Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur (C.G.)

Scheme and Syllabus

of

M. Sc. (Botany)

Program Code: MSCBOTR101

Semester system for affiliated college
(As per LOCF and credit system)

w.e.f. 2023-2024

(As approved by AC and EC meetings held on 16.08.2023 and 18.04.2023 respectively)

अटल बिहारी वाजपेयी विश्वविद्यालय, बिलासपुर (छ.ग.)

कोनी पुलिस थाना के सामने, बिलासपुर–रतनपुर मार्ग, कोनी, बिलासपुर (छ.ग.) 495009

Website: www.bilaspuruniversity.ac.in

Scheme of M.Sc. Botany under Semester System
Program Code: MSCBOTR101

Semester	Course Code	Subject Name	Credit			Total Credit	Marks			
							ESE	IA	Total	
			L	T	P				Max	Min
First	BOTT101	Biology and Diversity of Virus, Bacteria, Fungi and Algae	3	1	-	4	80	20	100	36
	BOTT102	Cell Biology and Molecular Biology	3	1	-	4	80	20	100	36
	BOTT103	Biology and Diversity of Bryophyta and Pteridophyta	3	1	-	4	80	20	100	36
	BOTT104	Plant Resource Utilization and Conservation	3	1	-	4	80	20	100	36
	BOTP101	Lab 1: Based on Paper BOTT101 and BOTT102	-	-	2	2	-	-	100	36
	BOTP102	Lab 2: Based on Paper BOTT103 and BOTT104	-	-	2	2	-	-	100	36
		Total	**12**	**4**	**4**	**20**	**-**	**-**	**600**	-
Second	BOTT201	Biology and Diversity of Gymnosperms and Paleobotany	3	1	-	4	80	20	100	36
	BOTT202	Cytology and Genetics	3	1	-	4	80	20	100	36
	BOTT203	Taxonomy of Angiosperms	3	1	-	4	80	20	100	36
	BOTT204	Plant Structure, Development and Reproduction	3	1	-	4	80	20	100	36
	BOTP201	Lab 1: Based on Paper BOTT201 and BOTT202	-	-	2	2	-	-	100	36
	BOTP202	Lab 2: Based on Paper BOTT303 and BOTT304	-	-	2	2	-	-	100	36
		Total	**12**	**4**	**4**	**20**	**-**	**-**	**600**	

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M. Sc. (Botany) Programs

Program Outcomes (POs)

After the completion of M.Sc. (Botany) Program, the students will be able to:

PO1	Knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.
PO2	Identify credible scientific sources to interpret and evaluate the evidences.
PO3	Get ability to apply the process of science by formulating hypotheses and design experiments based on the scientific method.
PO4	Analyse and interpret results generated through studies in botany, taxonomical treatments, field studies, excursion tours and laboratory techniques used in the subject.
PO5	Understand the issues of environmental contexts and sustainable development with respect to assessment, conservation and utilization of floral diversity.
PO6	Capability for developing innovative and solution cantered approach for handling any kind of problem and the paradigm of scientific temperament.
PO7	Understanding for the development of the applications of biological materials in food, health, medicine and environment for sustainable development of the society

Program Specific Outcomes

On completion of program students will be specifically able to:

PSO1	Identify and classify the plants by using the key characters.
PSO2	Students would be benefited with knowledge of core subjects like plant diversity, physiology and biochemistry, molecular cytogenetic and application of statistics etc.
PSO3	Learn about practical technique in lab for detail study of plant cell structure, reproduction, anatomy, breeding procedures for hybridization. Practice of subject with knowledge to design experiments, analyse and interpret data to reach to an effective conclusion.
PSO4	Students would perform functions that demand higher competence in national/international organizations with sporty and helping spirits. Prepare the students for many competitive exams like PSC, UPSC NET SET.
PSO5	They become competent enough in various analytical and technical skills related to plant sciences.

Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: I**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTT101**		
2	Course Title	**Biology and Diversity of Virus, Bacteria, Fungi and Algae & Lichen**		
3	Course Type	**Theory Paper**		
4	Pre-requisite (If any)	**NIL**		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Acquire knowledge about virus structure, steps in virus infection and role of Mycoplasma in causing plant diseases. • Describe the morphological features, cell arrangement and structural components of bacterial cell. • Demonstrate and understanding of various algal groups, their classification, characteristics, reproduction and economic importance. • Demonstrate and understanding of various fungal groups, their classification, characteristics, reproduction and economic importance. • Identify microorganisms and their role in various environments.		
6	**Credit Value**	**4**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course Total No. of Hours: 60		
Unit	**Topics**	**No. of Hrs.**
I	**General Microbiology:** General account and ultrastructure, nutrition and reproduction, biology and economic importance of archaebacteria and eubacteria. **Cyanobacteria:** salient feature structure, reproduction and biological importance. **Viruses:** Characteristics and ultrastructure of virions, Isolation and purification of viruses, chemical nature, replication, transmission of virus economic importance. **Mycoplasma:** General characteristics and reproduction, Role in causing plant diseases.	12
II	**Mycology – I:** General characters of fungi, cell ultrastructure, unicellular and multicellular organization, cell wall component, nutrition (Saprobic, biotrophic and symbiotic), reproduction (vegetative, asexual, sexual), heterothallism, heterokaryosis, Parasexuality, recent trends in classification.	12
III	**Mycology -II:** Phylogeny of fungi, general account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidomycotina, Deuteromycotina. Fungi in industries, medicine and as food, fungal diseases in plant and humans, Mycorrhizae, fungi as biocontrol agent.	12
IV	**Phycology - I:** Algae in diversified habitat (terrestrial, fresh water, marine water). Thallus organization, cell structure, reproduction (vegetative, asexual, sexual) Criteria for classification of algae, Pigments, reserve food, flagella, classification.	12
V	**Phycology – II:** Salient feature of following division: Protochlorophyta, chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta, Rhodophyta, Role of algae in algal blooms algal biofertilizers, algae as food, feed and use in industries. **Lichen:** Thallus structure, classification and reproduction, Lichen research in India. Economic importance of Lichens.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. An introduction to Fungi. - Dubey, H. C. Vikas Publishing House, New Delhi. 2012.
2. Plant Pathology - Sharma, P. D. Vivek Rastogi for Rastogi & Co., Meerut. 1995.
3. An introduction to Mycology – Mehrotra, R. S., Aneja, K. R. Wiley Eastern Limited, New Delhi 1990.
4. The text book of Microbiology - Ananthanarayan, R. Jayaram Paniker C. K., Orient Longman Limited, Hyderabad (A. P.) India
5. Dubey, R. C. and Maheshwari, D. (2000) Microbiology S. Chand and Company Ltd., Delhi.
6. General Microbiology- Schelegel, H. G. (1995). Cambridge University Press, U. K.
7. Introduction to Plant Viruses - Mandahar, C. C. (1978). S. Chand and Co. Ltd. Delhi.
8. Introductory Mycology - Alexopoulos, C. J., Mims, C. W. and Blackwell, M. John Wiley & Sons. Inc. U.S.A. 2012
9. Introductory Phycology, Kumar, H. D. (1988), Affiliated East-West Press Ltd., New Delhi.
10. Text book of Algae - Sharma O. P, (1986) Tata Macgraw Hill New Delhi

