

# **ST. XAVIER'S COLLEGE (AUTONOMOUS)**

## **AHMEDABAD**

### **Choice based credit system**

### **Botany SYLLABUS**

(Semester V-VI)



**(EFFECTIVE FROM JUNE 2021)**

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**BOTANY**  
**Choice Based Credit System (CBCS) Theory syllabus**

**PROGRAMME SPECIFIC OUTCOMES**

**PSO1: Knowledge:** Understanding the nature and basic concepts of all the plant groups, their morphology, anatomy, taxonomy, physiology, biochemistry, genetics, components at the molecular level, 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 the 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, team work 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 enquiry.

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY I**  
**[ALGAE, FUNGI, BRYOPHYTES, PTERIDOPHYTES]**  
**[BO- 5501]**  
**Choice Based Credit System (CBCS) Theory syllabus**  
**Effective from June-2021**

**Semester V**

**Paper: ADVANCED BOTANY-I [ALGAE, FUNGI, BRYOPHYTES, PTERIDOPHYTES]**

**Course Code: BO- 5501**

**Total Credits: 04**

**Total teaching hours: 60**

**COURSE OUTCOMES (CO)**

On Completion of this course, the Student will be able to-

**CO1:** Differentiate between various groups of Algae and know their role in human welfare as well as understand the lifecycles of selected groups.

**CO2:** Know about the classification, occurrence and distribution and will understand the structure, reproduction and life histories of selected Fungi.

**CO3:** Gain knowledge on mushroom cultivation and will understand the evolution of the Sporophyte in Bryophytes.

**CO4:** Distinguish various bryophytes and learn about their life cycles and know about the adaptive features of Bryophytes as land plants.

**CO5:** Classify Pteridophytes based on Reimer's classification and will understand the evolution, structure, reproduction and life history of the selected Pteridophyte groups.

**Unit I: ALGAE**

**1. Outline Classification system of G M Smith (1955) with Salient features of Divisions.**

2. Structure, Reproduction (excluding development) and life history:

- a. CYANOPHYTA: Scytonema, Nostoc
- b. CHLOROPHYTA: Chara, Chlamydomonas
- c. PHAEOPHYTA: Sargassum,
- d. RHODOPHYTA: Polysiphonia
- e. CHRYSOPHYTA: Diatoms (Bacillariophyceae)
- f. **Role of Algae in Agriculture (Algal Bio fertilizers) and Medicine.**

**3. Algal Toxins, Algal species as Indicators of Industrial Wastes.**

**Unit II: FUNGI**

1. Occurrence, Distribution, Structure, Reproduction, utilization and life history (excluding development):
  - a. MASTIGOMYCOTINA: Phytophthora
  - b. ASCOMYCOTINA: Aspergillus (Eurotium)
  - c. BASIDIOMYCOTINA: Agaricus
  - d. MIXOMYCOTINA: General account
2. **Classification of G.C. Ainsworths.(1966,1971,1973)**
3. **Outline Classification of Alexopolus and C.W. Mims (1979).**
4. **Mycotoxins,**
5. **Mucormycosis**
6. General Account of Mushroom cultivation

**Unit III: BRYOPHYTA**

1. Adaptation in Bryophytes and land plants
2. **Comparative account of morphology, reproduction and adaptation in Marchantia, Anthoceros and Funaria.**
3. Evolution of Sporophyte.
4. Structure, Reproduction and life history (excluding development):
  - a. HEPATICOSPODIA: Marchantia
  - b. ANTHOCEROTOPSIDA: Anthoceros
  - c. BRYOPSISIDA: **Sphagnum**
5. **Vegetative reproduction in Bryophytes.**
6. **Bryophyte Ecology and Bryo-Cenology.**

**Unit IV: PTERIDOPHYTES**

1. Classification of Pteridophytes by Reimer (1954).
2. Structure, Reproduction and life history (excluding development):
  - a. PSILOTOPSISIDA: Psilotum
  - b. SPHENOPSISIDA: Equisetum
3. **Origin and Evolution of Pteridophytes.**

**Reference Books:**

- Smith, Gilbert M; *Cryptogamic Botany Algae & Fungi* Volume 1; 2nd edition; McGraw-hill Book Comp. Tokyo, 1955.
- Vasishtha B.R. And Sinha A. K. - *Botany for degree students Part 1 ALGAE*; S. Chand & Company Ltd, 1st edition, revised 2005.
- Vasishtha B.R. And Sinha A. K. - *Botany for degree students Part 2 FUNGI*; S. Chand

& Company Ltd, 1st edition, revised 2005.

- Ainsworth, G.C.; Bisby, G.R.; Kirk, P.M. (ed.); *Ainsworth & Bisby's Dictionary of the Fungi*, 10th edition; CABI Publishing: 2008.
- Alexopoulos, Constantine J.; Mims, Charles W; *Introductory Mycology*; 3rd edition; New Delhi: Wiley Eastern Limited, 1983.
- Webster, J; *Introduction to Fungi*; Cambridge University Press, 1985.
- Smith, Gilbert M; *Cryptogamic Botany Bryophyta & Pteridophyta* Volume 2; 2nd edition; McGraw-hill book Comp. Tokyo, 1955.
- 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.
- Sharma, O.P. 2012; *Pteridophyta*; Tata McGraw Hill Education Pvt. Ltd. New Delhi.
- Singh V., Pande P.C., Jain D.K.; *A Textbook of Botany*, 4<sup>th</sup> Edition; Rastogi publications, 2013.
- Sporne, K.K. 1991. *The Morphology of Pteridophytes*. B.I. Publishing Pvt. Ltd. Bombay.

#### EVALUATION [10 marks CIA]

5 marks	Test, quiz, multiple choice, etc	1 hour
5 marks	Students will do a survey of internet websites for Algae/Fungi/Bryophytes/ Pteridophytes. Based on this they will prepare an assignment on any one of the above topics: Points for evaluation: Presentation (20%) + Content (20%) + Choice of topic (10%) + Illustrations (20%) + Referencing (10%) + Overall impression (20%).	

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY-II**  
**[SYSTEMATIC BOTANY, ANGIOSPERMS, EMBRYOLOGY AND ANATOMY]**  
**[BO- 5502]**  
**Choice Based Credit System (CBCS) Theory syllabus**  
**Effective from June-2021**

**Semester – V**

**Paper name: ADVANCED BOTANY-II [SYSTEMATIC BOTANY, ANGIOSPERMS, EMBRYOLOGY AND ANATOMY]**

**Course Code: BO- 5502**

**Total Credits: 04**

**Total teaching hours: 60**

**COURSE OUTCOMES (CO)**

On Completion of this course, the student will be able to-

**CO1:** Comprehend the principles and rules of ICBN and will gain knowledge on Engler and Prantle's system of classification.

**CO2:** Gain Knowledge on Plant nomenclature, **E-Flora and E-Herbarium** and will understand herbarium techniques and botanical keys as also appreciate the role of Herbaria and Botanical gardens.

**CO3:** Describe the morphology, classification, distinctive features and economic importance of selected Angiosperm families.

**CO4:** Understand the concepts of Apomixis, Polyembryony and Sexual incompatibility and will learn about the different types of endosperms and their functions.

**CO5:** Learn about secretory and absorbing tissue systems and along with it they will know about mineral crystals deposited in plant cells and understand the phenomenon of leaf fall.

**CO6:** Study about Applied Plant Anatomy and Embryology and understand about Root – stem transition.

**Unit I: SYSTEMATIC BOTANY**

1. Principles of taxonomy, merits and demerits of systems of classification of Engler and Prantle.

2. Plant nomenclature: ICBN. Principles and Rules. Effective and Valid publication, Rule of Priority and its typification, author citation, rejection and retention of names.

3. Herbarium techniques: Plant collection and preparation of Herbarium (of all groups of plants).
4. Herbaria and Botanical Gardens: History, role and major Herbaria and Botanical gardens of the world.
5. Plant Identification: characters considered before plant identification, methods; botanical keys: construction of dichotomous keys – Indented and bracketed keys.
6. E-Flora and E-Herbarium.

## Unit II: ANGIOSPERMS

Classification as per Bentham and Hooker with economic importance

### 1. DICOTYLEDONS:

- a. Polypetalae: Capparidaceae, Sterculiaceae, Rhamnaceae, Combretaceae.
- b. Gamopetalae: Asclepiadaceae, Boraginaceae, Bignoniaceae
- c. Apetalae: Amaranthaceae, Chenopodiaceae

### 2. MONOCOTYLEDONS: Commelinaceae, Cyperaceae

## Unit III: EMBRYOLOGY

1. Sexual incompatibility: Causes, Types and Significance.
2. Endosperm: Types: free nuclear, cellular, helobial, ruminant; functions of endosperm.
3. Polyembryony: causes, types and significance.
4. Apomixis: definition, types and significance.
5. Role of Embryology in Taxonomy.

