ST. XAVIER'S COLLEGE (AUTONOMOUS)

AHMEDABAD

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

(Semester VI)

(EFFECTIVE FROM NOVEMBER 2025)

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 and utilization 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 – VI of the following department under the Faculty of Science based on the Undergraduate Curriculum Framework - 2023, to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

Course	Title	Content	Hours /week	Credit
DSC-1 (Theory)	Advanced Botany IV	U-1: Pteridophytes & Fossils U-2: Gymnosperms & Fossils U-3: Anatomy U-4: Biostatistics	4 hrs	4
DSC-2 (Theory)	Advanced Botany V	U-1: Systematic Botany and Ethnobotany U-2: Angiosperms U-3: Plant Physiology & Bioinformatics U-4: Plant Breeding	4 hrs	4
DSC-3 (Lab)	Advanced Botany Practicals- II	Practical based on the Theory syllabus, Papers I and II.	8 hrs	4
Subject Specific Minor	Molecular Biology, Biotechnology & Traditional Medicine	U-1: Molecular Biology U2: Biotechnology U3: Traditional Indian Systems of Medicine U4: Health, Immunity & Ayurveda	4 hrs	4
Internship	Botany Internship		120hrs	4

St. Xavier's College (Autonomous), Ahmedabad

Syllabus of Semester – VI of the following departments under the Faculty of Science, based on Under Undergraduate Curriculum Framework - 2023, to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

BSc. (Hons.) Botany

Major Course – Advanced Botany 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		
Advanced Botany IV (BOMC661C)	4	0	0	10 + 2 from a recognized board in any stream	Basics of Biology

LEARNING OBJECTIVES (LO)	
LO-1	To describe the morphology, anatomy, and reproductive structures of representative Pteridophytes and Gymnosperms.
LO-2	To explain the life cycles and alternation of generations in vascular cryptogams and gymnosperms.
LO-3	To discuss the process of fossil formation, types of fossils, and their importance in tracing plant evolution.
LO-4	To analyze anatomical adaptations and various types of anomalous secondary growth in stems and roots.
LO-5	To apply basic statistical tools to collect, organize, and interpret biological data for botanical studies.
LO-6	To evaluate the ecological significance and economic importance of lower vascular plants in natural and applied contexts.
Course OUTCOMES (CO)	

On Completion of this course, the student will be able to	
CO-1	Understand the structure, reproduction, and life cycles of Pteridophytes and Gymnosperms.
CO-2	Explain fossil formation, types, and their significance in the study of plant evolution.
CO-3	Analyze anatomical adaptations and anomalous secondary growth in stems and roots.
CO-4	Apply statistical methods to interpret biological data and draw meaningful conclusions.
CO-5	Evaluate the economic importance and ecological roles of lower vascular plants.
CO-6	Understand the structure, reproduction, and life cycles of Pteridophytes and Gymnosperms.

Unit I: PTERIDOPHYTES & FOSSILS (15L)

1. Structure, Reproduction and Life History (excluding development):
   a) LYCOPSIDA: *Isoetes*
   b) PTEROPSIDA: *Marsilea*
2. Apospory and Apogamy
3. Economic importance of Pteridophytes.

Pteridophyte Fossils:

4. Palaeobotany: Fossils & Pseudo fossils, fossilisation & theory of fossilisation, types of fossils.
5. Psilophytales: General Characters: *Rhynia*
6. Lepidodendrales: General Characters: *Lepidodendron* and *Lepidocarpon*

Unit II: Gymnosperms & Fossils (15L)

1. Morphology, anatomy, reproduction, and life history:
   a. GINKGOALES: Ginkgo
   b. GNETALES: *Gnetum*
2. Indian contribution to Gymnosperms.

