AC/27.04.2022/RS1

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

Affiliated to Mumbai University

Syllabus under Autonomy - June 2022

Program: S. Y. B. Sc.

Course: Botany

Choice Based Credit System (CBCS)

with effect from the academic year 2022-23

PROGRAMME SPECIFIC OUTCOMES (PSOs)

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

- **PSO1:** Identify the different groups of plants and gain 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 a better future.
- **PSO7:** Understand the scope, current trends, job prospects and career avenues in Botany.
- **PSO8:** Share social and environmental consciousness with fellow citizens and motivate them towards taking fundamental steps towards environmental conservation.

PREAMBLE

Keeping in tune with the revised autonomous syllabus of F. Y. B. Sc. the committee has taken utmost care to maintain the continuity in the flow of information of higher level at S. Y. B. Sc. Hence some of the modules of the existing university S. Y. B. Sc. syllabus have been upgraded with the new modules in order to make the learners aware about the recent developments in various branches of Botany (like Thallophyta, Spermatophyta, Genetics, Molecular Biology, Plant physiology, Biochemistry, Environmental Botany, Medicinal Botany, etc.). Various interdisciplinary courses such as Biostatistics, Bioinformatics, Biotechnology & Bioinstrumentation are also introduced to make the students at par with the updated tools and techniques.

Three papers of theory and practicals (Semester - III & Semester - IV together) are compulsory for the students.

Each theory period shall be of 48 minutes duration. Theory component shall have 135 instructional periods per semester. Each practical will be of 3 periods of 48 minutes 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 the 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 III

Course	PAPER I			PAPER II			PAPER III			Grand Total
	Internal	**External**	**Total**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**	
Theory	40	60	100	40	60	100	40	60	100	**300**
Practicals	-	50	50	-	50	50	-	50	50	**150**

Overall Examination and Marks Distribution Pattern for Semester IV

Course	PAPER I			PAPER II			PAPER III			Grand Total
	Internal	**External**	**Total**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**	
Theory	40	60	100	40	60	100	40	60	100	**300**
Practicals	-	50	50	-	50	50	-	50	50	**150**

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

To be implemented from the Academic year 2022-2023

SEMESTER III

Course Code	UNIT	TOPICS	Credits	L /Weeks
SIUSBOT31	PLANT DIVERSITY II			
	I	Thallophyta (Algae) and Bryophyta	2	1
	II	Angiosperms		1
	III	Modern Techniques to Study Plant Diversity		1
SIUSBOT32	FORM AND FUNCTION II			
	I	Cell Biology	2	1
	II	Cytogenetics		1
	III	Ecology and Environmental Botany		1
SIUSBOT33	CURRENT TRENDS IN PLANT SCIENCES I			
	I	Pharmacognosy and Phytochemistry	2	1
	II	Forestry and Economic Botany		1
	III	Industry Based on Plant Products		1
SIUSBOTP3.1	Practicals based on courses Plant Diversity II, Forms and Functions II, and Current Trends in Plant Sciences I in theory		3	9

SEMESTER IV

Course Code	UNIT	TOPICS	Credits	L /Weeks
SIUSBOT41	PLANT DIVERSITY II			
	I	Thallophyta: Fungi, Plant Pathology	2	1
	II	Pteridophyta and Palaeobotany		1
	III	Gymnosperms		1
SIUSBOT42	FORM AND FUNCTION II			
	I	Anatomy	2	1
	II	Plant Physiology and Plant Biochemistry		1
	III	Molecular Biology		1
SIUSBOT43	CURRENT TRENDS IN PLANT SCIENCES I			
	I	Horticulture and Gardening: Introduction to Horticulture	2	1
	II	Biotechnology		1
	III	Biostatistics and Bioinformatics		1
SIUSBOTP4.1	Practicals based on courses Plant Diversity II, Forms and Functions II, and Current Trends in Plant Sciences I in theory		3	9

SEMESTER III THEORY

Course Code	Title	Credits & Lectures
SIUSBOT31	**PLANT DIVERSITY II**	**2 Credits & 45 Lectures**

LEARNING OBJECTIVES: The course, Plant Diversity II, comprises the units on Thallophyta (Algae) & Bryophyta, Angiosperms and Modern techniques to study plant diversity. The course includes detailed study of diversity in algae, bryophytes and their future applications in industry and environment. It aims to provide understanding of floral morphology of angiospermic flowers. It would help to explore the Angiosperm families / subfamilies & their economic importance and also their systematic position. It would allow learning of the modern techniques in Microscopy, Chromatography and Electrophoresis.

COURSE OUTCOMES:

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

CO1: The life cycles of *Volvox* and *Sargassum.*

CO2: The general characters of division Phaeophyta.

CO3: Anthocerotae among Bryophyta along with life cycle of *Anthoceros*.

CO4: Identification and classification of plants based on Bentham & Hooker's system of classification.

CO4: Floral morphology of angiosperms.

CO6: Introduction to E-herbaria, microscopy, chromatography, and electrophoresis.

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

Unit I: Thallophyta (Algae) & Bryophyta (15 Lectures)

- Structure, life cycle and systematic position of *Volvox*. (G. M. Smith's system of classification to be followed)
- General characters of Division Phaeophyta: distribution, cell structure, range of thallus, economic importance.
- Structure, life cycle and systematic position of *Sargassum*.
- General account of class Anthocerotae - structure, life cycle and systematic position of *Anthoceros*.
- Applied Aspects: Algal Culturing, Applications of bryophytes in agriculture and horticulture.

Unit II: Angiosperms (15 Lectures)

Morphology of Flowering Plants

- **Flower Morphology**: Parts of a flower, flower symmetry;
  - Thalamus, insertion of floral leaves on the thalamus
  - The accessory whorls: Calyx types and modifications, Corolla – forms; Aestivation, The Perianth;
  - The Essential whorls: Androecium parts of the androecium, Number and insertion of stamens, Union of stamens; Types of corona; Gynoecium: the carpel, style and stigma; Union of carpel; Ovary: placentation, types of ovules.
- With the help of **Bentham and Hooker's system of Classification for flowering plants** study the vegetative, floral characters and economic importance of the following families:
  - Magnoliaceae
  - Leguminosae (Papilionaceae, Caesalpinae, Mimosae)
  - Asteraceae
  - Amaranthaceae
  - Palmae

Unit III: Modern Techniques to Study Plant Diversity (15 Lectures)

- Preservation methods: Dry (Herbarium) and Wet (Fixation). E-Herbarium (digitization).
- Microscopy: Principle and working of Light and Electron microscope.
- Chromatography: Principles and techniques in paper and thin layer chromatography, and HPTLC.
- Principles and techniques of Horizontal and Vertical gel electrophoresis.

Course Code: SIUSBOT31	**REFERENCE BOOKS: Course Title: PLANT DIVERSITY II**
Unit I:	**Thallophyta (Algae) & Bryophyta**

- Chapman, V. J. (1941). An Introduction to the Study of Algae. New York Macmillan Cambridge at the University Press.
- Fritsch, F. E. (1956). The Structure and Reproduction of Algae. Cambridge University Press
- Gangulee, H. C., Das, K. S. and Datta C. (1988). College Botany Vol. I, Central Education Enterprises.
- Belcher, H. and Swale E. (1982) Culturing Algae: A guide for schools and colleges, Institute of Terrestrial Ecology, Culture Centre of Algae and Protozoa publication.
- Parihar, N. S. (1961) Bryophyta, Central Book Depot.

- Robert Andersen, Algal Culturing Techniques (2005) Phycological Society of India, Elsevier, Academic Press.
- Sharma, O. P. (2014) Bryophyta, McGraw Hill Publications.
- Smith G. M. (1955). Cryptogamic Botany Vol I and II by McGraw Hill Publications
- Vashishta B.R. (2005). Botany for Degree students Bryophyta & Pteridophyta. S. Chand and Co. Publ.

