

**PROPOSED SYLLABUS**  
**S.Y.B.Sc. BOTANY THEORY PAPER-I**  
**(SEMESTER-III & IV)**



**ABASAHEB GARWARE COLLEGE**  
**KARVE ROAD, PUNE-411004.**  
*(Autonomous College)*

**Three Year B.Sc. Degree Program in Botany**

**S.Y.B.Sc Botany**

**Choice Based Credit System Syllabus**

**To be implemented from Academic Year 2023- 2024**

**Title of the Course: B. Sc Botany****1. Structure of Course:**

<b>Structure B.Sc. Botany syllabus</b>					
Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Compulsory Course	USBO 111	Plant life and utilization I	2
			USBO 112	Plant morphology and Anatomy	2
			USBOP 113	Practical based on BO 111 & BO 112	1.5
	2	Compulsory Course	USBO 121	Plant life and utilization II	2
			USBO 122	Principles of plant science	2
			USBOP 123	Practical based on BO 121 & BO 122	1.5
2	3	Compulsory Course	USBO 231	<b>Taxonomy of Angiosperms and Plant Ecology</b>	<b>2</b>
			USBO 232	<b>Plant Physiology</b>	<b>2</b>
			USBOP 233	<b>Practical based on USBO 231 &amp; USBO 232</b>	<b>2</b>
	4	Compulsory Course	USBO 241	<b>Plant Anatomy and Embryology</b>	<b>2</b>
			USBO 242	<b>Plant Biotechnology</b>	<b>2</b>
			USBOP 243	<b>Practical based on USBO 241 &amp; USBO 242</b>	<b>2</b>
3	5	Discipline Specific Elective Course	USBO 351	Botany Theory Paper 1	2
			USBO 352	Botany Theory Paper 2	2
			USBO 353	Botany Theory Paper 3	2
			USBO 354	Botany Theory Paper 4	2
			USBO 355	Botany Theory Paper 5	2
			USBO 356	Botany Theory Paper 6	2
			USBO 357	Botany Practical Paper 1	2
			USBO 358	Botany Practical Paper 2	2
		Skill Enhancement course	USBO 359	Botany Practical Paper 3	2
			USBO 3510	Botany Theory Paper 7	2
3	6	Discipline Specific Elective Course	USBO 361	Botany Theory Paper 1	2
			USBO 361	Botany Theory Paper 2	2
			USBO 362	Botany Theory Paper 3	2
			USBO 363	Botany Theory Paper 4	2
			USBO 364	Botany Theory Paper 5	2
			USBO 365	Botany Theory Paper 6	2
			USBO 366	Botany Practical Paper 1	2
			USBO 367	Botany Practical Paper 2	2
		Skill Enhancement course	USBO 368	Botany Practical Paper 3	2
			USBO 3610	Botany Theory Paper 7	2
			USBO 3611	Botany Theory Paper 8	2

**2. Equivalence of Previous Syllabus:**

<b>SPPU Course (2020) CBCS Pattern</b>	<b>New Course (2022) CBCS Pattern</b>
BO-231: Taxonomy of Angiosperms and Plant community	USBO 231: Taxonomy of Angiosperms and Plant Ecology
BO-232: Plant Physiology	USBO 232: Plant Physiology
Semester III: Practical based on BO 231 & BO 232	USBOP 233: Semester III: Practical based on USBO 231 & USBO 232
BO-241: Plant Anatomy and Embryology	USBO 241: Plant Anatomy and Embryology
BO-242: Plant Biotechnology	USBO 242: Plant Biotechnology
Semester IV: Practical based on BO 241 & BO 242	USBOP 243: Semester IV: Practical based on USBO 241 & USBO 242

**S.Y.B.Sc. Botany CBCS Pattern  
(Semester III, Paper I) 2023-2024  
USBO 231: Taxonomy of Angiosperms and Plant Ecology - 2 Credits (30  
Lectures)**

