Scheme of B.Sc. Botany

Year	Course Code	Subject Name	Theory/ Practical	Total Credit	Total Marks	
					Max	Min
First year	BOT-1T	Microbial Diversity and Plant Pathology	Theory	4	50	17
	BOT--2T	Archegoniateae and Plant Architecture	Theory	4	50	17
	BOT--1P	LAB 1 : Microbial Techniques and Archegoniate identification	Practical	2	50	17
Second year	BOT--3T	Plant Systematics, Economic Botany and Ethnobotany	Theory	4	50	17
	BOT--4T	Plant Anatomy, Embryology and Plant Breeding	Theory	4	50	17
	BOT--2P	LAB 2 : Plant Identification and Embryology	Practical	2	50	17
Third year	BOT -5T	Plant Physiology and Ecology	Theory	4	50	17
	BOT -6T	Cytogenetics, plant tissue culture and biometry	Theory	4	50	17
	BOT -3P	LAB 3 : Experiments in Physiology, Biochemistry & Molecular biology	Practical	2	50	17

Note: There shall be four extra credits in each year for internship/apprenticeship. The certificate of extra credits for this would be provided by the concern university and it is not mandatory.

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Part A : Introduction				
Programme: Certificate		**Class B.Sc.-I**	**Year: 2022**	**Session: 2022-23**
1.	Course Code	**BOT-1P**		
2.	Course Title	**Microbial Techniques and Archegoniate identification**		
3.	Course Type	**Practical**		
4.	Pre-requisite (if any)	No		
5.	Course outcomes:	After the completion of the course the students will be able to: • Understand the instruments, techniques and good lab practices for working in a microbiology laboratory. • Develop skills for identifying microbes and using them for Industrial, Agriculture and Environment purposes. • Practical skills in the field and laboratory experiments in Microbiology & Pathology. • learn to identify Algae, Lichens and plant pathogens along with their Symbiotic and Parasitic associations. • Can initiate his own Plant & Seed Diagnostic Clinic • Can start own enterprise on microbial products		
6.	Credit Value	2		
7.	Total Marks	Max. Marks: 50	Min. Passing Marks:17	

Part B : Content of the Course	
Total No. of Periods – 30	
Tentative Practical List	**Topic * (Minimum Any three from each unit depending on facilities and syllabus.** **20% for spotting, 10% each for viva and sessional and rest 60 % marks equally in each unit.)**
	INSTRUMENTS & TECHNIQUES: 1. Laboratory safety and good laboratory practices. 2. Principles and application of Laboratory instruments-microscope, incubator, autoclave, centrifuge, Laminar air flow, filtration unit, shaker, pH meter. 3. Buffer preparation & titration 4. Cleaning and Sterilization of glassware 5. Preparation of media- PDA and NAM 6. Inoculation and culturing of Fungi and bacteria **BACTERIAL IDENTIFICATION:** 1. Isolation of bacteria. 2. Staining techniques: Gram's, staining
	MYCOLOGY: 1. Study/ Slide preparation and . Staining of fungi. *Rhizopus, Saccharomyces, Penicillium, Peziza, Ustilago, Puccinia; Fusarium, Alternaria. Agaricus*:

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2. . Lichens: crustose, foliose and fruticose specimens. **PHYCOLOGY:** 1.Study / Slide preparation and Staining of algae – *Volvox, Oedogonium* and *Chara; Vaucheria;Ectocarpus Polysiphonia*
EXPERIMENTAL PLANT PATHOLOGY Isolation of pathogen from diseased leaf. Identification: Pathological specimens of Brown spot of rice, Bacterial blight of rice, Loose smut of wheat, , red rot of sugar cane, Tikka disease of ground nut, Slides of uredial, telial, pycnial & aecial stages of *Puccinia*, Few viral and bacterial plant diseases. like- Leaf curl of Papaya, Citrus canker **PRACTICALS IN APPLIED MICROBIOLOGY** 1. Isolation of rhizosphere to non rhizosphere population of bacteria. 2. Isolation of phyllosphere microflora. 3. Alcohol production from grapes in anaerobic condition 4. Isolation of lactic acid bacteria from curd. 5. Enzyme production and assay – catalase, protease and amylase.
Bryophyta: Study of morphology and anatomy of : 1. *Riccia* 2. *Marchantia* 3. *Anthoceros* 4. *Sphagnum* **Pteridophyta:** Study of morphology and anatomy of : 1. *Lycopodium* 2. *Selaginella* 3. *Equisetum* 4. *Pteris* 5. *Marselia*
Gymnosperm: Study of morphology and anatomy of : 1. *Cycas* 2. *Pinus* 3. *Ephedra*

Part C - Learning Resource
Text Books, Reference Books, Other Resources
Suggested Readings: 1. Practical Botany (Part I) ISBN #:81-301-0008-8 Sunil D Purohit, Gotam K Kukda & Anamika Singhvi Edition:2013 Apex Publishing House Durga Nursery Road, Udaipur, Rajasthan (bilingual). 2. Pandey S.K. (2012). Quick Concept of Botany. Publisher LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany (ISBN: 978-3-8484-3104-5). 3. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., New Delhi. 4. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.