Unit II:	**Angiosperms**

- Bendre, Ashok. (2009-10), A textbook of Practical Botany second Edn. Rastogi Publ.
- Davis, P. H. and V. H. Heywood (1991). Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi.
- Eames A.J. (1961). Morphology of Angiosperms, McGraw Hill Book Co.
- Jain S.K. and Rao R.R. (1976). Handbook of Field and Herbarium Methods, Today and Tomorrow Publishers, New Delhi.
- Judd Walter S., Campbell, C. S., Kellogg, E. A., Stevens, P.F. and M. J. Donoghue. (2008). Plant Systematics- A Phylogenetic Approach. Sinauer Associates, INC, Publishers. Sunderland,
- Lawrence, G. H. M. (1951). Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.
- Manilal, K. S. and M. S. Muktesh Kumar (1998). A Handbook of Taxonomic Training. DST, New Delhi.
- Massachusetts, USA. Cooke, T. (1903-1908). The Flora of the Presidency of Bombay, Vol. I-III.
- Naik, V. N. (1984). Taxonomy of Angiosperms. Tata McGraw-Hill, New Delhi.
- Pandey S N and Mishra S D (2013) Taxonomy of Angiosperms S Chand Publ.
- Sambamurthy A V S S (2005) Taxonomy of Angiosperms S Chand Publ.
- Vashishtha P C (2011) Taxonomy of Angiosperms S Chand Publ.
- Subramanyam N S (1997) Modern Plant Taxonomy S Chand Publ.
- Simpson, M.G. (2010). Plant Systematics. Elsevier, Amsterdam.
- Singh G. (2004). Plant Systematics, 2nd edn, Oxford and IBH, New Delhi.
- Sivarajan, V.V. (1984). Introduction to Principles of Plant Taxonomy, Oxford and IBH,New Delhi.
- Takhtajan, A. (1969). Flowering plants - Origin and Dispersal. Oliver and Boyd, Edinburg.
- Taylor, D.V. and L.J. Hickey (1997). Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.

Unit III:	**Modern Techniques to Study Plant Diversity**

- Ghosal, S., and Avasthi, A. S. (2018). Fundamentals of Bioanalytical Techniques and Instrumentation. PHI Learning Pvt. Ltd. ISBN:9789387472402, 938747240X.
- Hofmann, A., and Clokie, S. (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press. ISBN 978-0-521-51635-8; ISBN 978-0-521-73167-6.
- Srivastava, M. L. (2008). Bioanalytical Techniques. Alpha Science International. ISBN-13: 978-1842654255; ISBN-10: 184265425X.

Course Code	Title	Credits & Lectures
SIUSBOT32	**FORM AND FUNCTION II**	**2 Credits & 45 Lectures**

LEARNING OBJECTIVES: The course, Form & Function II, comprises the units on Cell Biology, Cytogenetics and Ecology & Environmental Botany. The course would allow the students to explore the ultrastructure and functions of various cell organelles. It would encourage students to learn the concepts related to cell division, cell cycle as well as types of nucleic acids. It would make students understand the structures, causes and effects of chromosomal aberrations, sex determination, maternal effects with their examples. It would help to grasp the principles governing ecology and environmental biology with reference to biogeochemical cycles, ecological factors, and community ecology.

COURSE OUTCOMES:

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

CO1: Ultrastructure and functions of cell organelles.

CO2: The process of Cell Division and its significance.

CO3: The concept of cell cycle and its regulation

CO4: Ultrastructure of Interphase Nucleus. Types, structure, and functions of Nucleic Acid.

CO5: The Cytological and Genetic Effects Chromosomal Aberrations.

CO6: Basic concepts of Sex determination, Sex linked, and sex influenced- sex limited traits.

CO7: Learning the fundamentals of Extranuclear Genetics.

CO8: Basic concepts of sedimentary biogeochemical cycles.

CO9: The various ecological factors affecting soil characteristics.

CO10: Basic concepts of community ecology w. r. t. qualitative and quantitative characters.

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

Unit I : Cell Biology (15 Lectures)

- **Ultrastructure and functions of the following cell organelles**: Mitochondrion (membranes, cristae, F_1 particles and matrix), Peroxisomes and Glyoxysomes, Ribosomes (prokaryotic, eukaryotic and subunits).
- **Cell division and its significance**: Cell cycle and its regulation, Meiosis, differences between Mitosis and Meiosis.
- **Nucleic Acids**: Types, structure and functions of DNA and RNA.

Unit II : Cytogenetics (15 Lectures)

- **Variation in Chromosome Structure (Chromosomal Aberrations):**
  - Definition, origin, cytological and genetic effects of the following: Deletions, Duplications, Inversions and Translocations.
- **Sex Determination, Sex Linked and Sex Influenced - Sex Limited Traits:**
  - **Sex determination:** Chromosomal Methods: heterogametic males and heterogametic females. Sex determination in monoecious and dioecious plants. Genic Balance theory of sex determination in *Drosophila*, Lyon's Hypothesis of X chromosome inactivation.
- **Sex Linked:** Eye colour in *Drosophila*, Haemophilia, colour blindness
- **Sex Influenced - Sex Limited Traits:** Baldness in man
- **Extranuclear Genetics:** Organelle heredity: Chloroplast determined heredity - Plastid transmission in plants, Streptomycin resistance in *Chlamydomonas*. Male sterility in maize

Unit III : Ecology and Environmental Botany (15 Lectures)

- **Biogeochemical Cycles**: Sedimentary cycles: Sulphur and Phosphorus, Bioaccumulation and biomagnification
- **Ecological factors**: Concept of environmental factors, soil as an edaphic factor, soil composition, types of soil, soil formation, soil profile.

Community ecology: Characters of community - quantitative characters and qualitative characters

Course Code: SIUSBOT32	**REFERENCE BOOKS: Course Title: FORM AND FUNCTION II**
Unit I:	**Cell Biology**

- De Robertis and De Robertis. (2017). Cell and Molecular Biology 8Ed.
- Karp, G. (1999). Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
- Powar C.B. (1991). Cell biology Himalaya Publishing House.
- Verma, P. S., V. K. Agrawal. (2008) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. 3rd edition S. Chand & Co, New Delhi, India.

Unit II:	**Cytogenetics**

- Atherly, A.G., Girton, J.R. and McDonald, J. F. (1999) The science of genetics. Sauders College Pub. Fort Worth USA.
- Benjamin Lewin, Jones and Bartlett (2009), Genes IX, Oxford, University press. New York, USA.

- Benjamin Lewin, Jones and Bartlett (2011), Genes X, 2011 Oxford, University press. New York, USA.
- Burnham, C.R. (1962) Discussions in cytogenetics. Burgess Pub. Co., Minnesota.
- Channarayappa, (2010) Cell biology University Press.
- Freifelder David (1990) Microbial Genetics, Narosa Publishing House
- Gardner E J (2006) Principles of Genetics, Wiley; 8th edition.
- Griffiths, A.J.F and Gilbert, W.M (2007) Modern genetic analysis. (2nd edn). W.H. Freeman and Company, New york.
- Hartl, D.L., Jones E.W. (2001). Genetics: Principle and analysis (4th edn) Jones and Barlett Pub., USA.
- Khush, G S (1973) Cytogenetics of Aneuploids. Academic press New York, London.
- Russel, P.J. (1998). Genetics (5th edn). The Benjamin/ Cummins Pub. Co., Inc. USA.
- Snustad, D.P. and Simmons, M.J. (2000). Principles of genetics (4th edn). John Wiley and Sons, Inc., USA.
- Strickberger, M.W (2015) Genetics (4th edn). McMillan Publishing company, New York.

