculture

Unit 1 **14 lectures**

Introduction: Importance and scope of floriculture and landscape gardening. Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

Unit 2 **14 lectures**

Ornamental plants: Flowering annuals: Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms aną Cycads; Ferns and fern allies; Cultivation of plants in pots; Indoor gardening; Bonsai. Principles of Garden Designs: English, Italian, French, Persian.
Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps. Hedge, Edging, Lawn, Flowerbeds, Shrubbery, Borders. Watergardens. Some Famous gardens of India.

Floriculture and greenhouse technology. Commercial aspects and exporting of flowers and ornamental plants. Quarantine and testing requirements.

Unit III **14 lectures**

Landscaping Places of public importance: Landscaping highways and educational institutions. Commercial Floriculture: Factors affecting flower production. Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera. Gladiolus, Marigold, Rose, Lilium, Orchids). Diseases and Pests of Ornamental Plants.

Reference:

1. Randhawa, G.S. and A. Mukhopadhyay. 1986. Floriculture in India. Allied Publishers.
2. Adams, C., M. Early, J. Brook and K. Bamford. 2015. Principles of Horticulture. Routledge, U.K.

MAHARANI LAKSHMI AMMANNI COLLEGE FOR WOMEN AUTONOMOUS
END SEMESTER EXAMINATION

BLUEPRINT

Open Elective Course (OEC-4)

PAPER: FLORICULTURE

UNIT	NO. OF HOURS	NUMBER OF QUESTIONS				TOTAL NO. OF QUESTIONS UNDER EACH UNIT
		1 mark (Answer all)	2 marks (Any 4 questions)	5 marks (Any 4 questions)	8 marks (Any 3 questions)	
I	14	2	2	1	1	6
II	14	3	1	2	1	7
III	14	3	2	1	1	7

MAHARANI LAKSHMI AMMANNI COLLEGE FOR WOMEN, AUTONOMOUS

Open Elective Course (OEC-3)
PAPER: FLORICULTURE

Question paper pattern

Time: $2^{1}/_{2}$ hours **Max. Marks: 60**

INSTRUCTIONS: 1. Answer all sections
2. Draw diagrams wherever necessary

PART – A

A. Answer **all** the following in one word/: (8x1=8)

1.
2.
3.
4.
5.
6.
7.
8.

PART – B

B. Write **any four** of the following: (4x2=8)

9.
10.
11.
12.
13.
14.

PART – C

C. Answer **any four** of the following: (4x5=20)

15.
16.
17.
18.
19.

PART – D

D. Answer **any three** of the following: (3x8=24)

20.
21.
22.
23.

MAHARANI LAKSHMI AMMANNI COLLEGE FOR WOMEN AUTONOMOUS
III BSc V Sem NEP BOTANY Curriculum
Plant Morphology and Taxonomy (Theory)

Program Name	**B.Sc. in BOTANY**	Semester	**V**
Course Title	**Plant Morphology and Taxonomy (Theory)**		
Course Code:	**BOT-501T**	No. of Credits	**04**
Contact hours	**60 Hours**	Duration of SEA/Exam	**2 ½ hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Understanding the main features in Angiosperm evolution.
CO2. Ability to identify, classify and describe a plant in scientific terms, thereby, Identification of plants using dichotomous keys. Skill development in identification and classification of flowering plants.
CO3. Interpret the rules of ICN in botanical nomenclature.
CO4. Classify Plant Systematic and recognize the importance of herbarium and Virtual Herbarium, evaluate the Important herbaria and botanical gardens.
CO5. Recognition of locally available angiosperm families and plants and economically important plants. Appreciation of human activities in conservation of useful plants from the past to the present.

Contents	**60 Hrs**
Unit 1:	**15 hrs**
Morphology of Root, Stem and Leaf. Their modifications for various functions. Inflorescence – types, Fruits–types, Structure of flower - Floral diagram and floral formula. **Introduction to Taxonomy**: History, objectives, scope and relevance of Taxonomy. **Systems of classification**: Artificial, Natural and Phylogenetic; brief account of Linnaeus', Bentham & Hooker's, Engler and Prantl's system and APG IV System (2016)-Merits and demerits of classifications. **Taxonomic Literature:** Floras, Monographs and Journals. **Herbaria and Botanical Gardens:** Important herbaria and Botanical Gardens of the world (Royal Botanic Gardens, Kew, England) and India (Indian Botanical Garden, Calcutta) and their roles. Technique of Herbarium Preparation.	

