

AC – 20/05/2025

Item No. – 6.6 (N) (2ab) Sem. III & IV

As Per NEP 2020

University of Mumbai



Syllabus for Minor Vertical 2 (Scheme – III)

Faculty of Science

Board of Studies in Botany

Second Year Programme : Botany

Semester	III & IV	
Title of Paper	Sem.	Total Credits 4
I) Integrated Approaches in Plant Sciences I	III	2
II) Practical in Plant Sciences I		2
Title of Paper		Credits
I) Integrated Approaches in Plant Sciences II	IV	2
II) Practical in Plant Sciences II		2
From the Academic Year		2025-26

Sem. - III

Syllabus B.Sc. (Botany) (Sem.- III)

Title of Paper: Integrated Approaches in Plant Sciences I

Sr. No.	Heading	Particulars
1	Description of the course : Including but Not limited to :	This course provides a comprehensive overview of plant forms, life cycles, cell organelles, and genetic mechanisms, integrating biostatistical tools for data analysis. It lays the foundation for advanced studies in plant biology and biotechnology, essential for understanding plant structure and function. The skills learned apply to agricultural innovation, plant breeding programs, and data-driven research in plant sciences. It complements courses in botany, molecular biology, genetics, and biostatistics, enhancing interdisciplinary learning. Students can pursue careers as plant biologists, geneticists, biotechnologists, research scientists, and agricultural consultants.
2	Vertical :	Minor
3	Type :	Theory / Practical
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks

7	Course Objectives: To enable the learner 1. Identify the different types of plant forms based on structure. 2. Acquire knowledge about the life cycles of different plant forms. 3. Gain the knowledge of cell organelles, Nucleic Acids. 4. Learn the structure and function of plant cell organelles. 5. Acquire knowledge of genetic inheritance and aberrations. 6. Familiarize themselves with biostatistical applications.
8	Course Outcomes: The learner will be able to 1. Recognize the different types of plant forms based on structure. 2. Describe the life cycles of different plant forms. 3. Elaborate the structure of cell organelles, Nucleic Acids. 4. Identify and understand the structure and functions of plant cell organelles. 5. Discuss the cause of variation in chromosome number. 6. Use knowledge of biostatistics.

9	Module 1: Cryptogams 15 Lectures
	1. Thallophyta: • Interesting Facts about Algae • Systematic position (G. M. Smith 1955), and life cycle (excluding development stages of sex organs) of <i>Vaucheria</i> • Interesting Facts about Fungi • Systematic position (G. M. Smith 1955), and life cycle (excluding development stages of sex organs) of <i>Xylaria</i> 2. Bryophyta and Pteridophyta: • Thallus structure of liverworts, Hornworts & Mosses. (One example of each) • Habitat and Pteridophytes: Aquatic, terrestrial and xerophytic. Activity: • Poster Presentation / Oral Presentation / Digital Collection of Thallophyta, Bryophyta, Pteridophyta.
	Module 2: Cytogenetics and Biostatistics 15 Lectures
	1. Cell Biology: • Ultrastructure and functions of cell organelles: Nucleus, Golgi bodies. • Meiosis in Plant Cells and its Significance. 2. Cytogenetics • Variation in Chromosome number: Aneuploidy, Euploidy and its types. 3. Molecular biology and Biostatistics • Transcription in Eukaryotes • RNA processing 4. Biostatistics: • Introduction, concept and problems based on Standard error, Chi Square. Activity: • Poster Presentation / Oral Presentation / Model of Nucleus, Golgi bodies, Transcription, Variation in Chromosome number