Reference Books:

1. The fungi. - Mehrotra, B. S., Today and Tomorrow's Printers and Publishers, New Delhi. 1992
2. Microbiology - Pelczar M., Chan E. C. S. and Krieg, N. R. Tata Mc Grew Hill Publishing Co. Ltd. New Delhi (1996).
3. Introduction to Fungi - Webster, J., Cambridge University Press, London. 1970.
4. Morphology and Taxonomy of fungi – Bessy E. A., Scientific Pub. Jodhpur 2015.
5. Microbiology: Fundamentals and Applications – Purohit, S. S., Agro Bios. Jodhpur 2002
6. An Introduction to Algae - Morris, I (1986) Cambridge Univ. Press, UK.
7. Introduction to Bacteria - Cliffton, A. (1958). McGraw Hill Book Co., New York.
8. Phycology - Lee, R. E. (2013). IV edition Cambridge University Press, London
9. The Algae - Chapman V. J. and Chapman D. J. (1973) Macmillan publishers

E-Resources:

1. **http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YT3BMQlQ3TG5iKy8wUVJaYzNHdWNvYURRaGpzY3doMVlONExBV3BxbE1GM0MzVVZUR1BxZVNHVlJ5bG9iMWpJcGc9PQ**
2. **https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering**
3. **https://vidyamitra.inflibnet.ac.in/index.php/search**
4. **http://www.rarebookroom.org/**

Algae:

5. **https://static1.squarespace.com/static/543d47ace4b0f40897fde705/t/5f2354c933f63d6164f19ee7/1596151032120/Activity+Adi_Khen.pdf**
6. **https://www.biologydiscussion.com/algae/algae-definition-characteristics-and-structure-with diagram/46727#:~:text=The%20algae%20are%20ubiquitous%20(present,mainly%20dwell%20in%20aquatic%20environments.**
7. **Fungi - https://www.biologydiscussion.com/fungi/fungi-meaning-characteristics-and-occurrence-botany/46481**

Bacteria:

8. **https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-01.pdf**
9. **https://www.inspiritvr.com/general-bio/prokaryotes-and-viruses/bacteria-structure-and-classification-study-guide**

Viruses:

10. **https://www.inspiritvr.com/general-bio/prokaryotes-and-viruses/viruses-structure-and-classification-study-guide**
11. **https://www.biologydiscussion.com/viruses/viruses-meaning-nature-and-structure/24292**

Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: I**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTT102**		
2	Course Title	**Cell Biology and Molecular Biology**		
3	Course Type	**Theory Paper**		
4	Pre-requisite (If any)	**NIL**		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Learn about structural organization and function of intracellular organelles. • understand the structure and functions of Chloroplast, Mitochondria and Ribosomes. • Students will get to know about the structure and function of plant cell. • Understand about cell cycle and apoptosis. • Understand about ultrastructure of DNA.		
6	**Credit Value**	**4**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course Total No. of Hours		
Unit	**Topics**	**No. of Hrs.**
I	**The Dynamics of cell:** Structural organization of plant cell, types of specialized plant cell, chemical foundation and biochemical energetics. **Cell wall:** Structure and function, synthesis and growth. **Plasma Membrane:** Structure, Models of plasma membrane, functions, Site of ATP synthetase, Ion carrier, channels and pumps, receptors, plasmodesmata and its role in movement of molecules.	12
II	**Chloroplast:** Structure, genome organization, gene expression, nucleo-chloroplastic interaction. **Mitochondria:** Structure, genome organization, biogenesis and function. **Other cell organelles:** Structure and function of micro bodies, Golgi apparatus and Endoplasmic reticulum.	12
III	**Ribosomes:** Structure, Site of protein synthesis, mechanism of translation: Initiation, elongation and termination. **Plant Vacuoles:** Tonoplast, Membrane ATPase, transporter, function as storage organelle. **Nucleus:** Structure, nuclear envelope, nuclear pore complex, nucleolus.	12
IV	**Cell shape and Motility:** The cytoskeleton, organization and role of microtubules and microfilament, motor movement, implications of flagellar and other movements. **Cell cycle and Apoptosis:** mechanism of programmed cell death (PCD). **Karyokinesis** — Mitosis and Meiosis, Cell cycle, Role of cyclins and cyclin dependent kinases, Cytokinesis and Cell plate formation.	12
V	**Nucleic Acid:** DNA ultrastructure, A, B & Z Forms of DNA, Nucleosome organization. DNA replication, damage & repair, transcription, splicing of mRNA, mRNA transport, rRNA biosynthesis & Structure, role of tRNA.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Girald Karp (2012), 7th Edition, Cell and Molecular Biology, Concepts and Experiments, John Wiley and Sons, Inc.
2. Powar C. B. (2005), Third edition, Cell Biology, Himalaya Publishing Mumbai.
3. Gupta, P. K. (2007) Cell and Molecular Biology, Rastogi Publication, Meerut, India.

Reference Books:

1. Lewin, B. (2005) Gene VIII Oxford University Press, New York, USA
2. Robertis, D. and Robertis, D. Cell Biology.
3. Wolfe, S. L. (1993) Molecular and Cellular Biology, Wadsworth Publishing Co, California, USA.
4. Lodish, H., Berk. A., Zipurski, S. L, Matsudarria, P., Baltimore, D. and Darneli, J., (2000) Molecular Cell Biology, W. H. Freeman and Co., New York, USA.

