



Progressive Education Society's
Modern College of Arts, Science
and Commerce (Autonomous),
Ganeshkhind, Pune - 16

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:**

Structure B.Sc. Botany syllabus					
Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Compulsory Course	22 - BO 111	Diversity of Cryptogams	2
			22 - BO 112	Plant morphology and Anatomy	2
			22 - BO 113	Practical based on BO 111 & BO 112	1.5
	2	Compulsory Course	22 - BO 121	Diversity of Phanerogams	2
			22 - BO 122	Plant Physiology and Molecular Biology	2
			22 - BO 123	Practical based on BO 121 & BO 122	1.5
2	3	Compulsory Course	23 - BO 231	Angiosperms Systematics and Plant Ecology	2
			23 - BO 232	Plant Physiology	2
			23 - BO 233	Practical based on 23 -BO 231 & 23 - BO 232	2
	4	Compulsory Course	23 - BO 241	Plant Anatomy and Embryology	2
			23 - BO 242	Plant Biotechnology	2
			23 - BO 243	Practical based on 23 - BO 241 & 23 - BO 242	2

2. Equivalence of Previous Syllabus:

Old Course (2020 CBCS Pattern)	New Course (2023 CBCS Pattern) Autonomous
BO 231: Taxonomy of Angiosperms and Plant Ecology	23 - BO 231 Angiosperms Systematics and Plant Ecology
BO 232: Plant Physiology	23 - BO 232 Plant Physiology
BO 241: Plant Anatomy and Embryology	23 - BO 241 Plant Anatomy and Embryology
BO 242: Plant Biotechnology	23 - BO 242 Plant Biotechnology
Semester III: Practical based on BO 231 & BO 232	23 - BO 233 Practical based on 23 -BO 231 & 23 - BO 232
Semester IV: Practical based on BO 241 & BO 242	23 - BO 243 Practical based on 23 - BO 241 & 23 - BO 242

**S.Y.B.Sc. Botany CBCS Pattern
(Semester III, Paper I) 2020-2021
BO 231: Taxonomy of Angiosperms and Plant Ecology - 2 Credits (30 Lectures)**

Sr. No.	Topic Details	No. of Lectures
	Credit-I	15
1.	Introduction to Angiosperms Taxonomy Definition, scope, objectives and importance of taxonomy Concept of Systematics with brief historical background	01
2.	Systems of classification 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	02
3	Biometrics, Numerical Taxonomy and cladistics Characters; Variations; OTUs, character weighting and coding; cluster analysis; Phenograms, cladograms (monophyly, Paraphyly, polyphyly and clades) (definitions and differences) methods of illustrating evolutionary relationship (phylogenetic tree)	03
4	Phylogeny of Angiosperm Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence,)	02
5.	Study of Plant Families 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	07
	Credit-II	15
4.	Botanical Nomenclature 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	05

5.	Introduction to ecology 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.	06
6.	Ecological grouping of the plants 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.	04

References-

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28. Singh N.P. (2003) Flora of Maharashtra Volume-III BSI, Kolkatta
29. Singh N.P., S. Karthikeyan (1996) Flora of Maharashtra Volume-I, BSI, Kolkatta
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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

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) 2020-2021
BO 232: Plant Physiology - 2 Credits (30 Lectures)**

Credit I:

- | | |
|---|-----------|
| 1. Introduction to Plant Physiology
Scope and applications of plant physiology | 2L |
| 2. Absorption of water
21 Role of water in plants
22 Mechanisms of water absorption with respect to crop plants
23 Factors affecting rate of water absorption | 3L |
| 3. Ascent of sap
31 Introduction and definition.
32 Transpiration pull or cohesion-tension theory, evidences and objections
33 Factors affecting ascent of sap | 3L |
| 4. Transpiration
41 Definition
42 Types of transpiration – cuticular, lenticular and stomatal
43 Structure of stomata
44 Mechanism of opening and closing of stomata –Steward’s hypothesis, active K ⁺ transport mechanism
45 Factors affecting the rate of transpiration
46 Significance of transpiration
47 Antitranspirants
48 Guttation
49 Exudation | 7L |

Credit II:

- | | |
|---|-----------|
| 5. Nitrogen metabolism
51 Introduction and role of nitrogen in plants
52 Nitrogen fixation by <i>Rhizobium</i> and BGA
5.2.1 Symbiotic nitrogen fixation, nitrogenase enzyme- structure and function
5.2.2 Non-symbiotic nitrogen fixation
53 Importance and production technique of BGA
54 Denitrification, ammonification and nitrification
55 Reductive amination and transamination | 7L |
| 6. Seed dormancy and germination
61 Definition, types of seed dormancy and germination
62 Methods to break seed dormancy
63 Metabolic changes during seed germination
64 Role of phytohormones to improve seed germination
65 Vigor Index | 4L |
| 7. Physiology of flowering
71 Photoperiodism – Concept, definition, short day plants, long day plants and day neutral | 4L |

plants.

