ST. XAVIER'S COLLEGE (AUTONOMOUS)

AHMEDABAD

Botany Syllabus
for
Four-Year Undergraduate Programme
as per
National Education Policy (NEP-2020)
(Semester IV)

(EFFECTIVE FROM JUNE 2024)

ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD
BOTANY
Theory syllabus

PROGRAMME SPECIFIC OUTCOMES

PSO1: Knowledge: Understanding the nature and basic concepts of all the plant groups, their morphonology, anatomy, taxonomy, physiology, biochemistry, genetics, components at the molecular level, the relationship between structure and function, plant diversity, and ecology.

PSO2: **Laboratory skills**: Students learn to carry out practical work in the field and in the laboratory related to interpreting plant morphology and anatomy, plant identification and collection, vegetation analysis techniques, physiochemical analyses of plant materials, analysis of data using appropriate statistical methods, documentation of field visits, visits to gardens and nurseries.

PSO3: **Environmental concern**: Students become aware of natural resources and understand the impact of plant diversity in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development with respect to assessment, conservation andnutilization of floral diversity.

PSO4: **Employability/future prospects**: Students develop critical thinking, scientific attitudes, problem-solving skills, presentation skills, teamwork capacities, and an aptitude that is highly valuable to employers in the sector of academia, research and industry and which will facilitate them for taking up and shaping successful careers in Botany.

PSO5: **Scientific communication**: Effective written and oral scientific communication skills, especially the ability to transmit the fundamental concepts of the subject in a clear and concise manner.

PSO6: Life-long learning: Students are prepared for lifelong learning by drawing attention to the vast world of knowledge of plants and by enhancing their ability to engage in independent learning by introducing them to the methodology of systematic academic inquiry.

ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD

Syllabus of Semester – IV of the following department under Faculty of Sciencebased on Under Graduate Curriculum Framework - 2023 to be implemented from the Academic Year 2024-25.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

Course	Title	Content	Hours /week	Credit
DSC-1 (Theory)	Basics of Botany-V	U-1: Gymnosperms U-2: Plant Geography and Forestry U-3: Plant Physiology I U-4: Plant Physiology II	4 hrs	4
DSC-2 (Theory)	Basics of Botany-VI	U-1: Morphology and Taxonomy U-2: Economic Botany U-3: Palynology U-4: Genetics	4 hrs	4
DSC-3 (Lab)	Basics of Botany Practicals-IV	Practical based as per Theory syllabus Paper I and II.	8 hrs	4
Minor (Theory)	Essentials of Botany-I	U-I: Plant Physiology I U-II: Plant Physiology II	2 hrs	2
Minor (Lab)	Essentials of Botany-I	Practical based on the syllabus as per theory	4 hrs	2
SEC	Organic Farming Practices and Certification	https://onlinecourses.swayam2.ac.in/cec25_hs41/preview	2 hrs	2
AEC		(To be offered by the concerned subject Department)		
VAC		(To be offered by the concerned subject Department)		

St. Xavier's College (Autonomous), Ahmedabad

Syllabus of Semester – IV of the following departments under the Faculty of Science based on Under Graduate Curriculum Framework - 2023 to be implemented from the Academic Year 2024-25.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

BSc. (Hons.) Botany

Major Course – I: Basics of Botany-V

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Pre-requisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
Basics of Botany V (BOMC441C)	4	0	0	10 + 2 from a recognized board in any stream	Basics of Biology

LEARNING OBJECTIVES (LO)	
LO-1	To examine the morphology, anatomy, reproduction, and life cycle of selected Gymnosperm species and understand their economic importance.
LO-2	To gain knowledge of plant geography, forest types, biomes and classification, and develop an understanding of forest conservation methods.
LO-3	To understand the value of forest resources and explore the roles of social forestry and agroforestry.
LO-4	To describe the photosynthesis process, including light reactions, and identify factors that impact photosynthetic efficiency.
LO-5	To understand the mechanisms of water absorption and ascent of sap in plants, and identify key macro- and micronutrients along with their functions.
Course OUTCOMES (CO)	

On Completion of this course, the student will be able to	
CO-1	Examine the morphology, anatomy, reproduction, and life cycle of selected Gymnosperms and identify their economic importance.
CO-2	Gain an understanding of plant geography, forest types, biomes and classification while developing skills in forest conservation techniques.
CO-3	Comprehend the value and uses of forest resources and apply principles of social forestry and agroforestry.
CO-4	Explain the photosynthesis process and light reactions, identifying factors that influence photosynthetic efficiency.
CO-5	Understand water absorption and ascent of sap in plants, and identify the sources and functions of macro- and micronutrients.