E-Resources:

1. https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Cell_Molecular_Biology
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==
3. http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXI4VU9YT3BMQlQ3TG5iKy8wUVJaYzNHdWNvYURRaGpzY3doMVlONExBV3BxbE1GM0MzVVZUR1BxZVNHVlJ5bG9iMWpJcGc9PQ
4. https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering
5. https://vidyamitra.inflibnet.ac.in/index.php/search
6. http://www.rarebookroom.org/
7. **Cell Cycle- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
8. **Cell Wall - https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
9. **Chloroplast and Mitochondria-** https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==
10. **Cell Membrane -https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
11. **Cytoskeleton - https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
12. **Nucleus - https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
13. **PCD- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
14. **Golgi Complex - https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
15. **DNA - https://www.biologydiscussion.com/dna/dna-structure-function-packaging-and-properties-with-diagram/16966**

Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: I**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTP101**		
2	Course Type	**Practical Paper**		
3	Pre-requisite (If any)	**NIL**		
4	**Credit Value**	**2**		
5	**Total Marks**	**External Marks: 100**	**Min Passing Marks:36**	

Part B		
Total No. of Hours: 30		
Based on Paper	**SUGGESTED LABORATORY WORK / FIELD EXERCISES**	**No. of Hrs.**
BOTT101	**Cyanophyta:** - Range of thallus organization and reproductive structures, types showing unicellular, colonial, trichome, filamentous, branched (pseudo and true branched). **Chlorophyta:** -Chlamydomonas, Pandorina, Eudorina, Volvox, Chlorella, Pediastrum, Hydrodictyon, Scenedesmus, Ulothrix, Cladophora, Draparnaldia, Draparnaldiopsis, Fristschiella, Chara, Nitella, Coleochaete, Ulva, Oedogonium, Zygnema, Spirogyra. **Phaeophyta:** - Ectocarpus, Dictyota, Laminaria, Fucus, Sargassum. **Rhodophyta:** - Porphyra, Batrachospermum, Gelidium, Gracillaria, Champia, Polysiphonia. Thallus organization, Spore producing organs, Tissue differentiation and accessory structures of following – **Mastigomycotina:** - Synchytrium, Saprolegnia, Achlya, Peronospora, Plasmopora,Albugo, Sclerospora. **Zygomycotina:** - Mucor, Rhizopus, Pilobolus. **Ascomycotina:** - Yeast, Penicillium, Claviceps, Xylaria, Trichoderma, Taphrina, Protomyces, Eurotium, Erysiphe, Phyllactinia, Uncinula. **Basidiomycotina:** - Uromyces, Ravenelia, Monosporidium, Puccinia, Melampsora, Ustilago, Agaricus, Pleurotus, Ganoderma, Polyporus, Cyathus, Lycoperdon, Geaster. **Deuteromycotina:** - Aspergillus, Fusarium, Cercospora, Colletotrichum, Alternaria, Curvularia, Cladosporium	15
BOTT102	• Identification of different stages of mitosis from suitable plant material. (Onion root tips, garlic root tips). • Identification of meiosis from suitable plant material. (Onion floral buds). • Microtomy of bud and root • Isolation of cell organelles: Mitochondria, Chloroplast, Nucleus, Lysosomes and their assay by succinate dehydrogenase activity (Mitochondria), acid phosphatase activity (Lysosome), acetocarmine staining (Nucleus) and microscopic observation (Chloroplast). • Study of mitotic index from suitable plant material. • Study of cyclosis(rotation/circulation) in cells of suitable plant material. • Preparation of stain and its uses: Acetocarmine, acetoorcein, safranine, iodine, cotton blue, fast green, lactophenol, xylol, egg albumen etc. • Study of structure different types of DNA and RNA • Formation and significance of chromosomal bridge, micronuclei, acentric and dicentric due to Chromosomal aberrations • Physical and chemical mutagens and its role.	15

Note: This is a tentative list of experiment, Teacher may add experiments according to their resources.

Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: I**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTT103**		
2	Course Title	**Biology and Diversity of Bryophyta and Pteridophyta**		
3	Course Type	**Theory Paper**		
4	Pre-requisite (If any)	**NIL**		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Describe characteristic features of bryophytes and their classification, reproduction and economic importance. • Know about morphological, anatomical and reproduction in various pteridophytic groups. • Know about evolution of sporophyte in Bryophyte. • Describe origin of seed habitat. • Describe fossil cryptogams		
6	**Credit Value**	**4**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course Total No. of Hours: 60		
Unit	**Topics**	**No. of Hrs.**
I	**Bryophyta - I:** Morphology, structure, reproduction, distribution, classification and, evolution of gametophytes and Sterilization of sporogenous tissue. Vegetative reproduction in bryophytes, Economic and ecological importance of bryophytes. **Fossil Bryophytes:** General account.	12
II	**Bryophyta - II:** General account (morphology, anatomy, reproduction and interrelationship) of the following groups – Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Funariales, Polytricales.	12
III	**Pteridophytes - I:** Morphology, structure, anatomy and reproduction, classification, evolution of steles, heterospory and origin of seed habit. **Fossil Pteridophytes:** General account.	12
IV	**Pteridophytes - II:** Morphology, anatomy, and reproduction of the following groups: Psilopsida and Lycopsida.	12
V	**Pteridophytes - III:** Morphology, anatomy, and reproduction of the following groups: Sphenopsida & Pteropsida	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Stewart, W. N. and Ruthwell, G. W. (1993) Paleobotany and the Evolution of Plants. Cambridge Univ. Press, UK.
2. Vashishtha, B. R. (2005) Pteridophytes S. Chand and Co., Delhi.
3. Vashishtha, B. R. (2005) Bryophytes S. Chand and Co., Delhi.
4. Parihar, N. S. 1999: An Introduction to Embryophyta Vol-I & II, Bryophyta and Pteridophytes Central Book Depot. Allhabad
5. Rashid, A 1998 An Introduction to Bryophyta Vikas publication House, Pvt, New Delhi

Reference Books:

1. Puri, P. (1980) Bryophytes, Atma Ram and Sons, Delhi.
2. Sporne, K. K. (1991) The Morphology of Pteridophytes, B. I. Publishing Pvt. Ltd. Bombay.
3. Sundara Rajan, S. 1994: Introduction to Pteridophyta
4. Andrews H. N. 1961 Studies in Palaeobotany, John Wiley and Sons, New York

E-Resources:

1. **https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Cell_Molecular_Biology**
2. **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
3. **http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YT3BMQlQ3TG5iKy8wUVJaYzNHdWNvYURRaGpzY3doMVlONExBV3BxbE1GM0MzVVZUR1BxZVNHVlJ5bG9iMWpJcGc9PQ**
4. **https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering**
5. **https://vidyamitra.inflibnet.ac.in/index.php/search**
6. **http://www.rarebookroom.org/**
7. **Pteridophytes - https://www.biologydiscussion.com/pteridophytes/pteridophytes-meaning-general-characters-and-affinities/53012**
8. **Sphagnum - https://www.biologydiscussion.com/botany/bryophytes/sphagnum-introduction-structure-and-affinities/46315#:~:text= Introduction%20to%20Sphagnum%3A,accumulates%20or%20where%20water%20drips.**
9. **Bryophytes –https://www.biologydiscussion.com/bryophyta/bryophyta-features-classification-and-economic-importance/5654**
10. **https://www.biologydiscussion.com/bryophyta/list-of-20-bryophytes-with-diagram/31966**
11. **Porella - https://www.biologydiscussion.com/bryophyta/structure-of-porella-with-diagrams/46170**
12. **Paleobotany-https://www.biologydiscussion.com/palaeobotany/palaeobotany-meaning-and-significance/53320**

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Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: 1**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTT104**		
2	Course Title	**Plant Resource Utilization and Conservation**		
3	Course Type	**Theory Paper**		
4	Pre-requisite (If any)	**NIL**		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • To analyze the threat and suggest conservative measures. • Medicinal plants and aromatic plants and their importance is made known along with their identification. • Get knowledge about the various food, fodder, fiber crops and forest products. • Develop understanding about the role of biodiversity in Ecosystem functions. • Get knowledge about the various government organization related to biodiversity conservation.		
6	**Credit Value**	**4**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Total No. of Hours: 60		
Unit	**Topics**	**No. of Hrs.**
I	**Biological diversity:** Concept and level, role of biodiversity in ecosystem, function and stability, speciation and extinction, IUCN categories of threat, distribution and global pattern, terrestrial biodiversity, hot spots. **Plant biodiversity:** Concept, status in India, utilization and concerns.	12
II	**Principal of Conservation:** Extinctions, environmental status of plant based on international Union for conservation of nature. ***In-situ* conservation:** Strategies for *In – situ* conservation, international efforts and Indian initiatives, protected areas in Indian sanctuaries, national parks, biosphere reserves, wetland, mangroves and coral reefs for conservation of wild biodiversity.	12
III	***Ex-situ* Conservation:** Strategies for *Ex- situ* conservation, Principles and practices, botanical gardens, gene bank, seed in vitro repositories, cry banks, general account of the activities of botanical survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR) India Council of Agriculture Research (ICAR), Council of Scientific and Industrial Research (CSIR) and the Department of Biotechnology (DBT) for conservation non-formal conservation efforts.	12
IV	**Economic Botany - I:** World centers of primary diversity of domesticated plants; The Indo Burmese center, plant introduction and secondary center. **Origin, Evolution, Cultivation and Uses of:** (i) food, forage and fodder crop, (ii) fiber crops (iii) medicinal and aromatic plants (iv) vegetable and (v) oil yielding crops.	12
V	**Economic Botany - II:** Important Fire —Wood and Timber Yielding Plant. Non-wood Forest Products (NWFPS); such as bamboos, rattans, raw materials for paper napkin, gums, tannins, dyes, resins and fruits. **Green Revolution:** Benefits and consequences, Innovations for meeting world food demands, plant used as avenue trees for shade, pollution control and aesthetics.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Barker, H. G. (1978) Plant and Civilization. C. A. Wadsworth, Belmont.
2. Frankel, O. H., Brown, A. H. D. and Burdon, J. J., (1995) Conservation of Plant Diversity. Cambridge Univ. Press, Cambridge, U. K.
3. Kochar, S. L. (1998) Economic Botany of The Tropics. McMillan India Ltd., New Delhi.
4. Paroda, R. S. and Arora R. K. (1991) Plant Genetic Resources and Conservation and Management IPGRI (publications). South Asia Office, c/o NBPGR, Pusa Campus, New Delhi.
5. Pinstrup- Anderson, P. Et Al (1999) World Food Prospects; Critical Issues for Early 21st Century. International Food Policy Research Institute, Washington D. C. USA.
6. Rogers, N. A. And Panwar, H. S. (1998) Planning A Wild Life Protected Area Network In India Vol. I The Report, Wildlife Institute Of India, Dehradun.
7. Scheri, R. W. (1972) Plants for Man. Englewood Cliffs, New Jersey, Prentice Hall.

Reference Books:

1. Annonymous (1997) National Gene Bank. Indian Heritage on Plant Genetic Resources (Booklet) NBPGER, New Delhi.
2. Heywood, V. (1995) Global Bio-Diversity Assessment, UNEP. Cambridge Univ. Press, Cambridge, U.K.
3. Heywood, V.H. and Wyse Jackson, P. S. (1991) Tropical Botanical Garden: Their Role in Conservation and Development. Academic Press, San Digo.
4. Swaminathan, M. S. And Kocchar (1989) Plants and Society, MacMillan Publication Ltd. London.
5. Kothari, A. (1997) Understanding Bio-Diversity: Life Sustainability and Equity. Orient Longam.