## Unit IV: ANATOMY

1. Secretory tissue system (excluding Laticiferous)
2. Absorbing tissue system.
3. Waste Material: Mineral crystals-
  - a. Calcium oxalate- prismatic raphides, spheraphides
  - b. Calcium carbonate- Cystolith.
4. Leaf – fall.
5. Root – stem transition.
6. Applied Plant Anatomy: Anatomy related to Taxonomy.

### Reference Books:

- 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.

- Singh, V; *Taxonomy*. Rastogi Publication, Meerut; 2010.
- Singh, G.; *Plant Systematics- Theory and Practice*; New Delhi: Oxford and IBHPublishing Co. Pvt. Ltd, 1999.
- Subramanian, N.S.; *Modern plant taxonomy*; New Delhi : 1st edition; Vikas Publishing House Pvt. Ltd. , 1995.
- Verma B.K. *Introduction to Taxonomy of angiosperms*. New Delhi:PHI Learning Pvt. Ltd., 2011.
- Bhojwani, S.S.;Bhatnagar, S.P.; *The embryology of angiosperms*; revised edition; Delhi : Vikas Publishing House Pvt. Ltd. , 1996.
- Maheshwari, P.; *Introduction to the embryology of angiosperms*; 2nd edition, reprint; New Delhi : Tata Mcgraw-Hill Publishing Company Limited , 1971.
- Eames, Arthur J.;MacDaniels, Laurence H.; *An introduction to plant anatomy*; 2ndedition. 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).
- Gangulee, Das, and Dutta – College Botany Vol I.
- Tayal M.S.; *Plant Anatomy*; Rastogi publications, 1983.
- Dutta, A.C.; *A Class-book of Botany*; 15th edition; Calcutta: Oxford University Press,1976.

#### EVALUATION [10 marks CIA]

5 marks	Test, quiz, multiple choice, multiple choice, etc	1 hour
5 marks	Students will attend a Workshop where relevant issues related to botanical problems/challenges will be presented. They will then choose a problem to work with in groups. Points for evaluation: Presentation (20%) + Content (20%) + Choice of topic (20%) + Illustrations (20%) + Overall impression (20%).	



**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY-III**  
**[PLANT PHYSIOLOGY, BIOCHEMISTRY, CELL BIOLOGY, GENETICS]**  
**[BO- 5503]**  
**Choice Based Credit System (CBCS) Theory syllabus**  
**Effective from June-2021**

**Semester – V**

**Paper name: ADVANCED BOTANY-III [PLANT PHYSIOLOGY, BIOCHEMISTRY, CELL BIOLOGY, GENETICS]**

**Course Code: BO- 5503 Total**

**Credits: 4**

**Total teaching hours: 60**

**COURSE OUTCOMES (CO)**

On Completion of this course, the student will be able to-

**CO1:** Understand the concept of R.Q, growth correlations and the basic process of senescence.

**CO2:** Assess seed dormancy and germination in plants and **learn about fruit ripening.**

**CO3:** Classify amino acids, vitamins and proteins and understand their synthesis, structure and types.

**CO4:** Learn about Nitrogen metabolism and Nitrogen fixation and understand the process of lipid metabolism.

**CO5:** Gain Knowledge on Cell science with respect to interaction, differentiation, cell cycle and Programmed Cell Death in plants and understand the structure and morphology of Chromosomes.

**CO6:** Learn about Linkage, crossing over, mutation.

**CO7:** Understand the basics of DNA fingerprinting along with its importance and know about introns and their significance.

**Unit I: PLANT PHYSIOLOGY**

1. Dormancy: Causes of dormancy. Methods of breaking dormancy.
2. Germination: Different phases of germination and Factors affecting germination.
3. Growth correlations.
4. Respiration:
  - a. R.Q.
  - b. Factors affecting respiration.
5. Senescence and aging: Introduction, types of senescence, mechanism, factors affecting senescence.
6. Fruit ripening: molecular basis and manipulation.

**Unit II: BIOCHEMISTRY**

1. Amino acids: Classification, structure, protein and non-protein amino acids
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2. Protein: Classification of protein on the basis of structure
3. Lipids: Synthesis, alpha & Beta -oxidation
4. Nitrogen metabolism and Nitrogen fixation
5. General account of structure and functions of vitamins

### Unit III: CELL BIOLOGY

1. Ultra structure of Chromatin.
2. Cell differentiation
3. Cell-cell interaction
4. Cell Cycle:- Interphase, Mitosis, Meiosis
5. Programmed Cell Death (PCD) in plants.

### Unit IV: GENETICS

1. Linkage: Coupling & Repulsion hypothesis; Linkage groups.
2. Crossing over: Chromosome mapping, three point test cross; interference and coincidence.
3. Gene mutations- Types- somatic/germ line, spontaneous/induced, substitutions-transversion, transition; effect of substitution mutation on phenotype- Missense, Nonsense, Neutral, Silent mutations.
4. DNA damage and repair.
5. Introns and their significance.
6. DNA finger printing and its importance.

#### Reference Books:

- Devlin, Robert M.; Witham, Francis H.; Plant Physiology; 4th edition, Indian reprint; Delhi: CBS Publishers & Distributors, 1986(2001).
- Ganguly A.K., Kumar N.C.; General Botany, Vol II, Part II: Introduction to plant physiology; 7<sup>th</sup> Edition; Emkay Publications, 1990.
- Hans-Walter Heldt., *Plant Biochemistry* – Academic Press. 2004
- 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.; Parke, Robert V.; Vascular plants: form and function; London:Macmillan & Co Ltd, 1964.
- Salisbury, Frank B.; Ross, Cleon W.; Plant physiology; 3rd edition, Reprint; New Delhi :CBS Publishers & Distributors , 1986(2001).
- Sinha, B.K.; Pandey, S.N.; Plant Physiology; 1st edition; New Delhi : Vikas Publishing House 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.
- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D.; Molecular Biology of the Cell. New York: Garland Publishing, Inc..
- Arumugon, N.; *Cell Biology, Genetics, Evolution*. Kanyakumari: Saras Publication.
- De Robertis, E.D.P.; Nowinski, Wiktor W.; Saez, Francisco A.; *Cell Biology*; Philadelphia : W.B. Saunders Company , 1970.

- Gupta, P.K.; *Cytogenetics*; 1st edition, reprint; Meerut : Rastogi Publications , 2004.
- Kleinsmith, L.J. and Kish, V.M.; *Principles of Cell and Molecular Biology*, 2nd Ed., New York, USA: Harper Collins College Publishers, 1995.
- Lewin, B.; *Genes VIII*; New York: Oxford University Press, 2000.
- Powar, C.B; *Genetics*; Vol 1 & 2; Himalaya Publishing House, 2003.
- Russel, P.J; *Genetic*; Harper Collins College, 1992.
- Stent, G.S.; *Molecular Genetics*; San Francisco: W.H. Freeman, 1971.
- Strickberger, M.W.; *Genetics*. New Delhi: PHI Learning Pvt. Ltd., 2008.
- Watson, J.D; T. A. Baker, S. P. Bell, A. Gann, M. Levine, R. Losick; *Molecular Biology of the Gene*, 5th Edition; Pearson Education, 2004.
- Wolfe, S. L.; *Molecular and Cellular Biology*. California, USA: Wadsworth Publishing Co., 1993.

#### EVALUATION [ 10 marks CIA]

5 marks	Test, quiz, multiple choice, etc	1 hour
5 marks	Students will prepare an assignment on any one of the following: Plant Physiology / Biochemistry/ Cell Biology / Genetics. Points for evaluation: Presentation (20%) + Content (20%) + Choice of topic (20%) + Illustrations (20%) + Overall impression (20%).	

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**APPLIED BOTANY-I**  
**[ECOLOGY, HERBAL COSMETOLOGY, ECONOMIC BOTANY, BIostatISTICS]**  
**[BO- 5504]**  
**Choice Based Credit System (CBCS) Theory syllabus**  
**Effective from June-2021**

Semester - V

**Paper name: APPLIED BOTANY-I [ECOLOGY, HERBAL COSMETOLOGY, ECONOMIC BOTANY, BIostatISTICS]**

**Course Code: BO- 5504 Total**

**Credits: 4**

**Total teaching hours: 60hrs**

**COURSE OUTCOMES (CO)**

On Completion of this course, the Student will be able to-

**CO1:** Comprehend the basic concepts of plant communities, succession, plant indicators and Limiting factors and analyze the different methods of studying plant communities.

**CO2:** Understand the importance of plant antioxidants and learn about the application and current status of herbal cosmetics as also about biomagnification and related processes.

**CO3:** Study plants with several economically important uses and will learn domestic preservation methods for pulses and cereals.

**CO4:** Analyze the implications of Biometrics and will learn procedures and methods for collection, interpretation and representation of data.

**Unit I: ECOLOGY**

1. Vegetation development: Causes and types of succession: Mechanism of ecological succession; Changes in ecosystem properties during succession; Hydrosere, Xerosere.

2. Structure of Plant Communities; Methods of studying plant communities: Analytical and Synthetic characters of plant community; Raunkiaer's life forms, Biological Spectrum.

