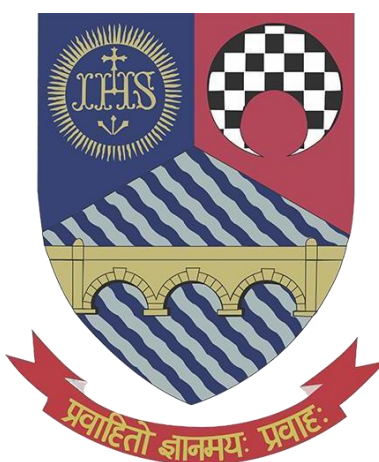


ST. XAVIER'S COLLEGE (AUTONOMOUS)

AHMEDABAD

Choice based credit system

M.Sc. Botany SYLLABUS



(Effective from June 2024)

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 morphonology, 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

SEM I (M.Sc. Botany)			
Course Code	Course Title	Hours/Week	Credits
PBO-1801	Plant Diversity-I	4	4
PBO-1802	Taxonomy, Ethnobotany and Ecology	4	4
PBO-1803	Physiology, Anatomy, Embryology and Cell Biology	4	4
PBO- 1804	Applied Botany I (Horticulture, Post-harvest technology Organic farming & Genetics)	4	4
PBO- 1805L	Botany Practicals-I	4	4
PBO-1806L	Botany Practicals-II	4	4

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-1801: PLANT DIVERSITY-I
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Plant Diversity-I
Course Code: PBO- 1801
No. of Credits: 04
Learning Hours: 60 hrs

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Learn about the characteristics, structure and classification of bacteria and virus, learn about virus pandemics in recent years.

CO2: Know the classification, habitat distribution, origin and evolution, life cycle patterns and salient features of various groups of algae.

CO3: Be acquainted with classification, general characteristics, structure, comparative account of various groups of fungi, homothallism and heterothallism, parasexual cycle, physiological specialization in races of fungi and spore dispersal mechanisms; learn about fungal identification.

CO4: Understand vegetative and reproductive innovations in bryophytes, their role in ecosystem dynamics and global carbon budget, symbiotic fungal associations, bryogeography and conservation, hormonal regulation in bryophytes, population ecology and genetics of bryophytes.

CO5: Learn about sexual dimorphism in bryophytes and the biologically active compounds in them and about the cytogenetic and molecular genetics of moss species.

UNIT 1: MICROBES AND VIRUS

A) Bacteria:

1. Characters of Bacteria, classification of Bacteria (based on flagella),

ultra-structure (cell wall, flagella, fimbriae, pilli, slime layer, S-layers; cell membrane; mesosomes, ribosomes, cytoplasmic inclusion bodies and nucleoid), nutrition, reproduction and economic importance of Bacteria.

2. Salient features of major bacterial groups according to Bergey's Manual of Systematic Bacteriology

B) Virus:

1. General characters of viruses, types of viruses (on the basis of genome).
2. Ultra-structure of Virions
3. Viroids and Prions: a general account.
4. General account: SARS -family viruses, Covid-19 virus- origin, causes and response measures.

UNIT 2: ALGAE

1. Classification of Algae by G. M. Smith (1955) and R. E. Lee (1989)
2. Origin and evolution of sex in Algae, reproduction and life-cycle patterns in Algae.
3. Thallus organization in Algae
4. Algae in diversified habitats -terrestrial, freshwater and marine; distribution in India and Gujarat
5. Detailed account (Cell ultrastructure, reproductive methods and life-cycle pattern) of Cyanophyta, Chlorophyta, Euglenophyta, Chrysophyta, Phaeophyta and Rhodophyta.
6. Economic significance: biofertilizers, biofuels, phytoremediation using Algae

UNIT 3: MYCOLOGY

1. Outline classification by Alexopoulos and Mims (1979). Interrelationships of Myxomycetes, Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes.
2. An introduction to fungal identification keys, identification of Fungi on the basis of spore morphology, Molecular identification of Fungi, Fossil fungi.
3. General characteristics, ultrastructure, hyphal growth, aggregations in Fungi, nutrition and reproduction.
4. Homothallism and Heterothallism in Fungi, Homokaryosis and Heterokaryosis, hormonal control in sex organ development in Fungi. Physiological specialization and physiological races in Fungi.
5. Parasexual cycles, reduction in sexuality in Fungi. Spore dispersal mechanisms.
6. Introduction, types and structure of Mycorrhizae (with special reference to AM fungi), Factors affecting mycorrhizal colonization.

UNIT 4: BRYOPHYTA

1. Comparative account of life history in Marchantiales, Jungermanniales, Anthocerotales, Funariales, and Sphagnales.
2. Origin and phylogenetic relationships of bryophytes, distribution of bryophytes in India, fossil history of bryophytes.
3. Bryophytes and land plant evolution, role of bryophytes in ecosystem dynamics and in the global carbon budget
4. Desiccation and regeneration of bryophytes, cytogenetics of bryophytes; polyploids and aneuploidy, plant growth regulators in bryophytes.
5. Bryophytes in a changing world, contribution of some Indian bryologist, conservation biology of bryophytes.

Reference books:

- N. Arumugam: Cell Biology and Molecular Biology, Seventh Edition, Saras publication, 2014
- R.C. Dubey and D.K. Maheswari: A textbook of Microbiology, 1st Edition, S. Chand and Company Ltd, 2004
- Channarayappa: Cell Biology, University Press (India), private Limited, 2010
- 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.
- Kar, Ashok Kumar; Gangulee, Hirendra Chandra; College Botany: Volume II; 2nd edition; Kolkata: New Central Book Agency (P) Ltd, 1989, 2006.
- Shaw AJ and B Goffinet: Bryophyte Biology. Cambridge University Press, 2000.
- Geissler and Greene S: Bryophyte Taxonomy, methods, practices and floristic explorations J. Cramer, Germany, 1982.
- Richardson DHS: The Biology of Mosses. John Wiley & Sons, Inc New York, 1981.

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-1802: TAXONOMY, ETHNOBOTANY AND ECOLOGY
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Taxonomy, Ethnobotany and Ecology

Course Code: PBO- 1802

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Understand about the objectives, goals and aims of Plant taxonomy, history of taxonomy, major contributions of scientists.

CO2: Learn about Plant nomenclature, plant herbarium techniques and use of botanical keys for plant identification.

CO3: Know about the scope of Ethnobotany, the methods and techniques used in ethnobotanical studies, the ethnobotanical tribes of Gujarat and Ethnobotany in arts, magico- religious beliefs, and plants used by tribals in scarcity and ethnoveterinary plants.

CO4: Be acquainted with the ecological perspective of the Campus: its biodiversity, climate variations, waste regulations air quality.

UNIT 1: SYSTEMATIC BOTANY-I

1. Introduction to Plant taxonomy and Systematics; objectives, goals, and aims of Plant systematics. Hierarchical stages of Systematics and categories of Taxonomy. Basic components of Taxonomy. Process of Identification.
2. Plant taxonomy through the ages in India: Major contributions of W. Roxburgh, J. D. Hooker, Rev., T. Cooke, Fr. Hermenegild Santapau, S. J. and G.L. Shah.
3. Comparison of systems of classification: Linnaeus, Bentham and Hooker, Engler and Prantl, and APG.
4. Plant Nomenclature: Common name, scientific name, binomial nomenclature. International Code of Botanical Nomenclature (ICBN): salient features; Rules: priority, limitation of priority, ranks of taxa; typification; effective and valid publications; author citation; retention, choice and rejection of names and epithets, names of hybrids and cultivated plants.

5. Plant Herbarium: History, functions, kinds, important herbaria of the world. Methods for preparing an herbarium, herbarium of other groups of plants (Algae, Fungi, Bryophytes, Pteridophytes and ancillary collections).
6. Botanical keys: Diagnostic, synoptic and artificial keys-Single access (sequential)-bracketed and indented keys and multi-access keys, edge-punched and body-punched (polyclave) keys, tabular and lateral keys; computerized keys, their merits and demerits.

UNIT 2: ANGIOSPERMS – I

Study of ANGIOSPERM families with special reference to characteristic features, interrelationships, distribution, common examples, economic importance and phylogeny (APG IV)

Dicotyledon:

Polypetalae: Nymphaeaceae, Portulacaceae,

Gameopetalae: Oleaceae, Acanthaceae, Laminaceae

Apetalae: Casurinaceae, Piperaceae

Monocotyledon: Liliaceae, Araceae.

UNIT 3: ETHNOBOTANY -I

1. Ethnobotany, its scope, interdisciplinary approaches. Main world centers of ethnobotanical studies, workers & literature of Ethnobotany. Contributions of AICRPE and FRLHT to ethnobiology of India.
2. Ethnic groups of India: major and minor tribes, life styles of ethnic tribes, conservation practices of biodiversity, taboos and totems.
3. Ethnobotany of major tribal communities (Bhils, Vasavas, Gamits, Chaudhris, etc) of Gujarat.
4. Methods and techniques used in Ethnobotany: Field level activities for data collection-approach, documentation (audio, video recording, photographs, interview – methods, questionnaire, and data sheet), consent forms. People’s biodiversity Register (PBR).
5. Ethnobotanical aspects of Art & literature with special reference to folklore, taboos, magico-religious beliefs.

UNIT 4: CAMPUS ECOLOGY

1. **Understanding the campus:** origin and history; departments, building designs, architecture, various facilities, organizational set up, origin and history, beneficiaries.

2. **Biodiversity:** Flora and fauna, seasonal variations, exotic plants and weeds, horticultural species, arboretum, significance of campus species from ecological and conservation perspective.
3. **Ecoclimate:** Serenity of the campus; ecological factors – rainfall, temperature, impact of plants; campus as an ecosystem; rain water harvesting, water crisis and conservation.
4. **Waste regulation:** Waste disposal; litter vs solid waste, basics of solid waste management, Orbin bins; Aerobiology- aerosols (physical, chemical, optical properties), particulate matter, Black Carbon, atmospheric cleanliness.
5. **Eco-watching:** Tree cover – qualitative and quantitative analysis: belt transect (density, abundance and frequency); basics of bird watching, unique trees and animals.

