AC/27.06.2023/RS1

SIES

College of Arts, Science & Commerce (Autonomous)

RISE WITH EDUCATION

NAAC REACCREDITED - 'A' GRADE

SIES College of Arts, Science and Commerce (Autonomous)
Sion (West) Mumbai: 400022

Affiliated to Mumbai University

Syllabus under Autonomy - June 2023

Program: T. Y. B.Sc. (6 Units)

Course: Botany

Choice Based Credit System (CBCS)

with effect from the academic year 2023-24

PREAMBLE

In the revised autonomous syllabus, the committee has taken utmost care to maintain the continuity in the flow of information at T.Y.B.Sc. level. Hence, some of the modules of the existing university syllabus have been upgraded with the new modules in order to introduce the learners to the recent developments in various branches of Botany.

All the papers of theory and practicals (Semester - V & Semester - VI together) are compulsory for the TYBSc Botany (6 Units) students according to their specialization.

Each theory period shall be of 48 minutes duration. Theory component shall have 240 instructional periods per semester. Each practical will be of 4 periods each.

MODALITY OF ASSESSMENT:

Theory Examination Pattern

A) Internal Assessment – 40M

(20M Class Test + 15M Assignment/Case study/ ppt. + 05 Class participation)

B) External examination – 60M (Semester End Theory Assessment)

i. Duration - These examinations shall be of two hours duration.
ii. Theory question paper pattern: attached herewith.

Practical Examination Pattern:

A. Internal Examination: There will not be any internal examination/ evaluation for practicals.
B. External (Semester end practical examination)

The students are required to present a duly certified journal for appearing at practical examination, failing which they will not be allowed to appear for the examination. In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from the Head of the Department/ Co-ordinator of the department; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern for Semester V

Course	PAPER I			PAPER II			PAPER III			PAPER IV			Grand Total
	Int	Ext	Total	Int	Ext	Total	Int	Ext	Total	Int	Ext	Total	
Theory	40	60	100	40	60	100	40	60	100	40	60	100	**400**
Practicals	-	50	50	-	50	50	-	50	50	-	50	50	**200**

Overall Examination and Marks Distribution Pattern for Semester VI

Course	PAPER I			PAPER II			PAPER III			PAPER IV			Grand Total
	Int	Ext	Total	Int	Ext	Total	Int	Ext	Total	Int	Ext	Total	
Theory	40	60	100	40	60	100	40	60	100	40	60	100	**400**
Practicals	-	50	50	-	50	50	-	50	50	-	50	50	**200**

PROGRAMME SPECIFIC OUTCOMES (PSOs)

After completing the graduation (B.Sc.) programme in Botany, the learners would be able to -

- **PSO1:** Identify the different groups of plants and gain the knowledge about plant biodiversity and its conservation.
- **PSO2:** Learn different techniques, protocols, methodologies during study and apply them in future.
- **PSO3:** Utilize the botanical knowledge for problem solving and for taking real time decisions while working with plants.
- **PSO4:** Learn good laboratory practices and acquire research skills required for industrial support services.
- **PSO5:** Inculcate scientific temperament, good reasoning power, technological and analytical skills while designing the experiments.
- **PSO6:** Develop interest in pursuing higher studies in plant sciences and allied fields to develop better future.
- **PSO7:** Understand the scope, current trends, job prospects and career avenues in Botany.
- **PSO8:** Share social and environmental consciousness with the fellow citizens and motivate them towards taking fundamental steps towards environmental conservation.

T.Y.B.Sc. Botany Syllabus (Restructured for Choice-Based Credit System)

To be implemented from the Academic year 2023-2024

SEMESTER V

COURSE CODE	UNIT	TOPICS	CREDITS	L /WEEK
SIUSBOT51	PLANT DIVERSITY III			
	I	Microbiology	2.5	1
	II	Algae		1
	III	Fungi		1
	IV	Plant Pathology		1
SIUSBOTP52	PLANT DIVERSITY IV			
	I	Paleobotany	2.5	1
	II	Angiosperms I		1
	III	Anatomy I		1
	IV	Palynology		1
SIUSBOT53	FORM AND FUNCTION III			
	I	Cytology and Molecular biology	2.5	1
	II	Physiology I		1
	III	Environmental Botany		1
	IV	Plant tissue culture		1
SIUSBOTP54	CURRENT TRENDS IN PLANT SCIENCES II			
	I	Ethnobotany and Mushroom Industry	2.5	1
	II	Biotechnology I		1
	III	Instrumentation		1
	IV	Pharmacognosy and medicinal botany		1
SIUSBOTP5.1(6U)	Practicals based on course I & II in theory		3	8
SIUSBOTP5.2(6U)	Practicals based on course III & IV in theory		3	8

SEMESTER VI

COURSE CODE	UNIT	TOPICS	CREDITS	L /WEEK
SIUSBOT61	PLANT DIVERSITY III			
	I	Bryophyta	2.5	1
	II	Pteridophyta		1
	III	Bryophyta and Pteridophyta: Applied aspects		1
	IV	Gymnosperms		1
SIUSBOTP62	PLANT DIVERSITY IV			
	I	Angiosperms II	2.5	1
	II	Anatomy II		1
	III	Embryology		1
	IV	Biostatistics		1
SIUSBOT63	FORM AND FUNCTION III			
	I	Plant Biochemistry	2.5	1
	II	Physiology II		1
	III	Genetics		1
	IV	Bioinformatics		1
SIUSBOTP64	CURRENT TRENDS IN PLANT SCIENCES II			
	I	Plant biotechnology II	2.5	1
	II	Plant Geography		1
	III	Economic Botany		1
	IV	Post-harvest Technology		1
SIUSBOTP6.1(6U)	Practicals based on course I & II in theory		3	8
SIUSBOTP6.2(6U)	Practicals based on course III & IV in theory		3	8

SEMESTER V THEORY

Course Code	Title	Credits & Lectures
SIUSBOT51	**PLANT DIVERSITTY III**	**2.5 Credits & 60 lectures**

LEARNING OBJECTIVES

The course Plant Diversity III in Semester V includes the units Microbiology, Algae, Fungi and Plant pathology. The course aims to expose the students to the world of different types of microbes. It would teach them culturing & fermentation techniques. It would highlight the importance of studying the morphology, general characteristics and economic importance of algae and fungi. The course would impart the students the knowledge of different plant diseases with special reference to symptoms, causal factors, disease cycle and develop integrated approach towards their control.