3. Plant community as Plant indicators.

4. Principles of limiting factors.

**5. Biomagnification, Bioaccumulation and Biotransformation.**

**UNIT II: HERBAL COSMETOLOGY**

**1. Plant antioxidants: Free radicals; sources and types; antioxidant defense; superoxide dismutase, catalase, antioxidant vitamins; vitamin C and E. Use of antioxidants in cosmetics.**

**2. Application of herbs in the following herbal cosmetics**

• **Herbal Hair care products**

• **Herbal Skin care products**

• **Herbal Perfumes**

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- **Herbal drinks**
- **Herbal Oral Care**

### 3. Current status of Herbal Cosmetic Industry in India; problems and future prospects.

#### Unit III: ECONOMIC BOTANY

1. Classification based on the economic use of the following plants. Study the binomial, family, morphology of useful part, products and uses.

- FRUITS: Papaya, Banana, Mango
- VEGETABLES: (i) Root:-Carrot  
(ii) Stem:-Potato  
(iii) Leaves:-Cabbage  
(iv) Fruit:-Cucumber
- BEVERAGES: Tea, Coffee.
- FATS and OILS: Sunflower oil, **Palm oil**
- GUMS and RESINS: Gum Arabic, Asafoetida
- INSECTICIDES: Neem, Tobacco
- FUEL: Jatropha, *Pongamia pinnata*
- Essential oil: mint and Citronella**

2. Domestic Preservation methods for Pulses and Cereals.

#### Unit IV: BIOSTATISTICS

1. Biometrics: Aims and objectives as applicable to biological science. Methods of data collection and its graphical representation.

2. Measures of central tendency: Mean, median and mode

3. Measures of Dispersion: Range, mean deviation, standard deviation, standard error and 't' test. Chi square and goodness of fit. Simple Linear regression. Frequency of distribution; Normal, binomial, Poison distribution.

#### Reference Books:

- Miller, G; Tyler; *Textbook of Ecology*, New Delhi: Cengage Learning India, 2009.
- Odum, E.; Barrick M.; Barrett G.; *Fundamentals of Ecology*, 5<sup>th</sup> edition; New Delhi:Cengage Learning India, Pvt. Ltd., 1971.
- Sharma, P.D.; *Ecology and Environment*; 7th edition; Meerut: Rastogi Publishers, 1998.
- Subrahmanyam, N.S.; Sambamurty, A.V.S.S.; *Ecology*; 1st edition; New Delhi: NarosaPublishing House, 2000.
- Burlando Bruno, *Herbal principles in Cosmetics*; CRC Press, Newyork; 2010
- Chattopadhyay P.K., *Herbal Cosemtics and Ayurvedic Medicines*; NIIR Project Consultancy Services; Delhi; 2013.
- H. Panda; *Herbal beauty product*; Asia Pacific Business Press; Delhi; 2005
- Vimaladevi. M, *Textbook of Herbal Cosemtics*; CBS Publishers & Distributors; 2018.
- Hill A.F.; *Economic Botany*, 2<sup>nd</sup> Edition; New York: McGraw -Hill, 1992.
- Sambamurty, A.V.V.S & Subrahmanyam, N.S;. *A Text Book of Economic Botany*. Wiley Eastern Ltd., New Delhi, Bangalore; 1989.
- Kochhar S.L., Elbaum L., Einstein E.; *Economic Botany in the Tropics*; Pan MacMillan,2012.
- Samba MurtyA.V.S.S., Subramanyam N.S.; *Economic Botany of Crop Plants*; Asia techPublishers,

2000.

- Verma V.; Text Book of Economic Botany; Delhi: Ane Books, 2009.
- Mahajan, B.K.; Methods in biostatistics; 6th edition; New Delhi : Jaypee Brothers, 1997.
- Rastogi, Veer Bala.; Fundamentals of Biostatistics; 2nd edition, reprint; New Delhi : AneBooks India , 2006(2008).

**EVALUATION [10 marks CIA]**

5 marks	Test, quiz, multiple choice, etc	1 hour
5 marks	Students will prepare an assignment on any one of the following: Plant Ecology/ Plant Geography/ Economic Botany/ Biostatistics. Points for evaluation: Presentation (20%) + Content (20%) + Choice of topic (20%) + Illustrations (20%) + Overall impression (20%).	

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**Elective Paper: ORGANIC FARMING [BO- 5401]**  
**Choice Based Credit System (CBCS) Theory syllabus**  
**Effective from June-2021**

**Semester – V**

**Elective Paper: ORGANIC FARMING**

**Course Code: BO- 5401**

**Total Credits: 02**

**Learning hours: 30 hrs**

**COURSE OUTCOMES (CO)**

On Completion of this course, the student will be able to-

CO1: Understand the basics concepts of organic farming.

CO2: Learn organic plant nutrient management.

CO3: Understand organic plant production and protection.

CO4: Learn about methods of organic certification.

**Unit I: CONCEPT OF ORGANIC FARMING**

1. Organic farming: Definition, History and concepts.
2. Principles, aims and objectives of organic farming,
3. Types of organic farming. Characteristics of an organic farm.
4. Benefits of organic farming; need for organic farming, conventional farming v/s organic farming.

**Unit II: ORGANIC PLANT NUTRIENT MANAGEMENT**

1. Soil tillage, land preparation and mulching.
2. Composting and manuring: vermicomposting and preparation of vermiwash, organic manure and FYM, green manure.
3. Liquid Organic fertilizers- "Jivamrut", Beejamrit and Panchgavya.
4. Biofertilizers and other practices to control diseases.
5. Propagation-seed, planting materials and seed treatments, Seed and Planting techniques in Organic Farming

**Unit III: ORGANIC PLANT PRODUCTION AND PROTECTION**

1. Cultural and Mechanical practices of plant protection, Biopesticides and other practices to control diseases.
2. Livestock Management in Organic Farming
3. Crop Rotation Practices in Organic Farming, Water Management in Organic farm, Organic Standards.
4. Weed management.

#### **Unit IV: ORGANIC CERTIFICATION**

1. Organic Standards in India
2. Organic Certification process; Procedure of Inspection and Certification; Documentation for Organic Certification;
3. Quality Management and Organic Trademark; Concept of Marketing and Indian Organic Market.
4. Economics of Organic Farming and Government Schemes to support Organic Farming.
5. Environment Protection via Organic Farming.
6. Terrace farming.

#### **Reference Books:**

1. Palaniappan S.P& Anandurai K.1999.Organic Farming–Theory and Practice. Scientific Publishers, Jodhpur
2. Joshi,M.2014. New Vistas of Organic Farming 2<sup>nd</sup> Ed. Scientific Publishers, Jodhpur.
3. Farming system: Theory and Practice-S.A.Solaimalai
4. Organic Farming: Theory and Practice-S.P. Palaniappanand K.A. Annadurai
5. A hand book of Organic Farming by A.K.Sharma
6. PGS guidelines (National Centre for Organic Farming) Sajiv Kheti: Anand Agriculture University
7. Kitchen Garden – Anand Agriculture University
8. Organic Vegetable cultivation – Jatan
9. Organic Food & Certification – Jaivik Bharat



**PRACTICAL**  
**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY PRACTICALS-I [BO- 5505L]**  
**Choice Based Credit System (CBCS) Practical syllabus**  
**Effective from June-2021**  
**Semester – V**

**Semester – V**

**Paper name: ADVANCED BOTANY PRACTICALS-I**

**Course Code: BO- 5505L**

**Total Credits: 5**

**Total teaching hours: 75 hrs**

**COURSE OUTCOMES (CO)**

On Completion of this course, the Student will be able to-

**CO1:** Make micro preparations of vegetative and reproductive structures of Algae, fungi, bryophytes and pteridophytes (studied in theory).

**CO2:** Identify members of the major angiosperm families (from the theory) by observing their diagnostic features and economic importance.

**CO3:** Demonstrate exposition and mounting of endosperm, absorbing tissue, secretory tissue, tracheary element and waste materials in plants.

**CO4:** Know the process of pollen germination and the phenomenon Leaf fall.

**CO5:** Devise methods to improve basic skills and techniques related to plant physiology, biochemistry and ecology.

**CO6:** Create basic skills to make cytological preparations and identification of various stages of cell division and to identify charts related to genetics.

**CO7:** Solve problems related to genetics and statistics.

**CO8:** Acquire knowledge on **Herbal cosmetics** and Economic uses of selected plants.

**CO9:** Acquire skills to undertake a field study and present a report along with herbarium sheets and botanical specimens.

**CO10: Acquire skills to undertake development of Herbal products.**

**PRACTICAL I: Session I**

(Algae, Fungi, Bryophytes, Pteridophytes)

**Study of types through fresh, preserved material and permanent slides.**

(a) Identify and classify following types:

**ALGAE:** Scytonema, **Nostoc**, **Chlamydomonas**.

**FUNGI:** Aspergillus.

**BRYOPHYTA:** Anthoceros, Marchantia, **Sphagnum**.

**PTERIDOPHYTA:** Psilotum, Equisetum.

(b) Structure and Reproductive organs: **ALGAE:**

Chara, Sargassum. **FUNGI:** Phytophthora,  
Agaricus.