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E-learning Resources:

5. https://community.plantae.org/tags/mooc
6. futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
7. https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html
8. https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
9. http://allaboutalgae.com/benefits/
10. https://repository.cimmyt.org/xmlui/bitstream/handle/10883/3219/64331.pdf
11. https://www.mooc-list.com/tags/microbiology
12. http://www.agrifs.ir/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%7D%20%5B8
13. 171339239%5D%20%281984%29.pdf
14. https://www.coursera.org/courses?query=plants
15. http://egyankosh.ac.in/handle/123456789/53530
16. https://www.classcentral.com/tag/microbiology
17. https://www.edx.org/learn/microbiology
18. https://www.mooc-list.com/tags/microbiology
19. https://www.udemy.com/topic/microbiology/

Part D – Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE): Not Applicable University Exam(UE): 50 Marks		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	As per rules

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Part A: Introduction				
Program: **Certificate course in Microbial Techniques and Archaegoniate identification**		Class: **B.Sc.I Year**	Year: **2022**	Session:**2022-2023**
1.	Course Code	**BOT-1T**		
2.	Course Title	**Microbial Diversity and Plant Pathology**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	NO		
5.	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to • Understand the Viruses, Bacteria, Phycology, Mycology and Plant pathology • Learn microbial techniques which will be beneficial for agriculture and industry. • Learn life cycles of selected genera of different groups • Understand etiology of plant diseases • Apply their knowledge in the crop fields to eradicate or avoid the diseases • Apply different biofertilizers to enhance productivity		
6.	**Credit Value**	**Theory: 4**		
7.	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 17**	

Part B: Content of the Course		
Total Periods: 60		
Unit	**Topics**	**No. ofPeriod**
I	**Microbial Techniques & instrumentation:** Microscopy – Light, phase contrast, scanning and transmission electron microscopy, staining techniques for light microscopy. Common equipment of microbiology lab and principle of their working – autoclave, oven, laminar air flow, centrifuge, colorimetry, spectrophotometry, electrophoresis, immobilization methods, fermentation and fermenters.	12
II	**Microbial world:** Cell structure of Eukaryotic and prokaryotic cells, Gram positive and Gram-negative bacteria, Structure of bacteria; Bacterial Growth curve, factors affecting growth of microbes; Sporulation, reproduction, recombination in bacteria. Viruses, general characteristics, Structure of viruses, Bacteriophages and TMV; Lytic and Lysogenic cycles, viroid, Prions & mycoplasma, phytoplasma, actinomycetes and their economic uses. **Applied Microbiology:** Food fermentations and food produced by microbes, Production of antibiotics, enzymes, alcoholic beverages, Lactic acid and Acetic acid production. Antigen, antibody and production of monoclonal antibodies (Hybridoma techniques).	12
III	**Phycology:** General characteristic features, classification and range of thallus organization. Classification and life cycle of –*Volvox, Oedogonium, Chara, Vaucheria,Ectocarpus* and *Polysiphonia*. Economic importance of algae - Role of algae in soil fertility, algae as biofertilizer , blue green algae and nitrogen economy of soil; algae as biofuel	12

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IV	**Mycology , Mushroom Cultivation, Lichenology & Mycorrhiza:** General characteristic features, Economic importance and Classification of Fungi. Distinguishing characters of Myxomycota: General characters of Mastigomycota: *Phytophthora* and *Albugo*, Zygomycota: *Rhizopus* and *Mucor*, Ascomycota: *Saccharomyces*, *Penicillium*, *Peziza*. Basidiomycota: *Ustilago, Puccinia, Agaricus*; Deuteromycota: *Colletotrichum*, *Fusarium, Alternaria*. Heterothallism, Physiological specialization, Heterokaryosis & Parasexuality, Mushroom cultivation- Button and Oyster mushroom General account of lichens, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.	12
V	**Plant Pathology:** Disease concept, Symptoms, Etiology, Primary and secondary inoculum, pathogenesis, Koch's Postulates. Mechanism of infection and predisposing factors. Disease reoccurrence, Defence mechanism : physical and biochemical, Disease Resistance, Systemic fungicides,Organomercurials and sulphur containing fungicides **Diseases and Control**: Symptoms, Causal organism, Disease cycle and Control measures of – Early & Late Blight of Potato, Damping of seedlings, False Smut of Rice/ Brown spot of rice, Black Stem Rust of Wheat, Alternaria spot and White rust of Crucifers, Red Rot of Sugarcane, Wilting of Arhar, Mosaic diseases on tobacco and cucumber, yellow vein mosaic of bhindi; Citrus Canker, Little leaf of brinjal; Disease management: Quarantine organizationand Integrated plant disease management, Biological control	12