- 72 Phytochrome theory, role of phytohormones in induction and inhibition of flowering
- 73 Applications of photoperiodism
- 74 Vernalization–concept and definition, mechanism of vernalisation, applications of vernalisation and devernialization

References:

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S.Y.B.Sc. Botany CBCS Pattern
Practical (Semester III Paper III) 2020-2021
BO 233: Practical based on BO 231 & BO 232

Practical based on Taxonomy of Angiosperms and Plant Ecology, and Plant Physiology

Sr. No.	Title	No. of Practical
Taxonomy of Angiosperms and Plant Ecology		
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
Plant Physiology		
7	Perform phytochemical test for starch and protein in germinating and non germinating seeds	1
8	Isolation of Leaf Protein Concentration (LPC) from suitable plant material.	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 a. Commercial biofertilizers b. Imbibition in seeds c. Ringing experiment d. Arc Auxanometer e. Spectrophotometer f. Nitrogen fixing bacteria / BGA (specimen/ slide)	1
12	Calculate seed germination percentage and vigor index	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 sessilis (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 rottleri (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) 2020-2021****BO 241: Plant Anatomy and Embryology- 2 Credits (30 Lectures)****Credit-I Plant anatomy:****(15 Lectures)****1. Introduction****2L**

1.1 Definition

1.2 Scope of plant anatomy

2. Epidermal tissue system**3L**

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

3. Mechanical tissue system**3L**

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

4. Normal secondary growth**3L**

4.1 Introduction

4.2 Normal secondary growth in dicotyledonous stem

4.3 Development of annual rings, periderm, bark, tyloses and lenticel

5. Anomalous secondary growth**4L**

5.1 Introduction

5.2 Causes of anomalous secondary growth

5.3 Anomalous secondary growth in:

a) Dicotyledonous stem (*Bignonia*),b) Dicotyledonous root (*Raphanus*),c) Monocotyledonous stem (*Dracaena*)**Credit-II Plant Embryology****(15 Lectures)****7. Introduction****1L**

7.1 Definition and scope of plant embryology

8. Microsporangium and male gametophyte**4L**

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 Structure of Dicotyledonous and Monocotyledonous embryo.	

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7. Pijush Roy, Plant Anatomy. New Central Book Agency Ltd, Kolkata
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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) 2020-2021
BO 242: Plant Biotechnology (2 Cr- 30 Lectures)**

Credit I:

Chapter 1 Introduction to Plant Biotechnology	3L
1.1 History and definition	
1.2 Scope and importance of plant biotechnology	
1.3 Current status of biotechnology in India.	
Chapter 2 Plant Tissue Culture	8L
2.1 Concept of plant tissue culture and cellular totipotency	
2.2 Basic techniques: Types of culture, Media preparation, sterilization, inoculation, incubation, hardening	
2.3 Applications with reference to: Micropropagation, Somaclonal variation, Haploid production, Protoplast fusion & Somatic hybrids, Embryo rescue, Production of secondary metabolites.	
2.4 Commercial Plant Tissue culture laboratories in Maharashtra and India.	
Chapter 3 Single Cell Protein (SCP)	4L
3.1 Concept and definition	
3.2 Importance of proteins in diet	
3.3 Production of SCP from <i>Spirulina</i> and Yeast	
3.4 Importance & acceptability of SCP	
Credit II:	
Chapter 4 Plant Genetic Engineering	5L
4.1 Introduction, concept	
4.2 Tools of genetic engineering (restriction enzymes, ligases, plasmid vectors)	
4.3 Gene cloning Technique	
4.4 Applications of plant genetic engineering: insect pest resistance, abiotic stress tolerance, herbicide resistance	
Chapter 5 Genomics, Proteomics and Bioinformatics	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.	
Chapter 6 Bioremediation	2L
6.1 Introduction and concept	
6.2 Microbial remediation	
6.3 Phytoremediation	
Chapter 7 Biofuel technology	3L
7.1 Definition, Concept and types of Renewable and nonrenewable energy sources	
7.2 Definition and concept of Biogas, Bioethanol, Biobutanol, Biodiesel & Biohydrogen	

References

1. B.D. Singh (4th 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) 2020-2021
BO 243: Practical based on BO 241 & BO 242

Sr. No.	Title	No. of Practical
Plant Anatomy and Embryology		
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</i> / <i>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
Plant Biotechnology		
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	1
8	Preparation & sterilization of MS medium	1
9	Surface sterilization and Inoculation of nodal sector, leaf, anther and maize embryo	2
10	Laboratory cultivation of <i>Spirulina</i>	1
11	Demonstration practical on transgenic crops viz; Bt-Cotton, Golden rice	1
12	Demonstration of principle and working of agarose gel electrophoresis, centrifuge, spectrophotometer	1
13	Visit to plant tissue culture laboratory	1