

AC/24.02.2024/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 NEP effective from June 2024 Offered by:

Department of Botany

Program: S. Y. B.Sc. Course: Botany (DSC) Major

**Choice Based Credit System (CBCS) with effect from the
academic year 2024-25**

SYUGP Credit Structure break-up from 2023-24 (Across All courses)										
Level	Sem	Major	Elect	Minor	O E	VSC	VE C	OJT, FP, RP, CEP		Degree/ Cum Cr
						SEC		CC		
5 (2024-25)	Sem 3	(3T+1P) + (3T+1P)	0	(3T+1P)	2	VSC Major/ Minor	2	FP/CEP 2 (Sci) & CC 2	22	88 UG Diploma
	Sem 4	(3T+1P) + (3T+1P)	0	(3T+1P)	2	SEC Major/ Minor	2	FP/CEP 2 (Art/Com) & CC 2	22	

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 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 S. Y. B. Sc. syllabus have been upgraded with the new modules as per the guidelines of NEP, in order to make the learners aware about the recent developments in various branches of Botany (like Thallophyta, Spermatophyta, Plant anatomy, Genetics, Molecular Biology, Plant physiology, Biochemistry, Ecology and Environmental Botany, Medicinal Botany, Plant biotechnology, Industrial Botany, etc.). Various interdisciplinary courses such as Biotechnology & Bioinstrumentation are also introduced to make the students at par with the updated tools and techniques.

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

Each theory period shall be 60 minutes in duration. The theory component shall have 96 instructional periods per semester. Each practical will be 2 periods of 60 minutes each.

**S. Y. B. Sc. Botany Syllabus Under NEP
To be implemented from the Academic year 2024-2025**

**Major subject: 1 SEM – III SECOND YEAR BSc (BOTANY MAJOR)
(Credits: 4)**

Theory: Paper I – Plant Diversity III				
Paper Code	Unit No.	Unit Name	Credits	Lectures/week
SIUBOMJ211	1	Algae & Bryophyta	03	01
	2	Angiosperms		01
	3	Plant anatomy		01
Practical I – Plant Diversity III				
SIUBOMJP211	Based on SIUBOMJ211 (Practical I)		01	02

**Major subject: 2 SEM – III SECOND YEAR BSc (BOTANY MAJOR)
(Credits: 4)**

Theory: Paper II –Functional Botany III				
Paper Code	Unit No.	Unit Name	Credits	Lectures/week
SIUBOMJ212	1	Ecology and Phytogeography	03	01
	2	Plant Physiology: Photosynthesis and Respiration		01
	3	Pharmacognosy & Phytochemistry		01
Practical II – Functional Botany III				
SIUBOMJP212	Based on SIUBOMJ212 (Practical II)		01	02

Semester III Plant diversity III (4Cr) (Major)	Hr. 45 Cr. 03
Course code: SIUBOMJ211	
Paper I - Plant Diversity III	
LEARNING OBJECTIVES: The course, Plant Diversity III, comprises units on Thallophyta (Algae) & Bryophyta, Angiosperms, and Plant Anatomy. The course includes a detailed study of diversity in algae, bryophytes, and their future applications in industry and the environment. It aims to provide an understanding of the floral morphology of angiospermic flowers. It would help to explore the Angiosperm families/subfamilies & their economic importance and their systematic position. The course would help to relate the structure with function by studying different anatomical details. The course would teach students the process and need for secondary growth in plants.	
<u>COURSE OUTCOMES:</u>	