Keywords: Microbial techniques, Mushroom cultivation, Mycology,Lichenology & Mycorrhiza, Plant diseases

Part C -Learning Resources

Suggested Readings:

1. Microbiology Fundamental and Applications (hindi) (pb) 9. ISBN: 9788188826230 Edition: 03Year : 2016Author : Dr. Purohit SS , Dr. Deo Publisher : Student Edition Language : Hindi
2. Modern Microbiology (hindi) (hb) ISBN: 9788177543599Edition : 1Year : 2018Author : Dr. Purohit SS , Dr. Singh T Publisher : Agrobios (India)
3. Plant pathology by R.S. Mehrotra, Tata McGraw-Hill Publication

Text Books:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Aggarwal, S. K. 2009. Foundation Course in Biology, A one books Pvt. Ltd., New Delhi.
5. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, NewDelhi.
6. Annie Ragland, 2012. Algae and Bryophytes, Saras Publication, Kanyakumari, India.
7. Basu, A. N. 1993. Essentials of Plant Viruses, Vectors and Plant diseases, New Age International, New Delhi.
8. Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut,India.
9. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., NewDelhi.
10. Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press, London.
11. Sharma, P.D. (2011). Plant Pathology. Meerut, U.P.: Rastogi Publication.
12. Webster, J., Weber, R. (2007). Introduction to Fungi, 3rd edition. Cambridge, U.K.: Cambridge University Press..
13. Pandey B.P. 2001. College Botany Volume 1, S Chand & Company Pvt.Ltd, New Delhi.
14. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
15. .Pelzar, 1963. Microbiology, Tata Mc Graw Hill, New Delhi

5. Rangaswamy, G. 2009, Disease of Crop Plants in India, Prientice Hall of India, New Delhi.

Online Resources

i. https://indianculture.gov.in/rarebooks/economic-botany-india

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ii. https://www.infinityfoundation.com/mandala/t_es/t_es_tiwar_botany_frameset.htm
iii. https://www.researchgate.net/publication/335715457_Ancient_Indian_rishi's_Sages_knowledge_of_botany_and_medicinal_plants_since_Vedic_period_was_much_older_than_the_period_of_Theophrastus_A_case_study_who_was_the_actual_father_of_botany
iv. https://www.scribd.com/presentation/81269920/Botany-of-Ancient-India
v. https://insa.nic.in/writereaddata/UpLoadedFiles/IJHS/Vol17_2_17_PKBhattacharyya.pdf

Suggested equivalent online courses:

1. https://indianculture.gov.in/rarebooks/economic-botany-india
2. https://community.plantae.org/tags/mooc futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
3. https://www.coursera.org/courses?query=plants
4. http://egyankosh.ac.in/handle/123456789/53530
5. https://www.classcentral.com/tag/microbiology
6. https://www.edx.org/learn/microbiology
7. https://www.mooc-list.com/tags/microbiology
8. https://www.udemy.com/topic/microbiology/ https://ucmp.berkeley.edu/bacteria/bacteria.html
9. https://www.livescience.com/53272-what-is-a-virus.html
10. https://gclambathach.in/lms/Economic%20importance%20of%20Algae.pdf
11. https://www.slideshare.net/sardar1109/algae-notes-1
12. https://www.onlinebiologynotes.com/algae-general-characteristics-classification/
13. https://www.sciencedirect.com/topics/immunology-and-microbiology/fungus
14. https://ucmp.berkeley.edu/fungi/fungi.html
15. https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf
16. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293
17. http://www.hillagric.ac.in/edu/coa/ppath/lect/plpath111/Lect.%201%20%20Introduction-Pl%20Path%20111.pdf
18. http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf
19. https://www.apsnet.org/edcenter/disimpactmngmnt/topc/EpidemiologyTemporal/Pages/ManagementStrategies.aspx
20. https://learn.saylor.org/course/view.php?id=23&sectionid=6821
21. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
22. http://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf
23. https://lipidnanostructuresgroup.weebly.com/
24. https://zoology4civilservices.wordpress.com/2016/06/18/65/
25. https://microbenotes.com/laminar-flow-hood