Reference books

- Lawrence, George H.M.; Taxonomy of Vascular Plants; 1st edition; New Delhi: Oxford & IBH Publishing Co., 1967.
- Naik, V.N.: 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 IBH Publishing 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.
- Miller, G; Tyler; Textbook of Ecology, New Delhi: Cengage Learning India, 2009.
- Odum, E.; Barrick M.; Barrett G.; Fundamentals of Ecology, 5th 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: Narosa Publishing House, 2000
- Jain, S. K.; Glimpses of Indian Ethnobotany, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, 1981 .
- Jain, S. K. ; Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow, 1989 .
- Jain, S. K.; A Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.

- Jain, S. K., Mudgal, V., Banerjee, D. K., Guha, A., Pal, D. C. and Das, D.; Bibliography of Ethnobotany, Botanical Survey of India, Howrah. 1984.
- Jain S.K.; Contribution to Indian Ethnobotany, Sci. Publ. Jodhpur. 1997.
- Trivedi, P.C and Sharma Niranjana; Text Book of Ethnobotany; Pointer pub, 2011.

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-1803: PHYSIOLOGY, ANATOMY, EMBRYOLOGY AND
CELL BIOLOGY
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Physiology, Anatomy, Embryology and Cell Biology

Course Code: PBO- 1803

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Understand about the photosynthetic mechanism, photosynthetic complexes, photosynthetic pathways and reactive oxygen species.

CO2: Understand about Anatomy in relation to roots, stems and tactile organs, and learn about the application of Anatomy in systematics, evolution and ecology.

CO4: Learn about pollen classification, floral meristems, factors affecting flowering, types of Palynology and about pollen biotechnology in agriculture.

CO5: Understand about cell components, structure, function and biogenesis, cell communication principles, cell cycle and Apoptosis, and organellar genomes.

UNIT I: PLANT PHYSIOLOGY I

1. Photosynthesis: Organization of photosynthetic apparatus, light absorbing pigments, organization of light antenna systems, mechanism of electron transport, proton transport and ATP synthesis in chloroplast. Repair and regulation of photosynthetic machinery, role of carotenoids, genes and polypeptide of photosynthetic complexes, Bioenergetics of light reaction, generation of proton gradient and ATP synthesis
2. Dark reaction of photosynthesis- Calvin Cycle, CO₂ concentrating mechanism in plants
3. Reactive oxygen species – formation, role and scavenging

UNIT II: ANATOMY

1. Stem anatomy, vascular elements, functional differentiation, p proteins. Role of cambium.
2. Tactile sense organs, gravitational and optical sense organs in plants.
3. Applied plant anatomy: Application of anatomical studies in climatology, genetics and plant breeding, biomedical research and forensic science.
4. Plant anatomy in systematics, ecology and evolution: Phylogeny of xylem and phloem elements; wood anatomy, nodal anatomy, mineral inclusion in systematics and evolution; leaf and wood anatomy in ecological perspective; anatomical response to pollutants.

UNIT III: EMBRYOLOGY

1. NPC system of pollen classification by Erdtman and Straka (1961).
2. Floral meristem, intrinsic and extrinsic factors controlling flowering, flower development in Arabidopsis and Antirrhinum, ABC model of flower development, flower architecture and mutations.
3. Palynology, morpho graphic palynology, aeropalynology, melitto-palynology, and Paleopalynology. *Eurypalynous and stenopalynous taxa*.
4. Sterility –phenomenon and applications in hybrid seed production, male sterility-chemical induction, through recombinant DNA technology.
5. Pollen biotechnology in agriculture- optimizing yield; effective plant pollinator interactions through case studies.

UNIT IV: CELL BIOLOGY

1. Cell components and their functions: new insights in structure and function of cytoplasmic cell organelles; nucleus; its components, chromatin structure DNA packaging in eukaryotes, structure and function of plant cytoskeletal genes and gene products; protein sorting and intracellular trafficking.
2. Cell communication: general principles.
3. Cell Cycle and Apoptosis: Check points during cell cycle-G1 to S, progression of S phase, G2 to M phase, Anaphase check points and components involved as regulators of check points; role of cyclins and CDKs, synthesis and degradation of cyclins, structural features of CDKs and cyclins, activation and inactivation of cyclin dependent kinases.

Reference books

- 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).
- 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 editon; 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, M A:Willard Grant, 1983
- 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).
- Tayal M.S.; Plant Anatomy; Rastogi publications, 1983.
- Pandey S N, Chadha A. A Textbook of Anatomy and Embryology: Vikas Publishing House, 19996
- Bhattacharya k., Majumdar R., Bhattacharya G.S. A Textbook of Palynology

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-1804: APPLIED BOTANY I
(Horticulture, Post harvest, Organic farming & Genetics)
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Applied Botany I (Horticulture, Post harvest, Organic farming & Genetics)

Course Code: PBO- 1804

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOMES (CO)

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

CO1: Learn about Horticultural plants, their classification, importance, canopy classification and management.

CO2: Be acquainted with anatomical and physiological aspects of cutting, grafting, budding and layering; with plant modification and variegated plant parts.

CO3: Understand about soilless medium plant culture, floriculture and value-added products.

CO4: Understand about Post harvest handling of various plant produce, its procedure, preservation, marketing.

CO5: Know about the basics of Organic farming, its applications and uses; its business and practical aspects.

CO6: understand about principles of inheritance, applications of genetics and the techniques involved in genetical studies.

UNIT 1: HORTICULTURE

1. Classification of horticultural plants; economic and industrial importance of Horticulture
2. Canopy classification and management, spacing and land utilization, GIS and tree mapping.
3. Variegated plant parts, Chimeras.
4. Anatomical and physiological aspects of: rooting of cuttings, grafting, budding and layering, specialized stem and roots (plant modifications).
5. Bioponics (soil-less medium), Hydroponics, Aeroponics, Aquaponics, NFT (Nutrient Film Technique).
6. Floriculture: Cut flowers, loose flowers, factors affecting flower production (light, temp, humidity, CO₂, water, soil and nutrients), flower forcing and year-round flowering through physiological interventions, chemical regulation and environmental manipulation

UNIT 2: POST HARVEST TECHNOLOGY

1. Introduction, role, need and goal for post-harvest technology.
2. post-harvest handling of perishables i.e., fruits, vegetables and flowers. Physiology and Biochemistry of Horticultural Produce. Factors affecting the quality of horticultural produce.
3. Importance of post-harvest management; nature and causes of post-harvest losses; maturity indices, harvesting and post-harvest handling of fruits and vegetables; ripening process; factors responsible for deterioration of harvested fruits and vegetables; methods of storage; marketing mechanism; packaging technology.
4. Importance and scope of fruit and vegetable preservation in India.

UNIT 3: ORGANIC FARMING

1. Concepts and scope of organic farming, Requirements for organic farming, Farm components for an organic farm.
2. Conversion to organic farming: Process, farm and climate related challenges to conversion, criteria for selection of crops during conversion, Organic certification process.
3. Fundamentals of Organic livestock management and Water management.
4. Nutrient management in Organic farming: Organic fertilizers, types – compost, vermicompost, green manure, animal manure, microbial fertilizer (Bio enzymes), mineral fertilizer.
5. Potentials and constraints for vermiculture in India.
6. National and International status of Organic farming, Agencies and Institutes related to organic farming in India, Organic food quality and health, Government schemes to support Organic farming.
7. Entrepreneurship development: concept and approaches. Permaculture-basic concept and applications, the concept of Vegan organic farming.

UNIT 4: GENETICS

1. Genetics – principles of inheritance, Gene interactions, Chromosomal mutations
2. Gene editing, FTO genes, CRISPR, Genetic surgery
3. Molecular basis of genetics, transcription, translation. Post translational modification.
4. Recombinant DNA technology, restriction enzymes, gene cloning, choice of vectors, applications in plant diseases
5. DNA-types, and RNA-types, DNA barcoding-methods, status, significance and challenges, Construction of genomic/ cDNA library, PCR
6. DNA analysis, Southern – Northern blotting, sequencing, molecular markers, microarrays, RNA interference, small RNAs, microRNAs, RNAi based modifications.

Reference books

- Bhattacharjee S.K.; Advances in ornamental horticulture, Pointer publication, 2005
- Charles, Griner; Floriculture: Designing and merchandising, Delmar Cengage Learning, 2000
- Choudhary D., Mehta A.; Flower crops: Cultivation and Management, Oxford Book Company, 2010
- Manibhushan K. R.; Textbook of Horticulture, Laxmi publications Pvt. Ltd, 2018
- Randhawa G.S.; Mukhopadhyay A.N., Floriculture in India, Allied publishers pvt. Ltd, 1998
- Singh K.V.; Horticulture, Shree publishers and distributors, 2016
- Bhattacharjee, S.K; Landscape Gardening and Design with Plants; Jaipur: Aavishkar Publishers, 2012.
- De, L.C.; Handbook of Gardening; Jaipur: Sheetal Printers, 2012.
- Laeeq Futehally; Gardens: National Book Trust: 1978.
- Percy Lancaster; Gardening in India; New Delhi: Mohan Makhijani and Rekha Printers, 1979.
- K.P. Sudheer, V. Indira; Post harvest technology of Horticultural Crops, New India Pub. Agency, 2007
- Jacob John; A handbook on post- harvest management of fruits and vegetables, Daya publishing House, 2008
- Sharma Satish; Post harvest management and processing of fruits and vegetables, NIPA publishers, 2010
- Wojciech J. Florkowski, Nigel Banks, Robert L. Shewfelt; Post harvest handling: A System approach, 2014
- Bansal Mamta; Basics of Organic Farming; CBS Publishers, 2018.
- Joshi, M.; New Vistas of Organic Farming; 2nd Ed. Scientific Publishers, Jodhpur; 2012.
- Maliwal P.L.; Principles of Organic farming: Textbook; Scientific Publishers, 2020.
- Palaniappan S.P. and Annadurai K.; Organic farming theory and practice; Scientific Publishers, 2018.
- Reddy, S.R.; Principle of Organic farming; Kalyani Publishers, 2017.
- Sharma A.K.; A hand book of Organic Farming; Agrobios, 2016.
- Solaimalai, S.A.; Farming System: Theory and Practice; Kalyani Publishers, 1990.
- Wheeler P.A. and Ward Ronald B.; Non-toxic Farming Handbook; Trans National Agronomy, 1989.
- PGS guidelines (National Centre for Organic Farming) Sajiv Kheti: Anand Agriculture University.

ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD
BOTANY PRACTICALS-I [PBO- 1805L]
Choice Based Credit System (CBCS)
Effective from June-2024
M.Sc. BOTANY SEMESTER I PRACTICALS

Semester – I

Paper name: BOTANY PRACTICALS-I

Course Code: PBO- 1805 L

Total Credits: 4

Total teaching hours: 60 hrs

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Demonstrate microbiological and fungal techniques

CO2: Examine the classification, distribution, morphology, anatomy, reproduction and life cycle of Algae, Fungi, and Bryophyte types mentioned in the syllabus.

CO3: Study about Botanical nomenclature and Keys so that they can identify species by themselves.

CO4: Recognize members of the major Angiosperm families (studied in theory) by identifying their diagnostic features and economic importance.

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

CO6: Demonstrate herbarium preparation techniques.

CO7: Learn about Ecology and Ethnobotany through Charts.

CO8: Learn to prepare reports related to field trip/ Herbarium/ Ecological aspects of the campus.

1. Study of types of algae through fresh, preserved material and permanent slides- Spirulina, Microcystis, Cosmarium, Zygnema, Cladophora, Acetabularia, Navicula, Dictyota, Laminaria, Padina, Gracillaria, Gelidium.
2. Study of types of Fungi through fresh, preserved material and permanent slides- Perenospora, Phythium, Rhizopus, Erysiphae, Taphrina, Polyporus, Geaster, Alternaria, Fusarium, Uncinula.
3. Study of types of Bryophytes through fresh, preserved material and permanent slides of Bryophytes- Targionia, Fimbriaria, Porella, Fossombronia, Peltia, Anthoceros, Sphagnum, Funaria, Pogonatum, Polytrichum.
4. Isolation, culture and identification of bacteria and fungi from various sources.
5. Study of Botanical nomenclature and Botanical keys.
6. Study of families as per theory syllabus including floral formula and floral diagram.
7. Identification and study of Ethnobotanical importance of some plants of Gujarat.

8. To study the following Ecological instruments-Rain gauge, Thermometer, Thermo hygrometer, Hygrometer, Auxanometer, Electronic hypsometer, Relaskop
9. Estimation of Total iron.
10. Estimation of acidity in different water samples.
11. Study of vegetation by Line transect method and Belt transect method.
12. Study of vegetation by Quadrat method.
13. Study of vegetation by Species area curve.
14. Determination of capillarity of different soils.
15. Determination of Soil texture.
16. Submissions: Botanical tour excursion report

ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD
BOTANY PRACTICALS-II [PBO- 1806 L]
Choice Based Credit System (CBCS)
Effective from June-2024
M.Sc. BOTANY SEMESTER I PRACTICALS

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Equip students with skills and techniques related to Plant Physiology and Cell biology so that they can design their own experiments.

CO2: Study the anatomical structure of pollen grains, leaves and seedcoats by using specific techniques so that they can learn the practical use of stains in Anatomy and identify various internal structures.

CO3: Study of embryological techniques so that students become equipped with their applications.

CO4: Learn about Horticultural techniques so that students can develop their horticultural skills.

CO5: Recognize the role of Gardening in day-to-day life to so as to enhance entrepreneurship skills.

CO6: Study of post-harvest handling techniques of plant produce so that the students can look for developing their entrepreneurship setups.

CO7: Learn the preparation of organic, manure, fertilizers to instill the idea of sustainability in the students.

Semester – I

Paper name: BOTANY PRACTICALS-II

Course Code: PBO- 1806L

Total Credits: 4

Total teaching hours: 60 hrs

1. Estimation of chlorophyll and carotenoids.
2. Estimation of nitrate reductase activity.
3. To perform Thin layer chromatography of lipids.
4. Isolation and assay of Castor oil Seed lipase.
5. Measurement of water status by Water Content Method.
6. To study the effect of IAA on the permeability of cytoplasm to water
7. To study Root and Stem anatomy (selected dicot and monocot species)
8. Maceration technique of selected wood samples.
9. To study active and inactive cambium.
10. To perform the Acetolysis technique.
11. To understand principle & working and of Camera Lucida and to calculate cell area using Camera Lucida.
12. Study of airborne pollen by sampling method.
13. Study of Poly embryonic seeds. (Mango/ Citrus)

14. Isolation and purification of nuclei and their staining with Feulgen stain or DAPI.
15. Isolation of chloroplasts and determination of number of chlorophyll molecules per chloroplast.
16. Demonstration of cutting, budding, layering and grafting.
17. Study of root initials or primordium in selected cuttings
18. Demonstration of Potting and Repotting.
19. Preparation of various articles using fresh and dried flowers.
20. Processing of fruits and vegetables to value added products: jam, pickles, squash.
21. Study of shelf -life of cut flowers.
22. Study of karyotype preparation from photomicrograph of arrested metaphase of root meristems
23. Quantitative estimation of plant genomic RNA.
24. Solve the genetical problems (Gene interactions, inheritance)
25. Demonstration through charts- DNA Barcoding methods, Southern and northern blotting methods, PCR
26. Visit to processing units to study the processing, layout, Equipments, hygiene, sanitation and residual / waste management, final product/Visit to flower and Vegetable mark

SEM II (M.Sc. Botany)			
Course Code	Course Title	Hours/Week	Credits
PBO-2801	Pteridophytes, Gymnosperms, Applied Mycology and Forestry	4	4
PBO-2802	Taxonomy, Ethnobotany and Environmental Biology	4	4
PBO-2803	Plant Physiology, Histochemistry, Enzymology and Plant breeding	4	4
PBO-2804	Applied Botany-II (Gardening, Plant tissue culture, Plant Biotechnology & Biostatistics)	4	4
PBO-2805L	Botany Practicals-III	4	4
PBO-2806L	Botany Practicals-IV	4	4
		24	24

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-2801: Pteridophytes, Gymnosperms, Applied Mycology and Forestry
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Pteridophytes, Gymnosperms, Applied Mycology and Forestry

Course Code: PBO- 2801

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Learn about the classification, morphology, reproduction, general account of pteridophytes, fossil pteridophytes, ornamental ferns and Economic importance.

CO2: Understand the evolutionary significance, classification, morphology, reproduction of living and fossil gymnosperms, method of preservation of fossils and evolutionary trends.

CO3: Be acquainted with applied aspects of mycology by studying various types of fungi like Endophytic fungi, Entomopathogenic fungi, Biodegrading fungi, Bioremediating fungi, application in industrial preparations and Mycorrhizal applications in agriculture, forestry and heavy metal tolerance.

CO4: Differentiate between climatic and vegetative regions of India, forest regions of World and India, major & minor forest products of Gujarat, types of forestry, Forest mensuration and Management and learn about scope of forestry.

UNIT 1: PTERIDOPHYTES

1. Outline classification of Pteridophytes by Bierhorst (1971).
2. Morphology, reproduction, distribution, general account of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.
3. Study of following Fossil Pteridophytes (Systemic position, structure of sporophytes and gametophytes, Reproduction)
 - a. Psilophytales:- Asteroxylon
 - b. Lepidodendrales:- Lepidodendron, Stigmara, Lepidocarpon
 - c. Calamitales:- Calamites
4. Cultivation and maintenance of ornamental ferns.
5. Economic importance of Pteridophytes

UNIT 2: GYMNOSPERMS & PALEOBOTANY

1. Concept of progymnosperms and its evolutionary significance.
2. Classification of Gymnosperm by D.D. Pant (1957) with insight of history of Classification proposed.
3. Study of morphology, anatomy, reproductive organs and affinities of extant members of following orders: Coniferales, Ginkgoales, Taxales, Ephedrales, Gnetales.
4. Systematic study of fossil plants through ages:
 - a. Palaeozoic Gymnosperms: Glossopteris
 - b. Mesozoic Gymnosperms: Williamsonia
5. Fossils: Introduction, preservation, preparation and age determination, systematics, reconstruction and nomenclature.
6. Major evolutionary events and trends-in retrospect.

UNIT 3: APPLIED MYCOLOGY

1. Ecology of endophytic Fungi in leaf litter decomposition and importance in medicinal plants.
2. Fungi as a microbe for Solid waste management (Biodegradation, Bioremediation strategies)
3. Role of Entomopathogenic fungi as a measure of biological control of pests.
4. Myconanotechnology as a new and emerging science in medicine.
5. Biotechnological applications- alcohol, biodiesel, Cells as bio factories, etc.
6. Large scale commercial utilization of fungi in Gujarat and India and research level investigations of AM fungi done in Gujarat/ India.
7. Mycorrhizal Diversity and its significance or functions (in agriculture and forestry), Role of AM fungi in restoration of degraded lands and heavy metal tolerance.

UNIT 4: PHYTOGEOGRAPHY AND FORESTRY

1. Introductory Phytogeography - static and dynamic, Climate and Climatic regions of India, vegetational regions of India.