Unit I: GYMNOSPERMS

1. Classification of Gymnosperms by **Chamberlain** (1934).
2. Life history of ***Pinus*** including Morphology, Anatomy, Reproduction, and Embryogeny.
3. Life history of ***Ephedra*** including Systematic position, Occurrence, Morphology, Anatomy, and Reproduction (excluding development).
4. Economic Importance of Gymnosperms.

UNIT II: PLANT GEOGRAPHY AND FORESTRY

1] Plant Geography:

i. **Introduction and objectives of Plant geography.**
ii. **Major Biomes of the World.**
iii. **Biosphere reserves of India.**

2] Forestry:

i. **Classification and importance of Forests.**
ii. **Types of Forests in India.**
iii. **Forest Wealth: Uses of Forest: Ecological and Economical**
iv. **Social Forestry and Agroforestry**
v. **Forest Conservation.**

Unit III: PLANT PHYSIOLOGY I

1. Photosynthetic apparatus.
2. Photosynthetic pigments.
3. Light-dependent phases: Photosystems I and II
4. Photophosphorylation: Cyclic and Non-Cyclic.
5. Light-independent phases: Path of Carbon fixation in C_3, C_4 and CAM cycle.
6. Factors affecting Photosynthesis: External and Internal.

Unit IV: PLANT PHYSIOLOGY II

1. Absorption of water
    a. Structure of Water Molecule
    b. Physico-chemical properties of water
    c. Mechanism of water absorption
        (i) Active absorption.
        (ii) Passive absorption.
    d. Factors affecting the rate of water absorption.
2. Theories of Ascent of Sap
    a. Root pressure theory
    b. Physical force theory: (i) Capillary action (ii) Atmospheric Pressure and Cohesion- tension theory (Dixon's Theory)
3. Mineral Nutrition in Plants:
    a. Macro and Micronutrients – C, H, O, N, S, P, K, Ca, Fe, Mg, Mn, Zn, B, Cu, Mo Source and Functions.

Suggestive Reading:

- Pandey, S.N., Trivedi, P.S. and Misra S.P; *A Textbook of Botany Vol. I and II*, Vikas Publishing House Pvt. Ltd, 2005.
- Parihar, N.S.; Pteridophytes: *An introduction to Embryophyta*, Vol.II; 4th edition;Allahabad: Central Book Depot, 1962.
- Kar, Ashok Kumar; Gangulee, Hirendra Chandra; *College botany*: Volume II; 2nd edition; Kolkata: New Central Book Agency (P) Ltd, 1989, 2006.
- Bhatnagar, S.P. and Moitra, A; *Gymnosperms*; New Delhi: New Age International Pvt. Ltd.,1996.
- Chopra, G.L; *Gymnosperms*; Jullundhar: S. Nagin & Co.
- Coulter, J.M. & Chamberlain, C.J; *Morphology of Gymnosperms*; Allahabad: Central Book Depot, 1978.
- Vashishta, P.C; *Botany for degree student- Gymnosperms*; New Delhi: S. Chand Publications, 1983.
- Vashishta, P.C; Gymnosperms; New Delhi: S. Chand Publications, 1983.
- Noggle, Ray G.; Fritz, George J.; *Introductory plant physiology*; 2nd edition; New Delhi: Prentice-Hall Of India Private Limited, 1991.
- Sinha, B.K.; Pandey, S.N.; *Plant Physiology*; 1st edition; New Delhi: Vikas Publishing House Pvt. Ltd., 1981.
- Verma, V.; *Textbook of Plant Physiology*; New Delhi: Ane Books India, 2007.
- Salisbury, Frank B.; Ross, Cleon W.; *Plant Physiology*; 3rd edition, Reprint; New Delhi : CBSPublishers & Distributors , 1986(2001).
- Devlin, Robert M.; Witham, Francis H.; *Plant Physiology*; 4th edition, Indian reprint; Delhi :CBS Publishers & Distributors , 1986(2001).
- Kochhar, P.L.; *A textbook of Plant Physiology*; 7th edition; Delhi: Atma Ram &Sons, 1964.
- Fundamentals of Plant Physiology by Kumar and Purohit; Narosa Publication.

Suggested Online Links/Readings:

https://swayam.gov.in
https://www.iscnagpur.ac.in/knowledge_learning_files/5.7_General_Open_Access_e-Resources.pdf
https://www.tkdl.res.in/tkdl/langdefault/common/Home.asp?GL=Eng
https://ndl.iitkgp.ac.in
https://nptel.ac.in/course.html
www.ncert.in
https://books.google.co.in

Pedagogy:

1. Lecture method with teaching aids.
2. Audio-Visual Teaching mode with Projector Method.
3. Dialogue and context-based class.
4. Assignments, Learning seminars, Class Tests etc.
5. Open Online Sources and Tutorials.