Sr. No.	Topic Details	No. of Lectures
<b>Credit-I</b>		<b>15</b>
<b>1.</b>	<b>Introduction to Angiosperms Taxonomy</b> Definition, scope, objectives and importance of taxonomy Exploration, Description, Identification, Nomenclature and classification Concept of Systematics with brief historical background Concept of herbarium their advantages and limitations Digital /e-herbarium and their advantages	<b>03 (2+1)</b>
<b>2.</b>	<b>Systems of classification</b> Comparative account of various systems of classification Artificial system- Carl Linnaeus Natural system- Bentham and Hooker Phylogenetic system- Engler and Prantl APG system- A brief review Data bases: concept and needs. Use of computer in plant classification	<b>05 (4+1)</b>
<b>3.</b>	<b>Study of Plant Families</b> Study of following families with reference to systematic position (As per Bentham and Hooker's system of classification), salient features, floral formula, floral diagram and any five examples with their economic importance – Annonaceae, Brassicaceae, Myrtaceae, Rubiaceae, Solanaceae, Apocynaceae, Nyctaginaceae and Amaryllidaceae	<b>07 (8 - 1)</b>
<b>Credit-II</b>		<b>15</b>
<b>4.</b>	<b>Botanical Nomenclature</b> Concept of nomenclature, brief history, Binomial nomenclature International Code for Nomenclature of Algae, Fungi and Plants (ICN)- Principles, Rules and Recommendations; 'Type' specimen and its types (Holotype, Paratype, Isotype, Lectotype, Neotype). Concept of Typification. Ranks and endings of taxa names, Coining of Genus and Species names Single, double and multiple authority citations.	<b>05</b>
<b>5.</b>	<b>Introduction to ecology</b> Definition, concept, scope, and interdisciplinary approach, autecology and synecology. Species diversity: definition, concept, scope, and types: Alpha, Beta and Gamma diversity. Methods of vegetation sampling: quadrat method, transect method, plot less method Genetic Diversity: definition, nature and origin of genetic variations Species Diversity: definition, origin of species diversity, diversity indices, species abundance Ecosystem Diversity: definition, major ecosystem types of the world, Hotspots in India – concept and basis of 'hotspot' identification.	<b>06</b>

<b>6.</b>	<b>Ecological grouping of the plants</b> Ecological grouping of the plants with reference to their significance of adaptive external and internal features: a) Hydrophytes, b) Mesophytes c) Xerophytes d) Halophytes with examples.	<b>04</b>
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2. Chapman, J.L. and Reiss, M.J. (1998). Ecology: Principles and applications. Cambridge, University Press.
3. Chopra G.L. (1984). Angiosperms: Systematics and Life-Cycle., Pradeep Publications
4. Cooke, Theodore (1903-8). The Flora of the Presidency of the Bombay Vol. I, II, III (Repr. ed), Botanical Survey of India.
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20. Santapau H. (1953). The Flora of Khandala on the Western Ghats of India. BSI
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#### IMPORTANT WEBSITES

THE FAMILIES OF FLOWERING PLANTS- L. Watson and M.J. Dallwitz

<https://www.delta-intkey.com/angio/index.htm>

ANGIOSPERM PHYLOGENY WEBSITE, version 14.

<http://www.mobot.org/MOBOT/research/APweb/>

THE PLANTS OF THE WORLD ONLINE PORTAL

<http://www.plantsoftheworldonline.org/>

INTERNATIONAL PLANT NAME INDEX (IPNI)

<https://www.ipni.org/>

TROPICOS

<https://www.tropicos.org/home>

BIODIVERSITY HERITAGE LIBRARY

<https://www.biodiversitylibrary.org/>

BOTANICUS DIGITAL LIBRARY

<https://www.botanicus.org/>

INTERNET ARCHIVE- DIGITAL LIBRARY

<https://archive.org/>

DATABASE OF PLANTS OF INDIAN SUBCONTINENT

<https://sites.google.com/site/efloraofindia/>

BOTANICAL SURVEY OF INDIA

[https://bsi.gov.in/content/1416\\_1\\_FloraofIndia.aspx](https://bsi.gov.in/content/1416_1_FloraofIndia.aspx)

FLOWERS OF INDIA

<http://www.flowersofindia.net/>

eFLORAS OF WORLD

<http://www.efloras.org/>

**S.Y.B.Sc. Botany CBCS pattern**  
**Semester III, Paper II**  
**USBO 232 – Plant Physiology – 2 credits (30 Lectures)**