Unit III:	**Ecology and Environmental Botany**

- Ambasht, R. S., and Ambasht, N. K. (2019). A Textbook of Plant Ecology.
- Braun-Blanquet, J. (1932). Plant Sociology. McGraw-Hill Book Company, New York.
- Dash, M. C. (1993). Fundamentals of Ecology. McGraw-Hill Education (India) Pvt Limited. ISBN:9780074601037, 0074601032.
- Kupchella, C. E., and Hyland, M. C. (1989). Environmental Science - Living Within the System of Nature. Allyn and Bacon. ISBN: 9780205120161, 0205120164.
- Misra, K. C. (1974). Manual of Plant Ecology. Oxford & IBH Publishing Company.
- V. Verma. Plant Ecology. ANE Books. ISBN: 9789380618005, 9789380618005.
- Verma, P. S., and Agarwal, V. K. (1983). Environmental Biology (Principles of Ecology). S. Chand Publishing. ISBN: 9788121908597.
- Weaver, J. E. and Clements, F. E. (1938). Plant Ecology. New York: McGraw-Hill Book Co., Inc. Ed. 2.

Course Code	Title	Credits & Lectures
SIUSBOT33	CURRENT TRENDS IN PLANT SCIENCES I	2 Credits & 45 Lectures

LEARNING OBJECTIVES: The course, Current Trends in Plant Sciences I, comprises the units on Pharmacognosy & Phytochemistry, Forestry & Economic Botany and Industry based on plant products. The course would create awareness about various pharmacopoeias and Scope of Ayurveda system of medicine. It would facilitate identification and understanding of the economic importance of forest products & fibres, spices, and condiments. It would develop Entrepreneurial skills among the students. It would enhance students' understanding of the economic and commercial value of botanical products as well as understanding of the industrial relevance of botanicals with respect to current demands of industry. It would teach them about the role of industrial enzymes and the process of biofuel production.

COURSE OUTCOMES:

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

CO1: Monographic study of a plant using pharmacopoeia.

CO2: Various secondary metabolites produced in plants & their role.

CO3: Traditional use of plants from Grandma's pouch**.**

CO4: Basic concepts in types of forest & Ecotourism in India.

CO5: Study of paper & starch yielding plants.

CO6: Economic importance of Plant-based beverages.

CO7: The concept of aromatherapy & nutraceuticals.

CO8: Basic concepts of plant-based beverages, plant enzyme industry and biofuels.

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

Unit I: Pharmacognosy and Phytochemistry (15 Lectures)

- Introduction to Pharmacognosy, Pharmacopoeia and Monographs.
- Botanical source, Active constituents and Medicinal uses of some medicinal plants from Grandma's pouch – *Zingiber officinalis, Mentha piperita, Piper nigrum, Ocimum sanctum, Adhatoda vasica*.
- Scope of Ayurveda system of medicine, herbal formulations and plants used.
- Study of secondary metabolites w.r.t chemical properties, occurrence, examples and therapeutic uses – alkaloids, glycosides, volatile oils, tannins.
- Adulteration and Substitution of medicinal drugs – Reasons & types.

- Adulteration of *Saraca asoca* with *Polyalthia longifolia*; *Glycyrrhiza glabra* with *Abrus precatorius*; *Bacopa monnieri* with *Centella asiatica.*

Unit II: Forestry and Economic Botany (15 Lectures)

- **Forestry**:
  - Types of forest in India
  - Agro-forestry and Urban forestry
  - Silviculture
  - Ecotourism: Definition, concept, scope & significance
  - Ecotourism destinations in Maharashtra – Radhanagari, Kas, Lavasa, Lonar (Case Studies)
- **Economic Botany**:
  - Classification of Fibres
  - Sources, Properties and Uses of Commercial Fibres: Cotton, Jute and Coir
  - Sources, Properties and Uses of Commercially important Spices and condiments: Nutmeg, Cardamom and Saffron
  - Paper yielding plants – Bamboo, Eucalyptus
  - Starch yielding plants – Tapioca, Elephant foot yam

Unit III: Industry based on plant products (15 Lectures)

- Aromatherapy oils with respect to botanical source, extraction, properties and applications: Ylang-ylang, Rose, Vetiver, Eucalyptus, Jasmine.
- Botanical and nutraceuticals: *Spirulina, Vanillin, Garcinia indica / Garcinia cambogia, Chlorella* and *Kale.*
- Plant-based beverages: Neera, Toddy, Coffee, Coco, Wine.
- Enzymes industry: Cellulases, Papain, Bromelain.
- Biofuels.

Course Code: SIUSBOT33	**REFERENCE BOOKS: Course Title: CURRENT TRENDS IN PLANT SCIENCES I**
Unit I:	**Pharmacognosy and Phytochemistry**

- Trivedi P C, (2006). Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
- Purohit and Vyas, (2008). Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
- Wallis, T. E. (1946). Textbook of Pharmacognosy, J & A Churchill Ltd. 2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
- Gurdeep Chatwal, (1980). Organic chemistry of natural products. Vol. I. Himalaya Publishing house.
- Kokate, C.K.; Purohit, A.P. and Gokhale, S.B. (2010). Pharmacognosy (45th ed.). Nirali Prakashan, Pune.
- Anonymous. (1999). The Ayurvedic Pharmacopoeia of India. Vol. I & II. Ministry of Health and Family Welfare, Govt. of India, New Delhi.
- Sivarajan, V.V. and Balachandran, I. (1994). Ayurvedic Drugs and Their Plant Sources. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Trease and Evans. (2009). Pharmacognosy (16th ed.). W. B. Saunders Co. Ltd., London.
- Khandelwal, K.R. (2002). Practical Pharmacognosy: Techniques and Experiments (9th ed.). Nirali Prakashan, Pune.

Unit II:	**Forestry and Economic Botany**

- Albert Fedrick Hill (1952) Economic Botany, A textbook of useful plants and plant products, McGraw Hill Publishers
- Bharucha, F. R. (1983) Plant Geography of India, Oxford University Press
- David Fennell (2004) Ecotourism – An Introduction, Taylor Francis
- Kochhar, S. L. (2016) Economic Botany – A Comprehensive Study, Cambridge University Press
- Parthiban, K. T., N. Krishnakumar, M. Karthick · (2018) Introduction to Forestry & Agroforestry
- Puri, G. S., R. K. Gupta, V. M. Meher-Homji (1989) Forest Ecology: Plant Form, Diversity, Communities and Succession, South Asia Books; Subsequent edition.
- Rakesh Vasantrao Patil (2021) Ecotourism in Maharashtra – Planning, Management and Sustenance, INSC International Publisher (IIP)
- Verma V. (2009) Textbook of Economic Botany, Anne Books India.

Unit III:	**Industry based on plant products**

- Aehle, W. Enzymes in Industry: Production and Applications. Wiley-VCH. ISBN: 978-3-527-31689-2.
- Buckle, J. (2003). Clinical Aromatherapy: Essential Oils in Practice. Elsevier Science. ISBN 0-443-07236-1.
- Chandrasekaran, M. (2016). Enzymes in Food and Beverage Processing. CRC Press, Taylor & Francis Group. ISBN - 13: 978-1-4822-2128-2.
- Crozier, A., Ashihara, H., Tomas-Barberan, F. (2012). Teas, Cocoa and Coffee: Plant Secondary

Metabolites and Health. Wiley & Blackwell. ISBN-13: 978-1-4443-3441-8.