**BRYOPHYTA: Sphagnum: Sex organs & Capsule,** Anthoceros and Marchantia sex organs.

**PTERIDOPHYTA: Equisetum: stem and cones; Psilotum: stem and synangium.**

(c) Submissions. Students are expected to submit Cryptogamic specimens.

### **PRACTICAL I: Session II**

Systematic Botany, Angiosperms, Embryology and Anatomy

**ANGIOSPERMS:** Study of families as per theory syllabus including floral formula and floral diagram. A minimum of ten herbarium sheets should be submitted.

Students must be taken on a Botanical excursion for studying vegetation in natural state. The Excursion report, and submission of specimens during the practical examination will be given due weightage.

#### **EMBRYOLOGY:**

(a) Exposition and mountings of

a. Endosperm haustoria: *Cucumis*.

b. Developing embryo : *Cyamopsis tetragonoloba* (Guvar)

(b) Study of Pollen germination on stigma in *Hibiscus*, *Datura*.

#### **ANATOMY:**

1. To study secretory tissue system through fresh material or permanent slides:

(1) Orange rind

(2) Lemon leaf

(3) Fern leaf (Hydathodes).

(4) Cycas rachis (Mucilage Duct)

2. Study of Tracheary elements by maceration technique:

(1) Nephrolepis rachis

(2) Cycas rachis

(3) Cucurbita Stem

(4) Maize Stem

3. Study of leaf fall (Abscission layer) through permanent slide.

4. Study of Waste materials:

(a) Calcium oxalate

a) Raphides [*Colocasia*].

b) Spheraphides [*Opuntia*].

(b) Calcium carbonate

a) Cystolith [Banyan leaf].

5. Study of Absorbing tissue system through fresh / preserved material or permanent slides.
- (1) Absorbing tissue: Orchid root
  - (2) Haustorial organ: Scutellum maize grain.
  - (3) Haustoria in Cuscuta.

### **PRACTICAL II: Session I**

Plant Physiology, Biochemistry, Cell Biology, Genetics

#### **PLANT PHYSIOLOGY & BIOCHEMISTRY:**

##### **1. Major experiments:**

The following physiological experiments to be performed by the students and results are expected:

- (i) To determine the water potential of given tissue (Any tuber)
- (ii) Separation of amino acids in a mixture by paper chromatography & their identification by comparison with standard R<sub>f</sub> value.
- (iii) Determine R.Q. of the given plant material of bud and or seedling.

##### **2. Minor experiments:**

The following experiments to be performed by the students:

- (i) Qualitative tests for proteins from plant material.
- (ii) Test for the presence of fats from oil seeds.
- (iii) To detect the seed viability.

#### **Biochemistry charts as per theory syllabus.**

#### **CELLBIOLOGY:**

1. To study mitosis in onion root tip by squash method
2. Histochemical localization of DNA, RNA and total protein
3. Electron micro photographs of following cell organelles:
  - a. Ultra structure of Chromatin
  - b. Chromosome: Lampbrush, Polytene
  - c. Cell-Cell interaction

#### **GENETICS:**

1. Genetics problems.
2. Charts on Gene mutations

### **PRACTICAL II: Session II**

(Ecology, **Herbal Cosmetology**, Economic Botany, Biostatistics)

#### **ECOLOGY:**

1. Determination of Frequency (%), Density and Abundance.
  2. Study of Biological Spectrum and prediction of vegetation of a given area by comparing it's biological spectrum to the normal.
  3. To study following ecological instruments:
    1. **GPS and Clinometer (Census)**
    2. **pH meter (Soil and water ph)**
    3. **Lux meter (determining light intensity)**
    4. **DO meter (Dissolved oxygen meter)**
-

**HERBAL COSMETOLOGY:**

1. Estimation of vitamin C from given herb.
2. Preparation of the following herbal products:
  - a. Skin Products (Face mask, Lip balm, Soap)
  - b. Hair Products (Hair oil)
  - c. Tooth powder

**ECONOMIC BOTANY:**

1. Thin layer chromatography of essential oil of mint and Citronella

Students are expected to identify plants or plant products (raw or processed) studied in theory and to know the binomial, family and morphology of the useful parts of source plants.

**BIOSTATISTICS:** Statistical Problems.

**Submissions:** Economic Botany Herbarium/ **Herbal Products.**

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY PRACTICALS-I [BO- 5505L]**  
**Choice Based Credit System (CBCS) Practical**  
**Effective from June-2021**

**BOTANY PRACTICAL PAPER**  
**PRACTICAL I: Session I**  
**(Algae, Fungi, Bryophytes, Pteridophytes)**

**Date:** \_\_\_\_\_

**Time: 3 hours**

**Total Marks: 35**

Q.1 Identify, classify and describe giving reasons. Draw the labeled diagrams of the peculiarities observed in Specimen A, B and C. (15)

Q.2 Expose the reproductive structure from the Specimen D. Make a sketch and show your preparation to the Examiner. (05)

Q.3 Identify and describe briefly the Slides / Specimens (08)

(E) Algae

(F) Fungi

(G) Bryophytes

(H) Pteridophytes

Q.4 Journal (02)

Q.5 Submissions (05)

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCE BOTANY PRACTICALS-I [BO- 5505L]**  
**Choice Based Credit System (CBCS) Practical**  
**Effective from June-2021**  
**PRACTICAL I: Session II**  
**(Systematic Botany, Angiosperms, Embryology and Anatomy)**

**Date:** \_\_\_\_\_

**Time: 3 hours**

**Total Marks: 35**

Q.1 Refer the **Specimens A** and **B** to their respective families. Giving reasons, including floral formula and floral diagrams. Draw labeled diagrams. (10)

Q.2 Expose and mount \_\_\_\_\_ from the given Material **C**. Stain if necessary. Show your Preparation to the Examiner. (05)

Q.3 Prepare a slide of Treachery elements of the given macerated material **D**. Describe the maceration technique. Stain if necessary. Draw the labeled diagram & show the slide to the Examiner.

**OR**

Q.3. Make a Section of the given plant Material **E** and show the reserve crystals to the Examiner. (05)

Q.4 Identify and describe (08)

(E) Embryology

(F) Embryology

(G) Anatomy

(H) Anatomy

Q.5 Journal (02)

Q.6 Herbarium (05)

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY PRACTICALS-I [BO- 5505L]**  
**Choice Based Credit System (CBCS) Practical**  
**Effective from June-2021**  
**BOTANY PRACTICAL PAPER**  
**PRACTICAL II: Session I**  
**(Plant Physiology, Biochemistry, Cell biology, Genetics)**

**Date: \_\_\_\_\_** **Total Marks: 35**  
**Time: 3 hours**

- Q.1 Perform the physiological experiment assigned to you. Tabulate your observations and calculate. Show your experiments and records to the Examiner. (08)
- Q.2 Perform the experiments per slip and show your results to the Examiner. (05)
- Q.3 Solve the genetic problem as per the slip. (05)
- Q.4 Prepare a slide showing cell division from the given specimen A. Stain if necessary & show the slide to the Examiner. Draw the labeled sketch. (07)
- Q.5 Identify & Describe. (08)  
 (B)Chart from Cell-Biology  
 (C)Chart from Biochemistry  
 (D)Physiology  
 (E)Genetics
- Q.6 Journal (02)

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY PRACTICALS-I [BO- 5505L]**  
**Choice Based Credit System (CBCS) Practical syllabus**  
**Effective from June-2021**  
**BOTANY PRACTICAL PAPER**  
**PRACTICAL II: Session II**  
**(Ecology, Herbal Cosmetology, Economic Botany, Biostatistics)**

**Date: \_\_\_\_\_** **Total Marks: 35**  
**Time: 3 hours**

- Q.1 To determine Abundance / Density / Frequency of any five species occurring in a given area. Tabulate your observations and result show your records to the Examiner. (Draw graphs if necessary) (08)
- Q.2 Compare the Biological spectrum of the given area with the normal and predict the type of vegetation. (05)
- OR**
- Q.2. Estimate Vitamin C content from the given plant material **Specimen A**. (05)
- Q.3 Solve the statistical problem as per the slip. (04)
- Q.4 Identify & Describe: (06)  
 (B) Economic Botany.  
 (C) Economic Botany. (D)Ecology instrument.
- Q.5 Journal (02)
- Q.6** Tour report, Viva and Submissions (**Economic botany/Herbal products**) (10)

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY-IV [BO- 6501]**  
**Choice Based Credit System (CBCS) Theory**  
**Syllabus Effective from June-2021**  
**Semester - VI**

**Paper: ADVANCED BOTANY-IV (PTERIDOPHYTES, GYMNOSPERMS, PALEOBOTANY, HISTOCHEMICAL METHODS AND TECHNIQUES)**

**Course Code: BO- 6501**

**Total Credits: 4**

**Total teaching hours: 60 hrs**

**COURSE OUTCOMES (CO)**

On Completion of this course, the Student will be able to-

**CO1:** Distinguish various Pteridophytes based on their structure, reproduction, life history and economic importance and also distinguish between Apospory and Apogamy.