MODE OF EVALUATION:

The evaluation will be divided into two parts.

ASSESSMENT	MARKS
INTERNAL	
Attendance	05
Assignment (Research component)	10
Continuous Internal Assessment I and II	35
TOTAL	50 marks
EXTERNAL	
End Semester Exam	50 marks

Students will prepare and present (in pairs) a Submission related to the topic of the Research Assignment on allotted topics. These submissions will be presented in the form of PPT/ Activity/Handwritten notes/ Article/Poster/ etc. Points for evaluation: Presentation (20%) + Content (20%) + Explanation (20%) + Creativity (20%) + Overall impression (20%).

St. Xavier's College (Autonomous), Ahmedabad

Syllabus of Semester – IV of the following departments under the Faculty of Science based on Under Graduate Curriculum Framework - 2023 to be implemented from the Academic Year 2024-25.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

BSc. (Hons.) Botany

Major Course – II: Basics of Botany -VI

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prerequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
Basics Of Botany - VI (BOMC442C)	4	0	0	10 + 2 from a recognized board in any stream	Basic Knowledge of Biology

LEARNING OBJECTIVES (LO)	
LO-1	To understand the characteristics of selected angiosperm families based on Bentham & Hooker's classification system.
LO-2	To develop foundational knowledge of fruit morphology and its role in plant reproduction and classification.
LO-3	To cultivate an appreciation for plants valued for their economic significance.
LO-4	To learn about pollen morphology, viability, and germination, and understand the practical applications of palynology in industries like agriculture, forensics, and environmental studies.
LO-5	To grasp the principles of genetics, understand gene interaction and sex determination in plants, and explore concepts like epistasis.
Course OUTCOMES (CO)	

On Completion of this course, the student will be able to	
CO-1	Generalize the characteristics of selected angiosperm families according to Bentham & Hooker's system of classification.
CO-2	Develop a basic understanding of fruit morphology and its significance in plant biology.
CO-3	Increase awareness and appreciation of plants valued for their economic significance.
CO-4	Understand pollen morphology, viability, and germination, and explore the applications of palynology in various industries.
CO-5	Gain a conceptual understanding of the principles of genetics, gene interactions, sex determination in plants, and epistasis.

Unit I: MORPHOLOGY & TAXONOMY

I] MORPHOLOGY

a. Morphology of fruits.

II] TAXONOMY

Classification of the following families as per Bentham and Hooker'ssystem of classification including examples of economic importance.

a. **Dicotyledons**:
   - *i.* Polypetalae: *Caesalpiniaceae,* ***Lythraceae***
   - *ii.* Gamopetalae: *Rubiaceae, Apocynaceae*
   - *iii.* Apetlae: *Euphorbiaceae*

b. **Monocotyledons**: *Arecaceae* and *Poaceae.*

UNIT II: ECONOMIC BOTANY

1. **TIMBER SPECIES:**
   - **a.** ***Tectona grandis***
   - **b.** ***Madhuca indica***
2. **FIREWOOD SPECIES:**
   - **a.** ***Zizyphus jujuba***
   - **b.** ***Acacia nilotic***
3. **ESSENTIAL OILS:**
   - **a. Sandalwood,**
   - **b. Eucalyptus,**
4. **FRUITS: Banana, Mango**
5. **VEGETABLES:**
   - **(i) Stem:-Potato**
   - **(ii) Root: Carrot**

6. BEVERAGES: Tea, Coffee.
7. FATS and OILS: Sunflower oil
8. GUMS and RESINS: Gum Arabic, Asafoetida
9. INSECTICIDES: Neem, Tobacco
10. MILLETS: Pearl Millet, Sorghum
11. Domestic Preservation Methods for Pulses and Cereals.

Unit III: PALYNOLOGY

1. Pollen and spore morphology- size and shape, polarity, apertures, exine stratification, and construction of palynogram.
2. Application of palynology in the honey industry, coal and oil exploration, forensic sciences, and pollen allergy.
3. Pollen viability and storage- Causes for loss of pollen viability, tests for pollen viability, and pollen storage.
4. Germination and growth of the pollen tube, factors affecting pollen tube growth.