- Hui, Y. H. (2012). Handbook of Plant-Based Fermented Food and Beverage Technology. Taylor & Francis Group, LLC. ISBN-13: 978-1-4398-7069-3.
- Jenkins, N. (2006). Aromatherapy in Essence. Hodder Arnold. ISBN-10: 0 340 92606 6; ISBN-13: 978 0 340 92606 2.
- Kumar, A., Ogita, S., and Yau, Y. (2018). Biofuels: Greenhouse Gas Mitigation and Global Warming - Next Generation Biofuels and Role of Biotechnology. Springer (India) Pvt. Ltd. ISBN 978-81-322-3761-7; ISBN 978-81-322-3763-1 (eBook).
- McGuinness, H. (2003). Aromatherapy: Therapy Basics. Hodder Arnold. ISBN-10: 0 340 876808; ISBN-13: 978 0 340 87680 0.

SEMESTER III PRACTICALS

SIUSBOTP3.1	**PRACTICAL I (PLANT DIVERSITY II), PRACTICAL II (FORM AND FUNCTION II) & PRACTICAL III (CURRENT TRENDS IN PLANT SCIENCES I)**	**3 Credits & 30 Lectures**

COURSE OUTCOMES:

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

CO1: Specimens of Algae and Bryophyta and about the details of the life cycles.

CO2: Floral morphology & angiosperm families/ subfamilies with suitable examples.

CO3: Modern Techniques to Study Plant Diversity.

CO4: Ultrastructure of cell organelles, estimation procedure of nucleic acids, inheritance pattern & chromosomal aberrations.

CO5: Concepts of ecological experimentations.

CO6: Identification of herbal drugs with their adulterants & economic importance.

PRACTICAL I – PLANT DIVERSITY II (SIUSBOTP3.1)

LEARNING OBJECTIVES:

- The course aims at enhancing the mounting skills of the students for the specimens of Algae and Bryophyta.
- It would allow the students to note the details of the life cycles of algae and bryophytes.
- It would impart knowledge about different floral morphology w. r. t. thalamus, calyx, corolla, androecium, gynoecium, perianth, corona, placentation and ovules.
- It would encourage the detailed study of angiosperm families/ subfamilies.
- The course would highlight the economic importance & distribution of various angiosperm families / subfamilies.
- The course also aims to provide hands-on training for the techniques like dry & wet preservation of plants, circular paper chromatography, chalk chromatography, thin layer chromatography, horizontal and vertical gel electrophoresis, etc.

1.	Study of stages in the life cycle of *Volvox* from fresh/ preserved material and permanent slides.
2.	Study of stages in the life cycle of *Sargassum* from fresh/ preserved material and permanent slides.
3.	Economic importance of Phaeophyta: *Laminaria*, *Sargassum*, *Fucus*, and *Macrocystis*.

4.	Study of stages in the life cycle of *Anthoceros* from fresh/ preserved material and permanent slides.
5.	Demonstration of culturing of algae.
6.	Identification of bryophytes with respect to their applications in agriculture & horticulture: (*Sphagnum* and *Funaria*)
7.	Study of Floral Morphology Part I: Parts of a flower, flower symmetry, types of thalamus, Calyx types and modifications, Corolla – forms; Aestivation, Perianth.
8.	Study of Floral Morphology Part II: Androecium parts of the androecium, Number and insertion of stamens, Union of stamens; Types of corona. Gynoecium: the carpel, style and stigma; Union of Carpel; ovary- placentation, types of ovules.
9.	Study of one plant from Magnoliaceae, Papilionaceae
10.	Study of one plant from Caesalpinae, Mimosae
11.	Study of one plant from Asteraceae
12.	Study of one plant from Amaranthaceae, Palmae
13.	Preparation of herbarium and wet preservation technique.
14.	Chromatography: Separation of amino by circular paper chromatography. Separation of plant pigments using Adsorption chromatography.
15.	Separation of Carotenoids by thin layer chromatography.
16.	Horizontal and Vertical Gel Electrophoresis – Demonstration.

PRACTICAL II – FORM AND FUNCTION II (SIUSBOTP3.1)

LEARNING OBJECTIVES:

- The course would allow the detailed study of ultrastructure of cell organelles.
- It would encourage students to learn different stages of meiosis and their staining techniques.
- It would impart knowledge about estimation of DNA & RNA from different plant sources.
- The course would teach students about Sex-linked inheritance using examples like eye colour in *Drosophila*, Haemophilia, colour blindness, as well as Sex influenced characters with examples like baldness in man, Hypertrichosis.
- It would make them understand Plastid Inheritance and various cytological consequences of chromosomal aberrations.

- The course would encourage the study of ecological factors and assessment of soil pH, water holding capacity and organic content.
- The course would explain the principle and working of various ecological instruments.
- It would teach about the concept of sampling with the study of vegetation by the list quadrat method.

1.	Study of the ultrastructure of cell organelles prescribed for theory from Photomicrographs.
2.	Staining of mitochondria by using Janus Green B Stain.
3.	Estimation of DNA from plant material (one Std & one Unknown, No Std Graph).
4.	Estimation of RNA from plant material (one Std & one Unknown, No Std Graph).
5.	Study of meiosis from suitable plant material
6.	Study of inheritance pattern with reference to Plastid Inheritance.
7.	Study of cytological consequences of chromosomal aberrations (Laggards, Chromosomal Bridge, Ring chromosome, Chromosomal ring) from permanent slides or photomicrographs.
8.	Problems based on sex linked inheritance.
9.	Study of Sex-linked inheritance (eye colour in *Drosophila*, Haemophilia, colour blindness) & Sex influenced characters (baldness in man, Hypertrichosis).
10.	Study of karyotypes Cri-du-chat, Philadelphia syndrome & D-G translocation.
11.	Study of the working of the following Ecological Instruments- Soil thermometer, Soil testing kit, Soil pH, Wind anemometer.
12.	Mechanical analysis of soil by the sieve method & pH of soil.
13.	Quantitative estimation of organic matter of the soil by Walkley and Blacks Rapid titration method.
14.	Study of vegetation by the list quadrat method.

PRACTICAL III – CURRENT TRENDS IN PLANT SCIENCES I (SIUSBOTP3.1)

LEARNING OBJECTIVES:

- The course would help to identify and know the economic importance of forest products, spices and condiments.
- It would explain the types of forest in India.
- It would help to analyse the difference among active drug and adulterants.
- It would encourage identification and evaluation of herbal cosmetics & nutraceuticals.

- The course would make students understand the separation of different essential oils.
- It would help in analysing the phytochemical nature of plants through various tests.

1.	Macroscopic and microscopic study to analyse the Adulteration of *Saraca asoca* wit *Polyalthia longifolia*; *Glycyrrhiza glabra* with *Abrus precatorius*; *Bacopa monnieri* wit *Centella asiatica*.
2.	Test for alkaloids, glycosides, saponins, phenolics.
3.	Identification of medicinal plants from Grandma's pouch - *Zingiber officinalis, Mentha piperita, Piper nigrum, Ocimum sanctum, Adhatoda vasica*.
4.	Preparation of herbal formulations from medicinal plants.
5.	Study of Types of forest in India.
6.	Sources, Properties & uses of: Fibres (Cotton, Jute and Coir)
7.	Sources, Properties & uses of: Spices & condiments (Nutmeg, Cardamom and Saffron)
8.	Sources, properties & uses of Paper yielding plants – Bamboo, Eucalyptus
9.	Sources, properties & uses of Starch yielding plants – Tapioca, Elephant foot yam
10.	Preparation of enzyme powder / bioenzyme and its estimation.
11.	TLC of Jasmine, Eucalyptus oil.
12.	Study of Botanical and nutraceuticals - *Spirulina, Vanillin, Garcinia indica/ Garcinia cambogia*, *Chlorella* and *Kale*
13.	Field visit to ecotourism destination / nearby forest and submission of the report.