**Credit I:**

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|--|-----------|
| <b>1. Introduction to Plant Physiology</b>   | <b>1L</b> |
| Scope and applications of plant physiology   |           |
| <b>2. Absorption of water</b>  | <b>2L</b> |
| 2.1 Role of water in plants  |           |
| 2.2 Mechanisms of water absorption with respect to crop plants   |           |
| 2.3 Factors affecting rate of water absorption   |           |
| <b>3. Ascent of sap</b>  | <b>3L</b> |
| 3.1 Introduction and definition.   |           |
| 3.2 Theories of ascent of sap, evidences and objections  |           |
| 3.3 Factors affecting ascent of sap  |           |
| <b>4. Transpiration</b>  | <b>4L</b> |
| 4.1 Definition   |           |
| 4.2 Types of transpiration – cuticular, lenticular and stomatal  |           |
| 4.3 Structure of stomata   |           |
| 4.4 Mechanism of opening and closing of stomata –Steward’s hypothesis, active K <sup>+</sup> transport mechanism         |           |
| 4.5 Factors affecting the rate of transpiration  |           |
| 4.6 Significance of transpiration  |           |
| 4.7 Antitranspirants   |           |
| 4.8 Guttation  |           |
| <b>5. Seed dormancy and germination</b>  | <b>2L</b> |
| 5.1 Definition, types of seed dormancy and germination   |           |
| 5.2 Methods to break seed dormancy   |           |
| 5.3 Metabolic changes during seed germination  |           |
| 5.4 Role of phytohormones to improve seed germination  |           |
| 5.5 Vigor Index  |           |
| <b>6. Physiology of flowering</b>  | <b>3L</b> |
| 6.1 Photoperiodism – Concept, definition, short day plants, long day plants and day neutral plants.                      |           |
| 6.2 Phytochrome theory, role of phytohormones in induction and inhibition of flowering                                   |           |
| 6.3 Applications of photoperiodism   |           |
| 6.4 Vernalization–concept and definition, mechanism of vernalization, applications of vernalization and devernialization |           |

**Credit II:**

- |   |           |
|---|-----------|
| <b>7. Nitrogen metabolism</b>                     | <b>7L</b> |
| 7.1 Introduction and role of nitrogen in plants   |           |
| 7.2 Nitrogen fixation by <i>Rhizobium</i> and BGA |           |



- 7.2.1 Symbiotic nitrogen fixation, nitrogenase enzyme- structure and function, hydrogenase enzyme and its role in nitrogen fixation
- 7.2.2 Non-symbiotic nitrogen fixation
- 7.3 Importance and production technique of BGA
- 7.4 Denitrification, ammonification and nitrification
- 7.5 Reductive amination and transamination

## **8. Respiration**

**8L**

- 8.1 Aerobic and anaerobic respiration
- 8.2 Mechanism of aerobic respiration – glycolysis, TCA cycle, terminal oxidation; enzymes involved and energy calculations
- 8.3 Pentose phosphate pathway
- 8.4 Anaerobic respiration

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**S.Y.B.Sc. Botany CBCS Pattern  
Practical (Semester III Paper III)**

**USBOP 233: Practical based on USBO 231 & USBO 232  
Practical based on Taxonomy of Angiosperms and Plant Ecology, and Plant  
Physiology**

Sr. No.	Title	No. of Practical
<b>Taxonomy of Angiosperms and Plant Ecology</b>		
1	Study of tools of taxonomy and ecological instruments (any four each)	1
2	Description of flowering plant in botanical terms	1
3	Study of plant families (any four)	3
4	Study of ecological adaptations in Hydrophytes with any two examples	1
5	Study of ecological adaptations in Xerophytes with any two examples	1
6	Study of vegetation by list count quadrat method.	1
<b>Plant Physiology</b>		
7	Perform phytochemical test for starch, proteins and lipids in germinating and non-germinating seeds	1
8	Protein estimation by Bradford method	1
9	Determination of Diffusion Pressure Deficit (DPD)	1
10	Determine rate of transpiration under different conditions of Sunlight, Shade and Wind	1
11	Demonstration of the following <ul style="list-style-type: none"> <li>a. Commercial biofertilizers</li> <li>b. Imbibition in seeds</li> <li>c. Arc Auxanometer</li> <li>d. Spectrophotometer</li> <li>e. Nitrogen fixing bacteria / BGA (specimen/ slide)</li> <li>f. Hill reaction</li> </ul>	1
12	Breaking of seed dormancy by different methods and their effect on seed germination and viability	1
13	Botanical excursion tour and visit to Floriculture industry / Soil testing center / Seed testing center	1

**N.B. Botanical excursion tour and submission of report along with herbarium of any five weeds of the following (List of Weeds attached).**