**CO2:** Learn about the structure of Microspores and male gametophytes in Gymnosperms and will appreciate the Indian contribution to Gymnosperms.

**CO3:** Understand the origin and evolutionary trends, morphology, anatomy, reproduction and life history of selected Gymnosperms.

**CO4:** Know about the Floristics distribution and study the general characters of Pteridophyte and Gymnosperm fossil plants.

**CO5:** Learn about basic concepts of histochemical methods and techniques and will be acquainted with the basics of killing and fixing.

**Unit I:- PTERIDOPHYTES**

1. Comparative account of morphology and reproduction in *Psilotum*, *Isoetes*, *Selaginella*, *Equisetum*, *Marsilea* and *Adiantum*.
2. Structure, Reproduction and life history (excluding development):
  - a. LYCOPSIDA: *Isoetes*
  - b. PTEROPSIDA: *Marsilea*
3. Apospory and Apogamy
4. **Economic importance of Pteridophytes.**

**Unit II: GYMNOSPERMS**

1. **Origin and evolutionary trends – primary vasculature, secondary wood, leaf, male gametophyte, female gametophyte and embryo.**
2. Morphology, anatomy, reproduction and life history:
  - a. GINKGOALES: Ginkgo
  - b. GNETALES: *Gnetum*
3. Indian contribution to Gymnosperms.

### **Unit III:- PALEOBOTANY (Fossils of Pteridophytes and Gymnosperms)**

1. Geological Time-Scale
2. Psilophytales: General Characters: *Rhynia*
3. Lepidodendrales: General Characters: *Lepidodendron* and *Lepidocarpon*
4. Bennettitales : Spore bearing organs
5. Cordaitales: *Cordaites*, *Cordaitanthus*
6. Pentoxylales (general account)
7. **Gondwana Flora**

### **Unit IV :- HISTOCHEMICAL METHODS AND TECHNIQUES**

1. General account of killing and fixing, Agents used for killing and fixing. Common fixatives-Formalin-Acetic-Alcohol, Chromic acid-Acetic acid mixture.
2. Dehydration and infiltration-General account of dehydration (Ethanol, Isopropyl alcohol, Acetone, Glycerine). Ethanol- Xylene series and Tertiary Butyl Alcohol Series.
3. Infiltration- Paraffin Wax method, Embedding.
4. Staining: Histochemical Staining and Vital Staining.
5. Mounting: Whole mount, Maceration (of conducting tissues) and Smears (Mitosis).
6. Adhesive for Section, Sealing for medium.

#### **Reference Books:**

1. Kar, Ashok Kumar; Gangulee, Hirendra Chandra; *College Botany: Volume II*; 2nd edition; Kolkata : New Central Book Agency (P) Ltd , 1989, 2006.
2. Pandey, S.N. , Trivedi, P.S. and Misra S.P; *A Textbook of Botany Vol. I and II*, Vikas Publishing House Pvt. Ltd, 2005.
3. Parihar, N.S.; Pteridophytes : *An introduction to Embryophyta*, Vol.II; 4th edition; Allahabad : Central Book Depot , 1962.
4. Sporne, K.K. 1991. *The Morphology of Pteridophytes*. B.I. Publishing Pvt. Ltd. Bombay, 1991.
5. Vashishta, B.R. 1983. *Botany for degree student- Pteridophyta*, S. Chand Pub, New Delhi, 1983.
6. Bhatnagar, S.P. and Moitra, A; *Gymnosperms*; New Delhi: New Age International Pvt.Ltd., 1996.
7. Chamberlain, Charles Joseph; Coulter, John Merle; *Morphology of Gymnosperms*; 2<sup>nd</sup> edition; Allahabad : Central Book Depot , 1964.
8. Chamberlain, Charles Joseph; *Gymnosperms: structure and evolution*; 2nd edition; New-York : Dover Publications, Inc , 1966.
9. Chopra G.L., Nagin S.; *Gymnosperms*; Jullundhar: S. Nagin & Co., 1978.
10. Coulter, J.M. & Chamberlain, C.J; *Morphology of Gymnosperms*; Allahabad: Central Book Depot, 1978.
11. Vashishta, P.C; *Botany for degree student- Gymnosperms*; New Delhi: S. Chand Publications, 1983.
12. Vashishta, P.C;. *Gymnosperms*; New Delhi: S. Chand Publications, 1983.
13. Johansen, D.A.; *Plant Microtechnique*. Mc Graw – Hill Book Company, Inc. New York, 1940.
14. Kanika, S.; *Manual of Microbiology – Tools and Techniques*; Ane's student edition, 2007.
15. Khasim, S.K., *Botanical Microtechnique; principles and Practice*, Capital Publishing Company, New Delhi., 2002.
16. Toji, T., *Essentials of botanical microtechnique*; Chennai: Apex Infotec Publ., 2004.



**EVALUATION [ 10 marks CIA]**

5 marks	Test, quiz, multiple choice, etc	1 hour
5 marks	Students will prepare an assignment on any one of the following: Pteridophytes/ Gymnosperms/ Paleobotany/ Histochemical Methods and Techniques. Points for evaluation: Presentation (20%) + Content (20%) + Choice of topic (20%) + Illustrations (20%) + Overall impression (20%).	

**ST. XAVIER'S COLLEGE (Autonomous),  
AHMEDABAD ADVANCED BOTANY-V [BO- 6502]  
Choice Based Credit System (CBCS) Theory  
syllabus Effective from June-2021  
Semester - VI**

**Semester – VI**

**Paper: ADVANCED BOTANY-V (SYSTEMATIC BOTANY,  
ANGIOSPERMS, ANATOMY, MICROBIOLOGY)**

**Course Code: BO-**

**6502 Total Credits:**

**4**

**Total teaching hours: 60 hrs**

**COURSE OUTCOMES (CO)**

On Completion of this course, the Student will be able to-

**CO1:** Analyze selected systems of classification and their principles, the types of taxonomic literature as also evaluate the interdisciplinary approaches to the advancement of plant taxonomy and the contributions of the BSI.

**CO2:** Identify members of the major angiosperm families by observing their diagnostic features and economic importance.

**CO3:** Understand the process of Normal and Anomalous Secondary thickening in selected plants.

**CO4:** Understand the concept of Nodal Anatomy.

**CO5:** Understand the basics of Bacteria and Viruses and appreciate the role of microbes in various fields.

**Unit I:- SYSTEMATIC BOTANY**

1. Principles of taxonomy, merits and demerits of system of classification of Hutchinson.
2. **Outline, merits and demerits of system of classification of Angiosperm Phylogeny Group system (APG).**
3. General account: Chemotaxonomy, Numerical taxonomy, Cytotaxonomy, Molecular taxonomy
4. BSI: its role in conservation of biodiversity.
5. **Taxonomic literature - Floras, Monographs, Dictionary, Periodicals, Index and Journals.**
6. **Herbarium practices and Ethics.**

**Unit II:- ANGIOSPERMS**

Classification as per Bentham and Hooker with economic importance

**1. DICOTYLEDONS:**

- a. **Polypetalae:** Menispermaceae, Meliaceae, Anacardiaceae, Umbelliferae.

- b. Gamopetalae:** Sapotaceae, Verbenaceae, Asteraceae
  - c. Apetalae:** Urticaceae, Polygonaceae
- 2. MONOCOTYLEDONS:** Cannaceae, **Orchidaceae.**

### **Unit III:- ANATOMY**

1. Anomalous secondary growth: Abnormal behavior of normal cambium Eg. *Achyranthes* and *Mirabilis* stem.
2. Accessory cambium formation and its activity. E.g., *Bougainvillea* and *Boerhaavia* stem
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 IV:- MICROBIOLOGY**

1. Brief outline; Nomenclature and classification of viruses, Properties of viruses, morphology and ultra-structures (Bacteriophage).
2. Types of bacteria; ultrastructure of bacteria.
3. Industrial application of microorganisms, Alcohol, Food Processing, Milk products, Antibiotics and Biopesticides, Biofertilizers.
4. Roles of microbes in agriculture- role in Nitrogen fixation.
5. Biodegradation of cellulose, lignin and petroleum wastes and heavy metal waste.