Suggested Activity for Assignment / Project:

- Students can prepare any herbal product of medicinal use from locally available plants at home and present the product with a brief presentation on the same.
- Students can prepare any of the given herbal cosmetics (face pack, herbal soap, kajal, herbal shampoo, herbal moisturiser, etc.) and present the product with a brief presentation on the same.

SEMESTER IV THEORY

Course Code	Title	Credits & Lectures
SIUSBOT41	**PLANT DIVERSITY II**	**2 Credits & 45 Lectures**

LEARNING OBJECTIVES: The course, Plant Diversity II, comprises the units on Thallophyta: Fungi, Plant Pathology, Pteridophyta & Palaeobotany and Gymnosperms. The course aims to provide insights about general characters, structure, life cycle & pathogenicity of fungi. It would help to understand and explain the basic features of pteridophytes and an account of palaeobotany. It would teach them about gymnosperms w. r. t. their distribution, life cycle and economic importance.

COURSE OUTCOMES:

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

CO1: General characters of Ascomycetae among fungi along with the life cycles of *Aspergillus* and *Xylaria*.

CO2: General characters of Basidiomycetae among fungi along with the life cycle of *Agaricus.*

CO3: Basic concepts of plant pathology & Fungi as bio-controlling agent.

CO4: Salient features of Psilophyta and Lepidophyta among the pteridophytes along with the life cycle of *Selaginella.*

CO5: Concept of Geological time scale and fossil formation process.

CO6: Study of Gymnosperms along with life cycles of *Pinus* and their economic importance.

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

Unit I : Thallophyta: Fungi, Plant Pathology (15 Lectures)

- General characters of Ascomycetae & Basidiomycetae (G. M. Smith's system of classification to be followed)
- Structure, life cycle and systematic position of *Aspergillus* and *Xylaria*
- Structure, life cycle and systematic position of *Agaricus*
- Plant Pathology: Symptoms, causative organism, disease cycle and control measures of Powdery mildew and Late blight of potato.
- Fungi as bio-controlling agent – *Trichoderma*, Predatory fungi (zoophagous, nematophagous, entomophilous)

Unit II: Pteridophyta and Paleobotany (15 Lectures)

- Salient features and classification up to orders (with examples of each) of Psilophyta and Lepidophyta (G. M. Smith's system of classification to be followed)
- Structure, life cycle and systematic position of *Selaginella*
- Palaeobotany- The geological time scale; Formation and types of fossils;
- Structure and systematic position of form genus *Rhynia*

Unit III : Gymnosperms (15 Lectures)

- Structure, life cycle and systematic position of *Pinus.* (C. J. Chamberlain's classification to be followed)
- Structure and systematic position of the form genus *Cordaites.*
- Economic importance of Gymnosperms: Ornamental gymnosperms; medicinal uses of gymnosperms, industrial applications of gymnosperms.

Course Code: SIUSBOT41	**REFERENCE BOOKS: Course Title: PLANT DIVERSITY II**
Unit I:	**Thallophyta: Fungi, Plant Pathology**

- Alexopoulos, C. J., Mims, C. W., and Blackwell, M. M. (1996) Introductory Mycology, Wiley publishers.
- Bilgrami, S.A. and Verma R.N. (1990). A Textbook of Modern Plant Pathology. Vikas Publishing House Pvt. Ltd.
- Gangulee H.C., Das K.S. and Datta C. (1988). College Botany Vol. I and Vol. II. Central Education Enterprises.
- Mehrotra, R. S. (2003), Plant Pathology, Tata McGraw Hill Publication.
- Smith G. M. (1955). Cryptogamic Botany Vol I and II by Mcgraw Hill Publications.
- Vashishta B.R (1992). Botany for Degree Students Fungi. S.Chand and Co. Publ.

Unit II:	**Pteridophyta and Paleobotany**

- Arnold, C. A. (1947). An Introduction to Paleobotany. McGraw Hill Book Company Inc.
- Parihar, N. S. (2019). Introduction to Embryophyta - Pteridophytes. Surjeet Publication. ISBN: 9788122904031, 8122904033.
- Rashid, A. (1999). An Introduction to Pteridophyta. Vikas Publishing.
- Smith, G. M. (1955). Cryptogamic Botany Vol II - Bryophytes and Pteridophytes. McGraw Hill Book Company Inc.

Unit III:	**Gymnosperms**

- Bhatnagar, S. P. and Moitra, A. (2004). Gymnosperms. New Age International (P) Ltd.
- Chamberlain, C. J. (1935). Gymnosperms Structure and Evolution. CBS Publishers &

Distributors. ISBN: 9788123912714, 9788123912714.

- Gangulee, H. C., Das, K. S., and Dutta, C. (2018). College Botany Volume I. New Central Book Agancy (P) Ltd. ISBN: 9788173810282.
- Singh, S. K. (2008). Gymnosperms and Paleobotany. Campus Books, New Delhi. ISBN 10: 8180301451 / ISBN 13: 9788180301452.

Course Code	Title	Credits & Lectures
SIUSBOT42	**FORM AND FUNCTION II**	**2 Credits & 45 Lectures**

LEARNING OBJECTIVES: The course, Form & Function II, comprises the units on Anatomy, Plant Physiology & Plant Biochemistry and Molecular Biology. The course would make students know the process and need of secondary growth in plants, mechanical tissue system and vascular bundles functions in plants. It would help to relate structure with function by studying different anatomical details. The basic concepts and applications of respiration, photorespiration, photoperiodism and vernalization would be explained. It aims to teach students the fundamentals of DNA replication and transcription.

COURSE OUTCOMES:

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

CO1: The different types of plant tissues and vascular bundles in the plant body.

CO2: Various processes related to respiration & photo respiration.

CO3: The concept of long-day and short-day plants.

CO4: Mechanism & applications of vernalization.

CO5: Fundamentals of DNA replication.

CO6: Central dogma of Protein synthesis w. r. t. transcription & RNA processing.

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

Unit I : Anatomy (15 Lectures)

- Normal Secondary Growth in Dicotyledonous stem and root.
- Growth rings, periderm, lenticels, tyloses, heart wood and sap wood.
- Mechanical Tissue system - Tissues providing mechanical strength and support, Principles & distribution of mechanical tissues in the plant body, I-girders in aerial and underground organs.
- Types of Vascular Bundles.
- Secretory tissues in plants: Ducts, Laticifers, Glands

Unit II : Plant Physiology and Plant Biochemistry (15 Lectures)

- **Respiration: Aerobic:** Glycolysis, TCA Cycle, ETS & Energetics of respiration; Anaerobic respiration.
- **Photorespiration**

- **Photoperiodism:** Phytochrome Response and Vernalization with reference to flowering in higher plants, Physico-chemical properties of phytochrome, Pr-Pfr interconversion, role of phytochrome in flowering of SDPs and LDPs.
- **Vernalization** mechanisms and applications.

Unit III : Molecular Biology (15 Lectures)

- **DNA replication**: Modes of Replication, Meselson and Stahl Experiment, **DNA replication in prokaryotes and eukaryotes**- enzymes involved and molecular mechanism of replication.
- **Protein Synthesis**: Central dogma of Protein synthesis Transcription and Translation in prokaryotes and eukaryotes: promoter sites, initiation, elongation and termination.
- RNA processing: Adenylation & Capping.

Course Code: SIUSBOT42	**REFERENCE BOOKS: Course Title: FORM AND FUNCTION II**
Unit I:	**Anatomy**

- Pandey, B. P. (2001) Plant Anatomy, S. Chand Ltd.
- Paulla J. Rudall (2007) Anatomy of flowering plants: An Introduction to structure and development, Cambridge University Press
- Roy P.; Plant Anatomy; (2010); 2nd Edition; New Central Book Agency Pvt. Ltd.