After completion of the course, learners would be able to understand:			
<p>CO1: The life cycles of <i>Volvox</i> and <i>Sargassum</i>.</p> <p>CO2: The general characters of division Phaeophyta.</p> <p>CO3: Applications and commercial significance of algae as biofertilizers, medicine, sewage treatment, and algal culturing.</p> <p>CO4: Applications of bryophytes in agriculture and horticulture.</p> <p>CO5: Anthocerotae among bryophyta along with the life cycle of <i>Anthoceros</i>.</p> <p>CO6: Identification and classification of plants based on Bentham & Hooker’s system of classification.</p> <p>CO7: Floral morphology of angiosperms.</p> <p>CO8: The normal and anomalous secondary growth in plants.</p> <p>CO9: Anatomical features like growth rings, periderm, lenticels, tyloses, heartwood, and sapwood.</p> <p>CO10: The secretory tissues in plants.</p>			
UNIT I –Algae & Bryophyta		15	
1	Structure, life cycle and systematic position of <i>Volvox</i> . (02)		
2	General characters of Division Phaeophyta (01)		
3	Structure, life cycle, and systematic position of <i>Sargassum</i> . (02)		
4	Economic Importance of algae concerning Biofertilizers; Medicine, Sewage treatment, Energy production. (02)		
5	General account of class Anthocerotae (01)		
6	Structure, life cycle, and systematic position of <i>Anthoceros</i> . (03)		
7	Applied Aspects: Algal Culturing, Applications of bryophytes in agriculture and horticulture. (04)		
UNIT II – Angiosperms		15	
1	<p>Flower Morphology: (05)</p> <ul style="list-style-type: none"> ● 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. 		

2	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:(10) <ul style="list-style-type: none"> ● Magnoliaceae ● Combretaceae ● Myrtaceae ● Leguminosae (Papilionaceae, Caesalpinae, Mimosae) ● Asteraceae ● Amaranthaceae ● Palmae 		
UNIT III – Plant anatomy		15	
1	Normal Secondary Growth in Dicotyledonous stem and root. (04)		
2	Growth rings, periderm, lenticels, tyloses, heartwood, and sapwood. (01)		
3	Anomalous secondary growth in the stems of <i>Bignonia</i> , <i>Aristolochia</i> , <i>Dracaena</i> . (05)		
4	Anomalous secondary growth in the storage roots of Beet and radish. (02)		
5	Secretory tissues in plants. (03)		

Course code: SIUBOMJ211	REFERENCE BOOKS: Course Title: PLANT DIVERSITY III
Unit I:	Thallophyta (Algae) & Bryophyta
<ul style="list-style-type: none"> ● 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:

Plant 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.

	Semester III	Hr.20 Cr. 1
	Course Code: SIUBOMJP211	
	Practical Paper I – Plant Diversity III	
1	Study of stages in the life cycle of <i>Volvox</i> from fresh/ preserved material and permanent slides.	
2	Study of stages in the life cycle of <i>Sargassum</i> from fresh/ preserved material and permanent slides.	
3	Economic importance of algae: Biofertilizers; Medicine, Sewage disposal, Water pollution, Energy production.	
4	Study of stages in the life cycle of <i>Anthoceros</i> from fresh/ preserved material and permanent slides.	
5	Study of floral morphology I with suitable examples: As per theory	
6	Study of floral morphology II with suitable examples: As per theory	
7	Study of Systematic botany I with suitable examples: As per theory	
8	Study of Systematic botany II with suitable examples: As per theory	
9	Study of Systematic botany III with suitable examples: As per theory	
10	Study of Systematic botany IV with suitable examples: As per theory	
11	Study of normal secondary growth in dicotyledonous stem and root	
12	Study of Anomalous secondary growth in the Stems of <i>Bignonia</i>	
13	Study of Anomalous secondary growth in the Stems of beet and radish	
14	Study of secretory tissues in plants – Ducts, Laticifers and Glands	

Semester III Functional Botany III (4Cr) (Major)		Hr45 Cr.03
Course code: SIUBOMJ212		
Paper II - Functional Botany III		
<p>LEARNING OBJECTIVES: The course, Functional Botany III, comprises the units on Ecology and Phytogeography, Plant physiology and Pharmacognosy & Phytochemistry. The course would create awareness about basic concepts in ecology, phytogeography, and their significance. The course will aid students in understanding the basic mechanism of photosynthesis, respiration, and photorespiration in plants. The course would introduce different allied branches of medicine and also enhance students' understanding about traditional medicines in grandma's pouch, secondary metabolites, psychoactive drugs, and adulteration in medicinal drugs.</p>		
<p>COURSE OUTCOMES:</p> <p>After completion of the course, learners would be able to understand:</p> <p>CO1: The different types of energy pyramids and process of energy flow in an ecosystem.</p> <p>CO2: The ecological adaptations observed in plants in response to the surrounding environment.</p> <p>CO3: Phytogeographical regions of India and scope of phytogeography.</p> <p>CO4: Basic process of photosynthesis in plants.</p> <p>CO5: Various processes related to respiration and photorespiration.</p> <p>CO5: Allied systems of medicine.</p> <p>CO6: Traditional use of plants from Grandma's pouch.</p> <p>CO7: Various secondary metabolites produced in plants and their role.</p> <p>CO8: Psychoactive drugs from plants.</p> <p>CO9: Adulterations in medicinal drugs.</p>		
UNIT I – Ecology and Phytogeography		15
1	Energy pyramids, Energy flow in an ecosystem. (04)	
2	Ecological adaptations in plants. (04)	
3	Phytogeography – Introduction, scope, significance. (03)	
4	Phytogeographical regions of India. (04)	
UNIT II – Plant physiology		15
1	Photosynthesis: Introduction and significance, site of photosynthesis, photosynthetic pigments – nature and functions, role of light, absorption and action spectrum, photosynthetic unit, photoluminescence, Emerson's effect, photosystems, Factors affecting photosynthesis. (04)	