### **Reference Books:**

1. Lawrence, George H.M.; *Taxonomy of Vascular Plants*; 1st edition; New Delhi: Oxford & IBH Publishing Co., 1967.
2. Raghavan, V.; *Developmental Biology of Flowering plants*; New York: Springer - Verlag, 1999.
3. Sharma, O.P.; *Plant Taxonomy*; 1st edition, reprint; New Delhi: Tata McGraw-Hill Publishing Co. Ltd., 1993(2002).
4. Sivarajan, V.V.; *Introduction to the Principles of Plant Taxonomy*; 2nd edition; Cambridge: Cambridge University Press, 1991.
5. Subramanian, N.S.; *Modern Plant Taxonomy*; New Delhi: 1st edition; Vikas Publishing House Pvt. Ltd., 1995.
6. 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).
7. Esau, Katherine; *Anatomy of seed plants*; 2nd edition; New York: John Wiley & Sons, 1977.
8. Fahn, A; *Plant anatomy*; 4th edition. Indian reprint; New Delhi: Aditya Books (P) Ltd., 1990(1997).
9. Tayal M.S.; *Plant Anatomy*; Rastogi publications, 1983.
10. Dubey, H. C.; *Bacteria, Viruses and Fungi*, New Delhi: 6th edition; Vikas Publishing House Ltd, 2004.
11. Patel R. J. and Patel K. R.; *Experimental Microbiology* Vol. –I; Amdavad: Aditya, 2000.
12. Pelczar M. J., Chan E. C. S. and Krieg N. R.; *Microbiology*; 27 the Reprint Edition; New

Delhi:Tata McGraw -Hall Publishing Company Ltd., 2004.

13. Powar and Daginawala; *General Microbiology* Vol.I & I I; Mumbai: Himalaya PublishingHouse, 1977.
14. Prescott, Harley and Klein; *Microbiology*, 6th edition; New Delhi: Tata McGraw -Hall publishing Company Ltd., 2004,
15. Sharma, P. D.; *Microbiology*, 6th edition; Delhi: Rajpal and Sons Publishing, 2010.

**EVALUATION [ 10 marks CIA]**

5 marks	Test, quiz, multiple choice, etc	1 hour
5 marks	Students will prepare an assignment related to the topic of Systematic Botany/ Angiosperms/ Anatomy/ Microbiology. Points for evaluation: Presentation (20%) + Content (20%) + Choice of topic (20%) + Illustrations (20%) + Overall impression (20%).	

**ST. XAVIER'S COLLEGE (Autonomous),  
AHMEDABAD ADVANCED BOTANY-VI [BO- 6503]  
Choice Based Credit System (CBCS) Theory  
Syllabus Effective from June-2021  
Semester - VI**

**Paper: ADVANCED BOTANY-VI (PLANT PHYSIOLOGY, BIOINFORMATICS, PLANT BREEDING, MOLECULAR BIOLOGY, BIOTECHNOLOGY)**

**Course Code: BO-**

**6503 Total Credits: 4**

**Total teaching hours: 60 hrs**

**COURSE OUTCOMES (CO)**

On Completion of this course, the Student will be  
able to-

**CO1:** Acquire basic knowledge about different plant growth regulators, plant movements, translocation of organic solutes and understand the physiological changes in plants during stress conditions.

**CO2:** Understand the history and current developments in the field of Biotechnology and Bioinformatics and understand the repositories of Biological Data Knowledge.

**CO3:** Understand the basic concepts of Plant breeding and learn the various techniques related to selection, hybridization and breeding.

**CO4:** Know about techniques of gene mapping, DNA sequencing, gene transfer and cryopreservation and know about DNA Barcoding, molecular markers and their applications.

**CO5:** Understand the biohazards of Recombinant DNA Technology, gain knowledge on Nano Biotechnology and appreciate the applications of Biotechnology.

**Unit I:- PLANT PHYSIOLOGY AND BIOINFORMATICS**

**PLANT PHYSIOLOGY**

- 1. Plant movements: Tropic and Nastic movements.**
- 2. Plant Growth Regulators: Discovery, Chemical nature (basic structure), biosynthesis, physiological functions and commercial applications (Auxins, Gibberellins, Cytokinins, Abscisic acid, Ethylene)**
- 3. Stress Physiology: Light stress and Temperature stress- Injury and resistance.**
- 4. Translocation of organic solutes: -**
  - a. Composition of phloem sap.**
  - b. Girdling experiments.**
  - c. Pressure flow model.**
  - d. Phloem loading and unloading.**
  - e. Significance and factors affecting phloem translocation**

## **BIOINFORMATICS**

1. Introduction to Bioinformatics, Internet and its uses, World Wide Web.
2. Tools used in Bioinformatics related to Biotechnology. **Introduction to data models and other data bases and services offered by NCBI and EBI.**

## **Unit II:- PLANT BREEDING**

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, Progeny selection.
4. Techniques of hybridization: emasculation, bagging, tagging, pollination and procedure of selfing. Hybridization 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.

## **Unit III:- MOLECULAR BIOLOGY**

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

## **Unit IV:- BIOTECHNOLOGY**

1. Application of Biotechnology in health and agriculture: Human insulin and vaccine production, gene therapy; Pollution Control.
2. Artificial Seeds from plants samples.
3. Methods of gene transfer in plants: 1) Micro injection, 2) Electroporation, 3) particle gun and 4) 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.**

### **Reference Books:**

1. Devlin, Robert M.; Witham, Francis H.; *Plant Physiology*; 4th edition, Indian reprint; Delhi : CBS Publishers & Distributors, 1986(2001).
2. Kochhar, P.L.; *A textbook of Plant Physiology*; 7th edition; Delhi: Atma Ram & Sons ,1964.

3. Noggle, Ray G.;Fritz, George J.; *Introductory Plant Physiology*; 2nd edition; New Delhi : Prentice-Hall Of India Private Limited , 1991.
4. Salisbury, Frank B.;Ross, Cleon W.; *Plant Physiology*; 3rd edition, Reprint; New Delhi :CBSPublishers & Distributors , 1986(2001).
5. Salisbury, Frank B.; Parke, Robert V.; *Vascular plants: form and function*; London: Macmillan & Co Ltd, 1964.
6. Sinha, B.K; Pandey, S.N.; *Plant Physiology*; 1st edition; New Delhi: Vikas Publishing HousePvt. Ltd. , 1981.
- 7.Sinha, R.K.; *Modern plant physiology*; 2nd edition; New Delhi: Narosa Publishing House ,2004.
8. Verma S. K. *Textbook of Plant Physiology and Biochemistry*; 4th edition; S. Chand & Company Ltd, 2003.
9. Verma, V.; *Textbook of Plant Physiology*; New Delhi: Ane Books India, 2007.
10. Witham, F.H., Delvin , R.M; *Plant Physiology*; Boston, MA: Willard Grant, 1983.
11. Ignacimuthu, S.; *Basic bioinformatics*; 4th edition; New Delhi: Narosa Publishing House ,2005.
12. Kar Dipak Kumar; Halder Soma; *Plant Breeding and Biometry*; 1<sup>st</sup> edition; Kolkata: NewCentral Book Agency y (P) Ltd., 2006.
13. Singh B.D; *Plant Breeding Principles and Methods*; 1<sup>st</sup> edition; Ludhiana: Kalyani Publishers ,2001.
14. Satyanarayana U.; *Biotechnology*; Kolkata: Books and Allied (P) Ltd, 2005.
15. Gupta P.K.; *Elements of Biotechnology*; Meerut: Rastogi Publications, 2009.
- 16 Arumugam, N.; Narayanan L. M. and Mani, A.; *Molecular Biology and Genetic Engineering*, 1<sup>st</sup> Reprint; Nagercoil: Saras Publication, 2008.

**EVALUATION [10 marks CIA]**

5 marks	Test, quiz, multiple choice, etc	1 hour
5 marks	Students will prepare an assignment on any one of the following: Physiology/ Bioinformatics/ Plant Breeding / Molecular Biology / Biotechnology. Points for evaluation: Presentation (20%) + Content (20%) + Choice of topic (20%) + Illustrations (20%) + Overall impression (20%)	

**ST. XAVIER'S COLLEGE (Autonomous),  
AHMEDABAD APPLIED BOTANY-II [BO- 6504]  
Choice Based Credit System (CBCS) Theory  
Syllabus Effective from June-2021  
Semester - VI**

**Semester – VI**

**PAPER: APPLIED BOTANY-II (ENVIRONMENTAL BIOLOGY,  
GARDENING, ETHNOBOTANY, FORESTRY)**

**Course Code: BO-**

**6504 Total Credits: 4**

**Total teaching hours: 60 hrs**

**COURSE OUTCOMES (CO)**

On Completion of this course, the student will be able to-

**CO1:** Familiarize with the major environmental problems like global warming, pollution, extinction and climate changes: their causes and potential solutions.

**CO2:** Understand the concepts of plant biodiversity and of Carbon footprint and will also gain knowledge on methods of documenting biodiversity.

**CO3:** Understand the principles of gardening, garden design and care, landscaping and nursery management.

**CO4:** Evaluate the history and development of Ethnobotany while appreciating the role of sacred groves and the significance of selected ethnomedicinal plants.

**CO5:** Learn about methods of ethnobotanical research and conservation.

**CO6:** Appreciate the types of forests in India, as well as forest-related Silviculture, wood and paper industries and to know about Social and Agroforestry as well as Forestry-related institutes and their importance in education and training.