COURSE OUTCOMES

After completion of the course, the learners would be able to:

CO1: Identify and classify the diversity of Bacteria, Fungi and Algae.

CO2: Study the role of microbes in fermentation technology.

CO3: Demonstrate and apply the various culturing techniques.

CO4: Know the systematics and life cycle with economic importance of various algae and fungi.

CO5: Study the pathogens causing crop diseases and damage.

CO6: Know and develop the integrated approach towards controlling plant diseases.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I: Microbiology ● Types of Microbes – Bacteria, Archaea, Viruses, Fungi, Algae, Rickettsia ● Culturing: Sterilization, media, staining, colony characters ● Pure cultures ● Role of microbes in fermentation: Alcohol and Antibiotics	**(15 lectures)**

Unit II: Algae ● Division Rhodophyta Classification and General Characters: Distribution, Cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual, Alternation of Generations, Economic Importance. ● Structure, life cycle and systematic position of *Polysiphonia, Batrachospermum* ● Classification and General Characters of Xanthophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. ● Structure, life cycle and systematic position of *Vaucheria* ● Classification and General Characters of Bacillariophyta: Distribution, Cell structure, pigments, reserve food, range of thallus, Reproduction: asexual and sexual, Alternation of Generations, Economic Importance. ● Structure, life cycle and systematic position of *Pinnularia*	**(15 lectures)**
Unit III: Fungi ● Life cycle of *Albugo* ● Basidiomycetes: Classification ● Life cycle of *Puccinia* ● Deuteromycetae: Classification and General Characters ● Life cycle of *Alternaria*	**(15 lectures)**
Unit IV: Plant Pathology ● Study of plant diseases: Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following. ▪ White Rust – *Albugo sp.* ▪ Tikka disease of ground nut – *Cercospora* ▪ Damping off disease – *Pythium* ▪ Citrus canker – *Xanthomonas* sp. ▪ Leaf curl – leaf curl virus ● Study of Physical, chemical and biological control methods of plant diseases.	**(15 lectures)**

Course Code	Title	Credits & Lectures
SIUSBOT52	**PLANT DIVERSITTY IV**	**2.5 Credits & 60 lectures**

LEARNING OBJECTIVES

The course Plant Diversity IV in Semester V includes the units Paleobotany, Angiosperms, Anatomy and Palynology. The course aims to expose the students to the world of fossil plants and flowering plants. It would make them understand the morphology of fruits & general characteristics and economic importance of angiosperms. It would develop interest among students by highlighting the different aspects of plant anatomy & palynology.

COURSE OUTCOMES

After completion of the course, learners would be able to:

CO1: Acknowledge types of fossils representing different groups & evaluate the scope of Paleobotany.

CO2: Enjoy morphological studies of plants through field visits.

CO3: Expertise in field study by identifying the diagnostic characters of angiosperm families.

CO4: Compare and justify the merits and demerits of systems of classification.

CO5: Identify the types of stomata for taxonomical studies.

CO6: Study the comparative account of anomalous secondary growth in root, stem, and leaves.

CO7: Understand pollen morphology and viability with industrial applications of palynology.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I: Paleobotany ● *Calamites* – All form genera Stem, leaf, male and female fructification ● *Lepidodendron*–All form genera root, stem, bark, leaf, male and female fructification ● *Lyginopteris* – All form genera root, stem, leaf, male and female fructification ● *Pentoxylon* – All form genera ● Contribution of Birbal Sahni, Birbal Sahni Institute of Paleobotany, Lucknow	**(15 lectures)**
Unit II: Angiosperms I ● Morphology of fruit ● Complete classification of Bentham and Hooker, Merits and demerits ● Hutchinson's classification – merits and demerits ● Bentham and Hooker's system of classification for flowering plants up to family with respect to the following prescribed families and economic and medicinal importance for members of the families: Capparidaceae, Rutaceae, Umbelliferae, Cucurbitaceae, Rubiaceae, Verbenaceae, Graminae	**(15 lectures)**

Unit III: Anatomy ● Anomalous secondary growth in the Stems of *Bignonia*, *Salvadora*, *Achyranthes*, *Aristolochia*, *Dracaena*. Storage roots of Beet, Radish ● Root stem transition ● Types of Stomata – Anomocytic, Anisocytic, Diacytic, Paracytic and Graminaceous	**(15 lectures)**
Unit IV: Palynology ● Pollen Morphology – Structure of pollen grain, shape and size variations in pollen, pollen units, polarity, symmetry, pollen wall, excrescences, apertures, NPC classification, exine ornamentations, LO analysis, significance of pollen morphology ● Germination and growth of pollen tube ● Pollen viability - Concept, deficiency, tests, pollen storage ● Application of Palynology in honey industry, coal and oil exploration, Aerobiology and pollen allergies, forensic science	**(15 lectures)**

Course Code	**Title**	**Credits & Lectures**
SIUSBOT53	**FORM AND FUNCTION III**	**2.5 Credits & 60 lectures**

LEARNING OBJECTIVES

The course Forms and Functions II of Semester V encompasses the units on Cytology, Molecular biology, Environmental botany and Plant Tissue culture. The course aims to introduce the students to the cytological aspects of nucleus, vacuole and giant chromosomes. It would teach them the process of transcription and translation in eukaryotes. It would develop interest among students by highlighting the different aspects of environmental botany and plant physiology. The course would impart knowledge about different techniques in Plant tissue culture & its application.