Unit IV: GENETICS

1. Extension of Mendelian Principles (Co-dominance, Incomplete dominance, Pleiotropy)
2. Gene interactions (Allelic and non-allelic genes, Complementary and Supplementary genes).
3. Cytoplasmic inheritance: **characteristics**, Plastid inheritance: eg in *Mirabilis*, **Mitochondrial inheritance**, Cytoplasmic male sterility eg, in Maize.
4. Sex determination in plants.
5. Epistasis (Dominant and Recessive Epistasis)

Suggestive Reading: -

- Dutta, A.C.; *A Class-book of Botany*; 15th edition; Calcutta: Oxford University Press, 1976.
- Gangulee, H.C., Das, K.S., Dutta C.T.; *College Botany* Vol I.; Kolkata: New Central Book Agency, 2002.
- Lawrence, George H.M.; *Taxonomy of Vascular Plants*; 1st edition; New Delhi: Oxford & IBH Publishing Co., 1967.
- Naik, V.N. 1984. *Taxonomy of Angiosperms;* New Delhi: Tata McGraw - Hill Publishing Co. Ltd., 1984.
- Sharma, O.P.; *Plant Taxonomy*; 1st edition, reprint; New Delhi: Tata McGraw-Hill Publishing Co. Ltd., 1993(2002)
- Sivarajan, V.V.; *Introduction to the principles of plant taxonomy*; 2nd edition; Cambridge: Cambridge University Press, 1991.
- Subramanian, N.S.; *Modern plant taxonomy*; New Delhi: 1st edition; Vikas Publishing House Pvt. Ltd., 1995.
- Singh, G.; *Plant Systematics- Theory and Practice*; New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd, 1999.
- Verma B.K. *Introduction to Taxonomy of Angiosperms*. New Delhi: PHI Learning Pvt.

Ltd.,2011.
- Verma V.; *Text Book of Economic Botany*; Delhi: Ane Books, 2009.
- Kochhar S.L., Elbaum L., Einstein E.; *Economic Botany in the Tropics*; Pan MacMillan, 2012.
- Hill A.F.; *Economic Botany*, 2nd Edition; New York: McGraw -Hill, 1992.
- Sambamurty A.V.S. S., Subramanyam N.S.; *Economic Botany of Crop Plants*; Asia tech Publishers, 2000.
- Nair, P.K.K.; *Essentials of palynology*; Bombay: Asia Publishing House, 1966.
- Nair, P.K.K.; *Advances in palynology*; 1st edition; Lucknow: National Botanic Gardens, 1964.
- Bhattacharya, Kashinath; Majumdar, Manas Ranjan; Bhattacharya, Swati Gupta; *A textbook of palynology: Basic and applied*; 1st edition; Kolkata: New Central Book Agency (P) Ltd, 2006.
- Powar, C.B; *Genetics*; Vol 1 & 2; Himalaya Publishing House*, 2003.*
- Strickberger, M.W.; *Genetics*. New Delhi: PHI Learning Pvt. Ltd., 2008.
- Arumugon, N.; *Cell Biology, Genetics, Evolution*. Kanyakumari: Saras Publication.
- Stent, G.S.; *Molecular Genetics*; San Francisco: W.H. Freeman,1971.
- Russel, P.J; *Genetic;* Harper Collins College, 1992.
- Noggle, Ray G.; Fritz, George J.; *Introductory Plant Physiology*; 2nd edition; New Delhi: Prentice-Hall of India Private Limited, 1991.
- Sinha, B.K.; Pandey, S.N.; *Plant Physiology*; 1st edition; New Delhi: Vikas Publishing House Pvt. Ltd., 1981.
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- Devlin, Robert M.; Witham, Francis H.; *Plant Physiology*; 4th edition, Indian reprint; Delhi: CBS Publishers &Distributors, 1986(2001).
- Kochhar, P.L.; *A textbook of Plant Physiology*; 7th edition; Delhi: Atma Ram &Sons, 1964.
- V. Kumaresan; Plant Ecology and Phytogeography, Saras Publication.
- S.A.Shah; Forestry for People; Indian Council of Agriculture Research; New Delhi.
- N.S. Subrahmanyam and AVSS Samba-murthy; Ecology; Narosa publication.