Virtual herbarium: E-flora, Documentation. **Plant identification**: Taxonomic dichotomous keys; indented (yolked) and bracketed keys. (Brief account only).	
Unit 2:	**15 hrs**
Plant descriptions: Common Terminologies used for description of vegetative and reproductive parts of the following families: **Study of the diagnostic features of Angiosperm families:** **Polypetalae**: Magnoliaceae, Brassicaceae, Apiaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Rutaceae, Cucurbitaceae. **Gamopetalae**: Rubiaceae, Asteraceae, Solanaceae, Apocynaceae, Lamiaceae. **Monochlamydeae**: Euphorbiaceae. **Monocotyledonae**: Musaceae, Arecaceae and Poaceae.	
Unit 3:	**15 hrs**
Plant Taxonomic Evidences: from palynology, embryology, cytology, phytochemistry and molecular data. **Taxonomic Hierarchy**: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy. Rank less system of phylogenetic systematics. **Botanical Nomenclature:** Principles and rules (ICN); SHENZAN code –brief account. Brief account of Ranks of taxa, Type concept (Typification), Rule of priority, Effective and Valid publication, rejection of names, Author citation. Nomenclature of hybrids / cultivated species.	
Unit 4:	**15 hrs**
Biometrics, Numerical Taxonomy; Phenetics and Cladistics: Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences). **Phylogenetic Systematics:** Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, paraphyly, polyphyly, clades, synapomorphy, symplesiomorphy, apomorphy, lineage sorting, serial homology etc). **Origin and evolution of angiosperms**: Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram). **Molecular taxonomy:** DNA sequence of chloroplast gene (rbcL)	

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Attendance	10
Test	10
Assignments	10

Seminar	10
Total	**40 Marks**
Formative Assessment as per NEP guidelines are compulsory	

BLUEPRINT

UNIT	NO. OF HOURS	NUMBER OF QUESTIONS				TOTAL NO. OF QUESTIONS UNDER EACH UNIT
		1 mark (Answer all)	2 marks (Any 4 questions)	5 marks (Any 4 questions)	8 marks (Any 3 questions)	
I	14	2	2	1	1	6
II	14	2	2	1	1	6
III	14	2	1	1	1	5
IV	14	2	1	2	1	6

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration) Total: 60 Marks

PART – A

A. Answer the following in one word/: (8x1=8)

1.
2.
3.
4.
5.
6.
7.
8.

PART – B

B. Write **any four** of the following: (4x2=8)

9.
10.
11.
12.
13.
14.

PART – C

C. Answer **any four** of the following: (4x5=20)

15.
16.
17.
18.
19.

PART – D

D. Answer **any three** of the following: (3x8=24)

20.

21.

22.

23.

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

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2	Datta S C, *Systematic Botany*, 4th Ed, Wiley Eastern Ltd., New Delhi, 1988.
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9	Lawrence - *Taxonomy of Vascular Plants* - Oxford & I B H, New Delhi.
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11	Manilal, K.S. and A.K. Pandey, 1996. *Taxonomy and Plant Conservation*. C.B.S. Publishers & Distributors, New Delhi.
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14	Pandey, S. N, and S.P. Misra (2008)-*Taxonomy of Angiosperms*- Anne Books India, New Delhi.
15	Radford A B, W C Dickison, J M Massey & C R Bell, *Vascular Plant Systematics*, 1974, Harper & Row Publishers, New York.
16	Singh G.2012. *Plant systematics: Theory and Practice*. Oxford and IBH, Pvt. Ltd., New Delhi.
17	Singh V. & Jain - *Taxonomy of Angiosperms* - Rastogi Publications, Meerut.
18	Sivarajan V. V - *Introduction to Principles of taxonomy* - Oxford &I B H New Delhi.
19	Any local/state/regional flora published by BSI or any other agency.

Plant Morphology and Taxonomy (Practical)

Program Name	**B.Sc. in BOTANY**		**Semester**	**V**
Course Title	**Plant Morphology and Taxonomy (Practical)**		Practical Credits	**02**
Course Code	**BOT-501P**		Contact Hours	**4 Hours per week**
Formative Assessment	**25 Marks**	Summative Assessment		**25 Marks**

Practical Content

1. Study of root, stem and leaf structure and modifications. Study of inflorescence types. Study of flower and its parts, Study of fruits. Floral diagram and floral formula. **8 hrs**
2. Study of families mentioned in theory. **28 hrs**
3. Identify plants/plant products of economic importance (resource botany) belonging to the families mentioned in the syllabus; with binomial, family and morphology of useful parts.
Red gram, Green gram, Horse gram, Black gram, Bengal gram, Indigo, *Luffa*, Asfoetida, Cumin, Coriander, Coffee, *Tulsi,* Tapioca, *Ricinus*, Rice, Wheat, Ragi, Sugarcane, Mustard and Ruta graveolens. **16 hrs**
4.**Field visit**: Local or outside area/ Botanical Garden/ tribal settlements minimum 1 to 3 days.
5. **Submission:** Record book, Tour report and Herbarium (Preparation of 02 properly identified herbarium specimens; mounting of a properly dried and pressed specimen of any common plants from your locality with herbarium label and 03 Virtual Herbaria).