COURSE OUTCOMES

After completion of the course, learners would be able to:

CO1: Describe the structure and functions of nucleus, vacuole, and giant chromosomes.

CO2: Understand the concept of genetic code and also translation and transcription in eukaryotes.

CO3: Gain and apply the knowledge of plant water relationship through various phenomena.

CO4: Acquire the knowledge about translocation of solutes and mineral nutrition in plants.

CO5: Investigate environmental conservation through bioremediation and phytoremediation.

CO6: Understand the phenomenon of plant succession.

CO7: Design and apply the basic protocols in Plant Tissue Culture.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I: Cytology and Molecular Biology ● Structure and function of nucleus ● Structure and function of vacuole ● Structure and function of giant chromosomes ● The genetic code: Characteristics of the genetic code ● Transcription and Translation in Eukaryotes	**(15 lectures)**
Unit II: Physiology ● **Water relations:** Potential, osmosis, transpiration, imbibition ● **Solute transport:** Transport of ions across cell membranes, active and passive transport, carriers, channels and pumps. ● **Translocation of solutes:** Composition of phloem sap, girdling experiment, pressure flow model, phloem loading and unloading, anatomy of sieve tube elements, mechanisms of sieve tube translocation, Munch's hypothesis. ● **Mineral nutrition:** Significance & deficiency symptoms of macronutrients (N, P, K, Mg, Ca) & micronutrients (S, B, Zn, Fe, Mn, Mo)	**(15 lectures)**
Unit III: Environmental Botany ● **Bioremediation:** Principles, factors responsible and microbial population in bioremediation. ● **Phytoremediation**: Metals, Organic pollutants ● **Plant succession**: Hydrosere and Xerosere – Formation of barren space, succession on the land citing different seres leading up to the climax, succession in water, ecesis, poly and monoclimax theories.	**(15 lectures)**
Unit IV: Plant Tissue Culture ● Applications of micropropagation in Floriculture and detailed study of Orchid culture. ● Plant cell suspension cultures for the production of secondary metabolites with special reference to Shikonin production. ● Somatic embryogenesis and artificial seeds- Concept, definition and various methods of protoplast fusion. ● Applications of somatic hybridization in agriculture.	**(15 lectures)**

Course Code	Title	Credits & Lectures
SIUSBOT54	CURRENT TRENDS IN PLANT SCIENCES II	2.5 Credits & 60 lectures

LEARNING OBJECTIVES

This course includes the units on Ethnobotany, Mushroom industry, Biotechnology, Instrumentation, Pharmacognosy and Medicinal Botany. It would help students to understand the basic principles & methods of ethnobotany, traditional medicines and their applications in different fields. It would also encourage the students to evaluate the potential of mushroom industry and entrepreunership development through the same. It will throw light on the construction of DNA libraries, analysis of genes and trendy instrumentation techniques. The course aims to elaborate the scope of pharmacognosy and medicinal botany through the study of herbal drugs.

COURSE OUTCOMES

After completion of the course, learners would be able to:

CO1: Understand the sources, data collection methods and applications of ethnobotany.

CO2: Gain knowledge about the traditional medicine and its utility in treating various ailments.

CO3: Explore the commercial methods of mushroom production.

CO4: Understand the construction of DNA libraries.

CO5: Analyze the genes and gene transcripts and gain knowledge about southern hybridization.

CO6: Know principle, working and operation of Calorimeter & Spectrophotometer.

CO7: Understand the utility of chromatography techniques and its applications.

CO8: Evaluate the importance and applications of herbal drugs through their monographic studies.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I: Ethnobotany and Mushroom Industry — **(15 lectures)**

- **Ethnobotany** - Definition, history, sources of data and methods of study.
- **Applications of Ethnobotany:** i) Ethnomedicines ii) Agriculture iii) Famine related plants iv) Toxic plants and Antidotes v) Edible plants
- **Traditional medicines:** Tribal medicines used in Maharashtra towards
  i) Skin ailments: *Rubia cordifolia,* Sandalwood
  ii) Liver ailments: *Phyllanthus, Andrographis*
  iii) Wound healing and ageing: *Centella, Typha, Terminalia, Tridax*
  iv) Fever: *Vitex negundo, Tinospora cordifolia* leaves
  v) Diabetes: *Momordica charantia, Syzygium cuminii*
- **Mushroom industry:** Commercial production of the mushrooms - *Pleurotus, Agaricus* and *Volvariella* with respect to composting, spawning, casing, harvesting, picking and packaging, nutritional value and economic importance.

Unit II: Biotechnology I ● Construction of genomic DNA libraries, Chromosome libraries and c-DNA libraries. ● Identification of specific cloned sequences in cDNA libraries and Genomic libraries ● Analysis of genes and gene transcripts – Restriction enzyme, analysis of cloned DNA sequences. ● Hybridization (Southern Hybridization)	**(15 lectures)**
Unit III: Instrumentation ● Colorimetry and Spectrophotometry (Visible, UV and IR) - Instrumentation, working, principle and applications. ● Chromatography: General account of Column chromatography. Principle and working of adsorption and partition chromatography, ion exchange chromatography, molecular sieve chromatography.	**(15 lectures)**
Unit IV: Pharmacognosy and Medicinal Botany Monographs of following drugs with reference to biological sources, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants – ▪ *Strychnos* seeds, ▪ Senna leaves, ▪ Clove buds, ▪ *Allium sativum,* ▪ *Acorus calamus* ▪ *Curcuma longa*	**(15 lectures)**

SEMESTER V PRACTICALS

PRACTICAL I (PLANT DIVERSITY III) & PRACTICAL II (PLANT DIVERSITY IV)

SIUSBOTP5.1(6U) Cr. 3

COURSE OUTCOMES

After completion of the course, the learners would be able to:

CO1: Acquire the knowledge about various microbiology Experiments.