**Unit I:- ENVIRONMENTAL BIOLOGY**

1. Plant Biodiversity: Concepts and levels, IUCN categories of threat, Red data books, Hotspots.
2. Brief account: EIA, International Biological Program; Man and Biosphere Program (MAB).
3. Climate change: Greenhouse Gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>), CFCs: Sources, Trends and Role, Consequences of Climate Change (CO<sub>2</sub>, Global warming, Sea level Rise,) Greenhouse effect and global warming; Ozone depletion.
4. Effect of Air, Water and Soil pollution on vegetation.
5. Carbon footprint.
6. **Mapping biodiversity, methods of estimating population density of plants and documenting biodiversity by PBRs; Role of GSBB, NBA.**



## **Unit II:- GARDENING**

1. Principles and Materials of Garden Design.
2. Garden features: Paths, walkways and avenues, arches, lawns, floral beds, hedges, edges. Topiary.
3. Garden operations: Pruning- principles & kinds.
4. Plant care: Manuring. Daily care & maintenance, repotting.
5. Landscape designs in India- Buddhist, Mughals, etc.
6. **Native flora, Vertical gardens. Small space gardens.**
7. Nursery management.
8. Bonsai. **Terrarium, Kokedama.**

## **Unit III:- ETHNOBOTANY**

1. History and development of Ethnobotany.
2. Ethnobotany in India.
3. Methods of Ethnobotanical research.
4. Mythology and conservation of ecosystems, sacred groves.
5. Plants used by tribes of Gujarat:
  - a. *Achyranthes aspera*
  - b. *Asparagus racemosus*
  - c. *Butea monosperma*
  - d. *Calotropis procera*
  - e. *Ficus religiosa*
  - f. *Jatropha gossypifolia*
  - g. *Tamarindus indica*
  - h. *Vitex negundo*

## **Unit IV:- FORESTRY**

1. **Definition, classification and importance of forests.**
2. **Forest types of Gujarat.**
3. **Physical properties, structural features and identification of wood.**
4. **Wood and Paper industries.**
5. **Silviculture: definition, aims. objectives and advantages.**
6. **Social forestry and Agricultural Forestry.**
7. **Forest Conservation. Afforestation.**
8. **Forest research education and training Institutes in India.**

### **Reference Books:**

1. Miller, G. Tyler; *Textbook of Ecology*, New Delhi: Cengage Learning India, 2009.
2. Odum, E.; Barrick M.; Barrett G.; *Fundamentals of Ecology*, 5<sup>th</sup> edition; New Delhi: Cengage Learning India, Pvt. Ltd., 1971.
3. Saha, T.K; *Ecology and Environmental Biology*; Kolkata: Books and Allied Pvt. Ltd.
4. Sharma, P.D.; *Ecology and Environment*; 7th edition; Meerut : Rastogi Publishers , 1998.

5. Subrahmanyam, N.S.; Sambamurty, A.V.S.S.; *Ecology*; 1st edition; New Delhi : Narosa Publishing House , 2000.
6. Bhattacharjee, S.K; *Landscape Gardening and Design with Plants*; Jaipur: Aavishkar Publishers,2012.
7. De, L.C.; *Handbook of Gardening*; Jaipur: Sheetal Printers, 2012.
8. Laeeq Futehally; *Gardens: National Book Trust: 1978*.
9. Percy Lancaster; *Gardening in India*; New Delhi: Mohan Makhijani and Rekha Printers,1979.
10. Trivedi, P.C; *Ethnobotany*; Jaipur: Aavishkar Publishers.
11. Jain, S.K; *Manual of Ethnobotany*; Jodhpur: Scientific Publication.
12. S.A.Shah; *Forestry for People*; Indian Council of Agriculture Research; New Delhi.

### EVALUATION [10 marks CIA]

5 marks	Test, quiz, multiple choice, etc	1 hour
5 marks	Students will prepare an assignment on any one of the following: Environmental Biology/ Gardening/ Ethnobotany/ Forestry. Points for evaluation: Presentation (20%) + Content (20%) + Choice of topic (20%) + Illustrations (20%) + Overall impression (20%).	

**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**Elective Paper: Medicinal**  
**Botany[BO- 6401]**  
**Choice Based Credit System (CBCS) Theory syllabus**  
**Effective from June-2021**  
**Semester - VI**

**Elective Paper: Medicinal Botany**

**Course Code: BO- 6401 Total**

**Credits: 2**

**Teaching hours: 30 hrs.**

**COURSE OUTCOMES (CO)**

On Completion of this course, the Student will be able to-

**CO1:** Understand history, scope and importance of Traditional Indian Systems of Medicine.

**CO2:** Gain knowledge on Health, Immunity and Ayurveda.

**CO3:** Understand Ethnobotany and modern medicine.

**CO4:** Know recent trends and scope in traditional medicine systems.

**Unit – 1: History, Scope and Importance of Traditional Indian systems of Medicine.**

- i) Definition and scope of Ayurveda
  - (a) Contribution of Charak and Sushruta.
  - (b) Panchamahabhutas and Saptadhatu.
  - (c) Concept of Rasayana drugs.
- ii) Siddha:
  - (a) Origin of Siddha medicinal system.
  - (b) Basis of Siddha system.
  - (c) Plants used in Siddha medicine.
- iii) Unani:
  - (a) History, Concept, Application and scope.
  - (b) Umoor-e-tabiya.
  - (c) Polyherbal formulations.

**Unit – 2: Health, Immunity and Ayurveda:**

1. Rutucharya and Dincharya and their Significance
2. Virrudh Aahar
3. Brief description of Ashtanga Hridayam and its Importance.
4. Introduction to Panchkarma and Tridosh concepts.
5. Plants used for the treatment of cardiac diseases, infertility, diabetes, blood pressure, cancer and skin diseases.

### Unit – 3: Ethnobotany and modern medicine

1. Contributions of Ethnobotany to Modern Medicine.
2. Ethnopharmacology.
3. Ethnobotany and legal aspects: Sharing of wealth concept with few examples from India. Biopiracy.
4. Intellectual Property Rights and Traditional Knowledge.
5. Ethnobotany and its relevance to Contemporary Research.
6. Ethnobotanical approaches of Traditional Medicine Studies.

### Unit – 4: Recent trends and scope in Traditional Medicine Systems:

1. Introduction to AYUSH mantra – of Government and its objectives.
2. Identification of selected dry plant materials by physical, anatomical and biochemical testing.
3. Categories of Ayurvedic products like churna, capsule, vati, arishta, asav, etc.
4. Quality parameters of above categories [Physicochemical, heavy metals and micro (bacteria & fungi)].
5. Research parameters of above said categories (adulteration / identification through TLC
6. Scope and importance of post-harvest technology.

### Reference Books:

1. Trivedi, P.C; *Medicinal Plants, Ethnobotanical Approach*, Agrobios India, 2006.
2. Purohit & Vyas; *Medicinal plants conservation: A scientific approach* 2nd edition, Agrobios India, 2008.
3. S.K. Bhattacharjee; *Handbook of Medicinal and Aromatic Plants*, India, 2004.
4. A.K. Sharma; *Recent Progress in Medicinal Plants* Vol.12, Globalization of Herbal Health, 2006.
5. L.D. Kapoor; *Handbook of Ayurvedic Medicinal Plants*, Boca Raton 2005.
6. K.R. Kirtikar and B.D. Basu; *Indian Medicinal Plants* (Vol 1- 4), Allahabad, 2006.
7. IUCN et al; *IUCN Red List Categories*, 1993.
8. M.P. Singh et al.; *Indigenous Medicinal Plants Social Forestry and Tribals*, Daya Publishing house, 2003.
9. V.V. Sivarajan & Balachandran; *Ayurvedic Drugs and their Plant Sources*, Oxford; IBH, 1994.
10. Godagama, Bishen Singh Mahendrapal Singh; *The Handbook of Ayurveda Shantha*, Dehradun, 2004.
11. Abdin, M.Z. and Y.P. Abrol, Y.P.; *Traditional Systems of Medicine*; Narosa Publishing House, New Delhi, 2006.
12. Balick, M.J. and Cox, P.A.; *Plants, People and Culture: The Science of Ethnobotany*; Scientific American Library, 1996.
13. Bera, S., Mukherji, Rozario, A.; *A Hand Book of Ethnobotany*; Kalyani Publishers, 2004.
14. Martin, G.J.; *Ethnobotany: A Methods Manual*. Chapman and Hall, 2008.
15. Trivedi, P.C., *Medicinal Plants Traditional Knowledge*. New Delhi, Delhi: I.K. International Publishing House Pvt. Ltd., 2006.
16. Trivedi, P.C., *Medicinal Plants. Utilization and Conservation*. Jaipur, Rajasthan: Aavishkar Publishers., 2009.

**PRACTICALS**  
**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY PRACTICALS-II [BO- 6505L]**  
**Choice Based Credit System**  
**(CBCS) Effective from June-2021**  
**BOTANY PRACTICAL SYLLABUS**

**PAPER: ADVANCED BOTANY PRACTICALS-II**

**Course Code: BO 6505L**

**Total Credits: 5**

**Total teaching hours: 75 hrs**

**COURSE OUTCOMES (CO)**

On Completion of this course, the Student will be able to-

**CO1:** Examine the classification, distribution, morphology, anatomy, reproduction and life cycle of Pteridophyte and Gymnosperm types mentioned in the syllabus.