2	Light reaction – Photolysis of water, photophosphorylation: Cyclic, noncyclic, chemiosmotic pathway. (03)		
3	Dark reaction- C ₃ cycle, C ₄ cycle & CAM. (03)		
4	Respiration: Aerobic: Glycolysis, TCA Cycle, ETS & Energetics of respiration; Anaerobic respiration (04)		
5	Photorespiration (01)		
UNIT III – Pharmacognosy & Phytochemistry		15	
1	Traditional and alternative systems of medicine- Ayurveda, Siddha, Unani and homoeopathy (03)		
2	Botanical source, Active constituents, and Medicinal uses of some medicinal plants from Grandma’s pouch – <i>Zingiber officinalis</i> , <i>Mentha piperita</i> , <i>Piper nigrum</i> , <i>Ocimum sanctum</i> , <i>Adhatoda vasica</i> . (02)		
3	Study of secondary metabolites w.r.t chemical properties, occurrence, examples, and therapeutic uses – alkaloids, glycosides, volatile oils, tannins. (04)		
4	Psychoactive drugs from plant sources and their effects. (02)		
5	Adulteration and Substitution of medicinal drugs – Reasons & types. Adulteration of <i>Saraca asoca</i> with <i>Polyalthia longifolia</i> ; <i>Glycyrrhiza glabra</i> with <i>Abrus precatorius</i> ; <i>Bacopa monnieri</i> with <i>Centella asiatica</i> . (04)		

Course Code: SIUBOMJ212	REFERENCE BOOKS: Course Title: Functional Botany III
Unit I:	Ecology and Phytogeography
<ul style="list-style-type: none"> ● 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. ● Bharucha, F. R. (1983). A textbook of the plant geography of India, Oxford University Press. 	

Unit II:	Plant Physiology
<ul style="list-style-type: none"> ● 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:	Pharmacognosy and Phytochemistry
<ul style="list-style-type: none"> ● 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. 	

	Semester III	Hr20 Cr. 1
	Course Code: SIUBOMJP212	
	Practical Paper II – Functional Botany III	
1	Estimation of primary productivity by harvest method.	
2	Estimation of primary productivity by chlorophyll method.	
3	Identification of plants adapted to different environmental conditions: Hydrophytes: Free floating (<i>Pistia/Eichhornia</i>); Rooted floating (<i>Nymphaea</i>); Submerged (<i>Hydrilla</i>), Mesophytes (any common plant); Hygrophytes (<i>Typha/Cyperus</i>), Xerophytes: Succulent (<i>Opuntia</i>); Woody Xerophyte (<i>Nerium</i>); Halophyte (<i>Avicennia pneumatophore</i>).	
4	Study of phytogeographical regions of India.	
5	Estimation of amount of chlorophyll present in the leaf tissue	
6	Separation of photosynthetic pigments by paper chromatography.	
7	Q10 – germinating seeds using Phenol red indicator.	
8	Study of absorption spectrum of chlorophyll.	
9	Macroscopic and microscopic study to analyze the Adulteration of <i>Saraca asoca</i> with <i>Polyalthia longifolia</i> ; <i>Glycyrrhiza glabra</i> with <i>Abrus precatorius</i> ; <i>Bacopa monnieri</i> with <i>Centella asiatica</i> .	
10	Test for alkaloids, glycosides, saponins, phenolics.	
11	Identification of medicinal plants from Grandma's pouch - <i>Zingiber officinalis</i> , <i>Mentha piperita</i> , <i>Piper nigrum</i> , <i>Ocimum sanctum</i> , <i>Adhatoda vasica</i> .	