CO2: Understand stages in the life cycle of algae & fungi mentioned in theory.

CO3: Identify the pathogens causing crop diseases and damage.

CO4: Know the systematics with morphological characteristics various angiospermic families mentioned in theory with morphology of fruits.

CO5: Explain the adaptions behind anomalous secondary growth and types of stomata in angiosperms.

CO6: Acquire the knowledge about various palynology Experiments.

PRACTICAL I – PLANT DIVERSITY III SIUSBOTP5.1(6U) Cr. 1.5

LEARNING OBJECTIVES:

- The course would allow the detailed study of aeromicrobiota, Minimum Inhibitory Concentration (MIC) and antimicrobial activity.
- It would help in the study of stages in the life cycle of some algae (*Polysiphonia, Batrachospermum, Vaucheria* and *Pinnularia*).
- It would also assist in the study of stages in the life cycle of some fungi (*Albugo*, *Puccinia* and *Alternaria*).
- It would impart knowledge about plant diseases (White rust, Tikka disease in Groundnut, Damping off disease, Leaf curl and Citrus canker) and their control measures.

Microbiology

- Study of aeromicrobiota by petriplate exposed method Fungal culture; Bacterial culture
- Determination of Minimum Inhibitory Concentration (MIC) of sucrose against selected microorganisms
- Study of antimicrobial activity by the disc diffusion method

Algae

Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides

- *Polysiphonia*
- *Batrachospermum*
- *Vaucheria*
- *Pinnularia*

Fungi

Study of stages in the life cycle of the following Fungi from fresh / preserved material and permanent slides

- *Albugo*
- *Puccinia*
- *Alternaria*

Plant Pathology

Study of the following fungal diseases:

- White rust
- Tikka disease in Groundnut
- Damping off disease
- Citrus canker
- Leaf curl

PRACTICAL II – PLANT DIVERSITY IV SIUSBOTP5.1(6U) Cr. 1.5

LEARNING OBJECTIVES:

- The course would assist in the study the fossil plants (*Calamites, Lepidodendron, Lyginopteris* and *Pentoxylon*).
- It would make the learners understand different types of fruits with suitable examples.
- It will assist in the diagnostic studies of families like Capparidaceae, Umbelliferae, Cucurbitaceae, Rubiaceae, Solanaceae, Commelinaceae and Graminae with suitable examples.
- It would make the learners expert in identifying the genus and species of a plant using Cooke's Flora.
- It will throw light on the anomalous secondary growth in stems (*Bignonia, Salvadora, Achyranthes, Aristolochia* and *Dracaena*) and roots (Beet and Radish) using double staining technique.
- It would teach them about the types of stomata.
- The course would also make them study pollen morphology (NPC analysis), pollen viability and effect of sucrose concentrations on *in-vitro* pollen germination and pollen analysis from honey sample.

Paleobotany

Study of the following form genera with the help of permanent slides/ photomicrographs.

- *Calamites*
- *Lepidodendron*
- *Lyginopteris*
- *Pentoxylon*

Angiosperms

- Morphology of fruit
- Study of one plant from each of the following Angiosperm families
- Capparidaceae
- Rutaceae
- Umbelliferae
- Cucurbitaceae
- Rubiaceae
- Verbenaceae
- Graminae
- Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families
- Identifying the genus and species of a plant with the help of Flora

Anatomy I

Study of anomalous secondary growth in the stems using double staining technique:

- *Bignonia*
- *Salvadora*
- *Achyranthes*
- *Aristolochia*
- *Dracaena*

Study of anomalous secondary growth in the roots of

- Beet
- Radish

Types of Stomata

- Anomocytic
- Anisocytic
- Diacytic
- Paracytic
- Graminaceous

Palynology

Study of pollen morphology (NPC Analysis) of the following by Chitale's Method

- *Hibiscus*
- *Datura*
- *Ocimum*
- *Crinum*
- *Pancratium*
- *Canna*

Determination of pollen viability

Pollen analysis from honey sample – unifloral and multifloral honey

Effect of varying concentration of sucrose on *In vitro* Pollen germination

PRACTICAL III (FORM AND FUNCTION III) & PRACTICAL IV (CURRENT TRENDS IN PLANT SCIENCES II) SIUSBOTP5.2(6U) **Cr. 3**

COURSE OUTCOMES

After completion of the course, the learners would be able to:

CO1: Explain the stages of meiosis & structure of giant chromosome.

CO2: Assess of water quality & estimation of Phosphate phosphorus and iron.

CO3: Acquire the knowledge about techniques involved in plant tissue culture.

CO4: Gain the analytical techniques of chromatographic separations.

CO5: Acquire the skills of mushroom cultivation as well as traditional knowledge about ethnobotany.

CO6: Analyse growth curve of *E. coli*, DNA isolation & separation of Plasmid DNA with understanding restriction mapping & southern blotting.

CO7: Carry out pharmacognostic studies of the plants mentioned in theory.

PRACTICAL III FORM AND FUNCTION III SIUSBOTP5.2(6U) **Cr. 1.5**

LEARNING OBJECTIVES:

- The course would make the students understand the stages of meiosis in *Tradescantia* buds.
- It will assist in detailed study of Polytene chromosome from *Chironomous* larva.
- It will help in predicting the sequence of amino acids in the polypeptide chain following translation.
- It will help to assess and estimate the Phosphate phosphorus and Iron content in plants.
- It will also equip the students with the skill of water quality assessment through estimation of Dissolved oxygen, Biological oxygen demand, Total Hardness and Salinity and Chlorinity.
- It will also give hands on experience of plant tissue culture techniques and would also make students proficient in preparation of stock solutions required for MS media preparation.