Gymnosperm Fossils:

3. Geological Time Scale
4. Bennettitales: Spore-bearing organs
5. Cordaitales: *Cordaites, Cordaitanthus*
6. Pentoxylales (general account)

Unit III: ANATOMY (15L)

1. Anomalous secondary growth: Abnormal behaviour of normal cambium, Eg, *Achyranthes* and *Mirabilis* stem.
2. Accessory cambium formation and its activity. E.g., *Bougainvillaea* and *Boerhaavia* stems
3. Abnormal secondary growth in fleshy roots. E.g., Carrot, Raphanus, and Beet root
4. Nodal Anatomy: -
   a. Unilacunar, Trilacunar, Multilacunar.

b. Leaf Trace and Leaf Gaps
c. Branch trace and Branch gaps

Unit II: BIOSTATISTICS (15L)

1. Introduction to Biostatistics – Scope and applications in Botany.
2. Methods of data collection and their graphical representation.
3. **Types of Data in Biology – Qualitative vs. Quantitative, Primary Vs Secondary.**
4. **Sampling methods (Random & Non-random sampling methods)**
5. Measures of Central Tendency – Mean, Median, Mode.
6. Measures of Dispersion – Range, Mean deviation, standard deviation, std error, Student's t-test, chi-square test.
7. **Correlations**.

Reference Books:

- Kar, Ashok Kumar; Gangulee, Hirendra Chandra; *College Botany*: Volume II; 2nd edition; Kolkata: New Central Book Agency (P) Ltd , 1989, 2006.
- 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.
- Sporne, K.K. 1991. *The Morphology of Pteridophytes.* B.I. Publishing Pvt. Ltd. Bombay,1991.
- Vashishta, B.R. 1983. *Botany for degree student- Pteridophyta*, S. Chand Pub, New Delhi,1983.
- Bhatnagar, S.P. and Moitra, A; *Gymnosperms*; New Delhi: New Age International Pvt.Ltd.,1996.
- Chamberlain, Charles Joseph; Coulter, John Merle; *Morphology of Gymnosperms*; 2nd edition;Allahabad: Central Book Depot , 1964.
- Chamberlain, Charles Joseph; *Gymnosperms: structure and evolution*; 2nd edition; New-York: Dover Publications, Inc , 1966.
- Chopra G.L., Nagin S.; *Gymnosperms*; Jullundhar: S. Nagin& Co., 1978.
- Coulter, J.M. & Chamberlain, C.J; *Morphology of Gymnosperms*; Allahabad: Central Book Depot,1978.
- Vashishta, P.C; *Botany for degree students- Gymnosperms*; New Delhi: S. Chand Publications,1983.
- Vashishta, P.C;. *Gymnosperms*; New Delhi: S. Chand Publications, 1983.
- Eames, Arthur J.; Mac Daniels, Laurence H.; *An introduction to Plant Anatomy*; 2nd edition. Reprint; New Delhi: Tata McGraw-Hill Publishing Company Limited, (1978, 2004).
- Esau, Katherine; *Anatomy of seed plants*; 2nd edition; New York: John Wiley & Sons, 1977.
- Fahn, A; *Plant anatomy*; 4th edition. Indian reprint; New Delhi: Aditya Books (P)Ltd., 1990(1997).
- Tayal M.S.; *Plant Anatomy*; Rastogi publications, 1983.
- Mahajan, B.K.; Methods in Biostatistics; 6th edition; New Delhi : Jaypee Brothers, 1997.
- Rastogi, Veer Bala.; Fundamentals of Biostatistics; 2nd edition, reprint; New Delhi : Ane

Books India, 2006(2008).

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 – VI of the following departments under the Faculty of Science, based on Under Undergraduate Curriculum Framework - 2023, to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

BSc. (Hons.) Botany

Major Course – II: Advanced Botany -V

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		
Advanced Botany V (BOMC662C)	4	0	0	10 + 2 from a recognized board in any stream	Basic Knowledge of Biology and familiarity with scientific terminology

LEARNING OBJECTIVES (LO)	
LO-1	To define key principles and concepts of plant taxonomy and their importance in classification.
LO-2	To differentiate between Hutchinson's and APG systems based on their outlines, merits, and demerits.
LO-3	To recognize the functions and contributions of the Botanical Survey of India (BSI) in plant exploration and conservation.
LO-4	To identify and use different sources of taxonomic literature such as floras, monographs, dictionaries, and journals.
LO-5	To explain methods used in ethnobotanical research and their relevance in studying human–plant relationships.

LO-6	Describe ethnobotanical uses of selected tribal plants of Gujarat — *Achyranthes aspera*, *Asparagus racemosus*, *Ficus religiosa*, and *Jatropha gossypifolia* and discuss the role of mythology and sacred groves in the conservation of ecosystems.