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50

Continuous Comprehensive Evaluation (CCE):As per rule

University Exam(UE): 50Marks

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Part A : Introduction				
Programme: Certificate		**Class B.Sc.-II**	**Year: 2022**	**Session: 2022-23**
1.	Course Code	**BOT-2P**		
2.	Course Title	**Plant Identification and Embryology**		
3.	Course Type	**Practical**		
4.	Pre-requisite (if any)	No		
5.	Course outcomes:	**Course outcomes:** After the completion of the course the students will be able: • To learn how plant specimens are collected, documented, and curated for a permanent record. • To observe, record, and employ plant morphological variation and the accompanying descriptive terminology. • To gain experience with the various tools and means available to identify plants. • To develop observational skills and field experience. • To identify a taxonomically diverse array of native plants. • To recognize common and major plant families. • Comprehend the concepts of plant taxonomy and classification of Angiosperms.		
6.	Credit Value	2		
7.	Total Marks	Max. Marks: 50	Min. Passing Marks:17	

Part B : Content of the Course

Total No. of Periods - 30

Tentative Practical List	**Topic*** ***(Topic * (Minimum Any three from each unit depending on facilities and syllabus. 20% for spotting, 10% each for viva and sessional and rest 60 % marks equally in each unit.)**
	Herbarium: Plant collection, Preservation and Documentation: Stepwise Practicing Herbarium techniques: 1. FIELD EQUIPMENTS, Collection of any wild 25 plant specimens 2. Learn to handle Herbarium making tools 3. Pressing and Drying of collected plant specimens 4. Special treatments for all varied groups of plants 5. Mount on standard herbarium sheets 6. Label them using Standard methods
	Arrange the prepapared herbarium according to Bentham and Hookers system of classification- 1.herb, shrub and trees 2. annual, biannual and perennial 3. cereals, pulses, vegetables and medicinal 4. ethanobotanical importance

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	Taxonomic Identification of angiospermic plants: Description of plants belonging to following families in semitechnical language and identification up to family level: Brassicaceae, Malvaceae, Fabaceae, Cucurbitaceae, Asteraceae, Apocyanaceae, Ascleapiadaceae, ,Solanaceae, Euphorbiaceae, Papaveraceae, Apiaceae Acanthaceae, Labiatae (Lamiaceae), Rubiaceae. Liliaceae, Musaceae, Poaceae. **Identification during field visits:** Field identification of common wild plants from families included in the theory syllabus.
	a) **Documentation of Ethnobotanical wisdom of area** b) **Study of economically valuable plants:** Medicinal plants, oil yielding plants, cereals, sugarcane, beverages etc.
	1. **Anatomy of:** Dicot root, stem and leaf 2. Monocot root, stem and leaf 3. Plants showing primary anomaly and anomalous secondary growth **a) Study of an angiospermic flower** **b) Dissection of Ladys finger /Tridax/citrus seeds for study of embryo**

Part C - Learning Resource	
Text Books, Reference Books, Other Resources	
	Suggested Readings: 1. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay. 2. Womersley, J. S. 1981. Plant collecting and herbarium development: A manual.S.K. Pandey (2012). Quick Concept of Botany. Publisher LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany (ISBN: 978-3-8484-3104-5). 3. Pandey S.K. (2012). Quick Concept of Botany. Publisher LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany (ISBN: 978-3-8484-3104-5). 4. Manilal, K. S. and M. S. Muktesh Kumar (ed.) (1998) A Hand book of Taxonomy Training, DST,N. Delhi 5. Dhopte, A.M. (2003) Principles and Techniques for Plant Scientists. - Agrobios,Jodhpur, India. 6. Jain, S.K. & R.R. Rao. 1977. A handbook of field and herbarium methods. Today & Tomorrow's Printers and Publishers, New Delhi. **E-learning Resources:** 1. http://egyankosh.ac.in/bitstream/123456789/13096/1/Unit-5.pdf 2. https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp18.pdf 3.https://www.researchgate.net/publication/267510854_The_Flowering_Plants_Handbook

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Part D – Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE): Not Applicable University Exam(UE): 50 Marks		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	Not Applicable

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Part A: Introduction				
Program: **Certificate course in Microbial techniques and Archaegoniate identification**		Class: **B.Sc. I Year**	Year: **2022**	Session: **2022-2023**
1.	Course Code	**BOT-2T**		
2.	Course Title	**Archegoniateae and Plant Architecture**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	NO		
5.	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to • Understand the General characteristics and affinities of Bryophytes, Pteridophytes and Gymnosperms • Phylogenetic relationships with the help of Palaeobotanical studies • Learn morphology, and- flower architecture of angiosperms		
6.	**Credit Value**	**Theory: 4**		
7.	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 17**	