2. Forests- definition, study of various forests of the world and India, Forest products – Major and minor with reference to Gujarat
 - a. Major forest products: **Timber**: Azadirachta indica, Bamboo **Fire wood**: Acacia nilotica, Prosopis cineraria **lac**: Selichera oleosa, Prosopis juliflora
 - b. Minor forest products: **Seed Oil**: Madhuca indica, Pongamia pinnata **Dye**: Butea monosperma, Wrightia tinctoria **Gum**: Sterculia urens, Commiphora wightii
3. Forestry: Agroforestry, Urban Forestry and Silviculture.
4. Influence of forest on environment, consequence of deforestation and industrialization, sustainable use of bioresources.
5. Forest mensuration, Forest management, scope of Forestry

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, VikasPublishing 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 student- Gymnosperms; New Delhi: S. Chand Publications,1983.
- Vashishta, P.C;. Gymnosperms; New Delhi: S. Chand Publications, 1983.
- Powar and Dagainawala; General Microbiology Vol.I & I I; Mumbai: Himalaya Publishing House, 1977.
- Prescott, Harley and Klein; Microbiology, 6th edition; New Delhi: Tata McGraw -Hall publishing Company Ltd., 2004
- Sharma, P. D.; Microbiology, 6th edition; Delhi: Rajpal and Sons Publishing, 2010.
- Miller, G. Tyler; Textbook of Ecology, New Delhi: Cengage Learning India, 2009.
- Odum, E.; Barrick M.; Barrett G.; Fundamentals of Ecology, 5th edition; New Delhi:Cengage Learning India, Pvt. Ltd., 1971.
- Saha, T.K; Ecology and Environmental Biology; Kolkata: Books and Allied Pvt. Ltd.

- Sharma, P.D.; Ecology and Environment; 7th edition; Meerut : Rastogi Publishers , 1998
 - V. Kumaresan; Plant Ecology and Phytogeography, Saras Publication.
- S.A.Shah; Forestry for People; Indian Council of Agriculture Research;

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-2802: Taxonomy, Ethnobotany and Environmental Biology
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Taxonomy, Ethnobotany and Environmental Biology

Course Code: PBO- 2802

No. of Credits: 04

Learning Hours: 60 hrs

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Differentiate between phenetic and phylogenetic system, relative merit and demerits of major classification system, variation and speciation in plants, ecads and ecotypes, various taxonomic literatures and taxonomic evidences used for identification of plants and learn about Botanical gardens.

CO2: Learn how to identify plants based on morphological characters and APG IV system of classification.

CO3: Know about the History of Ethnobotany in India and the contributions of major scientists, plants used in magico-religious belief, totems, folklores and folktales, Sacred groves and PBR.

CO4: Be acquainted with Population ecology, inter and intraspecific interactions, biodiversity assessment, threats and international efforts for conservation, sustainable development and its principles and strategies and Sustainable development Goals.

UNIT 1: SYSTEMATIC BOTANY II

- 1. Systems of angiosperm classification:** Phenetic versus phylogenetic systems; relative merits and demerits of major systems of classification.
- 2. Variation and Speciation in Plants:** Nature of variation, genotypic and phenotypic variation, nature of species, ecological species, ecads and ecotypes.
- 3. Taxonomic evidence:** Morphology, Floral anatomy and ultrastructure; Palynology; Ecology and Paleobotany.
- 4. Taxonomic literature:** General taxonomic indexes, world floras and manuals, monographs and revisions, bibliographies, catalogues, review serials, periodicals, glossaries, dictionaries, cultivated and economic plants, maps and cartography, biographical references, dates of publication, location of type specimens, dictionaries and addresses, colour charts, outstanding botanical libraries.

5. **Botanical Gardens:** History, Role, Special types, World's largest garden, Major Botanical Gardens of India, Botanical Survey of India.

UNIT 2: ANGIOSPERM -II

Study of ANGIOSPERMS family with special reference to characteristic features, interrelationships, distribution, common example, economic importance and phylogeny (APG IV)

Dicotyledon:

Polypetalae: Papaveraceae, Mimosaceae, Sapindaceae, Rutaceae

Gamopetalae: Solanaceae, Cucurbitaceae

Apetalae: Loranthaceae

Monocotyledon: Zingiberaceae, Poaceae, Musaceae

UNIT 3: ETHNOBOTANY-II

1. History of Ethnobotany in India. Contribution of .K.Janakiammal, S.K.Jain, K.S.Manilal, V.V Sivarajan & P.Pushpangadan.
2. Plants in Mythology and in magico-religious beliefs; taboos and totems, folklore and folktales.
3. Sacred groves: classification, distribution, ecological significance and threats; their significance in Biodiversity conservation
4. People's biodiversity Register (PBR).
5. Ethnobotany and Modern medicine.

UNIT 4 ENVIRONMENTAL BIOLOGY

1. Population ecology, concept, type, fluctuations, factors regulating size, mortality, natality. dynamics, Competition and coexistence, intra-specific interactions, inter-specific interactions, scramble and contest competition model.
2. Fragile ecosystems, Integrated coastal zone management-projects, scope and major findings
3. Biodiversity – assessment, conservation, biodiversity act of India and related international conventions.
4. Sustainable development; Principles, Concept and Strategies, Human impact on natural resources, threats, international efforts on sustainable development, SDGs, Petro crops
5. Molecular ecology, molecular approach to behavioral ecology, conservation genetics

Reference books

- Lawrence, George H.M.; Taxonomy of Vascular Plants; 1st edition; New Delhi: Oxford& IBH Publishing Co., 1967.
- Naik, V.N.: 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 IBH Publishing 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.
 - Miller, G; Tyler; Textbook of Ecology, New Delhi: Cengage Learning India, 2009.
 - Odum, E.; Barrick M.; Barrett G.; Fundamentals of Ecology, 5th 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: Narosa Publishing House, 2000
 - Jain, S. K.; Glimpses of Indian Ethnobotany, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, 1981 .
 - Jain, S. K. ; Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow, 1989 .
 - Jain, S. K.; A Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
 - Jain, S. K., Mudgal, V., Banerjee, D. K., Guha, A., Pal, D. C. and Das, D.; Bibliography of Ethnobotany, Botanical Survey of India, Howrah. 1984.
 - Jain S.K.; Contribution to Indian Ethnobotany, Sci. Publ. Jodhpur. 1997.
 - Trivedi, P.C and Sharma Niranjan; Text Book of Ethnobotany; Pointer pub, 2011.

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-2803: Plant Physiology, Histochemistry, Enzymology and Plant
Breeding
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Plant Physiology, Histochemistry, Enzymology and Plant Breeding

Course Code: PBO- 2803

No. of Credits: 04

Learning Hours: 60 hrs

On completion of this course, the student will be able to:

CO1: Learn about TCA cycle, Glycolysis, Plant water relationships- mechanism of transport, transpiration, stomatal movement, Growth analysis-growth parameters of plants, photosynthate translocation and Stress Physiology.

CO2: Understand various histochemical techniques related to mounting, sectioning, peeling, fixation, staining, permanent and temporary preparations and photography techniques.

CO3: Know about enzyme activity, types of enzymes, activation energy, kinetics, rate of reaction, Enzyme inhibition and purification of enzyme.

CO4: Be acquainted with the plant breeding techniques, activities, methods and Hybridization techniques.

UNIT 1: PLANT PHYSIOLOGY II

1. **Respiration:** Glycolysis, TCA cycle, electron transport, ATP synthesis
2. **Plant water relations:** Mechanism of water transport, Factors affecting the rate of transpiration, anti-transpirants, role of hormones and ions in stomatal movement.
3. **Crop Physiology:** Crop growth analysis, key growth parameters, Source-sink relationships, Translocation of photosynthates and factors influencing transport of sucrose and harvest index.
4. **Stress Physiology:** Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance, Alleviation of heavy metal stress by various technologies.

UNIT 2: HISTOCHEMICAL TECHNIQUES

1. Histochemical techniques Whole mounts, sections, peels for study of fine surface and internal structures of plants, stains, mounting for temporary preparations.
2. Killing, fixing, sectioning and staining for permanent preparations.
3. Unstained preparations and study of live cells, photographing stained preparations,

Pollen pistil interactions through temporary preparation.

4. Staining for callose, DNA, RNA, Proteins, insoluble polysaccharides.

UNIT 3: ENZYMOLOGY

1. Enzyme activity and specificity, Constitutive and Induced enzymes, allosteric enzymes, Isozymes, Factors affecting enzyme activity, Ribozymes, Abzymes;
2. Active site, Activation energy, Reaction rate, Mechanism of action, Kinetics: rate order of reactions.
3. Derivation of Michaelis Menten equation – single substrate; Michaelis Menten plot and Lineweaver Burke plot.
4. Enzyme inhibition: Reversible, irreversible with one example in each case, purification of Enzyme.

UNIT 4: PLANT BREEDING

1. **Introduction:** History of Plant Breeding, the disciplines to be known by a breeder– (Botany-cytogenetics-agronomy-physiology-pathology-entomology-biochemistry-bacteriology-statistics-plant biotechnology), objectives of plant breeding
2. **Activities in plant breeding:** Creation of new varieties, selection, evaluation, multiplication and distribution
3. **Breeding methods for Self- pollinated crops:** pure line selection, mass selection, pedigree selection, bulk method of selection, back cross method
4. **Breeding methods for cross-pollinated crops:** reciprocal and recurrent selection; development of hybrids, synthetics and composites.
5. **Hybridization:** History, techniques (bagging, tagging etc.) and consequences, objectives, types of hybridization –interspecific, intergeneric, distant hybridization, procedure of hybridization, plant ideotypes, Institutions involved in release of Crop varieties

Reference Books

- 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
- B.Sc. Botany Syllabus, St. Xavier's College (Autonomous), Ahmedabad-9 P CBSPublishers & Distributors , 1986(2001)
- 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: Kalyani Publishers, 2001.
- Satyanarayana U.; Biotechnology; Kolkata: Books and Allied (P) Ltd, 2005.

- Enzymes: Biochemistry, Biotechnology and Clinical Chemistry-Trevor Palmer
- Principles of Biochemistry- Lehninger, David L. Nelson and Michael M. Cox
- Fundamentals of Enzyme Kinetics: Athel Cornish and Bowden, Portland Press, 2004
- Understanding the control of metabolism: David Fell, Portland Press, 1996
- Fundamentals of Enzymology: Price and Stevens, OUP, 1999
- Johansen, D.A.; Plant Microtechnique. Mc Graw – Hill Book Company, Inc. New York, 1940.
- Kanika, S.; Manual of Microbiology – Tools and Techniques; Ane's student edition, 2007.
- Khasim, S.K., Botanical Microtechnique; principles and Practice, Capital Publishing Company, New Delhi., 2002.