Course OUTCOMES (CO)

On Completion of this course, the student will be able to	
CO-1	Explain the fundamental principles of plant taxonomy and compare various systems of classification including Hutchinson and APG systems.
CO-2	Evaluate the merits and demerits of modern and traditional classification systems in understanding angiosperm diversity
CO-3	Describe the role of the Botanical Survey of India (BSI) in taxonomy and biodiversity conservation.
CO-4	Utilize taxonomic literature such as floras, monographs, and journals for plant identification and documentation.
CO-5	Apply ethnobotanical methods to study traditional plant uses, with special reference to sacred groves and tribal plants of Gujarat.

Unit I: SYSTEMATIC BOTANY & ETHNOBOTANY (15L)

Systematic Botany

1. Principles of taxonomy, merits and demerits of the system of classification of Hutchinson.
2. Outline, merits, and demerits of the system of classification of the Angiosperm Phylogeny Group system (APG).
3. BSI: its role in conservation of biodiversity.
4. Taxonomic literature - Floras, Monographs, Dictionary, Periodicals, Index, and Journals.

Ethnobotany:

5. Methods of Ethnobotanical Research.
6. Mythology and conservation of ecosystems, sacred groves.
7. Plants used by tribes of Gujarat:
   a. *Achyranthes aspera*
   b. *Asparagus racemosus*
   c. *Ficus religiosa*
   d. *Jatropa gossypifolia*

Unit II: ANGIOSPERMS (15L)

Classification as per Bentham and Hooker, with economic importance

DICOTYLEDONS:

Polypetalae: Menispermaceae, Meliaceae, Anacardiaceae, Umbelliferae.

Gamopetalae: Sapotaceae, Verbenaceae, Asteraceae

Apetalae: Moraceae, Polygonaceae

MONOCOTYLEDONS: Cannaceae, Orchidaceae

Unit III: PLANT PHYSIOLOGY & BIOINFORMATICS (15L)

Plant Physiology:

1. Plant Growth Regulators: -Discovery, Chemical nature (Basic structure), Biosynthesis. Physiological functions and commercial applications of:-
   (a.) Auxins, (b.) Gibberellins (c.) Cytokinin's (d.) Abscisic acid, (e.) Ethylene

2. Stress Physiology: i) Light stress – Injury and Resistance in plants,
   ii) Temperature Stress – Injury and Resistance in Plants

3. Translocation of organic Solutes:-
   a. Composition of phloem sap
   b. Girdling Experiments
   c. Pressure flow model
   d. Phloem loading and uploading
   e. Significance of translocation
   f. Factors affecting translocation

Bioinformatics:

4. Introduction to bioinformatics and its applications.

Unit IV: PLANT BREEDING (15L)

1. Aims, objectives and impacts of plant breeding.
2. Procedure of plant introduction; merits and demerits of plant introduction.
3. Selection methods: Mass selection, Pure line selection, and Progeny selection.
4. Techniques of hybridisation: emasculation, bagging, tagging, pollination and the procedure of selfing. Hybridisation methods of plant breeding.
5. Self-pollinated plants: Pedigree method, Bulk method of breeding, Back cross method.
6. Cross-pollinated crops: Steps in producing hybrid maize, simple and reciprocal recurrent selection, and synthetic varieties.
7. Vegetatively propagated crops.

Reference Books:

- Lawrence, George H.M.; *Taxonomy of Vascular Plants*; 1st edition; New Delhi: Oxford& IBH Publishing Co., 1967.
- Raghavan, V.; *Developmental Biology of Flowering plants*; New York: Springer - Verlag,1999.
- 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.
- Trivedi, P.C; *Ethnobotany*; Jaipur: Aavishkar Publishers.
- Jain, S.K.; *Manual of Ethnobotany;* Jodhpur: Scientific Publication.
- 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.
- Noggle, Ray G.; Fritz, George J.; *Introductory Plant Physiology*; 2nd edition; New Delhi:Prentice-Hall Of India Private Limited, 1991.
- Salisbury, Frank B; Ross, Cleon W.; *Plant Physiology*; 3rd edition, Reprint; New Delhi : CBS Publishers & Distributors, 1986(2001).
- Salisbury, Frank B.; Parke, Robert V.; *Vascular plants: form and function*; London:Macmillan & Co Ltd, 1964.
- Sinha, B.K; Pandey, S.N.; *Plant Physiology*; 1st edition; New Delhi: Vikas PublishingHouse Pvt. Ltd. , 1981.
- Sinha, R.K.; *Modern plant physiology*; 2nd edition; New Delhi: Narosa Publishing House ,2004.
- Verma S. K. *Textbook of Plant Physiology and Biochemistry*; 4th edition; S. Chand &Company Ltd, 2003.
- Verma, V.; *Textbook of Plant Physiology*; New Delhi: Ane Books India, 2007.
- Witham, F.H., Delvin, R.M; *Plant Physiology*; Boston, MA: Willard Grant, 1983.
- Ignacimuthu, S.; Basic bioinformatics; 4th edition; New Delhi: Narosa Publishing House ,2005.
- Kar Dipak Kumar; Halder Soma; *Plant Breeding and Biometry*; 1st edition; Kolkata:New Central Book Agency y (P) Ltd., 2006.
- Singh B.D; *Plant Breeding Principles and Methods*; 1st edition; Ludhiana: KalyaniPublishers, 2001.

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%).

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Syllabus of Semester – VI of the following departments under the Faculty of Science based on Under Graduate Curriculum Framework - 2023, to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

BSc. (Hons.) Botany

Major Course – III: ADVANCED BOTANY PRACTICALS-II

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		
Advanced Botany Practicals - II (BOMC663L)	0	0	04	10 + 2 from a recognized board in any stream	Basic Knowledge of Biology, identification, observation, and analytical skills

LEARNING OBJECTIVES (LO)	
LO-1	To prepare, observe, and identify specimens of *Isoetes*, *Marsilea*, *Ginkgo*, and *Gnetum* along with related fossil materials (*Rhynia*, *Lepidodendron*, *Cordaites*, *Pentoxylon*).
LO-2	To interpret structures of reproductive organs and fossil slides to understand evolutionary and systematic relationships.
LO-3	To perform and record anatomical studies on stems and roots exhibiting normal and abnormal secondary growth using proper laboratory techniques.
LO-4	To solve biostatistical problems involving measures of central tendency, dispersion, and correlation relevant to botanical data.
LO-5	To conduct physiological experiments on photosynthesis, enzyme activity, and stress responses, and analyze results quantitatively using appropriate methods.

LO-6	To prepare permanent slides, herbarium sheets, and charts related to systematics, ethnobotany, and plant breeding, demonstrating applied botanical skills.

Course OUTCOMES (CO)

On Completion of this course, the student will be able to	
CO-1	Identify and classify representative genera of Pteridophytes and Gymnosperms through fresh, preserved, and fossil specimens.
CO-2	Examine and describe vegetative and reproductive structures of living and fossil plant materials using microscopic and slide-based study.
CO-3	Analyze anatomical details, including types of nodal anatomy and anomalous secondary growth, through double staining and microscopic techniques.
CO-4	Apply statistical tools to solve biostatistical problems and interpret biological data.
CO-5	Demonstrate experimental skills in plant physiology, including photosynthesis, respiration, and stress physiology.
CO-6	Explain and illustrate plant breeding and ethnobotanical principles through charts, specimens, and herbarium work, integrating theoretical understanding with practical application.

PRACTICAL PART A

UNIT I: PTERIDOPHYTES & FOSSILS:

i) Study of types through fresh preserved material and permanent slides.

a) Identify and classify the following types:

PTERIDOPHYTA: *Isoetes*, *Marsilea*.

b) Structure and Reproductive Organs:

PTERIDOPHYTA:

1. *Isoetes*: Sporophyll
2. *Marsilea*: Sporocarp

ii) The following Fossil Specimens and/or slides should be studied.

Pteridophytes Fossils:

1. **PSILOPHYTALES**: *Rhynia*: Stem T.S
2. **LEPIDODENDRALES**: *Lepidodendron*: Stem T.S.; *Lepidocarpon*: V.S.Seeds

UNIT II: GYMNOSPERMS & FOSSILS

i) Study of types through fresh preserved material and permanent slides.

a.) Identify and classify the following types:

GYMNOSPERMS: *Ginkgo*, *Gnetum*

b.) Structure and Reproductive Organs:

GYMNOSPERMS: *Ginkgo* & *Gnetum:* Male & female Cone, P.S, L.S. of Seed, and Leaf.

ii) Fossil Gymnosperms:

The following Fossil Specimens and / or slides should be studied.