E-Resources:

1. **http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YT3BMQlQ3TG5iKy8wUVJaYzNHdWNvYURRaGpzY3doMVlONExBV3BxbE1GM0MzVVZUR1BxZVNHVlJ5bG9iMWpJeGc9PQ**
2. **https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering**
3. **https://vidyamitra.inflibnet.ac.in/index.php/search**
4. **http://www.rarebookroom.org/**

   Biodiversity –
5. **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
6. **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
7. **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==**
8. **Economic Botany - https://www.biologydiscussion.com/medicinal-plants/medicinal-plants-found-in-india-economic-botany/56868**

Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: I**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTP102**		
2	Course Type	**Practical Paper**		
3	Pre-requisite (If any)	**NIL**		
4	**Credit Value**	**2**		
5	**Total Marks**	**External Marks: 100**	**Min Passing Marks:36**	

Part B		
Total No. of Hours: 30		
Based on Paper	**SUGGESTED LABORATORY WORK / FIELD EXERCISES**	**No. of Hrs.**
BOTT103	**Bryophyta: -** Morphology, Anatomy and reproductive structures of: - Hepaticopsida: - *Ricciocarpus, Riccia, Marchantia, Targionia, Astrella, Porella, Cyathodium, Plagiochasma,* Anthocerotopsida: -*Anthoceros, Notothyllus.* Bryopsida: -*Sphagnum, Funaria, Polytrichum,* **Pteridophyta: -** Study of the following members to observe arrangement of Sori on a receptacle: - *Isoetes, Osmunda, Angiopteris, Ceratopteris, Achrostichum, Gleichinia* Morphology, Anatomy and reproductive structures of: - *Psilotum, Selaginella, Lycopodium, Equisetum, Ophioglossum, Lygodium, Pteris, Pteridium, Adiantum, Marsilea, Salvinia, Azolla.*	15
BOTT104	**Medicinal and Aromatic plants:** Depending on the geographical location College/University select five medicinal and aromatic plants each from a garden, crop field or from the wild only if they are abundantly available for their uses. *Papaver somniferum, Atropa belladonna, Catharanthus roseus, Adhatoda vesca, Allium sativum, Rauvolffia serpentina, Withania somnifera, Phyllanthus amarus, Andrographis paniculata, Aloe barbadense, Mentha arvesis, Rosa sp. Pogostemon cablins, Origanum vulgare, Vetivera zizanioides, Jasminum grandiflorum, Cymbopoogon sp., Pandanus odoratissimus.* **Study of live or herbarium specimens or other visual materials to become familiar with these resources: Vegetable oils;** Mustard, Groundnut, Soya bean, Coconut, Sunflower and Castor. **Gums, Resins, Tannins and Dyes;** Perform simple tests for gums and resins. Prepare a water extract of vegetable tannins (*Acacia, Terminalia*, Mangroves. Tea. *Cassia* sp.) and dyes (Turmeric, *Bixa orellana, Indigo, Butea monosperma, Lawsonia intermis*) and perform tests to understand their chemical nature. **Visit to national parks, wild life sanctuaries or Botanical Garden.**	15

Note: This is a tentative list of experiment; Teacher may add experiments according to their resources.

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Website: www.bilaspuruniversity.ac.in

Name and Signatures of Members of Board of Studies

Sl. No.	Category	Name of Nominated Members	Signature
1.	Chairperson	Prof. Sudhir Kumar Tiwari	
2.	Members	Smt. Shubha Verma	
		Dr. K. P. Namdeo	
		Shree T. P. Chandra	
		Dr. Sandeep Shukla	
		Smt. Indu Kaushal	
3.	VC Nominated members	Prof. Divya Bagachi	
		Prof. T. C. Bhalla	
4.	Corporate / Industrial Area Representatives		

Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: II**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTT201**		
2	Course Title	**Biology and Diversity of Gymnosperms and Paleobotany**		
3	Course Type	**Theory Paper**		
4	Pre-requisite (If any)	**NIL**		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Critically differentiate the characters of three orders of Gymnosperm i.e., Ginkogales, Coniferales, and Ephedrales. • Understand the evolutionary tendencies and comparative morphology of Cycadeodales, Cordaitales and Cycadales. • Understand the brief account of Pteridospermales. • Describe the Geological time scale. • Know about fossil and Fossilization.		
6	**Credit Value**	**4**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course Total No. of Hours: 60		
Unit	**Topics**	**No. of Hrs.**
I	**Fundamental Concept:** General Characteristics, Diversity, Classification, Gymnosperms the vessel less & fruitless seed plants varying in the structure of their sperms, pollen grains, pollen germination & complexity of their female gametophyte, Ovule and Seed of Gymnosperm.	12
II	**Evolution, Classification and Distribution:** Origin of gymnosperm and evolutionary trends, classification of gymnosperm, polyembryony in gymnosperms and its role, distribution of gymnosperm in India, economic importance of gymnosperms.	12
III	**Paleobotany:** Meaning, concept and significance of paleobotany; techniques of paleobotany; important strata and work in India. **Fossil:** Meaning, types and significance of fossil; fossilization. fossil record of different geological strata. **Geological time scale:** Meaning, divisions and event.	12
IV	**Fossil Gymnosperms:** Brief account of the families of Pteridospermales—Lyginopteridaceae, Glossopteridaceae, Medullosaceae, Caytonaceae. **General account and affinities**: Cycadeoidales and Cordaitales	12
V	**Living Gymnosperms**: General account of Cycadales, Ginkgoales, Coniferals, Ephedrales, Welwithschiales and Gnetales, concept of living fossil (Cycas and Ginkgo), Angiospermic characters of *Gnetum*.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Bhatnagar, S. P., Moitra, A. (1996) Gymnosperms, New Age International Pvt. Ltd., New Delhi.
2. Vashishta, P. C. and Sinha, A. K. (2005) Gymnosperm, S. Chand Publishing Company, Delhi.
3. Singh, H. (1978) Embryology of Gymnosperms; Encyclopedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.
4. Sharma, O.P 1999 Gymnosperms. Pragati Prakashan, Meerut

Reference Books:

1. Sporne, K. K. (1991) The Morphology of Gymnosperm. B. I. Publishing Pvt. Ltd., Bombay.
2. Steward, W. N. and Ruthwell, G. W. (1993) Paleobotany and evolution of plants, Cambridge University Press, U. K.
3. Andrews H. N. 1961 Studies in Palaeobotany, John Wiley and Sons, New York

E-Resources:

1. **http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YT3BMQlQ3TG5iKy8wUVJaYzNHdWNvYURRaGpzY3doMVlONExBV3BxbE1GM0MzVVZUR1BxZVNHVlJ5bG9iMWpJcGc9PQ**
2. **https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering**
3. **https://vidyamitra.inflibnet.ac.in/index.php/search**
4. **http://www.rarebookroom.org/**
5. **Gymnosperm- https://www.biologydiscussion.com/gymnosperm/gymnosperms-definition-external-features-and-reproduction/53316**
6. **Paleobotany - https://www.biologydiscussion.com/palaeobotany/palaeobotany-meaning-and-significance/53320**
7. **Geological time scale- https://www.biologydiscussion.com/palaeobotany/notes-on-geological-time-scale-palaeobotany/53328**