Part B: Content of the Course		
Total Periods: 60		
Unit	**Topics**	**No. ofPeriod**
I	**Introduction to Archegoniates & Bryophytes:** Unique features of archegoniates, Bryophytes: General characteristic features and Affinities, adaptations to land habit, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction *of Riccia, Marchantia , Anthoceros* and *Sphagnum*. (Developmental details not to be included). Economic importance of bryophytes.	12
II	**Pteridophytes:** General characteristic features and affinities, Classification (up to family) with examples, Heterospory and seed habit, stelar evolution, economic importance of Pteridophytes, Morphology, anatomy and life cycle of *Psilotum, Lycopodium, Selaginella, Equisetum, Pteris* and *Marselia*.	12
III	**Gymnosperms:** Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, their examples, structure and reproduction; economic importance, Morphology, anatomy and life cycle of *Cycas, Pinus*and *Ephedra*.	12
IV	**Palaeobotany:** General account, Geological time scale; Brief account of process of fossilization & types of fossils and their study techniques; Fossil plants: *Rhynia, Williamsonia, Cycadeoidea.* Contribution of Prof. BirbalSahni	12
V	**Angiosperm Morphology (Stem, Roots, Leaves, Flowers and Inflorescence:** Morphology and modifications of root; Stem, leaf and bud. Types of inflorescences; flowers, flower parts, fruits and types of placentation; Definition	12

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	and types of seeds.	

Keywords: Archaegoniatae, Bryophyta, *Rhynia*, Heterospory, Angiosperms, Fossil

Part C -Learning Resources

1. Gangulee H. S. and K. Kar 1992. College Botany Vol. I and II. (New Central Book Agency)
2. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Pandey S.K. (2012). Quick Concept of Botany. Publisher LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany (ISBN: 978-3-8484-3104-5).
4. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
5. Rashid A (1999) An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi.
6. Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi.
7. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Pteridophyta, S. Chand and Company,
8. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Gymnosperms, S. Chand and
9. Parihar NS (1976) Biology and Morphology of Pteridophytes. Central Book Depot.
10. Bhatnagar SP (1996) Gymnosperms, New Age International Publisher.
11. Pandey BP (2010) College Botany Vol II S. Chand and Company, New Delhi .

Online Resources

1. https://www.anbg.gov.au/bryophyte/what-is-bryophyte.
2. https://pteridoportal.org/portal/index.php
3. https://www.conifers.org/zz/gymnosperms.php
4. http://www.mobot.org/MOBOT/research/APweb/
5. https://milneorchid.weebly.com/plant-id-for-beginners
6. http://webapp1.dlib.indiana.edu/inauthors/view?docId=VAC0868&doc.view=print
7. https://palynology.org/
8. http://www2.estrellamountain.edu/faculty/farabee/biobk/Biobookflowers.html
9. https://www.sciencelearn.org.nz/resources/100-plant-reproduction
10. https://palaeobotany.org

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50

Continuous Comprehensive Evaluation (CCE):As per rule

University Exam(UE): 50Marks

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Part A : Introduction				
Programme: Certificate		**Class B.Sc.-III**	**Year: 2022**	**Session: 2022-23**
1.	Course Code	**BOT-3P**		
2.	Course Title	**Experiments in physiology, Biochemistry & molecular biology**		
3.	Course Type	**Practical**		
4.	Pre-requisite (if any)	No		
5.	Course outcomes:	• **Course outcomes:** • After the completion of the course the students will be able to: • Know and authentic the physiological processes undergoing in plants along with • their metabolism • Identify Mineral deficiencies based on visual symptoms • Understand and develop skill for conducting molecular experiments for genetic • engineering		
6.	Credit Value	**2**		
7.	Total Marks	Max. Marks: 50	Min. Passing Marks:17	

Part B : Content of the Course

Total No. of Periods - 30

Tentative Practical List	**Topic*** ***(Topic * (Minimum Any three from each unit depending on facilities and syllabus.** **20% for spotting, 10% each for viva and sessional and rest 60 % marks equally in each unit.))**
	Plant water relation, Mineral Nutrition and translocation in phloem 1. Determination of osmotic potential of plant cell sap by plasmolytic method using leaves of *Rhoeo / Tradescantia.* 2. Osmosis – by potato osmoscope experiment 3. Effect of temperature on absorption of water by storage tissue and determination of Q10. 4. Experiment to demonstrate the transpiration phenomenon with the bell jar method 5. Structure of stomata (dicot & monocot) 6. Experiment to measure the rate of transpiration by using Ganong's/