**List of weeds**

*Acanthospermum hispidum* DC. Asteraceae  
*Aerva javanica* (Burm.f.) Juss. ex Schult. Amaranthaceae  
*Aeschynomene americana* L. Fabaceae Tropical America  
*Ageratum conyzoides* L. Asteraceae America  
*Alternanthera paronychioides* St. Hill. Amaranthaceae Tropical America  
*Alternanthera philoxeroides* (Mast.) Griseb. Amaranthaceae America  
*Alternanthera pungens* Kunth Amaranthaceae Tropical America  
*Alternanthera tenella* (L.) R.Br. ex DC. Amaranthaceae Tropical America  
*Amaranthus spinosus* L. Amaranthaceae Tropical America  
*Antigonon leptopus* Hk. & Arn. Polygonaceae America  
*Argemone mexicana* L. Papaveraceae West Indies

*Asclepias curassavica* L. Apocynaceae Tropical America  
*Bidens pilosa* L. Asteraceae Tropical America  
*Blainvillea acmella* (L.) Philipson Asteraceae Tropical America  
*Blumea eriantha* DC. Asteraceae Tropical America  
*Blumea lacera* (Burm.f.) DC. Asteraceae Tropical America  
*Boerhavia erecta* L. Nyctaginaceae Tropical America  
*Cardamine hirsuta* L. Brassicaceae Tropical America  
*Cassia absus* L. Caesalpiniaceae Tropical America  
*Cassia occidentalis* L. Caesalpiniaceae South America  
*Cassia pumila* Lam. Caesalpiniaceae Tropical America  
*Cassia tora* L. Caesalpiniaceae South America  
*Celosia argentea* L. Amaranthaceae Tropical America  
*Chrozophora rotleri* (Geis.) Spreng. Euphorbiaceae Tropical Africa  
*Cleome viscosa* L. Capparaceae Tropical America  
*Conyza canadensis* (L.) Cronquist Asteraceae South America  
*Coronopus didymus* (L.) Smith Brassicaceae South America  
*Cronton bonplandianum* Baillon Euphorbiaceae South America  
*Crotalaria pallida* Dryand Fabaceae Tropical America  
*Crotalaria retusa* L. Fabaceae Tropical America  
*Cryptostegia grandiflora* R.Br. Apocynaceae Madagascar  
*Cuscuta chinensis* Lam. Cuscutaceae Mediterranean  
*Cuscuta reflexa* Roxb. Cuscutaceae Mediterranean  
*Cyperus difformis* L. Cyperaceae Tropical America  
*Cyperus iria* L. Cyperaceae Tropical America  
*Datura innoxia* Mill. Solanaceae Tropical America  
*Dicoma tomentosa* Cass. Asteraceae Tropical America  
*Digera muricata* (L.) Mart. Amaranthaceae North America  
*Eclipta prostrata* (L.) L. Asteraceae Tropical America  
*Eichhornia crassipes* (Mart.) Solms Pontederiaceae Tropical America  
*Emilia sonchifolia* (L.) DC. Asteraceae Tropical America  
*Eupatorium adenophorum* Spreng. Asteraceae Central America  
*Eupatorium odoratum* L. Asteraceae South America  
*Euphorbia heterophylla* L. Euphorbiaceae Tropical America  
*Euphorbia hirta* L. Euphorbiaceae Tropical America  
*Galinsoga parviflora* Cav. Asteraceae Tropical America  
*Hyptis suaveolens* (L.) Poit. Lamiaceae South America  
*Ipomoea carnea* Jacq. Convolvulaceae Tropical America  
*Ipomoea hederifolia* L. Convolvulaceae Tropical America  
*Ipomoea obscura* (L.) Ker Gawl. Convolvulaceae Tropical Africa  
*Ipomoea pes-tigridis* L. Convolvulaceae Tropical Africa  
*Lagascea mollis* Cav. Asteraceae Tropical America  
*Lantana camara* L. Verbenaceae Tropical America  
*Malachra capitata* (L.) L. Malvaceae Tropical America  
*Malvastrum coromandelianum* (L.) Garcke Malvaceae Tropical America  
*Martynia annua* L. Pedaliaceae Tropical America  
*Mecardonia procumbens* (Mill.) Small Scrophulariaceae Tropical America  
*Mikania micrantha* Kunth Asteraceae Tropical America  
*Oxalis corniculata* L. Oxalidaceae Europe  
*Parthenium hysterophorus* L. Asteraceae Tropical America  
*Physalis minima* L. Solanaceae Tropical America  
*Pistia stratiotes* L. Araceae Tropical America  
*Portulaca oleracea* L. Portulacaceae South America  
*Prosopis juliflora* (Sw.) DC. Mimosaceae Mexico  
*Ruellia tuberosa* L. Acanthaceae Tropical America  
*Scoparia dulcis* L. Scrophulariaceae Tropical America  
*Solanum nigrum* L. Solanaceae Tropical America  
*Solanum torvum* Sw. Solanaceae West Indies  
*Sonchus oleraceus* L. Asteraceae Mediterranean  
*Spilanthes radicans* Jacq. Asteraceae South America