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-2804: Applied Botany II
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Applied Botany II

Course Code: PBO- 2804

No. of Credits: 04

Learning Hours: 60 hrs

On completion of this course, the student will be able to:

CO1: Learn about Xeriscaping, zero waste and low carbon landscape, climate resilience and vulnerability. Understand about home gardening and ornamental indoor plants and about Ecotourism.

CO2: Know the basics of using landscape softwares in garden designing and understand about nursery management and marketing strategies.

CO3: Learn about Media and culture preparation, culture techniques and culture initiation with various types of explants and its care.

CO4: Obtain understanding about plant biotechnological methods of somatic embryogenesis, gene transfer methods, and its applications.

CO5: perform biostatistical calculations with the help of methods like central tendency, dispersion, Anova, Correlation, Regression, probability and Hypothesis testing.

UNIT 1: GARDENING

1. Xeriscaping, hardscaping- types, materials used, lighting and water, water efficient landscape garden.
2. Ecological balance in landscape, Energy efficient landscape and garden.
3. Climate resilience and vulnerability of plants in a landscape and garden (plant selection as per the geographical location-wind direction, polar directions, light).
4. Home gardening: bottle garden, vertical garden, terrarium, important medicinal herbs in a home garden, foliage plants, flower plants, climbers, cacti and succulents, dried flowers, Ikebana.
5. Important Ornamental Indoor plants, care and maintenance strategies.
6. Ecotourism and gardens.
7. Basic introduction to Landscape designing softwares- CAD (computer aided design), 2D Drawing by Autocad in garden designing.
8. Nursery management: Exhibiting for effective sale- do's and don'ts; Marketing at the

nursery- do's and don'ts, Economics of a nursery: income, expenditure, resource management.

UNIT 2: PLANT TISSUE CULTURE

1. **Media and Culture Preparation:** Role of Micro and macro nutrients, Vitamins and carbon source in tissue culture, Media preparation- pH, Temperature, Solidifying agents, Slant Preparations etc. Maintenance of cultures, Environmental Conditions, explants characteristics.
2. **Culture techniques:** Explants selection, sterilization and inoculation; Various media preparations; MS, B5, SH PC L-2; Callus and cell suspension culture.
3. **Initiation of Cultures:** Induction and growth parameters; Culture initiation, Callus culture., Micropropagation through various explants (Leaf, Stem, Axillary bud, Tuber, Corms and Bulbills), Hardening

UNIT 3: PLANT BIOTECHNOLOGY

1. Definition Scope and impact of biotechnology - an overview.
2. Somatic embryogenesis. Artificial seeds. Applications. Protoplast culture, Use of protoplasts in genetic transformations.
3. Methods of gene transfer in plants. Agrobacterium and CaMV mediated gene transfer; direct gene transfer using PEG, microinjection, electroporation, microprojectile (biolistics) method, liposome mediated DNA delivery, Transposons as vectors.
4. Application of Plant Biotechnology: - Transgenic plants -Traits for improved crop production, Field testing of transgenic plants. Herbicide Resistance, Plant derived Vaccine, Genetic Pesticides, Pathogen resistance Molecular farming of antibodies in plants and Enhanced Nutrition.

UNIT 4: BIOSTATISTICS

1. The scope of biostatistics; Types of Data, Methods for Data Collection; Data Representation. Sampling: Reasons for sampling, methods of sampling,
2. Measures of central tendency, Measures of dispersion.
3. Probability: Definition, mutually exclusive events and addition rule, independent events and multiplication rule.
4. Probability distribution: Binomial, Poisson and Normal distribution
5. ANOVA—one way ANOVA.
6. Correlation: Pearson's correlation coefficient and Spearman's correlation.
7. Regression—Linear regression, Testing of hypothesis: Statistical hypothesis, critical region, level of significance, p-value, normal distribution T-test: t-test for mean.

Reference Books

- Bhattacharjee, S.K; Landscape Gardening and Design with Plants; Jaipur: Aavishkar Publishers, 2012.

- De, L.C.; Handbook of Gardening; Jaipur: Sheetal Printers, 2012.
- Laeeq Futehally; Gardens: National Book Trust: 1978.
- Percy Lancaster; Gardening in India; New Delhi: Mohan Makhijani and Rekha Printers, 1979.
- Satyanarayana U.; Biotechnology; Kolkata: Books and Allied (P) Ltd, 2005.
- Gupta P.K.; Elements of Biotechnology; Meerut: Rastogi Publications, 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).
- Chawla, H.S.; Introduction to Plant Biotechnology; New Delhi: Oxford and IBH publishing Co. Pvt. Ltd.
- Dube, R.C; A Text Book of Biotechnology, 4th edition; New Delhi: S. Chand and Company Ltd., 2012.
- Gupta P.K.; Elements of Biotechnology; Meerut: Rastogi Publications, 2009.
- Razdan, M.K.; Introduction to plant tissue culture; New Delhi: Oxford and IBH publishing Co. Pvt. Ltd.
- Satyanarayana U.; Biotechnology; Kolkatta: Books and Allied (P) Ltd, 2005

PRACTICALS

ST. XAVIER'S COLLEGE (Autonomous), AHMEDABAD
BOTANY PRACTICALS-III [PBO- 2805L]
Choice Based Credit System (CBCS)
Effective from June-2024
M.Sc. BOTANY SEMESTER II PRACTICALS

Semester – II

Paper name: BOTANY PRACTICALS-III

Course Code: PBO- 2805 L

Total Credits: 4

Total teaching hours: 60 hrs

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Demonstrate microbiological and fungal techniques

CO2: Examine the classification, distribution, morphology, anatomy, reproduction and life cycle of living and fossil Pteridophytes and living and fossil Gymnosperms mentioned in the syllabus.

CO3: Examine the role of fungal enzymes.

CO4: Providing an understanding about the mutual interaction between plant and fungi by learning the isolation of mycorrhizal species present in soil biota.

CO5: Equip students with the biodiversity and forest regions of India and the major and minor products obtained from the forest and Petrocrops

CO6: Examine the presence of various components like organic acids, alkaloids present in different forest products.

CO7: Study about the Botanical Keys so that they can identify species by themselves and indentify members of the major Angiosperm families as per syllabus

CO8: Awareness about plant Biodiversity Register (PBR) and its role in Ethnobotany..

1. Study of types of Pteridophytes through fresh, preserved material and permanent slides- Lycopodium, Selaginella, Pteris, Ophioglossum, Azolla, Fossil Pteridophytes: Asteroxylon, Lepidodendron, Lepidocarpon and Stigmaria, Calamites
2. Study of types of Gymnosperms through fresh, preserved material and permanent slides- Cycas, Ginkgo, Araucaria, Thuja, Gnetum, **Fossil Gymnosperm:** Glossopteris, Williamsonia, Pentoxylon, Ameylon.
3. Study of activity of Fungal cellulase.
4. Method for isolation of spores of AM fungi (Methodology, Gerdmann and Nicolson's, 1963)
5. Method for assessing root infection by mycorrhiza (Methodology, Philips and Haymann, 1970)
6. Study of biodiversity composition of different types of forest in India.
7. Measurement of tree height using non instrumental methods
8. Identification of forest products and their sources
9. Qualitative analysis of Organic acid, fats and oils, tannin and alkaloids, inorganic elements in plant ash.

10. Use of keys for identification of genus and species.
11. As per syllabus study of family with focus on APG IV system.
12. Study of Sacred grooves and its importance through field trip.
13. Study of modification in the Phenotype using any suitable plant material.
14. Identification of Petro crops- Latex yielding plant, Vegetable oil yielding plants, Essential oil yielding plants, Sugar producing plants.
15. Submissions- Workshop/Field trip report and SDGs

**BOTANY PRACTICALS-IV [PBO- 2806L]
Choice Based Credit System (CBCS)
Effective from June-2024
M.Sc. BOTANY SEMESTER IV PRACTICALS**

Semester – II

Paper name: BOTANY PRACTICALS-III

Course Code: PBO- 2806 L

Total Credits: 4

Total teaching hours: 60 hrs

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Equip students with the plant physiology and Enzymology experiments so that they can learn to design their own experiments based on the learning.

CO2: Recognize the steps involved in preparation of microscopic slides through histochemical techniques.

CO3: Equip students with the steps methods involved in Media preparation, Culture techniques, Inoculation and maintenance of Explant in Plant tissue culture laboratory

CO4: Study about the plant Biotechnological techniques like isolation of plant protoplast and preparation of artificial seeds.

CO5: Study of Plant tissue culture, Plant Biotechnology through charts.

CO6: Learn to prepare permanent slides.

1. Qualitative study of diurnal fluctuation of TAN in CAM plants
2. GOT and GPT
3. Determine k_m and V_{max} of enzyme amylase.
4. Determination of rate of transpiration by simple method (Conical flask method)
5. Demonstrate the effect of anti transpirant on the rate of transpiration by simple method.
6. Analysis of growth and yield parameters – LAD, NAR, CGR, LAI, LAR, SLA.
7. Separation of Plant Organic acids by Paper Chromatography.
8. Immobilization of Enzymes.
9. Study of Histochemical techniques through a. preparation of Stains, b. Types of Stains and Staining procedure, c. Mounting medium d. mounting, e. Laboratory Techniques.
10. Study of plant Breeder-s Kit
11. Study of methods and techniques of Plant breeding
12. Estimation of pollen sterility and fertility percentage based on anther characteristics.
13. Analysis of morphological difference in different cultivars/varieties of selected crop plant (any one)
14. Designing of landscape using charts and software.
15. Study of types of feature gardens.
16. Study of planting styles. (preparations by students themselves / chart preparations/ training sessions with experts).
17. Cleaning of glassware, sterilization procedures, culture needs, basic techniques in PTC
18. To learn the Composition and Preparation of M.S. Media.