1. **BENNETTITALES**: Spore-bearing organ
2. **CORDAITALES**: *Cordaites*: Stem T.S; *Cordianthus* – L.S of Cone.
3. **PENTOXYLALES**: T.S. of Stem

UNIT III: ANATOMY:

a.) Study of abnormal secondary growth through fresh materials through the double stain technique:

1. *Achyranthes* stem
2. *Bougainvillaea* stem
3. *Mirabilis* stem
4. *Boerhavia* stem
5. Carrot root
6. *Raphanus* root
7. Beet root

(b.) Study of Nodal anatomy as per the syllabus through charts.

a. Unilacunar, Trilacunar, Multilacunar.
b. Leaf Trace and Leaf Gaps
c. Branch trace and Branch gaps

UNIT IV: BIOSTATISTICS

Study of Biostatistics problems as per the syllabus.

PRACTICAL PART B

UNIT I: SYSTEMATIC BOTANY & ETHNOBOTANY

ETHNOBOTANY: Ethnobotanical specimens as prescribed in the theory syllabus.

UNIT II: ANGIOSPERMS

ANGIOSPERMS: Study of families as per the theory syllabus, including floral formula and floral diagram

UNIT III: PLANT PHYSIOLOGY & BIOINFORMATICS

A) MAJOR EXPERIMENTS:

1. To study the rate of photosynthesis under different intensity of light.
2. To study the rate of photosynthesis under the different wavelengths of light.
3. To study the rate of photosynthesis under different concentrations of CO_2.

4. Estimation of chlorophyll pigments using Spectrophotometer (Arnold's method).

B) MINOR EXPERIMENTS:

1. To study stomatal closure under the effect of ABA.
2. To study the effect of Temperature stress on cell membrane stability.
3. Preparation of the Standard curve of Glucose by Spectroscopic method. (Nelson-Somogyi Method, 1944)
4. Preparation of the Standard curve of Starch Glucose by Spectroscopic method. (Chinoy, J.J Method, 1939)
5. Demonstration**:** Girdling Movements in Plants.
6. Demonstration of respiratory enzymes in plant tissues:
   - Polyphenol Oxidase
   - Dehydrogenase
7. Preparation of solutions: Molar, Molal, Normal, % concentration.

UNIT IV: PLANT BREEDING

(a.) PLANT BREEDING: Charts as per the theory syllabus.

a) Hybridisation techniques
b) Mass selection method
c) Pure Line selection method
d) Pedigree method
e) Study bulk method

PROJECT:

Students will be submitting a **Permanent Slide** (2 stems and 2 roots from the syllabus) and **Herbarium** as per the syllabus. The evaluation will include a viva during practicals.

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**	

St. Xavier's College (Autonomous), Ahmedabad

Syllabus of Semester – VI of the following departments under the Faculty of Science, based on Under Undergraduate Curriculum Framework - 2023, to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

BSc. (Hons.) Botany

Subject Specific Minor: Molecular Biology, Biotechnology & Traditional Medicine

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		
Molecular Biology, Biotechnology & Traditional Medicine (BOMN661C)	4	0	0	10 + 2 from a recognized board in any stream	Basic Knowledge of Biology, identification, observation, and analytical skills

LEARNING OBJECTIVES (LO)	
LO-1	To discuss the structure, function, and sequencing of DNA and interpret gene mapping techniques in molecular biology.
LO-2	To identify potential biohazards associated with recombinant DNA technology and outline preventive biosafety measures.
LO-3	To explain applications of biotechnology in producing human insulin, vaccines, gene therapy, and pollution control strategies.
LO-4	To describe techniques of gene transfer in plants, including Agrobacterium-mediated transformation and particle gun methods.
LO-5	To illustrate the principles of Ayurveda such as Panchamahabhuta, Tridosha, Rutucharya, and their relation to human physiology.