**CO2:** Identify fossils of Pteridophytes and Gymnosperms.

**CO3:** Recognize members of the major Angiosperm families (studied in theory) by identifying their diagnostic features and economic importance.

**CO4:** Demonstrate anomalous secondary growth in specified plant materials.

**CO5:** Equip students with skills and techniques related to plant physiology and ecology so that they can design their own experiments.

**CO6:** Demonstrate microbiological techniques and herbarium preparation techniques.

**CO7:** Learn about plant breeding, molecular biology, ethnobotany, gardening and biotechnology through charts.

**CO8:** Prepare and submit personal reports of visits to a Garden, a Nursery, tour along with herbarium preparations and permanent slides.

**PRACTICAL I: Session I**  
**(Pteridophytes, Gymnosperms, Paleobotany, Histochemical methods and Techniques)**

**1. Study of types through fresh preserved material and permanent slides.**

(a) Identify and classify following types:

**PTERIDOPHYTA:** *Isoetes, Marsilea.*

**GYMNOSPERMS:** *Ginkgo*, *Gnetum*

(b) Structure and Reproductive organs:

**PTERIDOPHYTA:** *Isoetes*: Sporophyll

*Selaginella*: Cones

*Adiantum*: Sporophyll

*Marsilea*: Sporocarp

**GYMNOSPERMS:** *Ginkgo*, *Gnetum*

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

**Pteridophytes**

**PSILOPHYTALES:** *Rhynia*: Stem T.S

**LEPIDODENDRALES:** *Lepidodendron*: Stem T.S.

*Lepidocarpon*: V.S.Slide

**Gymnosperms:**

**BENNETTITALES:** Spore bearing organ

**CORDAITALES:** *Cordaites*: Stem T.S

*Cordianthus* – L.S of Cone.

Submission of photographs of at least 10 different Pteridophytes and Gymnosperms.

**PRACTICAL I: Session II**  
**(Systematic Botany, Angiosperms, Anatomy, Microbiology)**

**ANGIOSPERMS:** Study of families as per theory syllabus including floral formula and floral diagram.

**ANATOMY:**

(a.) Study of abnormal secondary growth:

- (1) *Achyranthes* stem
- (2) *Draceana* stem
- (3) *Bougainvillea* stem
- (4) *Mirabilis* stem
- (5) *Boerhavia* stem
- (6) Carrot root
- (7) *Raphanus* root
- (8) Beet root

(b.) Study of nodal anatomy as per syllabus.

**MICROBIOLOGY:**

(a.) Staining of bacteria through gram staining.

(b.) Electron micrograph: Bacteriophage virus & Bacteria.

**Submissions:** Herbarium sheets and Permanent Slides.

**PRACTICAL II: Session I:  
(Plant Physiology, Plant Breeding, Molecular Biology, Biotechnology)**

**PLANT PHYSIOLOGY**

**1. Major experiments:**

The following physiological experiments to be performed by the students and results are expected:

- (i) To study the rate of photosynthesis under different concentration of CO<sub>2</sub>.
- (ii) To study of the rate of photosynthesis under different wavelength of light
- (iii) To study of the rate of photosynthesis under different light intensities.

**2. Minor experiments:**

The following experiments to be performed by the students:

- (i) Hill reactions
- (ii) C<sub>3</sub> & C<sub>4</sub> plants demonstration by anatomical features.
- (iii) Demonstration of respiratory enzymes in plant tissues.
  - (a) Polyphenol Oxidase
  - (b) Dehydrogenase
- (iv) Preparation of solutions: Molar, Molal, Normal, Percent Concentrations

**3. Demonstration Experiments:**

**A. Tropic Movements:**

- (i) To demonstrate the phenomenon of geotropism.
- (ii) To demonstrate the phenomenon of hydrotropism.
- (iii) To demonstrate the phenomenon of phototropism.
- (iv) To demonstrate the phenomenon of thigmotropism.

**B. Nastic Movements**

**C. Girdling Movements in Plants**

**D. Study of Chemical Structures of Plant Growth regulators through Charts.**

**PLANT BREEDING:** Charts as per theory syllabus.

**MOLECULAR BIOLOGY:** Charts as per theory syllabus.

**BIOTECHNOLOGY:** Charts as per theory syllabus.

**PROJECT WORK:** Students will carry out a research project under the guidance of a Faculty. The findings will be presented at a Seminar. Project report is to be submitted and will be given due weightage.

**PRACTICAL II: Session II**  
**(ECOLOGY, GARDENING, ETHNOBOTANY, FORESTRY)**

**ECOLOGY**

1. Determination of Chloride content in water sample
2. Determination of Carbonate and Bicarbonate in water sample
3. Determination of Calcium content in water sample
4. Determination of Total hardness of water sample
5. **Determination of inorganic salts from the given soil sample.**

**GARDENING**

1. Visit to a garden to study the principles and materials used in landscape design. Report to be submitted during practical exam.
2. Visit to a Nursery to study its management. Report to be submitted during practical exam.

**ETHNOBOTANY:** Ethnobotanical specimens as prescribed in theory syllabus.

**FORESTRY**

- a. *Eucalyptus* sp.
- b. *Acacia arabica*
- c. *Mangifera indica*
- d. *Tectona grandis*
- e. *Shorea robusta* (Sal)

**Submissions:** Garden and Nursery visit Report, Wood samples, Herbarium of Ethnobotanical plants.



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**ADVANCED BOTANY PRACTICALS-II [BO- 6505L]**  
**Choice Based Credit System (CBCS) Practical**  
**Paper Effective from June-2021**  
**PRACTICAL I: Session I**  
**(Pteridophytes, Gymnosperms, Paleobotany, Histochemical Methods and Techniques)**

Maximum marks – 35

Date:

Time: 3 hours

- Q.1** Identify, classify and describe giving reasons. Draw the labeled diagrams of the peculiarities observed in Specimen **A**, **B** and **C**. (15)
- Q.2** Expose the reproductive structure from the Specimen **D**. Make a sketch and show your preparation to the Examiner. (05)
- Q.3** Identify and describe briefly the Slides / Specimens (08)
- (D) Pteridophytes
  - (E) Gymnosperms
  - (F) Pteridophyte fossils
  - (G) Gymnosperms fossils
- Q.4** Journal (02)
- Q.5** Submissions (05)

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**Choice Based Credit System (CBCS) Practical**  
**Paper Effective from June-2021**  
**PRACTICAL I: Session II**  
**(Systematic Botany, Angiosperms, Anatomy and Microbiology)**

- Q.1** Refer the Specimens **A** and **B** to their respective families. Giving reasons, including floral formula and floral diagrams. Draw labeled diagrams (08)
- Q.2** Prepare a double stained preparation of given Material **C**. Show your Preparation to the Examiner. (07)
- Q.3** Material **D**. Gram staining (04)
- Q.4** Identify and describe (04)
- (E) Microbiology
  - (F) Anatomy
- Q.5** Journal (02)
- Q.6** Submission: Herbarium sheets and Permanent slides. (10)

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**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY PRACTICALS-II [BO- 6505L]**  
**Choice Based Credit System (CBCS) Practical**  
**Paper Effective from June-2021**  
**PRACTICAL 2: Session I**  
**(Plant Physiology, Plant Breeding, Molecular Biology, Biotechnology)**

Maximum marks – 35

Date:

Time: 3 hours

- Q.1** Perform the physiological experiment assigned to you. Tabulate your observations and calculate. Show your experiments and records to the Examiner. (10)
- Q.2** Perform the experiments per slip and show your results to the Examiner. (05)
- Q.3** Identify & describe (08)
- (A) Physiology
  - (B) Chart from Plant Breeding
  - (C) Chart from Molecular Biology
  - (D) Chart from Biotechnology
- Q.4** Journal (02)
- Q.5** Project report & Viva (10)

**PRACTICALS**  
**ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD**  
**ADVANCED BOTANY PRACTICALS-II [BO- 6505L]**  
**Choice Based Credit System (CBCS) Practical**  
**Paper Effective from June-2021**  
**PRACTICAL 2: Session II**  
**(Ecology, Gardening, Ethnobotany, Forestry)**

Maximum marks – 35

Date:

Time: 3 hours

- Q.1** Estimate Calcium / Chloride / Carbonate and bicarbonate /Total hardness in terms of p.p.m in a water sample given to you. Tabulate your observations and results and show them to the Examiner. (08)
- Q.2** Test the given soil sample for presences of inorganic salts. (05)
- Q.3** Identify & Describe: (10)
- (A) Ethnobotany.
  - (B) Ethnobotany.
  - (C) Wood sample.
  - (D) Gardening chart
  - (E) Garden chart
- Q.4** Journal. (02)
- Q.5** Garden & Nursery visit report & Viva. (10)