Major subject: 1 SEM – IV SECOND YEAR BSc (BOTANY MAJOR)**(Credits: 4)**

Theory: Paper I – Plant Diversity IV				
Paper Code	Unit No.	Unit Name	Credits	Lectures/week
SIUBOMJ221	1	Fungi, lichens, and plant pathology	03	01
	2	Pteridophyta and Gymnosperms		01
	3	Modern techniques to study plant diversity		01
Practical I – Plant Diversity IV				
SIUBOMJP221	Based on SIUBOMJ221 (Practical I)		01	02

Major subject: 2 SEM – IV SECOND YEAR BSc (BOTANY MAJOR)**(Credits: 4)**

Theory: Paper II –Functional Botany IV				
Paper Code	Unit No.	Unit Name	Credits	Lectures/week
SIUBOMJ222	1	Cell Biology & Cytogenetics	03	01
	2	Plant Biotechnology		01
	3	Industry based on plant products		01
Practical II – Functional Botany IV				
SIUBOMJP222	Based on SIUBOMJ222 (Practical II)		01	02

Semester IV Plant diversity IV (4Cr) (Major)		Hr45 Cr.03
Paper Code: SIUBOMJ221		
Paper I - Plant Diversity IV		
<p>LEARNING OBJECTIVES: The course, Plant Diversity IV, comprises the units on Fungi, Lichens, and Plant Pathology; Pteridophyta and Gymnosperms, and Modern Techniques to Study Plant Diversity. The course aims to provide insights into the general characters, structure, life cycle, and pathogenicity of fungi and Lichens. It would help to understand and explain the basic features of pteridophytes and an account of paleobotany. It would teach them about gymnosperms concerning their distribution, life cycle, and economic importance. It would allow learning of modern techniques in Microscopy, Chromatography, and Electrophoresis.</p>		
<p>COURSE OUTCOMES:</p> <p>After completion of the course, learners will be able to understand:</p> <p>CO1: General characters of Ascomycetae among fungi along with the life cycles of <i>Aspergillus</i> and <i>Xylaria</i>.</p> <p>CO2: General characters of Basidiomycetae among fungi along with the life cycle of <i>Agaricus</i>.</p> <p>CO3: Study of the life cycle of lichens long with ecological significance and economic importance.</p> <p>CO4: Basic concepts of plant pathology & Fungi as bio-controlling agents.</p> <p>CO5: Salient features of Psilophyta and Lepidophyta among the pteridophytes along with the life cycle of <i>Selaginella</i>.</p> <p>CO6: Concept of Geological time scale and fossil formation process.</p> <p>CO7: Study of Gymnosperms along with life cycles of <i>Pinus</i> and their economic importance.</p> <p>CO8: Introduction to microscopy, chromatography, colorimetry & spectrophotometry, and electrophoresis.</p>		
UNIT I – Fungi, Lichens and Plant pathology		
1	<p>Fungi:</p> <ul style="list-style-type: none"> ● General characters of Ascomycetae & Basidiomycetae (02) ● Structure, life cycle and systematic position of <i>Penicillium</i>, <i>Xylaria</i> (02) ● Structure, life cycle and systematic position of <i>Agaricus</i> (02) 	
2	Plant Pathology: Symptoms, causative organism, disease cycle and control measures of Powdery mildew and Late blight of potato. (02)	

3	Fungi as bio-controlling agent – <i>Trichoderma</i> , Predatory fungi (zoophagous, nematophagous, entomophilous) (02)	
4	Mycorrhiza: Type, and Significance with reference to agriculture and forestry (01)	
5	Lichens: Classification, Internal structure of thallus, Reproduction & fructification, Ecological significance & Economic importance. (04)	
UNIT II – Pteridophyta and Gymnosperms		15
1	Salient features of Psilophyta and Lepidophyta (1)	
2	Structure, life cycle, and systematic position of <i>Selaginella</i> (3)	
3	Salient features of Cycadophyta and Coniferophyta (1)	
4	Structure, life cycle, and systematic position of <i>Pinus</i> . (3)	
5	Paleobotany- The geological time scale; Formation and types of fossils. (3)	
6	Structure and systematic position of form genus <i>Rhynia</i> & <i>Cordaites</i> . (4)	
UNIT III – Modern techniques to study plant diversity		15
1	Chromatography: Principles and techniques in paper and thin layer chromatography, and HPTLC. (04)	
2	Principles and techniques of Horizontal and Vertical gel electrophoresis. (03)	
3	Colorimetry and Spectrophotometry (Visible, UV and IR) - Instrumentation, working, principle and applications. (04)	
4	Principle, working and applications of electron microscopy- Scanning electron microscope (SEM) and Transmission electron microscope (TEM). (04)	