Cytology and Molecular Biology

- Mounting of Giant chromosomes from *Chironomous* larva
- Smear preparation from *Tradescantia* buds
- Predicting the sequence of amino acids in the polypeptide chain that will be formed following translation (Eukaryotic)

Physiology

- Estimation of Phosphate phosphorus (Plant acid extract)
- Estimation of Iron (Plant acid extract)

Environmental Botany

Estimation of the following in given water sample

- Dissolved oxygen demand
- Biological oxygen demand
- Hardness
- Salinity and Chlorinity

Micropropogation

Plant Tissue culture:

- Identification – Multiple shoot culture, hairy root culture, somatic embryogenesis
- Preparation of stock solutions for preparation of MS medium

  (Note: Concept of preparation of specified molar solutions should be taught and problems based on preparation of stock solutions for tissue culture media will be given)

PRACTICAL IV CURRENT TRENDS IN PLANT SCIENCES II Cr. 1.5

SIUSBOTP5.2(6U)

LEARNING OBJECTIVES:

- The course would give insight of ethnobotany and traditional medicines.
- It would encourage entrepreneurship development through mushroom cultivation.
- It will assist in determination of growth curve and generation time in *E. coli*.
- It would make them understand the Plasmid DNA isolation and separation of DNA using AGE.
- It would also encourage problem solving on restriction mapping and teach the concept of Southern blotting.
- It will help in the assessment of Beer Lambert's Law.
- It will teach them to separate dyes/ plant pigments using silica gel column and ion exchange chromatography.
- It will help to carry out pharmacognosic study of various medicinal plants.

Ethnobotany and Mushroom Industry

- Study of plants mentioned in theory for ethnobotany
- Mushroom cultivation (To be demonstrated)
- Identification of various stages involved in mushroom cultivation – spawn, pin head stage, mature/ harvest stage of *Agaricus, Pleurotus, Volvariella*

Biotechnology I

- Growth curve of E. coli
- Plasmid DNA isolation and Separation of DNA using AGE
- Restriction mapping (problems), Southern blotting

Instrumentation

- Demonstration of Beer Lambert's Law
- Experiment based on ion exchange chromatography for demonstration
- Experiment based on separation of dyes/ plant pigments using silica gel column.

Pharmacognosy

Macroscopic/ Microscopic characters and Chemical tests for active constituents of the following plants

- *Allium sativum*
- *Acorus calamus*
- *Curcuma longa*
- *Senna angustifolia*
- *Strychnos nux-vomica*
- *Eugenia caryophyllata*

SEMESTER VI

Course Code	Title	Credits & Lectures
SIUSBOT61	**PLANT DIVERSITTY III**	**2.5 Credits & 60 Lectures**

LEARNING OBJECTIVES

The course Plant Diversity III in Semester VI consists of units on Bryophyta, Pteridophyte, Applied aspects of Bryophytes and Pteridophytes and Gymnosperms. It would allow students to study different bryophytes, pteridophytes and gymnosperms with special reference to their morphology, anatomy, lifecycle and systematics. The course would also elaborate the applied aspects such as ecology, diversity, distribution, evolution and uses of bryophytes and pteridophytes in general. It would help students to understand economic importance of various coniferophytes.

COURSE OUTCOMES:

After completion of the course, learners would be able to:

CO1: Study life cycles of Bryophytes: *Marchantia, Pellia* and *Funaria*.

CO2: Understand life cycles of Pteridophytes: *Lycopodium, Equisetum, Adiantum* and *Marsilea*.

CO3: Judge the ecology, diversity, distribution, and evolution of Bryophytes and Pteridophytes.

CO4: Outline the economic importance of Bryophytes, Pteridophytes and Gymnosperms.

CO5: Learn systematics and lifecycle of Gymnosperms viz., *Thuja*, *Gnetum* and *Ephedra*.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I: Bryophyta ● Life cycle of *Marchantia* ● Life cycle of *Pellia* ● Life cycle of *Funaria*	**(15 lectures)**
Unit II: Pteridophyta ● Lepidophyta – Classification, general characters; Life cycle of *Lycopodium* ● Calamophyta – Classification, general characters; Life cycle of *Equisetum* ● Pterophyta – Classification and general characters, Life cycle of *Adiantum* and *Marsilea*	**(15 lectures)**
Unit III : Bryophytes and Pteridophytes: Applied aspects ● Ecology of Bryophytes ● Economic importance of Bryophytes ● Bryophytes as indicators ● Evolution of Sporophyte ● Economic importance of Pteridophytes ● Diversity and distribution of Indian Pteridophytes ● Types of sori and evolution of sori	**(15 lectures)**

Unit IV: Gymnosperms ● Systematic position and Life cycle of *Thuja* ● Systematic position and Life cycle of *Gnetum* ● Systematic position and Life cycle of *Ephedra* ● Economic importance of Gymnosperms	**(15 lectures)**

Course Code	Title	Credits & Lectures
SIUSBOT62	**PLANT DIVERSITTY IV**	**2.5 Credits & 60 Lectures**

LEARNING OBJECTIVES

The course Plant Diversity IV in Semester VI consists of units on Angiosperm, Anatomy, Embryology and Biostatistics. The course aims to generate interest amongst students about angiosperms and major botanical gardens in India. It would teach them different interesting aspects of ecological anatomy & embryology. The course would also update the students about biostatistical tests and their applications in data analysis.