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Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: II**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTT202**		
2	Course Title	**Cytology and Genetics**		
3	Course Type	**Theory Paper**		
4	Pre-requisite (If any)	**NIL**		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain knowledge on the organization of genes and chromosomes. • Understanding of the structure of chromosome and how the packaging of DNA occurs and Structural and Numerical alterations in chromosomes. • Understanding the role and process of mutation and different mutagenic agent which brings about mutation in the organism. • Understand fine structure of gene, genetic recombination and linkage and recombination frequencies in gene mapping. • Analyze karyotype and describe.		
6	**Credit Value**	**4**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course Total No. of Hours: 60		
Unit	**Topics**	**No. of Hrs.**
I	**Chromatin Organization:** Chromosome structure and packing of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA, euchromatin, karyotype: analysis and karyotype evolution. Specialized type of chromosome: polytene, lamp brush, B- chromosomes and sex chromosome.	12
II	**Genetics of Prokaryotes & Eukaryotic Organelles:** Mapping the bacteriophage genome, Genetic recombination in phage, genetic transformation, Conjugation& transduction in bacteria, cytoplasmic male sterility. **Gene Structure & Expression:** Genetic fine structure, cis-trans test, introns & their significance, RNA splicing, regulation of gene expression in prokaryotes & eukaryotes	12
III	**Fundamental concept of Genetics:** Darwinism & Lamarkism, Mendelians Law, Genetic Recombination: Recombination, independent assortment & crossing over, role of rec A & Rec BCD enzyme in recombination, site specific recombination, chromosome mapping linkage groups, genetic markers. **Mutation:** Spontaneous & induced mutation, molecular basis of gene mutations, Transposable elements in Prokaryotes & eukaryotes, mutation induced by Transposons, site directed mutagenesis, DNA damage & repair mechanism. Proto-oncogene & oncogenes.	12
IV	**Chromosomal Aberrations:** Aneuploids and Euploids; origin and production of aneuploid, allopolyploids, evolution of major crop plants. **Structure and Numerical Alterations in Chromosomes:** Deletion, duplication, translocation and inversion, their origin, occurrence and breeding behavior.	12
V	**Cytogenetic:** Effect of aneuploidy on phenotype in plant, transmission of monosomics & trisomics & their use in chromosome mapping, breeding behavior, translocation tester set Robertsonian translocation. **Molecular Cytogenetic:** Nuclear DNA content, C- value paradox, Cot curve & its significance, restriction mapping, in-situ hybridization, physical mapping of genes on Chromosomes, micro cloning. Alien gene transfer through chromosome manipulation.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. P. K. Gupta: Cytology, Genetics and Molecular Biology; (2009). Rastogi Publications
2. Hartl, D. L. Jones, E. W (1998) Genetics Principles and Analysis IV edition Jones and Bartlett Publishers Boston, USA.
3. Kush, G. S. (1973). Cytogenetics of Academic Press, New York, London.
4. Russel, P. J. (1998) Genetic. The Benjamin Cummings Publishing Company, Inc. USA.
5. Snustand, D. P and Simons, M. J. (2000) Principles of Genetics. John Willey and Sons. Inc., USA.

Reference Books:

1. Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J. D. (1981) Molecular Biology of Cell. Garland Publishing Inc. New York, USA.
2. Karp, G., (1999) Cells and Molecular Biology; Concepts and Experiments. John Willey and Sons. Inc. USA.
3. Lewin, B. (2005) Gene VIII. Oxford Univ. Press, USA.
4. Rathoure, A.K. & Shrivastava, M. (2015): Cell Biology and Genetics. Daya Publishing House, New Delhi.
5. Hyde (2016): Genetics and Molecular Biology: With Fundamentals of Biostatics. Mcgraw Hill, New Delhi.
6. Singh, R. J. (2016): Plant Cytogenetics. CRC Press, Taylor & Francis Group, New York.
7. Singh, B.S.& Singh, M. P. (2015): Cytogenetics. SSPH Publications, New Delhi.

E-Resources:

1. **https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Botany_Plants_Science**
2. **https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Biochemistry_Genetics_Microbiology**
3. **http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YT3BMQlQ3TG5iKy8wUVJaYzNHdWNvYURRaGpzY3doMVlONExBV3BxbE1GM0MzVVZUR1BxZVNHVlJ5bG9iMWpJcGc9PQ**
4. **https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering**
5. **https://vidyamitra.inflibnet.ac.in/index.php/search**
6. **http://www.rarebookroom.org/**
7. **Chromosome-https://www.biologydiscussion.com/chromosomes/chromosomes-meaning-types-and-functions-nucleus/70538**
8. **DNA-https://www.biologydiscussion.com/dna/dna-structure-function-packaging-and-properties-with-diagram/16966**
9. **RNA- https://www.biologydiscussion.com/rna/types-of-rna-ribonucleic-acid-4-types/44919**
10. **Chromosome aberration- https://www.biologydiscussion.com/genetics/chromosomal-aberrations/quick-notes-on-chromosomal-aberration-cell-biology/38997**
11. **Gene Mapping- https://www.biologydiscussion.com/genome/genetic-mapping/modern-genetic-mapping-in-eukaryotes-with-diagram/27077**

Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: II**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTP201**		
2	Course Type	**Practical Paper**		
3	Pre-requisite (If any)	**NIL**		
4	**Credit Value**	**2**		
5	**Total Marks**	**External Marks: 100**	**Min Passing Marks:36**	

Part B		
Total No. of Hours: 30		
Based on Paper	**SUGGESTED LABORATORY WORK / FIELD EXERCISES**	**No. of Hrs.**
BOTT201	**Gymnosperms: -** Morphology, Anatomy and reproductive structures of – Cycas, Zamia, Ginkgo, Pinus, Cryptomeria, Juniperous, Araucaria, Taxus, Cedrus Thuja, Podocarpus, Gnetum, Ephedra. Study of fossil record and Fossilization.	15
BOTT202	**Cytology and Genetics:** Problems on genetics: based on inheritance / interaction / crossing over / linkage. Karyotype analysis (Slide/ Photograph). To study the salivary gland chromosomes from Chironomous larva.	15

Note: This is a tentative list of experiment; Teacher may add experiments according to their resources.

Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: II**	**Year: 1**	**w.e.f.: 2023-2024**
1	Course Code	**BOTT203**		
2	Course Title	**Taxonomy of Angiosperms**		
3	Course Type	**Theory Paper**		
4	Pre-requisite (If any)	**NIL**		
5	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Comprehend the concept of plant taxonomy and classification of angiosperm. • Learn about various angiosperm families and its economic importance. • Study of locally available families of flowering plants. • Identification of genus and species of locally available wild plants. • Understand to ICBN and Melbourne code. • Learn about taxonomic evidences and taxonomic tools.		
6	**Credit Value**	**4**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course
Total No. of Hours: 60

Unit	Topics	No.of Hrs
I	**The Species Concept:** Taxonomic hierarchy, species, genus family & other categories, principles used in assessing relationship, delimitations of taxa & attribution of rank, salient feature of the international Code of botanical nomenclature and salient features of Melbourne code.	12
II	**System of Angiosperm Classification:** Phonetic versus phylogenetic systems, cladistics taxonomy Salient Features of the systems Proposed by Bentham and Hooker, Hutchinson, Takhtajan and Cronquist.	12
III	**Taxonomic Evidence:** Morphology, anatomy, embryology, cytology, phytochemistry, genome analysis & nucleic acid hybridization. **Taxonomy Tools:** Herbarium, floras, histological phytochemicals cytology serological biochemical & molecular techniques, computers & GIS.	12
IV	**Dicotyledons**: Taxonomic features, systematic phylogeny and economic importance of families- Ranunculaceae, Magnoliaceae, Nymphaeaceae, Capparidaceae, Caryophyllaceae, Asteraceae, Rosaceae, Rutaceae, Anardiaceae, Fabaceae, Myrtaceae, Asclepiadaceae, Bignoniaceae, Acanthaceae, Apiaceae, Lamiaceae, Euphorbiaceae, Moraceae.	12
V	**Monocotyledons:** Taxonomic features, systematic phylogeny and economic importance of families- Amaryllidaceae, Musaceae, Zingiberaceae, Liliaceae, Arecaceae, Cyperaceae, Poaceae.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Pullaiah, T. (2013) Text book of Biosystematics Theory and Practical Regency Publication New Delhi
2. Stace, C. A. (1989) Plant Taxonomy and Biosystematics, Edward Arnold Ltd. London.
3. Woodland, D. W. (1991) Contemporary Plant Systematic. Prentice Hall. New Jersey.
4. Sharma, A.K. And Sharma, R. (2007) Taxonomy, Pragati Prakashan, Meerut.
5. Baruah, A Handbook of Angiosperm Taxonomy and Useful Plants, Aavishkar Publishers
6. Nairne A K. Scientific Classification of Flowering Plants, Discovery publication house New Delhi.

Reference Books:

1. Cole, A. J. (1969) Numerical Taxonomy. Academic Press, London.
2. Devis, P. H and Heywood, V. H (1973) Principle of Angiosperms Taxonomy, Robert E. Kreiger. Pub. Co. New York.
3. Grant, V. (1971) Plant Speciation Columbia Univ. Press, New York.
4. Grant W. F. (1984) Plant Biosystematics. Academic. Press, London.
5. Heslop-Hrrison, J. (1967) Plant Taxonomy. English Language Book Assoc. and Edward Arnold Pub. Ltd. U.K.
6. Takhtajan A. L. (1997) Diversity and Classification of Flowering Plants. Columbia Univ. Press, New York.
7. Chopra, G. L. (2005) Angiosperm. Pradeep Publication Jalandhar

E-Resources:

1. **http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YT3BMQlQ3TG5iKy8wUVJaYzNHdWNvYURRaGpzY3doMVlONExBV3BxbE1GM0MzVVZUR1BxZVNHVlJ5bG9iMWpJcGc9PQ**
2. **https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering**
3. **https://vidyamitra.inflibnet.ac.in/index.php/search**
4. **http://www.rarebookroom.org/**
5. **https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Botany_Plants_Science**
6. **Plant Systematics- https://www.biologydiscussion.com/living-organism/systematics/systematics-history-basics-of-study-and-types/44581**
7. **System of Plant Classification- https://www.biologydiscussion.com/plants/classifications/system-of-plant-classification-3-types/30330**
8. **Taxonomy evidence - https://www.biologydiscussion.com/angiosperm/taxonomy-angiosperm/taxonomy-evidences-in-relation-to-plants-angiosperms/34797**
9. **Terminology - https://www.biologydiscussion.com/angiosperm/quick-notes-on-angiosperms-with-diagrams-botany/19672**