19. Inoculation of the explant in the medium and analysis of the prepared culture.
20. Study of Plant Tissue Cultural Instrument: a. Laminar Air Flow and Autoclave, c. Microwave Oven and Hot air oven, d. Centrifuge and Shaker
21. Isolation of plant protoplast
22. To study the preparation of artificial seeds
23. Demonstration through charts: - Biological gene transfer (Azobacterium), electroporation, Microinjection and microprojectile methods, steps involved in genetic engineering.
24. Submissions: 5 Permanent Slides (Root and stem)

SEM III (M.Sc. Botany)			
Course Code	Course Title	Hours/ Week	Credits
PBO-3801	Phytochemistry, Pharmacognosy, Herbal Cosmetology & Immunology	4	4
PBO-3802	Taxonomy, Medicinal Botany and Plant pathology	4	4
PBO-3803	IPR & Nanotechnology, Biosafety & Bioethics, Bioinformatics and Remote Sensing	4	4
PBO-3804	Research Methodology and Instrumentation	4	4
PBO-3805L	Botany Practicals-V	4	4
PBO-3806L	Botany Practicals-VI	4	4
	Total	24	24

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-3801: Phytochemistry, Pharmacognosy, Herbal Cosmetology and Immunology
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Phytochemistry, Pharmacognosy, Herbal Cosmetology and Immunology

Course code: PBO-3801

No. of credits: 4

Learning hours: 60 hours

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Learn the Principles and Extraction methods of Phytochemicals along with its types and Biosynthetic pathway, Study of Plant made Pharmaceuticals used for human race and Various Research Institutes in Gujarat related to Pharmacy.

CO2: Know about Ayurvedic Pharmacopoeia of India (API), Classification and evaluation methods of drugs, Importance of pharmacognosy in modern medicine and the Plant morphology and organoleptic characters of important medicinal plants.

CO3: Be acquainted with Analytical pharmacognosy by studying about Drug adulteration, Phytochemical screening test for secondary metabolites.

CO4: Understand present status, scope and benefits of herbal science as people preferring herbal cosmetics over other chemical products, Indian standards for cosmetology, quality control tests and packing material used for cosmetic products and adverse effects of chemical products.

CO5: Obtain understanding about plant innate immunity, role of genes, Immune cells-structure of antibodies, antigens, cell mediated responses.

UNIT 1: PHYTOCHEMISTRY

1. Definition, Introduction, types of phytochemicals
2. Phytochemicals: Extraction methods-and principles
3. Steroids: Occurrence, Distribution, types, biosynthesis, isolation and uses) cholesterol, diosgenin, estrone, estradiol, etc.)
4. Terpenoids: Occurrence, Distribution, types, biosynthesis, isolation and uses
5. Alkaloids: Occurrence, Distribution, types, biosynthesis, isolation and uses (atropine, quinine, papaverine, the baine, vincristine etc.)
6. Phenols and flavonoids: Occurrence, Distribution, types, biosynthesis, isolation and uses
7. Pharmacy and other related Research Institutes in Gujarat
8. Plant made Pharamceuticals (PMP) for human use.

UNIT 2: PHARMACOGNOSY

1. Introduction to Ayurvedic Pharmacopeia of India (API).
2. Definition, Importance, Classification of drugs - Chemical and Pharmacological, Comparative aspects of various ayurvedic drugs, Drug evaluation methods; Pharmacognosy and its importance in modern medicine
3. Plant morphology and organoleptic characters, microscopic, biological source, and medicinal uses of the following herbs: Lemongrass (*Cymbopogon citratus*), Mint (*Mentha piperita*), Tulsi (*Oscimum sanctum*), Arduisi (*Adhatoda vasica*), Capsicum
4. Analytical pharmacognosy: Drug adulteration- types, methods of drug evaluation- Biological testing of herbal drugs- phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

UNIT 3: HERBAL COSMETOLOGY

1. Introduction to Herbal Science: Historical Background, Present Status and Scope of the following with special reference to literature: Medicinal Botany, Pharmacognosy, Aroma Therapy, Cosmetology. Indian Standards (IS)
2. Packaging Materials Science: Materials used for packaging of cosmetic products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.
3. IS for various herbal products-, Shampoo, Oil, Soap, Lipstick, Kajal
4. Adverse effect of chemical cosmetics, Benefits of Herbal Cosmetics.

UNIT 4: IMMUNOLOGY

1. Role of genes in plant and animal immune system.
2. Plant innate immunity: Role of Salicylic Acid, Jasmonate and Ethylene Signaling, Pre-existing-structural innate mechanisms: The wax layer and cuticle, Cytoskeleton, Hydathodes, Lenticles, Guard cells, Trichomes, Idioblasts.
3. Immune cells - haemetopoiesis -detailed study of T and B cells, Types of immunity.
4. General structure of antibodies. Immunological role of Monoclonal antibodies.
5. Antigens-types, antigenicity and immunogenicity, Antigen-antibody interaction.

6. Emphasis on cell mediated and humoral immune responses-MHC molecules and antigen processing and presentation.

Reference Books

- Choudhary, M. I., & Atta-ur-Rahman. (1999). Recent advances in phytochemistry. Elsevier.
- Panda, H. (2005). Herbal drugs industry. National Institute of Industrial Research (NIIR) Board.
- Singh, V. K., & Govil, J. N. (Eds.). (1998). Recent advances in phytochemistry. Studium Press.
- Tewari, K. C., & Misra, B. N. (2000). Phytochemistry and pharmacognosy. Pragati Books.
- Jain, S. K. (2010). Medicinal plants. Daya Publishing House.
- Sharma, S. K. (Ed.). (2004). Phytochemicals and medicinal plants. Discovery Publishing House.
- Pharmacopoeia of India, latest Edition.
- Burlando Bruno, Herbal principles in Cosmetics; CRC Press, Newyork; 2010
- Chattopadhyay P.K., Herbal Cosmetics 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 Cosmetics; CBS Publishers & Distributors; 2018.
- Kuby Immunology (2007) 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN: 13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.
- Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley&Sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.
- Janeway's Immunobiology (2012) 8th ed., Murphy, K., Mowat, A., and Weaver, C.T., Garland Science (London & New York), ISBN: 978-0-8153-4243-4.

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-3802: Taxonomy, Medicinal Botany and Plant pathology
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: Taxonomy, Medicinal Botany and Plant pathology

Course code: PBO-3802

No. of credits: 4 Learning

hours: 60 hours

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Know about modern trends in Plant taxonomy, Phylogenomic approach in Plant systematic, applications of GIS and remote sensing and Role of taxonomists and its job opportunities.

CO2: Study Phylogeny, geographical distribution and economic importance of various Angiospermic plant families especially belonging to western India.

CO3: Understand about historical background, concept, application, quality test parameters and scope of Ayurveda

CO4: Study of various Ayurvedic systems, know about Ayush Ministry, its aims and objectives

CO5: Get an insight on Plant pathogens and their disease cycle, structural and biochemical defense mechanisms in plants, acquaint knowledge about biological warfare and Agroterrorism

UNIT 1: SYSTEMATIC BOTANY III

1. Literature: Pre-Linnean Plant Taxonomy
2. Modern trends in Plant taxonomy: Present status and future scope of taxonomy in India, vegetation survey, floristics, revisionary and monographic studies
3. Barcoding concept: Standard barcode markers; nrDNA, epDNA and mt DNA, Phylogenomic approach towards understanding Plant systematics.
4. Evolution: Plesimorphic and apomorphic characters, character weighing, the effects of evolutionary theory on systematic, monographic and floristic development.
5. Applied Taxonomy: GIS, Remote sensing and Plant Quarantine, Job opportunities, and role of taxonomists.

UNIT 2: ANGIOSPERMS III

1. Study of the following families with special reference to their phylogeny, geographical distribution and plants of economic importance and common examples, especially

belonging to Western India.

Dicotyledon:

Polypetalae : Moringaceae, Zygophyllaceae, Malpigiaceae

Gamopetalae: Passifloraceae, Plumbaginaceae, Lentibulariaceae

Monochlamydae/ Apetalae: Aristolochiaceae, Euphorbiaceae

Monocotyledon: Hydrocharitaceae, Typhaceae

UNIT 3: MEDICINAL BOTANY

1. Definition and Scope of Ayurveda, Contribution of Charak and Sushruta, Panchmahabhutas, Saptadhatu and Tridosh.
2. Introduction to Panchkarma, Rutucharya and Dincharya and their Significance, Virrudh Aahar and its Significances.
3. History, Concept, Application and scope: Siddha and Unani Medicinal System
4. Introduction to AYUSH mantra—of Government and its objectives.
5. Categories of Ayurvedic products like Churna, Kawath, Vati, Arishta, Asav, Taila etc.
6. Study of selected Quality test parameters of selected ayurvedic formulations (pH, Alcohol content, Total sugar, Heavy Ash, friability etc.)
7. Collection and Processing-Collection, harvesting, drying, garbling, packing, storage of crude drugs.