10	Text Books / Reference Books: 1. Text Book of Algae (1986) by O.P.Sharma. Tata McGraw Hill. 2. Text Book of Botany-Algae (1994) By B. P. Pandey. S. Chand. 3. Text Book of Botany 3rd Edition (2004) Prof. V. Singh, DR. P.C. Pandey & Dr. D.K Jain. Rastogi Publication. 4. Plant Pathology (1982) Dr. B. P. Pandey. S. Chand & Company LTD. 5. Text Book of Fungi (1989) by O.P.Sharma, Tata Mc.Graw 6. Morphology and Evolution of Vascular Plants (1989) by Gifford, E.M. and Foster A.S. publisher, W.H. Freeman & Co., New York. 7. An Introduction to Pteridophyte (1999) By Abdul Rashid. Reprint 2021, Vikas Publishing House Private Limited. 8. Cryptogamic Botany Volume I and II (1938,1955) by G M Smith McGraw Hill 9. Botany for Degree students-Pteridophytes by Vashishta B.R. (1996) 10. Textbook of Plant Pathology (2006) by A.V.S.S.Sambamurty. Reprint 2012) I.K. International Publishing House Pvt. Ltd. 11. College Botany Volume II(1989) reprint 2014 By Gangulee & Kar. New Central Book Agency (P)Ltd 12. College Botany Vol-III (1984) Reprint 2006 by Susil Kumar Mukherjee 13. Studies in Botany vol.1. 6th edition (Revised 2018) by J.N. Mitra, D.Mitra and Chowdhari, New Central Book Agency (P)LTD. 14. Biology of Bryophytes (1988) by Chopra, R.N., P.N.Kumar. 15. R. C. Dube (2008). A Text Book of Biotechnology, S. Chand. 16. P.K. Gupta (2019). Elements of Biotechnology. 17. Pal J.K. and Ghaskadabi S.S. (2008). Fundamentals of Molecular Biology. 18. Verma and Agrawal (2010). Molecular Biology 19. Devi P (2008). Principle and Methods of Plant Molecular Biology, Biochemistry and Genetics Agrobios, Jodhpur, India 20. Russel, P.J. 1998. Genetics (5th edn) The Benjamin/ Cummins Pub. Co., Inc. USA. 21. Lewin, B. Genes VIII. Oxford, University Press. New York, USA. . 22. Singh B. D. (2007). Plant Breeding. Kalyani Publishers. Ludhiana. 23. Chopra, V.L. (2000). Plant Breeding: Theory and Practice 2nd Ed. Oxford & IBH, New Delhi. 24. Das H. K. Ed. (2007) Textbook of Biotechnology. 3rd Edition. Wiley India (P) Ltd. 25. Genes X– Benjamin Lewin, Jones and Bartlett, 2011		
11	<table border="1"> <tr> <td>Internal Continuous Assessment: 40%</td><td>External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr> </table>	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
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12	<table border="1"> <tr> <td> Continuous Evaluation: 20 marks Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3) </td><td> Term end exam for 30 marks: Attempt any 2 questions out of 4 questions. </td></tr> </table>	Continuous Evaluation: 20 marks Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	Term end exam for 30 marks: Attempt any 2 questions out of 4 questions.
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S.Y. B. Sc. BOTANY: SEM III (Minor)

Course-II

Name of the Course: Practical in Plant Sciences I

60 Hours

Credits:02

List of Practicals (External)
1. Study of Stages in the Life Cycle of <i>Vaucheria</i>. 2. Study of the Ultrastructure of Cell Organelles: Nucleus, Golgi bodies. 3. Study of chromosomal abnormalities from treated root tips. (Colchicine/pDB) 4. Quantification of DNA from plant material. 5. Estimation of RNA from plant material. 6. Problems in Biostatistics: a. Standard error b. Chi square test

List of Practicals (Internal)
1. Study of stages in the life cycle of <i>Xylaria</i>. 2. Smear preparation using plant material.(Meiosis) 3. Study of Karyotypes - Down Syndrome and Turner Syndrome.