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	Farmer's potometer 7. Study of mineral deficiency symptoms using plant material/photographs. **Cell biology** 1. Study of plant cell structure with the help of epidermal peal mount of *Onion/Rhoeo/Crinum/ etc.* 2. Measurement of cell size by the technique of micrometry (Ocular and stage micrometer). 3. Determination of mitotic index/ meiotic index and frequency of different mitotic / meiotic stages in pre-fixed root tips and flower buds respectively.
	Nitrogen Metabolism, Photosynthesis & Respiration : 1. A basic idea of chromatography: Principle, paper chromatography , column chromatography and TLC; demonstration of chromatography. 2. Separation of photosynthetic pigments by paper chromatography. 3. Effect of quality of light/concentration of Carbon dioxide on photosynthetic rate in aquatic plant 4.Determination of the RQ starchy/ proteinaceous/ oily germinating seeds. **Genetics:** 1. Monohybrid cross (Dominance, codominance and incomplete dominance) 2. Dihybrid cross (Dominance and incomplete dominance) 3. Gene interactions (All types of gene interactions mentioned in the syllabus) a. Recessive epistasis 9: 3: 1. b. Dominant epistasis 12: 3: 1 c. Complementary genes 9: 7 d. Duplicate genes with cumulative effect 9: 6: 1 e. Inhibitory genes 13: 3 4. Observe the genetic variations among inter and intra specific plants. 5. Demonstration of Breeding techniques-Hybridization, emasculation/ bagging/ tagging experiment.
	Genetic material: 1. Instruments and equipments used in molecular biology. 2. Isolation of DNA from plants
	Techniques for biochemical analysis: 1. Weighing and Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution etc. 2. Separation of amino acids by paper chromatography. 3. Detection of organic acids: citric, tartaric, oxalic and malic from laboratory samples., 4. Qualitative Analysis of carbohydrates, 5. Estimation of reducing sugar by anthrone method, 6. Qualitative Analysis of Lipids 7. Qualitative analysis of Amino acids and Proteins
	Biostatistics: 1.Univariate analysis of statistical data: Statistical tables, Central

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	tendency - mean, mode, median, standard deviation and standard error (using seedling population /leaflet size). 2.Calculation of correlation coefficient values and finding out the probability. 3.Determination of goodness of fit in Mendelian and modified mono-anddihybrid ratios (3:1, 1:1, 9:3:3:1, 1:1:1:1, 9:7, 13:3, 15:1) by Chi-squareanalysis and comment on the nature of inheritance. 3. Computer application in biostatistics - MS Excel and SPSS

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Suggested Readings:

1. A Laboratory Manual Of Plant, Physiology, Biochemistry And Ecology ISBN: 9788177544589Edition: 01Year: 2012Author: Akhtar InamPublisher : Agrobios (India).
2. Wilson and Walker. Practical Biochemistry: Principles and Techniques. Cambridge University Press.U.K.
3. Pandey S.K. (2012). Quick Concept of Botany. Publisher LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany (ISBN: 978-3-8484-3104-5).
4. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.

E-learning Resources:

1. https://www.edx.org/learn/molecular-biology
2. https://krishikosh.egranth.ac.in/handle/1/5810039999
3. https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090
4. https://www.coursera.org/courses?query=genetics
5. https://www.coursera.org/courses?query=molecular%20biology
6. https://www.edx.org/learn/genetic-engineering
7. https://www.mooc-list.com/tags/genetic-engineering
8. https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907

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Part D – Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE): Not Applicable University Exam(UE): 50 Marks		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test/Assignment/Presentation	Not Applicable

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Part A: Introduction				
Program: **Diploma in Plant Identification and plant preservation**		Class: B. Sc. **II Year**	Year: **2023**	Session:**2023-2024**
1.	Course Code	**BOT-3T**		
2.	Course Title	**Plant Systematics, Economic Botany and Ethnobotany**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	NO		
5.	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to • Understand the Plant Taxonomy • Learn the characteristics of families included • Learn economic importance of different plants of the concerned families • Understand the traditional knowledge about the plants and possible application of this knowledge		
6.	**Credit Value**	**Theory: 4**		
7.	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 17**	