Paper Code: SIUBOMJ221	REFERENCE BOOKS: Course Title: PLANT DIVERSITY IV
Unit I:	Fungi and plant pathology
	<ul style="list-style-type: none"> ● 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 Gymnosperms
	<ul style="list-style-type: none"> ● 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.
- 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 Agency (P) Ltd. ISBN: 9788173810282.
- Singh, S. K. (2008). Gymnosperms and Paleobotany. Campus Books, New Delhi. ISBN 10: 8180301451 / ISBN 13: 9788180301452.

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.

Semester IV (Major)		Hr20 Cr. 1
Paper Code: SIUBOMJP221		
Practical Paper I – Plant Diversity IV		
1	Study of stages in the life cycle of <i>Penicillium</i> from fresh/ preserved material and permanent slides.	
2	Study of stages in the life cycle of <i>Xylaria</i> from fresh/ preserved material and permanent slides.	
3	Study of stages in the life cycle of <i>Agaricus</i> from fresh/ preserved material and permanent slides.	
4	Study of fungal diseases - Powdery Mildew and Late Blight of Potato	
5	Study of fungi as bio-controlling agent – <i>Trichoderma</i> , Predatory fungi (zoophagous, nematophagous, entomophilous) and wood rotting fungi and AM fungi	
6	Study of Lichens: Morphological types, Internal structure of thallus, V. S. of apothecia.	
7	Study of stages in the life cycle of <i>Selaginella</i> from fresh/ preserved material and permanent slides.	
8	Study of form genera <i>Rhynia</i> with the help of permanent slides/ photomicrographs.	

9	Study of stages in the life cycle of <i>Pinus</i> from fresh/ preserved material and permanent slides.
10	Study of the form genus <i>Cordaites</i> with the help of permanent slide/ photomicrographs.
11	Preparation of herbarium and wet preservation technique.
12	Chromatography: Separation of amino by circular paper chromatography.
13	Separation of Carotenoids by Thin Layer Chromatography.
14	Horizontal and Vertical Gel Electrophoresis – Demonstration.

Semester IV Functional Botany IV (4Cr) (Major)	Hr45 Cr.03
Paper code: SIUBOMJ222	
Paper II - Functional Botany IV	
<p>LEARNING OBJECTIVES: The course Functional Botany IV comprises of the units Cell Biology and Cytogenetics, Plant Biotechnology and Industry based on plant products. The course would allow the students to explore the ultrastructure and functions of various cell organelles. It would encourage students to learn concepts related to cell division 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 make students understand the applications of plant tissue culture and R-DNA technology. It would also highlight the applications of protoplast fusion and somatic hybridization in agriculture. 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.</p>	
<p>COURSE OUTCOMES:</p> <p>After completion of the course, learners would be able to understand:</p> <p>CO1: Ultrastructure and functions of cell organelles.</p> <p>CO2: The process of Cell Division and its significance.</p> <p>CO3: Ultrastructure of Interphase Nucleus. Types, structure, and functions of Nucleic Acid.</p> <p>CO4: The Cytological and Genetic Effects Chromosomal Aberrations.</p> <p>CO5: Basic concepts of Sex determination, Sex linked, and sex influenced- sex limited traits.</p> <p>CO6: Learning the fundamentals of Extranuclear Genetics.</p>	