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Part A: Introduction				
Program: M. Sc. (Botany)		**Semester: II**	**Year: 2023-24**	**w.e.f.: 2023-2024**
1	Course Code	**BOTT204**		
2	Course Title	**Plant Structure, Development and Reproduction**		
3	Course Type	**Theory Paper**		
4	Pre-requisite (If any)	**NIL**		
5	Course Learning Outcomes (CLO)	**At the end of this course, the students will be able to:** • Understand the process of seed germination and seedling growth. • Know about plants anatomical structure, their developmental patterns. • Know about secondary growth. • Learn about plant reproductive parts development of male, female gametophytes and fruits. • Understand to seed development and fruit growth.		
6	**Credit Value**	**4**		
7	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course Total No. of Hours: 60		
Unit	**Topics**	**No. of Hrs.**
I	**Seed Germination and seedling Growth:** Metabolism of nucleic acid, protein and mobilization of food reserve, plant movement, hormonal control of seedling growth, seedling development. **Shoot development:** Organization of shoot apical meristem (SAM), cytological and molecular analysis of SAM, control of cell division and cell communication, control of tissue differentiation especially xylem and phloem, secretary ducts and laticifers, wood development in relation to environmental factors.	12
II	**Root development:** Organization of root apical meristem (RAM), cell fates and lineages, vascular tissue differentiation, lateral tissues, hairs, root- microbe interaction. **Leaf Growth and differentiation:** determination, Phyllotaxy, control of leaf formation, differentiation of epidermis (with reference to stomata and trichomes), mesophyll.	12
III	**Plant Tissues:** Meristem and permanent tissues, parenchyma, chlorenchyma, sclerenchyma sclereids and fibres, xylem and phloem, structure, origin and differentiation. **Secondary Growth:** Structure, function and origin of cambium and cork cambium, ray and fusiform cells, secondary growth in dicot stem and root, abnormal secondary growth in monocot and dicot stem in various plants.	12
IV	**Reproduction:** Vegetative option and sexual reproduction flower structure and development, genetics of floral organ differentiation, sex determination plant. **Male Gametophytes:** Structure of anther, micro-sporogenesis, role of tapetum, pollen development and gene expression, male sterility sperm dimorphism and hybrid seed production, pollen germination, pollen tube growth and guidance, pollen storage, pollen allergy, pollen embryos.	12
V	**Female Gametophytes:** Ovule development, mega-sporogenesis, organization of the embryo sac, structure and development of embryo sac, Endosperm development Pollination, Pollen-pistil Interaction and Fertilization: Floral characteristic, pollination mechanism and vectors, breeding system, commercial consideration, structure of pistil, pollen-stigma interaction, Sporophytic and gametophytic self-incompatibility, double fertilization, in vitro fertilization. **Seed Development and Fruit Growth:** embryogenesis in dicot and monocot, poly-embryo, apomixes embryo culture, dynamics of fruit growth, biochemistry and molecules biology of fruit maturation.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Fahn, A. (1982) Plant Anatomy, Pergamon Press, Oxford.
2. Raghavan, V. (1999) Development Biology of Flowering Plants. Springer- Verlog, New York.
3. Steeves, T. A. and Sussex, I. M., (1989) Patterns in Plant Development, Cambridge University Press,
4. Bhojwani, S. S. and Bhatnagar, S. P. (2000) The Embryology of Angiosperms. Vikas Publishing House, New Delhi.
5. Proctor, M. and Yeo, P. (1973) The Pollination of Flowers, William Collins Sons, London.
6. Raghavan, V. (1997) Molecular Embryology of Flowering Plants. Cambridge University Press, London.
7. Sedegely, M., and Griffin, A. R. (1989) Sexual Reproduction of Tree Crops. Academic Press, London.

Reference Books:

1. Shivanna K. R., and Sawhney, V. K. (1970 Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.
2. Shivanna, K., and Johri B. M. (1985) The Angiosperm Pollen: Structure and Function. Willey Eastern Limited, New York.
3. Lyndon, R. F., (1990) Plant Development - The Cellular Basic. Unnin Hyman, London.
4. Fosket, D. E. (1994) Plant Growth and Development: A Molecular Approach. Academic Press, San Diego.
5. Howell, S. H. (1998) Molecular Genetics of Plant Development. Cambridge University Press, Cambridge, U. K.
6. Atwell, B. J. Kriederman, P. E. and Jumbull, C. G. N. (1999) Plant in action: Adaption in Nature, Performance in Cultivation. Macmillan Education, Sydney, Australia.
7. Bewley, J. D. and Black, M. (1994) Seeds: Physiology of Development and Germination, Plenum Press, New York.
8. Maheshwari, P. (2014) An introduction to the embryology of Angiosperm. Surjeet Publication Delhi.

E-Resources:

1. **http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YT3BMQlQ3TG5iKy8wUVJaYzNHdWNvYURRaGpzY3doMVlONExBV3BxbE1GM0MzVVZUR1BxZVNHVlJ5bG9iMWpJcGc9PQ**
2. **https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering**
3. **https://vidyamitra.inflibnet.ac.in/index.php/search**
4. **http://www.rarebookroom.org/**
5. **https://tripurauniv.ac.in/Page/SubjectWiseOnline_EBooks_Botany_Plants_Science**
6. **ApicalMeristem-https://www.biologydiscussion.com/botany/quick-notes-on-apical-meristems botany/20211**
7. **Anomalous Secondary Growth-https://www.biologydiscussion.com/plants/anomalous-structures/anomalous-structures-in-plants-with-diagrams/14073**
8. **Sexual Reproduction - https://www.biologydiscussion.com/angiosperm/sexual-reproduction-in-angiosperm-plants-steps/6506**
9. **Pollination - https://www.biologydiscussion.com/pollination/pollination-types-and-agents-biology/56145**
10. **Seed germination- https://www.biologydiscussion.com/seed/germination/seed-germination-definition-and-conditions-botany/48775**

Part A: Introduction				
Program: M. Sc. (Botany)		Semester: II	Year: 1	w.e.f.: 2023-2024
1	Course Code	BOTP202		
2	Course Type	Practical Paper		
3	Pre-requisite (If any)	NIL		
4	Credit Value	2		
5	Total Marks	External Marks: 100		Min Passing Marks:36

Part B		
Total No. of Hours: 30		
Based on Paper	SUGGESTED LABORATORY WORK / FIELD EXERCISES	No. of Hrs.
BOTT203	• Methods of non-destructive field collection and documentation. • Techniques of herbaria preparation. • Morphological characterization of selected families of dicots and monocots and identification up to families. • Preparation of artificial key based on appropriate character combination. • Identification of genus and species from Monocots and Dicots. • Identification of plant up to species with the help of modern flora keys. • Student submit duly prepared herbarium sheets.	15
BOTT204	• Study of microsporogenesis and gametogenesis in sections of anthers. • Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (*Maize,* Grasses, *Cannabis Sativa Crotolaria, Tradiscantia, Brassica, Petunia, Solanum melongena* etc.) • Estimating percentage and average pollen tube length in vitro. • Field study of several types of flowers with different pollination mechanisms (wind pollination thrips pollination bee/butterfly pollination, bird pollination. • Emasculation, bagging and hand pollination to study of pollen germination, seed set and fruit development using self-incompatible and obligate out crossing system. • Study of nuclear and cellular endosperm through dissections and staining. • Isolation of zygotic, globular, heart shaped, torpedo stage and nature embryo from suitable seeds and polyembryony in *citrus, jamun* (*Syzygium cumini*) etc. by dissections. • Study of endospermic and non-endospermic seed. • Study of seed dormancy and methods to break dormancy.	15

Note: This is a tentative list of experiment; Teacher may add experiments according to their resources.

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