Suggested Online Links/Readings:

https://swayam.gov.in
https://www.iscnagpur.ac.in/knowledge_learning_files/5.7_General_Open_Access_e-Resources.pdf
https://www.tkdl.res.in/tkdl/langdefault/common/Home.asp?GL=Eng
https://ndl.iitkgp.ac.in
https://nptel.ac.in/course.html
www.ncert.in
https://books.google.co.in

Pedagogy:

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MODE OF EVALUATION*:*

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ASSESSMENT	MARKS
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FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

BSc. (Hons.) Botany

Major Course – III: BASICS OF BOTANY PRACTICALS-IV

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Pre-requisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
Basics Of Botany Practicals - IV (BOMC443L)	0	0	4	10 + 2 from a recognized board in any stream	Basic Knowledge of Biology, identification, observation, and Analytic skills

LEARNING OBJECTIVES (LO)	
LO-1	To demonstrate skill in laboratory techniques and analytical methods for Gymnosperm study.
LO-2	To identify and analyze the various forest types and biomes in India.
LO-3	To apply basic experimental skills relevant to plant physiology.
LO-4	To classify plants using Bentham and Hooker's classification system.
LO-5	To recognize the economic importance of specific plants and describe fruit morphology.
LO-6	To analyze pollen morphology and explain the development and growth of the pollen tube.
LO-7	To solve basic genetics problems and interpret data using charts.
Course OUTCOMES (CO)	

On Completion of this course, the student will be able to	
CO-1	Demonstrate proficiency in experimental techniques and analytical methods for studying Gymnosperms.
CO-2	Analyze the types of forests and biomes found in India.
CO-3	Acquire foundational skills and techniques in Plant Physiology.
CO-4	Develop identification skills for plants based on Bentham and Hooker's classification system.
CO-5	Recognize the economic importance of selected plants and understand fruit morphology.
CO-6	Identify pollen morphology through sample analysis and understand pollen development and pollen tube growth.
CO-7	Apply problem-solving skills to genetics concepts and interpret data through charts.

PRACTICAL PART A

Unit 1: Gymnosperms

Ephedra:

i. Mountings of male and female cones.
ii. Mounting of Pollen grains.
iii. Permanent slides: T.S. of the stem, L.S. of the Ovary

Pinus:

i. Mounting of Pollen grain
ii. T.S. of *Pinus* needle.
iii. Specimens: Male cone, Female cone, Needle
iv. Permanent slides: Ovule, Needle, male cone L.S.

Unit II: Plant Geography and Forestry.

i. Preparation of a map showing the Biomes of the World
ii. Preparation of a map showing India's Biosphere Reserves.
iii. Preparation of a map showing the distribution of Forest types in India.

Unit-III Plant Physiology-I

i. Demonstration that oxygen evolved in photosynthesis.
ii. To study the Kranz anatomy.
iii. To study Hill Reaction by isolation of Chloroplast.
iv. Separation of Chlorophyll using the paper chromatography technique.

Unit-IV Plant Physiology-II

i. Conduction of water through xylem (Demonstration only).
ii. Estimation of macronutrients from the given sample.
iii. Estimation of micronutrients from the given sample.
iv. Study of water absorption in plants by Dye method.

PRACTICAL PART B

Unit I: Morphology and Taxonomy

i. Study of fruit morphology as per theory syllabus.
ii. Study families as per the theory syllabus.

Unit II: Economic Botany

Study of Specimens for Economic Botany as per theory syllabus.

Unit III: Palynology

i. Study of pollen morphology of *Hibiscus*, *Canna, Pancratium* and *Ocimum.*
ii. Determination of pollen viability.
iii. Study of pollen tube growth using different concentrations of sucrose.
iv. Pollen analysis from honey samples.

Unit IV: Genetics

i.) Genetics problems (as per syllabus).
   a) Co-dominance
   b) Incomplete dominance
   c) Pleiotropy
   d) Epitasis (Dominant and Recessive)

ii.) **Genetic Charts based on:**
   a. **Cytoplasmic inheritance in plants**
   b. **Sex determination in plants**

PROJECT:

The PROJECT will be **BASED ON SELECTED TOPICS OF THE SYLLABUS.** These are to be presented as an individual project This will be presented as a hand-written report, or a chart/series of charts, or through a PP presentation/Poster etc. The evaluation will include a Viva.

Suggested Readings:

1. Bendre Ashok M.; Ashok Kumar: A Text Book of Practical Botany; Vol 1; Meerut: Rastogi Publications, 2010
2. Practical Botany vol. I & II by Bendre and Kumar, Rastogi Publication
3. Practical Botany by S. C. Santra, Chatterjee and Das, New Central Book Agency.
4. Experimental Plant Ecology by Pratima Kapur and Sudha Rani, CBS Publication

MODE OF EVALUATION:

SR. NO.	EXAM PATTERN	INTERNAL EXAM		EXTERNAL EXAM	
		SESSION I	**SESSION II**	**SESSION I**	**SESSION II**
1	Practical/Performance	25	20	25	25
2	Attendance	0	05	00	00
	Total	**25**	**25**	**25**	**25**
	Grand Total	**25+25= 50 marks**		**25+25= 50 marks**	