Part B: Content of the Course		
Total Periods: 60		
Unit	**Topics**	**No. ofPeriod**
I	**Taxonomic Resources & Nomenclature:** Components of taxonomy (identification, nomenclature, classification); Taxonomic resources: Herbarium- functions & important herbaria, Botanical gardens, Flora, Keys- single access and multi-access. Principles and rules of Botanical Nomenclature according to ICBN	12
II	**Types of classification & Evidences:** Artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series) and Hutchinson classification. Introduction to taxonomic evidences from palynology, cytology and phytochemistry	12
III	**Families:** A study of the following families (Following Bentham & Hooker's system) with economic importance: Ranunculaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae, Myrtaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Apocynaceae, Acanthaceae, Asclepiadaceae, Solanaceae, Amaranthaceae, Euphorbiaceae, Papaveraceae, Apiaceae, Lamiaceae, Orchidaceae, Liliaceae, Musaceae and Poaceae.	12
IV	**Economically valuable plants:** Centre of origin and domestication of crop plants; Botanical name, family, part used and uses of oil yielding plants, fibre yielding plants, Rubber, Dyes, Timber, Sugar and beverages	12
V	**Ethnobotany:** Concept of Ethnobotany, Documentation, Conservation and application of Traditional Knowledge, Sacred grooves, Role of AYUSH, CIMAP and NMPB **Role of important medicinal plants in Traditional therapeutic practices:** *Aegle marmelos, Asparagus racemosus, Andrographis paniculata, Ocimum sanctum, Aloe vera, Nyctanthes arbor-tristis* etc. Conservation of medicinal plants and ethnomedicinal knowledge. Plants in primary healthcare: *Tinospora cordifolia, Ocimum sanctum, Aloe vera, Azadirachta indica* etc.	12

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Keywords: Taxonomy, classification, Families ,ethnobotany

Part C -Learning Resources

Suggested Readings:

1. Plant Systematics. Arun K. Pandey & Shruti Kansana. 2020. Jaya Publishing House.
2. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay.
3. Brandis, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors; Dehra Dun.
4. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://delta-intkey.com
5. https://www.naace.co.uk/school-improvement/ict-mark/
6. Pandey, B.P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd,New Delhi.
7. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
8. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
9. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers
10. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
11. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. New Delhi.
12. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency, India.
13. Reddy P. Parvatha. 2016. Sustainable crop protection under protected cultivation. Springer, Singapore.
14. Amit Deogirikar. 2019. A Text Book on Protected Cultivation and Secondary Agriculture. Rajlaxmi Prakashan, Aurangabad, India.
15. Singh, B., B. Singh, N. Sabir and M Hasan. 2014. Advances in protected cultivation. New India Publishing Agency, India.
16. Sharma, OP. 1996. Hill's Economic Botany (Late Dr. AF Hill, adopted by OP Sharma). Tata McGraw Hill Co. Ltd., New Delhi.

Suggested equivalent online courses:

1. https://www.easybiologyclass.com/topic-botany/
2. http://egyankosh.ac.in/handle/123456789/53530
3. https://www.delta-intkey.com/www/desc.htm
4. https://milneorchid.weebly.com/plant-id-for-beginners.html
5. https://plants.usda.gov/classification.html
6. https://www.senecahs.org/pages/uploaded_files/Plant%20Classification.pdf
7. https://www.ladykeanecollege.edu.in/files/userfiles/file/Dr_%20S_%20Nongbri%20III%20Sem%20ppt.pdf
8. https://www.brainkart.com/article/Bentham-and-Hooker-s-classification-of-plants---Dicotyledonae,- Gymnospermae-and-Monocotyledonae_1000/
9. https://libguides.rutgers.edu/c.php?g=336690&p=2267037
   https://www.delta-intkey.com/

Part D: Assessment andEvaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50

Continuous Comprehensive Evaluation (CCE):As per rule

University Exam(UE): 50Marks

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Part A: Introduction				
Program: **Diploma in Plant Identification and plant preservation**		Class: B.Sc. **II Year**	Year: **2023**	Session:**2023-2024**
1.	Course Code	**BOT-4 T**		
2.	Course Title	**Plant Anatomy, Embryology and Plant Breeding**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	NO		
5.	Course Learning. Outcomes (CLO)	At the end of this course, the students will be able to 1. Understand the internal structure of root, stem and leaves 2. learn about the anomalous secondary growth of some plants 3. understand the life cycle of angiospermic plants with details of microsporogenesis, megasporogenesis, fertilization and other developmental details up to embryogenesis 4. understand concept of plant breeding and its application		
6.	**Credit Value**	**Theory: 4**		
7.	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 17**	