Sem. - IV

Syllabus B.Sc. (Botany) (Sem.- IV)

Title of Paper: Integrated Approaches in Plant Sciences II

Sr. No.	Heading	Particulars
1	Description of the course : Including but Not limited to :	This course explores the characteristics of Gymnosperms and Angiosperms, garden design, photosynthesis, plant morphology, and biostatistics in plant sciences. It connects plant biology with horticulture, physiology, and statistical analysis, essential for research and practical applications. It complements studies in botany, horticulture, environmental science, and biostatistics, offering interdisciplinary learning. Professionals skilled in plant taxonomy, garden design, and statistical analysis are in demand for agriculture, landscaping, and research. Students can work as botanists, horticulturists, landscape designers, agricultural scientists, and research analysts.
2	Vertical :	Minor
3	Type :	Theory / Practical
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	30 Hours / 60 Hours
6	Marks Allotted:	50 Marks/100 Marks

7	Course Objectives: To enable the learner 1. Comprehend the characteristics and importance of Gymnosperms and Angiosperms. 2. Understand the various garden features and types of gardens. 3. Gain knowledge of Photosynthetic pigments, Photoperiodism and Vernalization 4. Acquire knowledge of the internal morphology of plants. 5. Develop problem solving skills in biostatistics.
8	Course Outcomes: The learner will be able to 1. Identify and compare vegetative and reproductive characteristics and applications of diverse plant groups. 2. Demonstrate knowledge of fundamentals involved in garden designing. 3. Describe the Photosynthetic pigments, process of Photoperiodism and Vernalization. 4. Discuss the internal morphology of plants. 5. Apply the problem solving skills in biostatistics.

9	Module 1: Spermatophyta and Gardening	15 Lectures
	1. Gymnosperms: • Interesting facts about gymnosperms. • Systematic position (Chamberlain,1934) and life cycle (excluding developmental stages of sex organs) of <i>Pinus</i>. 2. Angiosperms: • Parts of typical leaves, • Types of leaves- Simple and Compound, • Leaf Modifications in plants -Types - Phyllode, Tendrils, Thorns, Spines. • Types of inflorescences- Racemose, Cymose and Special Inflorescence 3. Garden designing: • Garden Plan - Objectives, types and characteristics. • Garden Features - Fences, Path, Lawn, Topiary, Hedges, Edges, Lawn, Arch and Pergola, Avenue, Flower Beds. Activities: • Explore the world's largest and oldest conifers via online resources. • Leaf impression art. • Explore a local botanical garden to document plant diversity.	
	Module 2: Anatomy, Plant Physiology, Biostatistics	15 Lectures
	1. Anatomy: • Meristem- Characteristics, types, and functions. • Permanent tissues in plants - Types, structure and functions. • Normal Secondary growth in dicot root and stem.	

2. Plant Physiology

- Respiration - Introduction, Types.
- Aerobic respiration - Glycolysis, Krebs cycle and ETS.
- Anaerobic respiration

3. Biostatistics

- Coefficient of correlation.
- Regression analysis.

Activities:

- Poster Presentation / Oral Presentation / Model of Anatomical structures (as per theory)
- Documentation of flowering in plants during different seasons in the vicinity.

10 Text Books / Reference Books:

1. College Botany Vol I by Gangulee Das and Datta (1959), 2011
2. College Botany Vol II by Gangulee and Kar Rev Edition (1989), 2011
3. College Botany, Volume III 3 by Sushil Kumar Mukherjee, 2006
4. Botany for Degree Students, Vahishta, Sinha and Kumar, S. Chand and Company Ltd, (1976), 2011
5. A Textbook of Botany by Prof.V. Singh, Dr. R.C. Pande, Dr. D. K. Jain, Rastogi Publication, 3rd Edition, 2004-2005.
6. A Text Book of Botany: Angiosperms by B.P. Pandey, S Chand Publication, 2001
7. College Botany by S. Sundar Rajan, Himalaya Publication, Edition 2021
8. Taxonomy of Angiosperms– Taxonomy, Systematic Botany, Economic Botany, Ethnobotany, by Annie Ragland, V. Kumaresan, Saras Publication., 2013
9. Complete Gardening in India – Gopal Swamiengar Edition, 4. Publisher, Gopaldaswamy Parthasarathy, 'Srinivasa', 1991.
10. Floriculture and Landscaping by Bose 1999 PRINT
11. Landscape Gardening and Design with Plants; author Supriya Kumar Bhattacharjee; publisher Pointer Publishers, 2004; ISBN 8179100855, 9788179100851.
12. Floriculture in India by G.S. Randhawa, A. Mukhopadhyay, Allied Publishers · Edition: 1st Edition, 2017.
13. Lincoln Taiz and Eduardo Zeiger (2010) Plant Physiology, 5th edition. Sinauer Associates, Inc. Publishers. Sunderland, USA.
14. Jain, V.K. (2000): Fundamentals of Plant Physiology, S.Chand & Co, New Delhi.
15. Verma, V. (2007): Text Book of Plant Physiology, Ane Books India, New Delhi.
16. Richard Crang , Sheila Lyons-Sobaski and Robert Wise (2018) Plant Anatomy A Concept-Based Approach to the Structure of Seed Plants
17. B. P. Pandey, Plant Anatomy, 1987, S. Chand and Co. Ltd, New Delhi