LO-6	To recognize and classify common medicinal plants and Ayurvedic formulations used in the treatment of major human diseases.
Course OUTCOMES (CO)	
On Completion of this course, the student will be able to	
CO-1	Explain the principles and applications of gene mapping, DNA sequencing, and molecular genomics including organelle genomes.
CO-2	Evaluate the ethical and biohazard aspects of recombinant DNA technology and modern molecular techniques.
CO-3	Apply biotechnological methods in health, agriculture, and environmental management, including gene transfer and transgenic plant production.
CO-4	Demonstrate understanding of nano-biotechnology, artificial seeds, cryopreservation, and germplasm storage as modern conservation tools.
CO-5	Describe the foundations of Ayurveda, Yoga, Naturopathy, and other traditional systems, emphasizing their biological and medicinal relevance.
CO-6	Assess Ayurvedic principles of health, immunity, and diet, and identify medicinal plants and formulations used for major diseases.

UNIT I: Molecular Biology (15L)

1. General account and techniques of gene mapping
2. DNA sequencing.
3. Biohazards of Recombinant DNA Technology.
4. Mitochondria and Chloroplast genomes.
5. DNA Barcoding: General account and applications

UNIT II: Biotechnology (15L)

1. Application of Biotechnology in health and agriculture: Human insulin and vaccine production, gene therapy, and Pollution Control.
2. Artificial Seeds from plant samples.
3. Methods of gene transfer in plants: Micro injection, Electroporation, particle gun, and Agrobacterium-mediated gene transfer.
4. Transgenic Plants with Improved: Protein Storage, Attractive flowers, High rate photosynthesis, Engineering for Preservation of Fruits, Bioreactors and advantages.
5. Cryopreservation and Germplasm Storage.
6. Nano Biotechnology: definition, concept and applications.

Unit – III: Traditional Indian Systems of Medicine.

1. Definition and scope of Ayurveda
2. Contribution of Charak and Sushruta.
3. Panchamahabhutas and Saptadhatu.
4. Introduction to YOGA and Naturopathy, Homoeopathy, Vrikshayurveda.

Unit – IV: Health, Immunity and Ayurveda:

1. Rutucharya and Dincharya and their Significance in Human Health.
2. Virrudh Aahar and its importance in Human health.
3. Introduction to Panchkarma, its procedure and Importance in Human health.
4. Tridosh concepts in Ayurveda.
5. Plants used for the treatment of cardiac diseases, infertility, diabetes, blood pressure, cancer and skin diseases.
6. Common Ayurvedic formulations and their Pros and Cons. (Solid Forms: Churmna; Vati, Semi Solid: Avaleha, Liquid: Swarasa, Asava, Taila; Kwatha)

Suggested Reading:

- Arumugam, N.; Narayanan, L. M. and Mani, A.; *Molecular Biology and Genetic Engineering,* 1st Reprint; Nagercoil: Saras Publication, 2008.
- Satyanarayana U.; *Biotechnology*; Kolkata: Books and Allied (P) Ltd, 2005.
- Gupta P.K.; *Elements of Biotechnology*; Meerut: Rastogi Publications, 2009.
- S.K. Bhattacharjee; *Handbook of Medicinal and Aromatic Plants,* India, 2004.
- A.K. Sharma; *Recent Progress in Medicinal Plants* Vol.12, Globalisation of Herbal Health, 2006.
- L.D. Kapoor; *Handbook of Ayurvedic Medicinal Plants*, Boca Raton 2005.
- K.R. Kirtikar and B.D. Basu; *Indian Medicinal Plants* (Vol 1- 4), Allahabad, 2006.
- V.V. Sivarajan & Balachandran; *Ayurvedic Drugs and their Plant Sources*, Oxford; IBH, 1994.
- Godagama, Bishen Singh Mahendrpal Singh; *The Handbook of Ayurveda Shantha*, Dehradun, 2004**.**
- Abdin, M.Z. and Y.P. Abrol, Y.P.; *Traditional Systems of Medicine*; Narosa Publishing House,New Delhi, 2006.
- Trivedi, P.C., *Medicinal Plants Traditional Knowledge*. New Delhi, Delhi: I.K. InternationalPublishing House Pvt. Ltd., 2006.
- Trivedi, P.C., *Medicinal Plants. Utilization and Conservation*. Jaipur, Rajasthan: Aavishkar Publishers., 2009.

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.

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Evaluation will be divided in two parts.