Unit II:	**Plant Physiology and Plant Biochemistry**

- Berg, J. M., Tymoczko, J. L., and Stryer, L. Biochemistry. (2002). W. H. Freeman and Company. ISBN: 0716730510; ISBN 13: 9780716730514.
- Lehninger, A. L., Nelson, D. L., and Cox, M. M. (2005). Lehninger Principles of Biochemistry. W. H. Freeman and Company. ISBN: 9780716743392, 0716743396.
- Salisbury, F. B. and Ross, C. W. (1969). Plant Physiology. Wadsworth Publishing Company. ISBN: 9780534416751, 0534416756.
- Taiz, L. and Zeiger E. (2002). Plant Physiology. Sinauer Associates; 3 Edition. ISBN: 0878938230.
- Voet, D., Voet, J. G., Pratt, C. W. (2008). Fundamentals of Biochemistry - Life at a Molecular Level. John Wiley & Sons, Inc. ISBN-13 978-0470-12930-2.

Unit III:	**Molecular Biology**

- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the Cell (2nd edition). Garland Pub. Inc., New York.
- Buchanan, Grissem and Jones, 2000, Biochemistry and Molecular Biology of Plants, American Soc. Plant Biologists, Waldorf
- Channarayappa, 2015, Molecular biology University Press.
- Cooper G M and Hausman R E, 2007, The Cell: Molecular Approach 4thEdn, SinauerAssociates, USA

- De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8thedn, Info-Med, Hongkong
- Glick B R and Pasternak J J, Molecular Biotechnology- Principles and Application of Recombinant DNA.
- Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
- Klug, W.S., Cummings, M.R., Spencer, C.A. ,2009. Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition.
- Lodish S, Baltimore B, Berk, C and Lawrence K, 1995, Molecular Cell Biology, 3rd edn, Scientific American Books, N.Y
- Rastogi Veer Bala Fundamentals of Molecular Biology Ane Books Pvt Ltd Hill Economic Botany.
- Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.

Course Code	Title	Credits & Lectures
SIUSBOT43	**CURRENT TRENDS IN PLANT SCIENCES I**	**2 Credits & 45 Lectures**

LEARNING OBJECTIVES: The course, Current Trends in Plant Sciences I, comprises the units on Horticulture & Gardening (Introduction to Horticulture), Biotechnology, Biostatistics and Bioinformatics. The course would impart knowledge required for identification of garden plants and garden locations, with various types of garden (Entrepreneurship). It would make students understand the applications of plant tissue culture, R-DNA technology and bioinformatics. It would teach them problem solving in Botany (Computational biology) using tools of Bioinformatics. It would demonstrate different Biostatistics tests and their applications for the analysis of biological data.

COURSE OUTCOMES:

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

CO1: Basic concepts in horticulture.

CO2: The technique of bottle garden and dish garden preparations.

CO3: Concept of garden locations.

CO4: Various sterilisation techniques, seed sterilisation & techniques in plant tissue culture.

CO5: Basic concepts of gene cloning.

CO6: Apply the concepts of Biostatistics for problem solving.

CO7: Comprehend the fundamental concepts related to descriptive and inferential biostatistics.

CO8: Understand the concept of databases and its applications.

CO9: Application of bioinformatics tools.

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

Unit I : Horticulture and Gardening: Introduction to Horticulture (15 Lectures)

- Introduction to Horticulture and Branches of Horticulture – Pomology, Olericulture, Nursery management, Floriculture, Landscaping
- Indoor styles of gardening – Bonsai, Dish Garden, Terrarium
- Flower arrangements – Indian & Western
- Formal and Informal gardens
- Garden locations with suitable plants for each – Avenues; Edges; Lawn; Arches & Pergolas; Flower bed
- Study of botanical garden – Veermata Jijabai Bhosle Udyan, Mumbai.

Unit II : Biotechnology (15 Lectures)

- **Introduction to plant tissue culture:**
  - Laboratory organisation and techniques in plant tissue culture
  - Totipotency
  - Organogenesis
  - Organ culture – root cultures, meristem cultures, anther and pollen culture, embryo culture.
- **r-DNA technology:**
  - Gene cloning
  - Enzymes involved in Gene cloning
  - Vectors used for Gene cloning.

Unit III : Biostatistics and Bioinformatics (15 Lectures)

- **Biostatistics:** The chi square test. Correlation – Calculation of coefficient of correlation.
- **Bioinformatics:** Information technology: History and tools of IT, Internet and its uses**.** Introduction to Bioinformatics- goal, need, scope and limitation, Aims of Bioinformatics: Data organisation, Tools of Bioinformatics- tools for web search, Data retrieval tools- Entrez, BLAST, Bioinformatics programme in India.

Course Code: SIUSBOT43	**REFERENCE BOOKS: Course Title: CURRENT TRENDS IN PLANT SCIENCES I**
Unit I:	**Horticulture and Gardening: Introduction to Horticulture**

- Bose T.K. & Mukherjee, D. (1972) Gardening in India, Oxford & IBH Publishing Co., New Delhi.
- Gorner, R. (1978). The growth of gardens. Faber and Faber. London.
- Kumar, N., (1997), Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. Institution.
- Randhawa, G. S. and Mukhopadhyay, A. (1986). Floriculture in India. Allied Publishers.
- Rao Manibhushan K.; Textbook of Horticulture; (2005), 2nd Ed; Macmillan India
- Swarup V (1983). Ornamental Horticulture, ICAR.

Unit II:	**Biotechnology**

- Abdin, M. Z., Kiran, U., Kamaluddin, and Ali, A. (2017). Plant Biotechnology: Principles and Applications. Springer. ISBN: 981102961X, 9789811029615.
- Chawla, H. S. (2002). Introduction to Plant Biotechnology. United Kingdom: Science Publishers. ISBN: 9781578082285, 1578082285.

- Glick, B. R., and Pasternak, J. J. (1998). Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press. ISBN:9781555811365, 1555811361.
- Peter, K. V. (2008). Plant Biotechnology: Methods in Tissue Culture. India: Universities Press. ISBN: 9788173716164, 8173716161.
- Plant Cell and Tissue Culture. (2013). Netherlands: Springer Netherlands. ISBN: 9789401726818, 9401726817.
- Principles of Plant Biotechnology. (2019). United States: Callisto Reference. ISBN: 9781641162258, 1641162252.
- Slater, A., Scott, N., and Fowler, M. (2008). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press. SBN: 9780199282616, 0199282617.

Unit III:	**Biostatistics and Bioinformatics**

- Baxevanis A. D., Francis Ouellette B. F. (2001). Bioinformatics A Practical Guide to the Analysis of Genes and Proteins- John Wiley & sons Inc.
- Campbell A. M., Heyer L. J. (2006). Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.
- Clewer, A.G. and Scarisbrick, A.H. (2001). Practical statistics and experimental design for plant and crop science –John Wiley, New York.
- D.W. Mount (2003). Bioinformatics – Sequence and genome analysis , BS Publishers, New Delhi.
- Ghosh Z. and Bibekanand M. (2008). Bioinformatics: Principles and Applications. Oxford University Press.
- Higgs PG and Attwood T. K. (2005). Bioinformatics and Molecular Evolution –Blackwell Publishing, Oxford, UK, 2005.
- Mead, R. and Curnow, R.N. Chapman and Hall (1983) Statistical methods in Agriculture and Experimental Biology
- Pevsner J. (2009). Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
- Senson CW Edt, (2002). Essentials of Genomics and Bioinformatics,. Wiley-VCH Publishers, NY.
- Snedecor G.W. and Cochran W.G. (1989). Statistical Methods –Affiliated East-West Press Pvt. Ltd.
- Westhead, D.R, Parish J.H. and Twyman, R.M. (2003) Bioinformatics., BIOS Scientific Publishers Ltd., Oxford.