*Synedrella nodiflora* (L.) Gaertn. Asteraceae West Indies  
*Tridax procumbens* L. Asteraceae Tropical America  
*Waltheria indica* L. Sterculiaceae Tropical America  
*Xanthium indicum* Koenig Asteraceae Tropical America  
*Youngia japonica* (L.) DC. Asteraceae South America

**SEMESTER IV****S.Y.B.Sc. Botany CBCS Pattern  
(Semester IV, Paper I) 2023-2024****USBO 241: Plant Anatomy and Embryology- 2 Credits (30 Lectures)**

<b>Credit-I Plant anatomy:</b>	<b>(15 Lectures)</b>
<b>1. Introduction</b>	<b>1L</b>
1.1 Definition	
1.2 Scope of plant anatomy	
<b>2. Epidermal tissue system</b>	<b>3L</b>
2.1 Structure, types and functions of epidermis	
2.2 Structure, types and functions of Stomata	
2.3 Epidermal outgrowths- non-glandular and glandular	
2.4 Motor cells	
<b>3. Mechanical tissue system</b>	<b>3L</b>
3.1 Principles involved in distribution of mechanical tissues with one example each	
a) Inflexibility,	
b) Incompressibility,	
c) Inextensibility and	
d) Shearing stress	
3.2 Vascular tissue system: Structure and function of xylem, phloem and cambium	
<b>4. Normal secondary growth</b>	<b>3L</b>
4.1 Introduction	
4.2 Normal secondary growth in dicotyledonous stem	
4.3 Development of annual rings, periderm, bark, tyloses and lenticel	
<b>5. Anomalous secondary growth</b>	<b>4L</b>
5.1 Introduction	
5.2 Causes of anomalous secondary growth	
5.3 Anomalous secondary growth in:	
a) Dicotyledonous stem ( <i>Bignonia</i> ),	
b) Dicotyledonous root ( <i>Raphanus</i> ),	
c) Monocotyledonous stem ( <i>Dracaena</i> )	
<b>Credit-II Plant Embryology</b>	<b>(15 Lectures)</b>
<b>7. Introduction</b>	<b>1L</b>
7.1 Definition and scope of plant embryology	
<b>8. Microsporangium and male gametophyte</b>	<b>4L</b>
8.1 Structure of tetrasporangiate anther	
8.2 Types of tapetum	
8.3 Sporogenous tissue	
8.4 Microsporogenesis: process and its types	
8.5 Types of microspore tetrad	

8.6 Male gametophyte: structure and development of male gametophyte

**9 Megasporangium and female gametophyte** **4L**

9.1 Structure

9.2 Types of ovules

9.3 Types of megaspore tetrads

9.4 Female gametophyte: structure of typical embryo sac

9.5 Types of embryo sacs – monosporic, bisporic and tetrasporic

**10. Pollination and Fertilization:** **3L**

10.1 Introduction and definition

10.2 Types of pollination

10.3 Germination of pollen grain

10.4 Entry of pollen tube- porogamy, mesogamy and chalazogamy

10.5 Double fertilization and its significance.

**11. Endosperm and embryo** **3L**

11.1 Endosperm: Types – nuclear, helobial and cellular.

11.2 Embryogeny: structure of dicot and monocot embryo and seed formation.

**References:**

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2. B P Pandey, Plant Anatomy. S Chand and Co. Ltd, New Delhi 1978
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4. Eams and Mc Daniel, An Introduction to Plant Anatomy, McGraw –Hill Book Co. Ltd and Kogakusha Co, Tokyo, Japan
5. Adriance S Foster Practical Plant Anatomy, D Van Nostrand Co. INC, New York
6. Esau, Plant Anatomy, Wiley Toppan Co. California, USA
7. Pijush Roy, Plant Anatomy. New Central Book Agency Ltd, Kolkata
8. Pandey S N and Ajanta Chadha, Plant Anatomy and Embryology, Vikas Publishing House, Pvt, Ltd, New Delhi
9. Bhojwani S S and Bhatnagar S P, An Embryology of Angiosperms
10. Maheshwari P, An introduction to Embryology of Angiosperm
11. Nair P K K Essentials of Palynology