COURSE OUTCOMES

After completion of the course, learners would be able to:

CO1: Expertise in field study by identifying the diagnostic characters of angiosperm families.

CO2: Understand the role of BSI and major Botanical gardens in India with respect to taxonomy.

CO3: Take comparative account of anatomical structures in plants with various ecological adaptations.

CO4: Study the process of micro/megasporogenesis & development of male and female gametophytes.

CO5: Identify and describe embryological concepts like double fertilization, embryo development.

CO6: To apply statistical tests like t test, ANOVA and Regression for the analysis of biological data.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I: Angiosperms II ● Major Botanical gardens of India – Indian Botanical Garden, Howrah; National Botanical Garden (NBRI) Lucknow; Lloyd Botanical Garden, Darjeeling; Lalbaugh or Mysore State Botanical Garden Bangalore ● Botanical survey of India and regional branches of India ● Study of following plant families ➢ Combretaceae ➢ Myrtaceae ➢ Apocynaceae ➢ Asclepiadaceae ➢ Acanthaceae ➢ Labiatae ➢ SF. Cannaceae	**(15 lectures)**

Unit II: Anatomy II Ecological adaptations and anatomy of: ● Hydrophytes (Submerged, Floating, Rooted) ● Hygrophytes ● Mesophytes ● Sciophytes ● Halophytes ● Epiphytes ● Xerophytes	**(15 lectures)**
Unit III: Embryology ● Microsporogenesis ● Megasporogenesis - Development of monosporic type, examples of all embryo sacs ● Types of ovules ● Double fertilization ● Development of embryo – *Capsella*	**(15 lectures)**
Unit IV: Biostatistics ● Test of significance student's *t*-test (paired and unpaired) ● Regression ● ANOVA (one way)	**(15 lectures)**

Course Code	Title	Credits & Lectures
SIUSBOT63	**FORM AND FUNCTION III**	**2.5 Credits & 60 Lectures**

LEARNING OBJECTIVES

The course Form and Function III in Semester VI consists of units on Plant Biochemistry, Plant Physiology, Genetics and Bioinformatics. The course would teach students structure of biomolecules, enzyme kinetics, nitrogen metabolism & PGRs. It would generate Genetic mapping in eukaryotes, Gene mutations & metabolic disorders. It would expose them to the latest techniques in bioinformatics and make them understand the organization, retrieval, analysis and application biological data.

COURSE OUTCOMES

After completion of the course, learners would be able to:

CO1: Study the structure of biomolecules like carbohydrates, proteins and lipids.

CO2: Understand the nomenclature, mode of action and kinetics of enzyles.

CO3: Study the nitrogen metabolism by learning various processes involved in it.

CO4: Evaluate the physiological and commercial applications of various plant growth regulators.

CO5: Explore concepts in genetic like Linkage, Crossing over, Gene recombination and mapping.

CO6: Learn about Gene mutations and metabolic disorders.

CO7: Gain and apply the knowledge for phylogenetic analysis and protein structure dynamics.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I: Plant Biochemistry ● **Structure of biomolecules:** Carbohydrates (sugars, starch, cellulose, pectin), lipids (fatty acids and glycerol), proteins (amino acids) ● **Enzymes**: Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis Menten equation, competitive non-competitive, and uncompetitive inhibitors.	**(15 lectures)**
Unit II: Plant Physiology II ● **Nitrogen metabolism:** Nitrogen cycle, root nodule formation, and leg haemoglobin, nitrogenase activity, assimilation of nitrates, (NR, NiR activity), assimilation of ammonia, (amination and transamination reactions), nitrogen assimilation and carbohydrate utilisation. ● **Physiological effects and commercial applications**: Auxins, Gibberillins, Cytokinins, Ethylene and Abscissic acid.	**(15 lectures)**
Unit III: Genetics ● Linkage & crossing over, Gene recombination, Genetic mapping in eukaryotes, Construction of genetic maps, three-point crosses and mapping chromosomes, problems based on the same.	**(15 lectures)**

● **Gene mutations**: Definition, types of mutations, causes of mutations, induced mutations, Ame's test. ● **Metabolic disorders**: Enzymatic and non-enzymatic – Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenylketonuria, albinism, sickle cell anaemia.	
Unit IV: Bioinformatics ● Organization of biological data, databases ● Exploration of data bases, retrieval of desired data, BLAST. ● Protein structure analysis and application ● Multiple sequence analysis and phylogenetic analysis	**(15 lectures)**

Course Code	Title	Credits & Lectures
SIUSBOT64	**CURRENT TRENDS IN PLANT SCIENCES II**	**2.5 Credits & 60 Lectures**

LEARNING OBJECTIVES

The course Current Trends in Plant Sciences II in Semester VI consists of units on Plant Biotechnology, Economic Botany, Plant Geography and Postharvest Technology. It would help students understand DNA sequence analysis, PCR and DNA barcoding. The course would provide opportunity to the students to explore the concept of biodiversity and to study Phytogeographical regions in India. It would impart them knowledge of Economic Botany for exploring the extraction and application of various types of oils. It aims to teach them about the current preservation techniques used in Postharvest industry.

COURSE OUTCOMES

After completion of the course, learners would be able to:

CO1: Explore the basic techniques of DNA sequencing and their applications.

CO2: Understand and apply the knowledge of PCR and DNA barcoding.

CO3: Explore Phytogeographical regions in India through theoretical and field studies.

CO4: Evaluate the concept, level, and importance of plant biodiversity.

CO5: Recognize the causes for loss of biodiversity and its conservation techniques.

CO6: Study the extraction and application of essential, fatty, and vegetable oils.

CO7: Investigate and apply commercially viable postharvest techniques.