ASSESSMENT	MARKS
INTERNAL	
Attendance	**05**
Assignments	**05**
Continuous Internal Assessment I and II	**15**
TOTAL	**25 marks**
EXTERNAL	
End Semester Exam	**25 marks**

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

St. Xavier's College (Autonomous), Ahmedabad

Syllabus of Semester – VI of the following departments under the Faculty of Science based on Under Graduate Curriculum Framework - 2023, to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

BSc. (Hons.) Botany

Internship –: Botany Internship

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		
Botany Internship (BOIN661C)	0	0	04	10 + 2 from a recognized board in any stream	Basic Knowledge of Biology, identification, observation, and analytical skills

LEARNING OBJECTIVES (LO)	
LO-1	Students will be able to independently perform standard field and laboratory techniques, including plant collection, preservation and microscopic observation.
LO-2	Students will correctly identify selected plant species using botanical keys and prepare well-organized herbarium specimens.
LO-3	Students will collect ecological data from natural habitats and analyze basic parameters such as diversity indices and phenological patterns.
LO-4	Students will design and execute a mini-research task during the internship, employing appropriate scientific methods.
LO-5	Students will prepare and present a scientifically structured internship report with proper data interpretation.
LO-6	Students will demonstrate ethical practices, teamwork, safety and professionalism during internship work.

Course OUTCOMES (CO)	
On Completion of this course, the student will be able to	
CO-1	**(Field & Lab Techniques):** Perform and document standard field, herbarium and laboratory techniques used in plant collection, preservation, microscopy and basic biochemical assays.
CO-2	**(Identification & Taxonomy):** Identify local flora to species level using keys and prepare a correctly labeled herbarium and species checklist.
CO-3	**(Ecology & Data Collection):** Collect, record and analyze ecological and phenological data (quadrats, transects, diversity indices, soil and microclimate observations).
CO-4	**(Research & Problem Solving):** Design a mini-research task during the internship, formulate objectives, apply appropriate methods and draw evidence-based conclusions.
CO-5	**(Communication & Reporting):** Prepare a professionally written internship report and deliver an oral/visual presentation summarising methods, results, interpretation and recommendations.
CO-6	**(Professionalism, Ethics & Career Readiness):** Demonstrate safe practice, ethical handling of biological materials, teamwork and reflect on career pathways and employability skills gained.

The Botany Internship is a 4-credit course requiring a minimum of **120 hours** of work as an intern in an approved area. It is mandatory for degree completion after three years and must focus on the student's field of study or an academically relevant area. Students must complete the internship before seeking exit after the sixth semester and before enrolling in the seventh semester.

The Botany Internship follows a structured workflow involving the HOD, Professor in charge, Internship Provider, Evaluation Committee, and the Student.
The HOD oversees the administrative aspects of the internship, including approval of student placements, communication of institutional guidelines, and verification of completion in harmony with the Prof.-In-Charge. The Professor In-Charge provides academic supervision by guiding the student in selecting suitable internship opportunities, preparing work plans, and maintaining academic standards. The Internship providing Organisation delivers practical training and submits feedback. The Evaluation Committee assesses the student's report, presentation, and performance. The student remains the central participant, completing assigned tasks and submitting all required documents. Students are required to maintain a daily logbook, follow institutional and organisational rules, and submit a certified completion report. Assessment will be based on the internship report, presentation/viva-voce, and feedback from the hosting organisation.

Possible Internship Areas:

- Research organisation/institute
- Industry
- Professional organisation related to students' area of specialisation
- Organisation not related to area of specialisation
- NGOs
- Government organisation
- Startup ventures
- Teaching internship

- Research internship
- Online internship

Students can also enrolled:
Internships offered through Central/State Govt. portals for offering internship/apprenticeship/skill development/training programmes shall also be considered as equivalent to internship courses.
Example: PM internship scheme https://pminternship.mca.gov.in/login/, internshala, lets intern, Killer launch, Hello Intern. Etc.

EVALUATION*:*

The evaluation will be divided into two parts.

Sr. No.	Continuous Internal Evaluation	Marks	End-of-Semester Evaluation	Marks
1	Activity log-book	10	Report	15
2	Synopsis of Internship	15	Presentation	10
3	Interim work presentation	10	Viva voce	10
4	Viva voce	15	Evaluation by Mentor (External person)	15
	Subtotal	**50**	**Subtotal**	**50**