SEMESTER IV PRACTICALS

SIUSBOTP4.1	**PRACTICAL I (PLANT DIVERSITY II), PRACTICAL II (FORM AND FUNCTION II) & PRACTICAL III (CURRENT TRENDS IN PLANT SCIENCES I)**	**3 Credits & 30 Lectures**

COURSE OUTCOMES:

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

CO1: Specimens of fungi, pteridophytes and gymnosperms also about the details of the life cycles.

CO2: Plant fossils & Fungal diseases.

CO3: Different types of tissues and secondary structures in plants.

CO4: Concepts of plant physiology experimentations.

CO5: Determination of DNA and Amino acid sequencing.

CO6: Various techniques of flower arrangements and plant tissue culture.

CO7: Solve the problems of biostatistics & application of Bioinformatics tools.

PRACTICAL I – PLANT DIVERSITY II (SIUSBOTP4.1)

LEARNING OUTCOMES:

- The course would teach students about the classification and life cycle of fungi like *Aspergillus*, *Xylaria* and *Agaricus.*
- It would encourage the detailed study of fungal diseases and their significance.
- It would make the students understand the stages in the life cycle of *Selaginella.*
- It would teach them about fossil pteridophyte *Rhynia*, using permanent slides / photomicrographs.
- It would make the students understand the stages in the life cycle of *Pinus.*
- It would teach them about fossil pteridophyte *Cordaites*, using permanent slides / photomicrographs.

1.	Study of stages in the life cycle of *Aspergillus* from fresh/ preserved material and permanent slides.
2.	Study of stages in the life cycle of *Xylaria* from fresh/ preserved material and permanent slides.
3.	Study of stages in the life cycle of *Agaricus* from fresh/ preserved material and permanent slides.

4.	Study of fungal diseases as prescribed for theory.
5.	Identification of fungi used as bio-controlling agents in agriculture and at post-harvest level: *Trichoderma,* and *Metarhizium anisopliae*.
6.	Study of stages in the life cycle of *Selaginella* from fresh/ preserved material and permanent slides.
7.	Study of form genera *Rhynia* with the help of permanent slides/ photomicrographs.
8.	Study of stages in the life cycle of *Pinus* from fresh/ preserved material and permanent slides.
9.	Study of the form genus *Cordaites* with the help of permanent slide/ photomicrographs.

PRACTICAL II - FORM AND FUNCTION II (SIUSBOTP4.1)

LEARNING OUTCOMES:

- The course would make students know the reason for secondary growth, mechanical tissue system and vascular bundles functions in plants.
- It would allow study of conducting tissues in Gymnosperms and Angiosperms through maceration technique.
- It would make them learn about growth rings, periderm, lenticels, tyloses, heartwood and sapwood from permanent slides.
- It would help them learn the technique of estimation of proteins by Lowry's method and aid them in preparation of standard graph.
- It would encourage detailed study of *in-vivo* NR activity in nitrogen metabolism in plants.
- It would help in calculating Q_{10} value from germinating seeds using phenol red indicator.
- It would help in analysing the interpretation of DNA sequence obtained by Sanger's method and sequencing of amino acids in the protein molecule synthesised from the given m-RNA strand.

1.	Study of normal secondary growth in the stem and root of a Dicotyledonous plant.
2.	Types of mechanical tissues, mechanical tissue system in aerial, underground organs.
3.	Study of conducting tissues- Xylem and phloem elements in Gymnosperms and Angiosperms through maceration technique.
4.	Study of different types of vascular bundles.

5.	Growth rings, periderm, lenticels, tyloses, heart wood and sap wood
6.	Mounting and study of ducts, laticifers and glands as secretory tissues in plants.
7.	Q_{10} – germinating seeds using Phenol red indicator.
8.	NR activity – *in-vivo*
9.	Estimation of proteins by Lowry's method (prepare standard graph).
10.	DNA sequencing- Sanger's method
11.	Determining the sequence of amino acids in the protein molecule synthesized from the given m-RNA strand (prokaryotic and eukaryotic).
12.	Study of the autoradiogram, polysome, Roling circle & semiconservative replication of DNA using photo micrographs.
13.	Problems based on Replication & Transcription.

PRACTICAL III - CURRENT TRENDS IN PLANT SCIENCES I (SIUSBOTP4.1)

LEARNING OUTCOMES:

- It would help in designing gardens and learning applications of horticulture (Entrepreneurship).
- The course would teach the concept and practice of Indian styles flower arrangements.
- The course would make students know about the construction of a bottle and dish garden.
- It would make them understand applications of plant tissue culture and R-DNA technology.
- It would provide clarity for identification of cloning vectors – pBR322, pUC18, Ti-plasmid.
- It would give understanding and application of biostatistics for analysis of biological data.
- The course would encourage the study of virtual data / literature and the use of bioinformatics.

1.	Making of flower arrangements: Bouquets, gajra, veni, garland, Floral rangoli.
2.	Preparation of garden plans – formal and informal gardens.
3.	Bottle and dish garden (Demonstration)
4.	Identification of plants suitable for different garden locations – avenues, edges, lawn, arches & pergolas; flower bed (two plants per location).

5.	Various sterilisation techniques.
6.	Preparation of Stock solutions; Preparation of MS medium
7.	Seed sterilisation and inoculation.
8.	Callus induction & Regeneration of plantlets from callus (Demonstration).
9.	Identification of the cloning vectors – pBR322, pUC18, Ti-plasmid
10.	Chi-square test
11.	Calculation of coefficient of correlation.
12.	Web Search – Google, Entrez
13.	BLAST and interpret the output

SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)
Three/Fourth Semester

Class: S.Y.B.Sc **Sub: Botany** **Paper: I/II/III**
Day: **Date:** **Time:** **Marks: 60**

N.B. :
- **All questions are Compulsory.**
- **Figures to the right indicate marks.**
- **Draw neat labelled diagrams wherever necessary.**

Q.1	**a)**	Unit I: Long answer question	**(10)**
		OR	
	a)	Unit I: Long answer question	**(10)**
	b)	Unit I: Short answer question	**(05)**
		OR	
	b)	Unit I: Short answer question	**(05)**
Q.2	**a)**	Unit II: Long answer question	**(10)**
		OR	
	a)	Unit II: Long answer question	**(10)**
	b)	Unit II: Short answer question	**(05)**
		OR	
	b)	Unit II: Short answer question	**(05)**
Q.3	**a)**	Unit III: Long answer question	**(10)**
		OR	
	a)	Unit III: Long answer question	**(10)**
	b)	Unit III: Short answer question	**(05)**
		OR	
	b)	Unit III: Short answer question	**(05)**
Q. 4		Write notes on the following:	**(15)**
	i)	Unit I	
		OR	
	i)	Unit I	
	ii)	Unit II	
		OR	
	ii)	Unit II	
	iii)	Unit III	
		OR	
	iii)	Unit III	

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SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)

S. Y. B. Sc. BOTANY SEMESTER III

PLANT DIVERSITY II

PRACTICAL I

Duration: 3 hours **Max. Marks: 50**

Q.1. Identify, classify and describe specimen **'A'** and **'B'**. Sketch neat and labelled diagrams of morphological/microscopical structures seen in the specimens. **10M**

Q.2. Classify specimen **'C'** up to its family giving reasons. Give floral formula. Sketch and label L. S. of flower and T. S. ovary. **10M**