UNIT 4: PLANT PATHOLOGY

1. Introduction to plant pathology, Disease triangle, Disease Cycle
2. Host Parasite relationship, economically significant and important plant
3. diseases (Powdery mildew, Early blight of potato)
4. Defense mechanisms of plants against infection: Preexisting and post existing
5. structural defense, Biochemical defense, hypersensitive reaction, SAR, role of
6. phytoalexins and other phenolic compounds.
7. Steps involved in diagnosis of plant Diseases- Koch's postulates, Inoculation
8. and isolation of pathogens from plant sample, purification of fungal culture,
9. Difference between abiotic and biotic symptoms in plants.
10. Epidemiology of Plant diseases, Plant disease forecasting, Prophylaxis/ Disease Control
11. 6. Aspects of applied plant pathology- Food Safety, Biological Warfare-Bio and Agroterrorism

Reference Books

- Lawrence, George H.M.; Taxonomy of Vascular Plants; 1st edition; New Delhi: Oxford & IBH Publishing Co., 1967.
- Naik, V.N.: 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 IBH Publishing 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.
- Trivedi, P.C. 2006 : Medicinal Plants, Ethnobotanical Approach, Agrobios India.
- Purohit & Vyas 2008 : Medicinal plants conservation : A scientific approach 2nd edition, Agrobios India.
- Handbook of Medicinal and Aromatic Plants by S.K. Bhattacharjee (2004).
- Recent Progress in Medicinal Plants Vol.12, Globalization of Herbal Health by A.K. Sharma (2006).
- Handbook of Ayurvedic Medicinal Plants by L.D. Kapoor (2005).
- Indian Medicinal Plants (Vol 1- 4) by K.R. Kirtikar and B.D. Basu (2006)
- IUCN Red List Categories by IUCN (1993).
- Indigenous Medicinal Plants Social Forestry & Tribals by M.P. Singh et al. (2003).
- Ayurvedic Drugs and their Plant Sources by V.V. Sivarajan & I. Balachandran, Oxford & IBH (1994).
- The Handbook of Ayurveda Shantha by Godagama, Bishen Singh Mahendrapal Singh, Dehradun (2004.)
- Abdin, M.Z. and Y.P. Abrol, Y.P. 2006. Traditional Systems of Medicine. Narosa Publishing House, New Delhi.
- Sambamurthy A.V.S.S; A Text Book of Plant Pathology; New Delhi: I.K.International, 2005.
- Sharma P.D.; Plant Pathology.; 4th edition; Meerut: Rastogi Publication, 2004.
- Singh R.S; Introduction to Principles of Plant Pathology; 4th edition; New Delhi: Oxford and IBH, 2009

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-3803: IPR & Nanotechnology, Biosafety & Bioethics, Bioinformatics
and Remote Sensing
Choice Based Credit System (CBCS) Theory syllabus
Effective from June-2024

Paper: IPR & Nanotechnology, Biosafety & Bioethics, Bioinformatics and Remote Sensing

Course code: PBO-3803

No. of credits: 4

Learning hours: 60 hours

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Acquaint knowledge about Historical background of IPR with certain agreements and treaties, Indian Patent Act 1970 and further amendments, process of patent filing and its importance.

CO2: Learn about the emerging field of Nanotechnology, utilization of nano materials for microbial systems and plant extracts, Application and risks related to use of nanotechnology for humans and environment.

CO3: Relate the concept of biosafety and bioethics with biotechnological research and laboratory practices.

CO4: Understand Bioinformatics and its application, gain knowledge about how to identify and handle biological and genetic data, sequence alignment, applications of Molecular Modeling and CADD.

CO5: Understand the concept of Remote sensing and its application in forestry, ecology and environment, GIS technology and its related hardware and software requirements, spatial and non-spatial information, GPS etc.

UNIT 1: IPR AND NANOTECHNOLOGY

1. **IPR:** Basics of IPR, Agreements and Treaties (History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970&recent amendments)
2. **PATENT:** Act (Sections), Rules, Forms, Fees & Sample filled in Forms, Preliminary & Inventions not Patentable, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies, Application for patents (Publication & Examination of application), Opposition to Grant of Patents & Anticipation, Prior Art Search, Drafting, Patent of Addition, Divisional Application Amendments, Revocation of patents, Convention application and PCT, Infringement
3. **Nanotechnology:** Introduction, properties of nano-materials, green synthesis of nano-materials, biological methods, use of microbial system & plant extracts, use of proteins & templates like DNA, Application of nano-materials in food, cosmetics, agriculture, environment management and medicine, Risk of Nanomaterial to human health and Environment

UNIT 2: BIOSAFETY AND BIOETHICS

1. **Biosafety:** Introduction; different levels of biosafety and its requirements, containment, Biohazard
2. **Biosafety guidelines:** Indian Regulatory Systems, GMO/LMO, RCGM, Environmental concerns, Roles of institutional biosafety Committee, GMO applications in food and agriculture, Risk management and communication
3. **Bioethics:** Biotechnology Product as Bioweapons, Ethical implications of biotechnological products and techniques, Ethics in publication rights

UNIT 3: BIOINFORMATICS

1. Introduction, overview and applications of Bioinformatics, Biological data and its characteristics.
2. Introduction to databases, types of databases, characteristics and major Bioinformatics databases (NCBI, EMBL/EBI, PDB, Swiss Prot/UniProt, GenBank etc., Inter Pro, ProDom, Pfam, KEGG, SCOP, CATH etc.), data retrieval and submission.
3. Introduction to basic bioinformatics file formats, Tools for Structure visualization.
4. Introduction and overview on Sequence alignment, Types of sequence alignment, Applications of sequence alignment, Types of BLAST, BLAST Algorithm and applications
5. Multiple sequence alignment: Introduction, overview and major applications, Protein structure prediction: Overview, Types, tools, applications
6. Introduction and applications of Molecular Modeling and CADD, Introduction, concept and applications of Molecular docking, Types of molecular docking

UNIT 4: REMOTE SENSING

1. Definition, Introduction and scope of remote sensing. Electromagnetic radiation, atmosphere window, Platforms, Sensors and type of scanning systems.
2. Basic characteristics of sensors; salient features of sensors used in LANDSAT, SPOT and Indian remote sensing satellites.
3. Aerial photography- vantage point, cameras, Filters and types of films. Elements of visual image interpretation. Multispectral Remote sensing, Microwave Remote sensing, Photogrammetry- Introduction, Stereo-scopical vision, Projection types.
4. Digital image and image structure, Image restoration and image enhancement. Image classification.
5. Remote sensing application in Forestry, Ecology and environment, Land use, Solid waste landfills, Agriculture, soils and geology, Disaster management, special focus on Gujarat
6. GIS technology and its uses in environmental science, Hardware and software requirement for GIS. Conceptual model of spatial information, Conceptual model of non-spatial information. GPS.

Reference Book

- Ignacimuthu, S.; Basic bioinformatics; 4th edition; New Delhi: Narosa Publishing House ,2005
- Jha, C. S., & Dadhwal, V. K. (2017). Remote sensing and geospatial analysis of ecological dynamics. Springer.
- Mishra, A., & Ghosh, P. K. (Eds.). (2016). Remote sensing and GIS for climate change studies in India. Springer.
- Rajendran, S., Singh, R. B., & Acharya, B. (2016). Geospatial applications for natural resources management. Springer.
- Das, D. (2006). Remote sensing and geographical information system. Narosa Publishing House.
- Raju, P. L. N., & Anbazhagan, S. (2015). Remote sensing and geospatial technologies in public health. Springer.
- Basu, I. (2018). Intellectual property rights: The law and practice of patents, copyrights, trade marks, and allied rights in India. LexisNexis.
- Narayanan, P. (2017). Law of trademarks and passing off. Eastern Book Company.
- Bhat, A. K. (2015). Intellectual property rights in India: A comprehensive review. Eastern Book Company.
- Saha, R. (2011). Law relating to intellectual property rights. Central Law Agency.
- Bansal, C. L. (2010). Law of trademarks in India. Thomson Reuters.
- Cornish, W. R., & Llewelyn, D. V. (2013). Intellectual property: Patents, copyright, trademarks, and allied rights (7th ed.). Sweet & Maxwell.
- Bently, L., & Sherman, B. (2018). Intellectual property law (5th ed.). Oxford University Press.
- Tiwari, A., & Mishra, A. K. (Eds.). (2013). Nanomaterials: A review of synthesis, properties, and applications. Scrivener Publishing.
- Gupta, R. K., & Tripathi, B. (Eds.). (2017). Nanotechnology and nanomaterials in the treatment of life-threatening diseases. CRC Press.
- Mishra, Y. K., & Mohapatra, S. (Eds.). (2013). Nanostructured materials for energy and environmental applications. Springer.

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-3804: Research Methodology and Instrumentation
Choice Based Credit System(CBCS) Theory syllabus
Effective from June-2024

Paper: Research Methodology and Instrumentation

Course code: PBO-3804

No. of credits: 4

Learning hours: 60 hours

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Study the principles and working of the instrument like Microscopy, Osmometer, radioactive techniques and centrifugal methods.

CO2: To acquaint knowledge of chromatographic, immunological, electrophoretic and spectroscopic techniques.

CO3: To gain knowledge about carrying out research scientifically by learning its meaning and objectives, concept of exploratory and types of research design, qualitative and quantitative research, data analysis and its presentation in the form of charts and graphs.

CO4: Learn about scientific research methodologies, format of writing a research paper, learn to refer resources for scientific research writing and study different forms of thesis or dissertation writing.

UNIT: 1 INSTRUMENTATION-I

1. Principles of microscopy; Light microscopy; Phase Contrast, Fluorescence microscopy; Polarizing and Electron Microscopy-SEM and TEM, Confocal microscopy, Chromosome banding, FISH, chromosome painting
2. Electrochemical techniques: Construction and working of equipment's for measurement of electrical conductivity, pH meter.
3. Measurement of water potential and osmolarity: Osmolarity equation, Osmolarity and osmotic pressure measurement, types of osmometers. Construction and working of osmometers.
4. Radioactive techniques: Isotopes and their half-life and biological half-life, Specific activity of radioisotopes, detection and measurement of radioactivity-radiation counters, liquid scintillation counters, autoradiography
5. Centrifugation methods; Differential & density gradient centrifugation, Ultracentrifugation

UNIT 2: INSTRUMENTATION-II

1. Chromatographic techniques: Paper, thin layer and column chromatography, gelfiltration, ion exchange and affinity chromatography, high pressure liquid chromatography, gas chromatography.
2. Immunological techniques: Immune response, Antibodies and their specificity, antigen antibody interactions, immunodiffusion and immunoelectrophoretic techniques, immunoassays, flow cytometry
3. Electrophoretic techniques: electro endo osmosis, electrophoresis under native and denaturing conditions, 2-D electrophoresis, SDS Page
4. Spectroscopic techniques: UV-visible and IR spectrophotometry, Infrared spectrometers, Luminometry and densitometry – principles and their applications, spectrofluorimetry, NMR and ESR spectroscopy, circular dichroism, atomic absorption and mass spectrometry, MALDITOF.