<p>CO7: Various sterilization techniques, seed sterilization & techniques in plant tissue culture.</p> <p>CO8: Basic concepts of gene cloning.</p> <p>CO9: Study of somatic embryogenesis and somatic hybridization along with their applications in agriculture.</p> <p>CO10: The concept of aromatherapy & nutraceuticals.</p> <p>CO11: Basic concepts and economic importance of plant-based beverages, plant enzyme industry and biofuels.</p> <p>CO12: Study of plants as sources of rubber, paper and fibres.</p>			
UNIT I – Cell biology and Cytogenetics		15	
1	Nucleic Acids: Types, structure and functions of DNA and RNA. (02)		
2	Cell division Meiosis and its significance. (02)		
3	Variation in Chromosome Structure (Chromosomal Aberrations): Definition, origin, cytological and genetic effects of the following: Deletions, Duplications, Inversions and Translocations. (04)		
4	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 <i>Drosophila</i> , Lyon's Hypothesis of X chromosome inactivation. (04)		
5	Sex Linked: Eye colour in <i>Drosophila</i> , Haemophilia, Colour blindness (01)		
6	Sex Influenced - Sex Limited Traits: Baldness in man (01)		
7	Extranuclear Genetics: Organelle heredity: Chloroplast determined heredity - Plastid transmission in plants, Streptomycin resistance in <i>Chlamydomonas</i> . Male sterility in maize (01)		
UNIT II – Plant Biotechnology		15	
1	r-DNA technology: (4) <ul style="list-style-type: none"> ▪ Gene cloning ▪ Enzymes involved in Gene cloning. ▪ Vectors used for Gene cloning. 		
2	Introduction to plant tissue culture: (5) <ul style="list-style-type: none"> ▪ Laboratory organization and techniques in plant tissue culture ▪ Totipotency ▪ Organogenesis ▪ Organ culture – root cultures, meristem cultures, anther and pollen culture, embryo culture. 		

3	Somatic embryogenesis and artificial seeds: Concept, definition, various methods, and applications. (3)		
4	Protoplast isolation, various methods of protoplast fusion, somatic hybridization, and its applications in agriculture. (3)		
UNIT III – Industry based on plant products		15	
1	Aromatherapy oils with respect to botanical source, extraction, properties and applications: Ylang-ylang, Rose, Vetiver, Eucalyptus, Jasmine. (04)		
2	Botanical and nutraceuticals: <i>Spirulina</i> , <i>Vanillin</i> , <i>Garcinia indica</i> / <i>Garcinia cambogia</i> , <i>Chlorella</i> and <i>Kale</i> . (03)		
3	Plant-based beverages: Alcoholic- Wine, Beer, and Toddy; Non-alcoholic Neera, Coffee, and Cocoa. (03)		
4	Enzymes industry: Cellulases, Papain, Bromelain. (02)		
5	Plants as a source of Biofuels- <i>Jatropha</i> , <i>Euphorbia</i> , <i>Calotropis</i> , and algae. (02)		
6	Plants as sources of rubber, paper, and fibers. (01)		

Course Code: SIUBOMJ222	REFERENCE BOOKS: Course Title: FUNCTIONAL BOTANY IV
Unit I:	Cell biology and Cytogenetics
<ul style="list-style-type: none"> ● 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. ● Atherly, A.G., Girton, J.R. and McDonald, J. F. (1999) The science of genetics. Saunders 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 II:

Plant 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:

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 IV (Major)	Hr20 Cr. 1
	Paper code: SIUBOMJP222	
	Practical Paper II – Functional Botany IV	
1	Estimation of DNA and RNA from plant material (one Std & one Unknown, No Std Graph).	
2	Study of meiosis from suitable plant material	
3	Study of inheritance pattern concerning Plastid Inheritance.	
4	Study of cytological consequences of chromosomal aberrations (Laggards, Chromosomal Bridge, Ring chromosome, Chromosomal ring) from permanent slides or photomicrographs. Study of karyotypes Cri-du-chat, Philadelphia syndrome & D-G translocation.	
5	Study of Sex-linked inheritance (eye colour in <i>Drosophila</i> , Haemophilia, Colour blindness) & Sex influenced characters (baldness in man, Hypertrichosis). Problems based on sex-linked inheritance.	
6	Preparation of Stock solutions; Preparation of MS medium	
7	Various sterilization techniques. Seed sterilization and inoculation.	
8	Callus induction & Regeneration of plantlets from callus (Demonstration).	
9	Identification of the cloning vectors – pBR322, pUC18, Ti-plasmid	
10	Identification – somatic embryogenesis, artificial seeds.	
11	Identification of plants as sources of biofuels, rubber, paper, and fibres.	