CIA – Class Test (20M) + Assignment/ Case Study/ Presentation (15M) + Class Participation (5M)

Unit I: Plant Biotechnology II ● DNA sequence analysis – Maxam – Gilbert Method and Sanger's method ● Polymerase Chain Reaction (PCR) ● DNA barcoding: Basic features, nuclear genome sequence, chloroplast genome sequence, *rbc*L gene sequence, *mat*K gene sequence, present status of barcoding in plants.	**(15 lectures)**
Unit II: Plant Geography ● **Phytogeographical regions of India** ● **Biodiversity**: ▪ Definition, diversity of flora found in various forest types of India ▪ Levels of biodiversity ▪ Importance and status of biodiversity ▪ Loss of biodiversity ▪ Conservation of biodiversity – *insitu* and *exsitu*; International efforts – Convention on Biological Diversity (CBD) ▪ Genetic diversity- Molecular characteristics	**(15 lectures)**

Unit III: Economic Botany ● **Essential Oils:** Extraction, perfumes, perfume oils, oil of rose, sandalwood, patchouli, champa, grass oils: *Citronella*, Vetiver. ● **Fatty oils**: Drying oil (linseed and soyabean oil), semidrying oils (cotton seed, sesame oil) and non-drying oils (olive oil and peanut oil). ● **Vegetable Fats**: Coconut and Palm oil.	**(15 lectures)**
Unit IV: Post Harvest Technology **Storage of Plant Produce - Preservation of Fruits and Vegetables** ● **Drying (Dehydration):** Natural conditions – Sun drying; Artificial drying- hot air drying, Vacuum drying, osmotically dried fruits, Crystallized or Candied fruits, Fruit Leather, Freeze Drying) ● **Freezing**: Cold air blast system, Liquid immersion method, Plate freezers, Cryogenic Freezing, Dehydrofreezing ● Canning ● Pickling (in brine, in vinegar, Indian pickles) ● Sugar Concentrates (Jams, Jellies, Fruit juices) ● Use of Chemical preservatives and antioxidants in preservation	**(15 lectures)**

SEMESTER VI PRACTICAL

PRACTICAL I (PLANT DIVERSITY III) & PRACTICAL II (PLANT DIVERSITY IV)
SIUSBOTP6.1(6U) Cr. 3

COURSE OUTCOMES

After completion of the course, the learners would be able to:

CO1: Know the economic importance of bryophytes and pteridophytes & stages in the life cycle of types mentioned in theory.

CO2: Recognize the benefits of gymnosperms with stages in the life cycle of types mentioned in theory.

CO3: Study the economic importance of bryophytes and pteridophytes.

CO4: Know the systematics with morphological characteristics various angiospermic families mentioned in theory with Identification of the genus and species with the help of flora.

CO5: Explain the adaptions exhibited by plants belonging to different ecological groups.

CO6: Acquire the knowledge about stages of micro / megasporogenesis & embryo development with In vivo growth of pollen tube.

CO7: Apply knowledge of biostatical principles in problem solving.

PRACTICAL I – PLANT DIVERSITY III SIUSBOTP6.1 (6U) Cr. 1.5

LEARNING OBJECTIVES:

- The course will teach them stages in the life cycle of some bryophytes (*Marchantia*, *Pellia* and *Funaria*) with respect to their vegetative and reproductive structures.
- It would also teach them stages in the life cycle of some pteridophytes (*Lycopodium, Equisetum, Adiantum* and *Marselia*) with respect to their vegetative and reproductive structures.
- It would throw light on economic importance of some byrophytes and pteridophytes.
- It will help in carrying out detailed study of sporophytes in bryophytes and types of sori and soral arrangement in pteridophytes.
- It would throw light on the life cycle stages in some gymnosperms (*Thuja, Gnetum* and *Ephedra)* with respect to their vegetative and reproductive structures.
- It will help in appreciating the benefits of gymnosperms.

Bryophyta

Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides

- *Marchantia*
- *Pellia*
- *Funaria*

Pteridophyta

Study of stages in the life cycles of the following Pteridophytes from fresh / preserved material and permanent slides

- *Lycopodium*
- *Equisetum*
- *Adiantum*
- *Marsilea*

Bryophytes and Pteridophytes: Applied aspects

- Economic importance of Byrophyta
- Economic importance of Pteridophyta
- Types of sporophytes in Bryophyta (from Permanent slides)
- Types of sori and soral arrangement in Pteridophytes

Gymnosperms

- Study of stages in the life cycles of the following Gymnosperms from fresh / preserved material and permanent slides
  - *Thuja*
  - *Gnetum*
  - *Ephedra*
- Economic importance of Gymnosperms

PRACTICAL II – PLANT DIVERSITY IV SIUSBOTP6.1 (6U) Cr. 1.5

- The course will help in carrying out detailed study of angiosperm families (Rhamnaceae, Combretaceae, Asclepiadaceae, Labiatae, Euphorbiaceae and Cannaceae).
- It would make learners proficient in identifying the genus and species with the help of flora.
- It would make students aware about the ecological anatomy of hydrophytes, mesophytes, sciophytes, halophytes, epiphytes and xerophytes.
- The course would impart knowledge about various stages of microsporogenesis and megasporogenesis, embryo development and *in-vivo* growth of pollen tube.
- It would help to develop the problem-solving aptitude through various biostatistics tests like Student's t-Test, Regression and ANOVA (one way) used in biological data analysis.