	18. Eams and Mc Daniel, An Introduction to Plant Anatomy, 1990, McGraw –Hill Book Co. Ltd and Kogakusha Co, Tokyo, Japan 19. P. Saxena and S. M. Das (2012) A Textbook of Plant Anatomy 20. P. J. Chandurkar, Plant Anatomy, 1971, Oxford and IBH publication Co. New Delhi 21. Adriance S Foster, Practical Plant Anatomy, 2000, D Van Nostrand Co. INC, New York 22. Esau, Plant Anatomy, 2000, Wiley Toppan Co. California, USA 23. Pijush Roy, Plant Anatomy, 2004, New Central Book Agency Ltd, Kolkata 24. Dr. Pranab Kumar Banerjee, Introduction to Biostatistics, S Chand & Co Ltd	
11	Internal Continuous Assessment: 40%	External, Semester End Examination 60% Individual Passing in Internal and External Examination
12	Continuous Evaluation through: 20 marks Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	Term end exam for 30 marks: Attempt any 2 questions out of 4 questions.

**S.Y.B.SC BOTANY: Sem IV
Course II**

Name of the Course: Practical in Plant Sciences II (Minor)

60 Hours

Credits: 02

List of Practicals - External
1. Types of Inflorescences (any one example of each type). 2. Study of Families: Malvaceae, Amaryllidaceae - Classification, Morphological peculiarities, Floral Formula, and Economic importance. 3. Study of temperature Coefficient Q₁₀ using Phenol red indicator 4. Separation of Carotenoids by Paper Chromatography. 5. Study of conducting tissues in Gymnosperms and Angiosperms through Maceration technique. 6. Study and application of Coefficient of correlation. 7. Study and application of Regression analysis.

List of Practicals - Internal
1. Study of Leaf morphology. (As per theory) 2. Garden Locations (Hedges, Edges, Lawn, Arch and pergola, Avenue, Flower Beds Rock Garden and Water Garden). 3. Designing of Garden: Formal and Informal Gardens. 4. Study of Normal Secondary Growth in dicot stem and root. 5. Study of anthocyanin as pH indicator.

Note:

- A minimum of **Two** field excursions (with at least one beyond the limits of Mumbai / Local Area) for habitat studies are compulsory.
- Field work of not less than **Eight hours** duration is equivalent to one period per week.
- Industrial visit/Institutional visit at least **One** per Semester is compulsory.
- **Certified Journal** to be submitted during practical examination.

QUESTION PAPER PATTERN (External and Internal)

Time:- 01hr		Paper: External Theory	30 marks
NB: 1. Attempt any 2 questions out of 4 questions 2. All Questions carry equal marks. 3. Draw neat and labelled diagrams wherever necessary.			
Q.No.	Descriptor	Module	Marks
Q1	Answer the following:		
A		1	08 M
B		2	07 M
Q2	Answer the following:		
A		1	08 M
B		2	07 M
Q3	Answer the following:		
A		2	08 M
B		1	07 M
Q4	Answer the following:		
A		2	08 M
B		1	07 M

Internal Theory 20 marks

Continuous Evaluation through:	Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)
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University of Mumbai
S. Y. B.Sc. Semester – III (NEP 2020) Practical Examination
BOTANY-PRACTICAL
External Practical Exam Skeleton Question Paper
Course II- (Minor)
Practicals in Plant Sciences I

N.B.