Pedagogy: Teaching and learning, conducting experiments, field visits,

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
Test	15
Field visit And Tour Report	05
Submission: Economic Botany (2 Marks) and Herbarium (3 Marks)	05

Total	25 Marks
Formative Assessment as per NEP guidelines are compulsory	

SCHEME OF PRACTICAL EXAMINATION

(Distribution of marks): 25 marks for the Semester end examination

1. Assign the specimens A, B & C to their respective families giving diagnostic features. 9 Marks
2. Describe D in technical terms, draw the floral diagram with floral formula. 3 Marks
3. Identify the specimen E, F & G with their Morphological, Biological and Economic importance. 6 Marks
4. Viva Voce. 2 Marks
5. Record Submission 5 Marks

Total: 25 marks

Marks & General instructions:

1. A, B, C: One Polypetalae, one Gamopetalae, one Monochlamydeae/Monocot (Identification and Classification 1mark, Diagnostic features 2 marks).
2. D: Specimen from family belonging to Gamopetalae/ Polypetalae. (Technical detail 2 marks, floral diagram floral formula 1 mark)
3. E, F, G: Root/Stem/Leaf modification/ inflorescence/ fruit (identification ½mark, description with diagram 1½mark).
4. Record Submission 5 Marks.

MAHARANI LAKSHMI AMMANNI COLLEGE FOR WOMEN AUTONOMOUS

III BSc V Sem NEP BOTANY Curriculum
PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY (THEORY)

Program Name	**BSc/ BOTANY**	Semester	**VI**
Course Title	**Plant Physiology and Plant Biochemistry (Theory)**		
Course Code:	**BOT-502T**	No. of Credits	**04**
Contact hours	**60 Hours**	Duration of Exam	**2 ½ hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Pre-requisite (s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Importance of water and the mechanism of transport.

CO2. To understand biosynthesis and breakdown of biomolecules.

CO3. Role of plant hormones in plant development and about secondary metabolites.

CO4. Preliminary understanding of the basic functions and metabolism in a plant body.

CO5. To understand the importance of nutrients in plant metabolism and crop yield.

Contents	**60 hrs**
UNIT I	**15 hrs**

Plant water relations: Importance of Water as a solvent, Diffusion, osmosis, imbibition, osmotic pressure, osmotic potential, turgor pressure, wall pressure, water potential, membrane and their permeability, SPAC concept. Mechanism of water absorption, Factors affecting water absorption. **Transpiration.** Loss of water, types, stomatal dynamics, stomatal mechanisms, significance, factors affecting transpiration. Guttation. Antitranspirants. **Mechanism of ascent of sap:** Vital and physical force theories. **Phloem Transport:** Transport of organic solutes. Path of transport, vein loading and unloading. Transcellular hypothesis, mass flow hypothesis. **Mineral nutrition:** Macronutrients (N, P, K, Mg) and micronutrients (Ca, Zn, Co and Mn), their deficiency symptoms in plants. A brief account on Aquaponics/hydroponics (Designing and Setting up). A brief account on Phloem transport.	
UNIT II	**15 hrs**
Photosynthesis: Introduction, ultra structure of the chloroplast, photosynthetic apparatus, principle of light absorption, Emerson's enhancement effect, photosystems I & II, Light reaction – Hill reaction, photophosphorylation (cyclic, non-cyclic), carbon reactions (Calvin Cycle, C4 – Pathway, CAM), Factors affecting the process. Photorespiration – Organelles involved mechanisms and significance. **Respiration**: Introduction, mechanism of aerobic respiration – glycolysis, TCA cycle, ETS and oxidative phosphorylation, mechanism of anaerobic respiration (alcoholic fermentation and lactic acid fermentation), Respiratory Quotient and its significance, factors affecting respiration. **Stress physiology:** water stress, heat stress, salt stress.	
UNIT III	**15 hrs**