Angiosperms

- Study of one plant from each of the following Angiosperm families
  - Combretaceae
  - Myrtaceae
  - Apocynaceae
  - Asclepiadaceae
  - Acanthaceae
  - Labiatae
  - SF. Cannaceae
- Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families
- Identify the genus and species with the help of flora

Anatomy

Study of Ecological Anatomy of

- Hydrophytes: *Hydrilla* stem, *Nymphaea* petiole, *Eichhornia* offset
- Epiphytes: Orchid
- Sciophytes: *Peperomia* leaf
- Xerophytes: *Nerium* leaf, *Opuntia* phylloclade
- Halophytes: *Avicennia* leaf and pneumatophore, *Sesuvium* / *Sueda* leaf
- Mesophytes: *Vinca* leaf

Embryology

- Study of various stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides / photomicrographs
- Mounting of Monocot (Maize) and Dicot (Castor and Gram) embryo
- *In vivo* growth of pollen tube in *Portulaca/Vinca*

Biostatistics

- *t*-test (paired and unpaired)
- Problems based on regression analysis
- ANOVA

PRACTICAL III (FORM AND FUNCTION III) & PRACTICAL IV (CURRENT TRENDS IN PLANT SCIENCES II) SIUSBOTP6.2(6U) **Cr. 3**

COURSE OUTCOMES

After completion of the course, the learners would be able to:

CO1: Assess kinetics of enzyme activity, estimate plants proteins, study effect of GA_3 and role of alpha- amino nitrogen in plants.

CO2: Solve the problems based on chromosome mapping.

CO3: Gain the knowledge about types & effects of mutations.

CO4: Acquire computational skills on Bioinformatic experiments. **CO5:** Identify plant material via DNA sequencing and barcoding.

CO6: Get the entrepreneurship skills with respect to postharvest technology.

CO7: Learn the concepts in plant geography.

CO8: Apply knowledge of distillation technology in perfumery.

PRACTICAL III – FORM AND FUNCTION III SIUSBOTP6.2 (6U) **Cr. 1.5**

LEARNING OBJECTIVES:

- The course would make students learn the estimation of proteins from sample.
- It will assist in understanding amylase activity and the factors affecting it (pH variation, substrate variation and temperature variation).
- It will impart knowledge about estimation of alpha-amino nitrogen and effect of GA_3 on seed germination.
- It will help in analysing problems based on three-point crosses, mutations and chromosome mapping.
- It will assist in evaluation of effect of PDB on mitosis in *Allium* root tips.
- It will impart the computational skills through experiments based on bioinformatics.

Plant Biochemistry

- Estimation of proteins by Biuret method
- Effect of temperature on the activity of amylase
- Effect of pH on the activity of amylase
- Effect of substrate variation on the activity of amylase

Plant Physiology

- Determination of alpha-amino nitrogen
- Effect of GA on seed germination
- Estimation of reducing sugars by DNSA method

Genetics

- Problems based on three-point crosses, construction of chromosome maps
- Identification of types of mutations from given DNA sequences
- Study of mitosis using pre-treated root tips of *Allium*

Bioinformatics

- BLAST: nBLAST, pBLAST
- Multiple sequence alignment
- Phylogenetic analysis
- RASMOL/ SPDBV

PRACTICAL IV - CURRENT TRENDS IN PLANT SCIENCES SIUSBOTP6.2 (6U) Cr. 1.5

LEARNING OBJECTIVES:

- The course would impart knowledge of molecular identification of plant material via DNA sequencing and plant barcoding.
- It would teach them about phytogeographical regions of India and vegetation map using Garmin's GPS instrument.
- It would develop problem solving aptitude through problems based on Simpson's diversity Index.
- The course would demonstrate extraction of essential oil using Clevenger apparatus and would also through light on the separation of essential oils by thin layer chromatography.
- It will help in estimating saponification value of palm oil.
- It will make student proficient in preparation of various processed products like Squash, Jam, Jelly and Pickle to promote entrepreneurship skills in students.

Plant Biotechnology II

- DNA sequencing (Sanger's Method)
- DNA barcoding of plant material by using suitable data

Plant Geography

- Study of phytogeographic regions of India
- Preparation of vegetation map using Garmin's GPS Instrument
- Problems based on Simpson's diversity Index

Economic Botany

- Demonstration: Extraction of essential oil using Clevenger
- Thin layer chromatography of essential oil of patchouli and *Citronella*
- Saponification value of palm oil

Post-Harvest Technology

Preparation of the following:

- Squash
- Jam
- Jelly
- Pickle

Note:

1. A minimum of four field excursions (with at least one beyond the limits of Mumbai) for habitat studies are compulsory. Field work of not less than eight hours duration is equivalent to one period per week for a batch of fifteen students.
2. A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of TYBSc Botany and the Field Report or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of TYBSc Botany as per the minimum requirements. In case of loss of a journal, the candidate must produce a certificate from the Head of the Department/ Institute that the practical for the academic year were completed by the student. However; such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.

SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)

SION (WEST), MUMBAI – 400 022

Fifth/Sixth Semester

Class: T.Y.B.Sc (6 Units) **Sub: Botany** **Paper: I/II/III/IV**

Day: **Date:** **Time:** **Marks: 60**

N.B.: **1)** **All questions are Compulsory.**

2) **Figures to the right indicate marks.**

3) **Draw neat labelled diagrams wherever necessary.**

Q.1 **a)** Unit I: Long answer question **(10)**

OR

a) Unit I: Long answer question **(10)**

b) Write note on **any one** of the following: **(05)**

i Unit I

ii Unit I

Q.2 **a)** Unit II: Long answer question **(10)**

OR

a) Unit II: Long answer question **(10)**

b) Write note on **any one** of the following: **(05)**

i Unit II

ii Unit II

Q.3 **a)** Unit III: Long answer question **(10)**

OR

a) Unit III: Long answer question **(10)**

b) Write note on **any one** of the following: **(05)**

i Unit III

ii Unit III

Q.4 **a)** Unit IV: Long answer question **(10)**

OR

a) Unit IV: Long answer question **(10)**

b) Write note on **any one** of the following: **(05)**

i Unit IV

ii Unit IV

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