**S.Y.B.Sc. Botany CBCS Pattern**  
**(Semester IV, Paper II)**  
**USBO 242 - Plant Biotechnology - 2 Credits (30 Lectures)**

**Credit 1:**

<b>Chapter 1 Introduction to Plant Biotechnology</b>	1L
1.1 Definition, Scope and importance of plant biotechnology	
1.2 Current status of biotechnology in India.	
<b>Chapter 2 Plant Tissue Culture</b>	10L
2.1 Concept of plant tissue culture and cellular totipotency	
2.2 Basic techniques: Types of culture, Components of medium and their role, Media preparation, sterilization, inoculation, incubation, hardening	
2.3 Applications with reference to: Micropropagation, Haploid production, Protoplast fusion & Somatic hybrids, Embryo rescue, Production of secondary metabolites.	
<b>Chapter 3 Bioremediation</b>	2L
6.1 Introduction and concept	
6.2 Microbial remediation	
6.3 Phytoremediation	
<b>Chapter 4 Biofuel technology</b>	2L
7.1 Definition, Concept and types of Renewable and nonrenewable energy sources	
7.2 Definition and concept of Biogas, Bioethanol, Biodiesel	
<b>Credit II:</b>	
<b>Chapter 5 Plant Genetic Engineering</b>	10L
4.1 Introduction, concept	
4.2 Tools of genetic engineering - restriction enzymes, ligases, vectors (plasmids, cosmids, phages, BAC, YAC, viruses)	
4.3 Gene cloning Technique	
4.4 Methods of gene transfer in plants (physical, chemical and <i>Agrobacterium</i> based methods)	
4.5 Applications of plant genetic engineering: insect pest resistance, abiotic stress tolerance (water stress, salt stress, plants to cope up with poor soil quality), herbicide resistance	
<b>Chapter 6 Genomics, Proteomics and Bioinformatics</b>	5L
5.1 Genomics- concept, types, methods used for whole genome sequencing	
5.2 Proteomics-concept, types, methods used in proteome analysis	
5.3 Bioinformatics-concept, database and its classification, data retrieval tools.	

**References -**

1. B.D. Singh (4<sup>th</sup> Edn 2012) Biotechnology-expanding horizons, Kalyani Publishers.
2. K.S. Bilgrami & A.K. Pandey (2007) Introduction to Biotechnology CBS Publishers and Distributors PVT LTD
3. M.K. Razdan (2002) Introduction to Plant Tissue Culture. Oxford and IBH Publishing Co., New Delhi.
4. H.S. Chawla (2005) Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. New Delhi.

**S.Y.B.Sc. Botany CBCS Pattern Practical (Semester IV Paper III) 2023-2024 USBOP 243:  
Practical based on USBO 241 & USBO 242**

Sr. No.	Title	No. of Practical
<b>Plant Anatomy and Embryology</b>		
1	Study of epidermal tissue system – non-glandular and glandular trichomes, multilayered epidermis, typical stomata (Dicotyledonous and Monocotyledonous).	2
2	Study of mechanical tissues and their distribution in root, stem and leaves.	1
3	Study of normal secondary growth in dicot stem – <i>Annona /Moringa</i> (Double stained temporary preparation).	1
4	Study of anomalous secondary growth in <i>Bignonia</i> and <i>Dracaena</i> stem (Double stained temporary preparation).	1
5	Study of tetrasporangiate anther and types of ovules with the help of permanent slides	1
6	Study of dicot and monocot embryo.	1
<b>Plant Biotechnology</b>		
7	Instruments/equipments used in plant tissue culture laboratory: Principle and working of Autoclave, oven, laminar air flow cabinet, micropipette, culture bottles/tubes with cotton plug Demonstration of principle and working of agarose gel electrophoresis, centrifuge, spectrophotometer	1
8	Preparation & sterilization of MS medium	1
9	Surface sterilization and Inoculation of nodal sector, leaf, anther and maize embryo	2
10	Demonstration practical on transgenic crops viz; Bt-Cotton, Golden rice Nucleotide and protein Sequence retrieval using NCBI, sequence alignment	1
11	Preparation of <i>Agrobacterium</i> culture, infection of leaves with <i>Agrobacterium</i> and hairy root formation	2
12	Visit to plant tissue culture laboratory	1