Q.3. Separate amino acids by circular paper chromatography. **08M**

OR

Separate carotenoids by thin layer / chalk chromatography. **08M**

Q.4. Identify and describe slide / specimen **'D' 'E', 'F'** and **'G'.** **12M**

Q.5. *Viva – voce*. **05M**

Q.6. Field report. **05M**

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KEY:

- **A: Algae-** (*Volvox/ Sargassum*)
- **B: Bryophyte-** (*Anthoceros*)
- **C: Families:** (Magnoliaceae, Papilionaceae, Caesalpinae, Mimosae, Asteraceae, Amaranthaceae, Palmae)
- **D: Algae (**Economic importance of Phaeophyta)/ **Bryophyta** (Economic importance)
- **E:** Floral Morphology
- **F:** Floral Morphology
- **G:** Horizontal or Vertical Gel Electrophoretic apparatus/ Herbarium

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SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)

S. Y. B. Sc. BOTANY SEMESTER III

FORM AND FUNCTION II

PRACTICAL II

Duration: 3 hours **Max. Marks: 50**

Q.1. Estimate DNA / RNA from given plant material **'A'** allotted to you. **10M**

Q.2. Perform smear preparation from material **'B'** allotted to you to show phases of Meiosis./ Staining of mitochondria by using Janus Green B Stain. **08M**

Q.3. Perform the Ecological experiment **'C'** allotted to you. **10M**

Q.4. Identify and describe the specimen/ slide/ photograph – **'D', 'E', 'F'** and **'G'.** **12M**

Q.5. Identify and describe the ecological instrument **'H'** and comment upon its working and applications. **05M**

Q.6. Journal. **05M**

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KEY:

- **D**: Ultra-structure of cell organelles
- **E**: Cri-du-chat, Philadelphia syndrome & D-G translocation
- **F**: Plastid Inheritance / chromosomal aberrations (Laggards, Chromosomal Bridge, Ring chromosome, Chromosomal ring)
- **G**: Sex-linked inheritance
- **H:** Ecological instrument (Soil thermometer, Soil testing kit, Soil pH, Wind anemometer)

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SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)

S. Y. B. Sc. BOTANY SEMESTER III

CURRENT TRENDS IN PLANT SCIENCES I

PRACTICAL III

Duration: 3 hours **Max. Marks: 50**

Q.1. Describe macroscopic characters of specimen **'A'**. **10M**

Q.2. Prepare face pack / herbal formulation and comment upon the role of the ingredients used. **08M**

Q.3. Estimate activity of enzyme / bioenzyme from given sample **'B'**. **08M**

Q.4. Perform the TLC of given oil sample **'C'**. **07M**

Q.5. Perform the test for_____from **s**pecimen **'D'.** **05M**

Q.6. Identify and describe **'E', 'F', 'G'** and **'H'.** **12M**

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KEY:

- **A**: Drug & adulterants: *Saraca indica / Polyalthia longifolia; Terminalia arjuna / Terminalia tomentosa; Centella asiatica / Bacopa monnieri; Glycyrrhiza glabra / Abrus precatorius*
- **B**: Evaluation of nutraceutical value of enzyme / bioenzyme
- **C**: TLC of Jojoba / Geranium / Lavender / Patchouli oil
- **D**: alkaloids, glycosides, saponins, phenolics (any 2)
- **E**: Plants from Granma's pouch
- **F**: Study of types of forest in India
- **G**: Fibres, spices & condiments
- **H**: *Spirulina, Vanillin, Garcinia indica/ Garcinia cambogia, Chlorella* and *Kale.*

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SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)

S. Y. B. Sc. BOTANY SEMESTER IV

PLANT DIVERSITY II

PRACTICAL I

Duration: 3 hours **Max. Marks: 50**

Q.1. Identify, classify and describe specimen **'A'** and **'B'**. Sketch neat and labeled diagrams of morphological / microscopical structures seen in the specimens. **12M**

Q.2. Identify, classify and describe specimen **'C'**. Sketch neat and labeled diagrams of morphological / microscopical structures seen in the specimen. **08M**

Q.3. Identify, classify and describe specimen **'D'**. Sketch neat and labelled diagrams of morphological / microscopical structures seen in the specimen. **08M**

Q.4. Identify and describe slides / specimen **'E'**, **'F', 'G'** and **'H'.** **12M**

Q.5. Field report. **05M**

Q.6. *Viva-voce*. **05M**

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KEY:

- **A & B**: Fungi (*Aspergillus, Xylaria, Agaricus*)
- **C**: Pteridophyte (*Selaginella*)
- **D**: Gymnosperm (*Pinus*)
- **E**: Plant pathology (Powdery mildew / Late blight of potato)/ Fungi used as bio-controlling agents.
- **F**: *Rhynia*
- **G**: *Pinus*
- **H**: *Cordaites*

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SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)

S. Y. B. Sc. BOTANY SEMESTER IV

FORM AND FUNCTION II

PRACTICAL II

Duration: 3 hours **Max. Marks: 50**

Q.1. Make a temporary stained preparation of T.S. of specimen **'A'** and comment on the secondary growth / Mechanical tissues observed / **10M**

Q.2. Macerate the given material **'B'** to expose the wood elements & comment upon it / Mount the secretory tissues of Specimen **'B'** and comment on the same. **5M**

Q.3. Perform the Physiological experiment **'C'** allotted to you. **10M**

Q.4. Determine the sequence of amino acids in the protein molecule synthesized from the given m-RNA strand (prokaryotic and eukaryotic) / sequence of DNA using Sanger's method from material **'D'** allotted to you. **08M**

Q.5. Identify and describe the specimen/ slide/ photograph – **'E', 'F'** and **'G'.** **12M**

Q.6. Journal. **05M**

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KEY:

- **A**: Dicot stem / dicot root / monocot stem / mechanical Tissue (*Coleus* stem, *Typha* leaf, Maize stem and Maize root /).
- **B**: *Annona / Magnolia* for maceration or Secretory tissues.
- **C**: NR activity – *in-vivo /* Estimation of proteins by Lowry's method/ Q_{10}
- **D**: DNA/ Amino acid sequencing
- **E**: Vascular bundles
- **F:** Tyloses / heart wood / sapwood / growth rings / periderm / lenticels.
- **G**: Autoradiogram, polysome, Rolling circle & semiconservative replication of DNA

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SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)

S. Y. B. Sc. BOTANY SEMESTER IV

CURRENT TRENDS IN PLANT SCIENCES I

PRACTICAL III

Duration: 3 hours **Max. Marks: 50**

Q.1.	Prepare a garden plan **'A'** with suitable garden locations.	**10M**
Q.2.	Perform seed sterilization technique **'B'**.	**06M**
Q.3. (a.)	Perform chi-square test/ coefficient of correlation using data **'C'** and analyze the result.	**10M**
Q.3. (b.)	Perform the experiment **'D'** related to web search.	**05M**
Q.4.	Perform given Indian style of flower arrangement **'E'**.	**10M**
Q.5.	Identify and describe slides / specimen **'F', 'G'** and **'H'.**	**09M**

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KEY:

- **A**: Garden plan
- **B**: Moong / Mustard seeds
- **E**: Gajra / Veni / Garland / Floral rangoli
- **F**: Terrarium / Dish Garden
- **G**: Cloning vector
- **H:** Plants suitable for different garden locations

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Note:

1. A minimum of **one field excursion per semester** 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 S. Y. B. Sc. Botany and the Field Report or a certificate from the Head of the Department to the effect that the candidate has completed the practical course of S. Y. B. Sc. Botany as per the minimum requirements. In case of loss of journal, a candidate must produce a certificate from the Head of the Department 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.

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