- 1. Candidates should show their slides/ preparations/ results for all questions to the examiner.**
- 2. Use of logarithm tables / simple calculator is allowed.**

TIME - 2 hours

Marks – 30

Q 1	Identify, and describe the specimen 'A'.	05M
Q.2	Prepare squash from the material 'B'. Draw and comment on the abnormality observed. / Perform _____ from the data 'B'.	08M
Q. 3	Estimate _____ from the material 'C'.	08M
Q.4	Identify and describe the specimen/ photograph/ Slide – 'D'.	04M
Q.5	Field Visit	05M

Key-

- A *Vaucheria* (vegetative /reproductive structures)
- B Treated root tips (Colchicine / pDB) / Standard Error/ Chi-square test
- C DNA / RNA
- D Nucleus / Golgi bodies

University of Mumbai
S. Y. B.Sc. Semester – III (NEP 2020) Practical Examination
BOTANY-PRACTICAL
Internal Practical Exam Skeleton Question Paper
Course II- (Minor)
Practicals in Plant Sciences I

N.B.

- 1. Candidates should show their slides/ preparations/ results for all questions to the examiner.**
- 2. Use of logarithm tables / simple calculator is allowed.**

TIME - 2 hours

Marks – 20

Q.1	Identify, and describe the specimen A .	06M
Q.2	Prepare a smear from the material ' B '. Draw, and comment on any one stage seen.	06M
Q.3	Identify, and describe the slide/ specimen/photomicrograph C .	03M
Q.4	Journal	05M

Key-

- A** Xylaria (vegetative /reproductive structures)
- B** Meiosis
- C** Karyotypes - Down Syndrome / Turner Syndrome.

University of Mumbai
S. Y. B.Sc. Semester – IV (NEP 2020) Practical Examination
BOTANY-PRACTICAL
External Practical Exam Skeleton Question Paper
Course - II (Minor)

Name of the Course: Practical in Plant Sciences II

N.B.

1. Candidates should show their slides/ preparations/ results for all questions to the examiner.
2. Use of logarithm tables / simple calculator is allowed.

Time 2 hrs

Total Marks- 30

Q 1	Macerate the material 'A' and identify the conducting tissues.	5M
Q.2	Classify specimen 'B' upto its family. Draw L. S. of Flower and T. S. of Ovary. Give floral formula.	6M
Q.3	Perform the experiment 'C' allotted to you.	6M
Q.4	Perform _____ from the given data 'D'.	5M
Q.5	Identify and describe the specimen/ photograph/ Slide – 'E'.	3M
Q.6	Field report submission	5M

Key

- A *Thuja* stem, *Annona* stem, *Sterculia* stem etc.
- B Plant Families: Malvaceae / Amaryllidaceae
- C Q10 / Carotenoid separation
- D Coefficient of correlation / Regression Analysis
- E Inflorescence types

University of Mumbai
S. Y. B.Sc. Semester – IV (NEP 2020) Practical Examination
BOTANY-PRACTICAL
Internal Practical Exam Skeleton Question Paper
Course - II (Minor)

Name of the Course: Practical in Plant Sciences II

N.B.

1. Candidates should show their slides/ preparations/ results for all questions to the examiner.
2. Use of logarithm tables / simple calculator is allowed.

Time: 2 hrs

Marks: 20M

- | | | |
|----|---|-----|
| Q1 | Make a temporary stained preparation of T.S. of specimen 'A' and comment on the secondary growth. | 04M |
| Q2 | Design garden 'B'. Show any two garden locations and mention any two plants used for the same. | 05M |
| Q3 | Tabulate the effect of _____ on the pH change for specimen 'C'. Analyse the observations. | 05M |
| Q4 | Identify and describe the specimen/ slides/photomicrographs 'D'. | 03M |
| Q5 | Journal | 03M |

Key

- | | |
|---|--------------------------|
| A | Dicot Stem / Dicot Root |
| B | Formal / Informal Garden |
| C | Anthocyanin pigment |
| D | Leaf morphology |



**Sign of the BOS
Chairman
Prin. Dr. Vasant Mali
BOS in Botany**

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

**Sign of the Offg. Dean
Prof. Shivram S. Garje
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Technology**