UNIT 3: RESEARCH METHODOLOGY-I

1. Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method– Understanding the language of research –Concept, Construct, Definition, Variable.
2. Problem Identification & Formulation – Research Question – Investigation Question– Measurement Issues– Hypothesis– Concept, Qualities and types.
3. Research Design: Concept, Importance in Research–Features of a good research design
4. –Exploratory Research Design, Types of Research Design–Concept, types and uses.
5. Qualitative and Quantitative Research: Concept, causality, generalization, replication. Merging the two approaches.
6. Measurement: Concept of measurement–Problems in measurement in research – Validity and Reliability. Levels of measurement– Nominal, Ordinal, Interval, Ratio.
7. Sampling: Sample, Sampling Frame, Sampling Error, Sample Size, Characteristics of a good sample.
8. Data Analysis: Data Preparation–Univariate analysis (frequency tables, bar charts, pie charts, percentages)

UNIT 4: RESEARCH METHODOLOGY-II

1. Scientific Writing – Layout of a Research Paper- Title- Developing an outline -The first step-The Introduction-Review of literature- The method: When, how, who, what? - Results-Discussion-Conclusion and Implications.
2. Science- Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
3. Resources in Scientific Writing-Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases, Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MSOffice, Software for detection ofPlagiarism, myths and misconceptions about writing, biases in writing (gender, sexual orientation, ethnic, age)
4. Various forms of scientific writing-1. Thesis or Dissertation, 2. Research Reports, 3. Articles for Journals, 4. Research Proposal, 5. Research Paper, 6. Review Paper

5. Documentation skills-Style elements in writing, Elements of editorial style

Reference Books

- Satyanarayana, U. (2014). *Biotechnology*. Elsevier.
- Bajpai, P. K. (2018). *Biotechnology: Fundamentals and applications*. Narosa Publishing House.
- Sethi, P. D. (2001). *HPLC: High performance liquid chromatography*. CBS Publishers & Distributors.
- Rai, V., & Yadav, M. (2014). *Advanced microscopy for nano-structured materials: Techniques and applications*. Springer.
- Williams, D. B., & Carter, C. B. (2009). *Transmission electron microscopy: A textbook for materials science (2nd ed.)*. Springer.
- Goldstein, J. I., Newbury, D. E., Joy, D. C., Lyman, C. E., Echlin, P., & Michael, J. R. (2017). *Scanning electron microscopy and X-ray microanalysis (4th ed.)*. Springer.
- Egerton, R. F. (2005). *Physical principles of electron microscopy: An introduction to TEM, SEM, and AEM*. Springer.
- Kirkland, E. J. (2010). *Advanced computing in electron microscopy (2nd ed.)*. Springer.
- Reimer, L., & Kohl, H. (2008). *Transmission electron microscopy: Physics of image formation (5th ed.)*. Springer
- Kothari, C. R., & Garg, G. (2019). *Research methodology: Methods and techniques (4th ed.)*. New Age International.
- Kumar, R. (2019). *Research methodology: A step-by-step guide for beginners (5th ed.)*. SAGE Publications India.
- Singh, Y. K. (2006). *Fundamental of research methodology and statistics*. New Age International.
- Bhattacharya, D. K. (2017). *Research methodology (2nd ed.)*. Excel Books.
- Krishnaswami, O. R., & Ranganatham, M. (2011). *Methodology of research in social sciences*. Himalaya Publishing House.
- Rajasekar, S. (2013). *Research methodology (3rd ed.)*. Vijay Nicole Imprints Private Limited.

**ST. XAVIER'S COLLEGE (Autonomous),
AHMEDABAD
BOTANY PRACTICALS-I [PBO- 3805L]
Choice Based Credit System (CBCS)
Effective from July-2023
M.Sc. BOTANY SEMESTER III PRACTICALS**

Semester – III

Paper name: BOTANY PRACTICALS-V

Course Code: PBO-3805 L

Total Credits: 4

Total teaching hours: 60 hrs

COURSE OUTCOMES (CO)

On completion of this course, the student will be able to:

CO1: Learn the detection of phytochemicals from plant extracts.

CO2: Identify medicinal plants based on its organoleptic characters and detect adulteration from plants.

CO3: Chromatographic detection of some common plant drugs by TLC.

CO4: To learn the application of herbs in cosmetic preparation.

CO5: Equip students with skills and techniques to identify plants using various resources

CO6: Demonstrate herbarium preparation techniques.

CO7: Learn about ayurvedic formulations.

CO8: Learn about the quality test parameters for ayurvedic formulations.

CO9: Learn to calibrate the size of any object in using microscope and learn about important plant diseases.

1. Detection of alkaloids (Datura / Sada-musfuli / Tirphal), flavonoids (Green Tea / Onion) and saponins (Karando) or from other suitable plant materials. (Chemical tests for the detection of alkaloids, phenols, saponins, flavonoids)
2. Study of biological source, organoleptic characters, and medicinal uses of the following herbs: Lemon grass, mint, tulsi, Adhatoda, Capsicum
3. Detection of adulteration in selected plants- Tulsi (black and white, Stevia, Lemon grass, mint, pepper
4. Extraction and chromatographic detection of some common plant drugs by TLC Emblica and Tulsi (Demonstration)
5. Preparation of following herbal cosmetology products- Face care: Lip care products (lipsticks/lip balm) 2. Eye Care: Kajal 3. Skin Care: Herbal Bathing Soap 4. Hair care: Oil and Shampoo
6. Study of immunology through charts- The wax layer and cuticle, Cytoskeleton, Hydathodes, Lenticles, Guard cells, Trichomes, Idioblasts.
7. Study of (a) published floras (International, National, regional and local), revision, monograph and check list.

8. Nomenclature Exercise using Taxonomic databases- theplantlist.org, IPNI, TROPICOS, eFloraindia, Etc.
9. Identification of wild and cultivated plant species using regional and national floras.
10. Preparation of Diversity Register of the Given area
11. Study of Angiosperm families as per the syllabus.
12. Preparation of ayurvedic formulations - Churna, Vati, Capsule.
13. Survey of local flora with respect their medicinal and economic importance and submission of 10 dry specimens.
14. Performing selected Quality test parameters of selected ayurvedic formulations (pH, Alcohol content, Total sugar, Heavy Ash, friability)
15. Learning calibration and measurement of fungal spores with the help of ocular micrometer and stage micrometer.
16. Study of some common fungal diseases (any 4) with diagnostic characteristics- Downy mildew, White rust of crucifer, Powdery mildew, Rust of Linseed, Ground nut leaf spot, Early blight of Potato

**ST. XAVIER'S COLLEGE (Autonomous),
AHMEDABAD
BOTANY PRACTICALS-VI [PBO- 3806L]
Choice Based Credit System (CBCS)
Effective from July-2023
M.Sc. BOTANY SEMESTER III PRACTICALS**

Semester – III**Paper name: BOTANY PRACTICALS-VI****Course Code: PBO- 3806L****Total Credits: 4****Total teaching hours: 60 hrs****COURSE OUTCOMES (CO)**

On completion of this course, the student will be able to:

CO1: Learn about biosafety measures in lab.**CO2:** Learn bioinformatics tools used for 3 D structure and protein docking.**CO3:** Understand use of softwares for remote sensing techniques.**CO4:** Relate the use of Mendeley software in reference management.**CO5:** To learn the technique of review paper preparation.**CO6:** To learn the technique of research paper preparation.**CO7:** Learn about instruments involved in biological research.

1. Study of Biosafety through Charts: a. General Safety measure, b. Biological, Physical and Chemical Hazards, C. Waste Disposal, d. First Aid
2. To search for biological data in Biological Databases, Data retrieval and submission methods.
3. Sequence Alignment using BLAST Tool
4. Multiple Sequence alignment using Clustal Omega OR Protein-ligand Docking
5. Preparation of diversity map for one plant in one area using google earth or QGIS software.
6. Interpretation of Remote sensing Images
7. To study various instruments important for biological research
8. To learn reference management using Mendeley software.
9. To learn to prepare a review paper.
10. To learn to prepare a research paper.
11. Submission of review paper

ST. XAVIER'S COLLEGE, AHMEDABAD
PBO-4801: Botany Dissertation
Choice Based Credit System (CBCS)
Theory syllabus
Effective from June-2023

SEMESTER – IV**Paper: Botany Dissertation****Course Code: PBO-4801****No. of Credits: 24****Duration of Dissertation: 360 hours****COURSE OUTCOMES (CO)**On completion of this course, the student will be able to:**CO1:** Conduct literature surveys and identify emerging research topics from botanical journals.**CO2:** Explore and recognize core research areas within the field of botany.**CO3:** Understand the significance of fieldwork in botanical research and gain experience in its application.**CO4:** Acquire knowledge of field work and of laboratory practices and essential prerequisites for conducting botanical research.**CO5:** Develop crucial research skills specific to botany, including experimental design and data interpretation.**CO6:** Gain practical experience with scientific instruments, enhance thesis writing capabilities, and improve data analysis and presentation skills.

A Dissertation has to be performed on a research topic by the student in the 4th semester. The dissertation will be performed under the guidance of a Professor from the Department who will be guiding the student through the duration of Dissertation. The student will have to submit the Dissertation work in the form of Thesis and open Presentation in front of the Examiner.

Dissertation evaluation will be done as follows:

Semester IV (Marks Distribution)		
Total Credits (24)	Evaluation (Out of 600)	
	Internal	External
1. Project/ Dissertation	120	240
2. Presenting in a seminar outside College/ Field work/ Tour	50	100
3. Assignment/ GD/ Industrial training	30	60
Total (marks)	200	400