Plant growth regulators: Definition of Growth, Kinetics, Factors affecting growth. Phytohormones- Physiological effects and Role of Auxins, Gibberellins, Cytokinins, Ethylene and ABA in plants. Applications of these hormones in agriculture and horticulture. **Synthetic growth regulators**: Classification, their effect on plant growth and development. Practical utility in agriculture and horticulture. **Photobiology** - A brief account of dormancy, Photoperiodism, Phytochrome and its role, Florigen concept, Vernalization. Senescence and Aging. **Plant Movements:** Spontaneous (Autonomic) and Induced (Paratonic) movements. **Defence Mechanism**- A brief account of Secondary metabolites (Phenolics, Flavonoids and Alkaloids) and their role in plant defence.	
UNIT IV	**15 hrs**
Nitrogen metabolism: Sources of nitrogen, Nitrogen fixation, nif genes in relation to symbiotic fixation in Rhizobium. Synthesis of amino acids, Nitrogen cycle, Nitrate metabolism and Assimilation of Ammonia. **Biomolecules:** Classification and functions of Carbohydrates, Proteins & Lipids. **Enzymes:** Nomenclature, classification, chemical composition, prosthetic groups coenzymes, cofactors, properties of enzymes, mechanism of enzymes action, enzyme kinetics, factors affecting enzyme activity, Inhibition of enzyme action (Competitive, Non-Competitive, feedback), Allosteric enzymes. **Vitamins** **Secondary plant products**: Structure, biosynthesis and distribution of terpenes, phenolics and nitrogen containing compounds.	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes

(POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Core competency															
Critical thinking															
Analytical reasoning															
Research skill															
Team work															

Formative Assessment for Theory paper DSC-BOT- C17-T

Assessment	Marks
Attendance	10 Marks
Test	10 Marks
Seminar	10 Marks
Assignment	10 Marks
Total	40 Marks
Formative Assessment as per guidelines are compulsory	

Pedagogy: Teaching, learning, Assignments, Practical and Seminar skills

BLUEPRINT

UNIT	NO. OF HOURS	NUMBER OF QUESTIONS				TOTAL NO. OF QUESTIONS UNDER EACH UNIT
		1 mark (Answer all)	2 marks (Any 4 questions)	5 marks (Any 4 questions)	8 marks (Any 3 questions)	
I	15	2	2	1	1	6

II	15	2	2	1	1	6
III	15	2	1	1	1	5
IV	15	2	1	2	1	6

GENERAL PATTERN OF THEORY QUESTION PAPER

(60 marks for semester end Examination with 2 hrs duration) Total: 60 Marks

PART – A

A. Answer the following in one word/: (8x1=8)

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PART – B

B. Write **any four** of the following: (4x2=8)

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PART – C

C. Answer **any four** of the following: (4x5=20)

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PART – D

D. Answer **any three** of the following: (3x8=24)

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21.

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23.

(Minimum 1 question from each unit and 10 marks question may have sub-questions for 7+3 or 6+4 or 5+5 if necessary)

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY (Practical)

Course Title	**Plant Physiology and Biochemistry (Practical)**	Practical Credits	**2**
Course Code	**BOT-502 P**	Contact Hours	**4 Hours**
Formative Assessment	**25 Marks**	Summative Assessment	**25 Marks**

Practical Content

1. Experiment to demonstrate the phenomenon of exosmosis and endosmosis.

2. To determine the osmotic pressure of the cell sap by plasmolytic method. (Major)

3. To demonstrate root pressure / transpiration pull in plants.

4. To compare the rate of transpiration from the two surfaces of leaf by cobalt chloride paper method

5. To demonstrate that oxygen is liberated in the process of photosynthesis.

6. Separation of photosynthetic pigments by paper chromatography and measure their Rf values (Major)

7. Estimation of total chlorophyll content by Arnon method. (Major)

8. To isolate and identify the amino acids from a mixture using paper chromatography. (Major)

9. To Study of Phototropism.

10. Qualitative test for Starch, Protein, Reducing Sugars and Lipids.

11. Estimation of TAN (Titratbale acid Number) from *Bryophllum* leaves/*Aloe vera*. (Major)

SCHEME OF PRACTICAL EXAMINATION

PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Time: 03 hrs **Max. Marks: 25**

1. Conduct Major Experiment A	06 marks
2. Comment on minor Experiments B & C	06 marks
3. Micro Chemical test D	03 marks
4. Viva-voce	05 marks
5. Practical Record	05 marks

General Instructions:

Q1. Osmotic potential/paper chromatographic separation of pigments **(A)**

Q2. $CoCl_2$ /O_2 evolution/Root pressure/transpiration pull experiments **(B & C)**

Q3. Qualitative tests for Starch, Protein, Reducing Sugars and Lipids **(D)**

Q4. Viva-voce

Q5. Practical record

Pedagogy: Teaching and learning, Seminar, Assignments, etc

Formative Assessment for Practical	
Assessment	**Marks**
Attendance	10 Marks
Test	10 Marks
Project report / Industrial visit	05 Marks
Total	**25 Marks**
Formative Assessment as per guidelines are compulsory	

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