Part B: Content of the Course		
Total Period: 60		
Unit	**Topics**	**No. ofPeriod**
I	**Meristems and related theories**: Meristematic and permanent tissues, Root meristem, Stem meristem and Leaf meristem. Theories of apical organization: Apical Cell Theory, Histogen Theory and Tunica Carpus Theory	12
II	**Anatomy and Secondary growth:** Anatomy of Root, Stem and Leaves of both Dicots and Monocots. Secondary growth in Dicots, Anomalous secondary growth in *Bignonia, Boerhaavia, Dracaena and Nycthanthes*	12
III	**Plant Embryology:** Flower: Structure and types (Complete, Incomplete, Perfect and Imperfect flower), Microsporangium and Microsporogenesis, Ovule: Structure and types, Megasporogenesis, Development of female gametophyte (Embryo sac), Types of Embryo sac, Pollination, Pollen-pistil interaction, Fertilization, Double fertilization, Endosperm and its types, Embryogenesis, Apomixis and Polyembryony	12
IV	**Plant Breeding**: Plant Introduction, Agencies of plant introduction in India, Procedure of introduction- Acclimatization- Achievements, Selection- mass selection, pure line selection and clonal selection. Genetic basis of selection methods	12
V	**Hybridization**: Procedure of hybridization, inter-generic, inter-specific and inter-varietal hybridization. Composite and synthetic varieties, Heterosis, Mutation and Molecular breeding (use of DNA markers in plant breeding). Role of hybrization in agriculture, horticulture and forestry	12
Keywords: Meristems, Anomalous secondary growth. Pure line selection. Hybridization.		

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Part C -Learning Resources

Text Books. Reference Books, Other Resources

1. M K Raxdan An Introduction to Plant Tissue Culture –; Oxfird& IBH Publishing Co.Pvt. Ltd.,New Delhi
2. Allard RW (1960) Principles of Plant Breeding. John willey and Sons. Inc. New York
3. BD Singh (2003) Plant Breeding. Kalyani Publishers
4. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi
5. Pandey BP (2010) College Botany Vol II, S. Chand and Company, New Delhi.
6. Maheshwari P (1971). An Introduction to Embryology of Angiosperms, McGraw Hill Book Co., London
7. Bhojwani SS and Bhatnagar SP (2000). The Embryology of Angiosperms (4th Ed.), Vikas Publishing House
8. Evert RF (2006). Esau's Plant Anatomy: Meristems, Cells and Tissues of the Plant body: Their Structure, Function and Development, John Willey and Sons, Inc
9. Pandey BP .Plant Anatomy, S. Chand Publishers, New Delhi
10. Srivastava HN (2006). Plant Anatomy, Pradeep Publications, Jalandhar

Suggested equivalent online resourses:

1. https://www.pnas.org/content/104/suppl_1/8641
2. https://www.journals.uchicago.edu/doi/pdfplus/10.1086/659998
3. https://bsi.gov.in/page/en/ethnobotany
4. http://www.legalserviceindia.com/article/l98-Intellectual-Property-and-Traditional-knowledge.html
5. https://www.brainkart.com/article/Economic-importance-Plants---Food,-Rice,-Oil,-Fibre,-Timber-yielding-plant_1095/
6. https://www.loc.gov/rr/scitech/tracer-bullets/economic-botanytb.html
7. http://nsdl.niscair.res.in/bitstream/123456789/127/1/Fibre%20crops%2C%20bamboo%2C%20timber%20-%20Final.pdf
8. https://www2.palomar.edu/users/warmstrong/econpls.htm
9. https://www.longdom.org/proceedings/phytochemistry-and-phytoconstituents-of-herbal-drugs-and-formulations-1668.html

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50

Continuous Comprehensive Evaluation (CCE):As per rule

University Exam(UE): 50Marks

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Part A: Introduction				
Program: **B.Sc.**		Class: B.Sc. **III Year**	Year: **2024**	Session:**2024-2025**
1.	Course Code	**BOT-5T**		
2.	Course Title	**Plant Physiology and Ecology**		
3.	Course Type	**Theory**		
4.	Pre-requisite (if any)	NO		
5.	Course Learning. Outcomes (CLO)	After the completion of the course the students will be able to: 1. Understand the role of Physiological and metabolic processes for plant growth and development. 2. Learn the symptoms of Mineral Deficiency in crops and their management. 3. Assimilate Knowledge about Biochemical constitution of plant diversity 4. acquaint the students with complex interrelationship between organisms and environment; 5. make them understand methods for studying vegetation, community patterns and processes,ecosystem functions, and principles of phytogeography. 6. This knowledge is critical in evolving strategies for sustainable natural resource managementand biodiversity conservation.		
6.	**Credit Value**	**Theory: 4**		
7.	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 17**	

Part B: Content of the Course		
Total Periods: 60		
Unit	**Topics**	**No. of Period**
I	**Plant water relation, Mineral Nutrition, Transpiration and translocation in phloem:** Importance of water, water potential and its components; Osmosis, Diffusion, Diffusion Pressure Deficit, Plasmolysis, Imbibition, Mechanism of water absorption, Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.Criteria of essentiality of elements; Role of essential elements- micro and macro elements; Symptoms of mineral deficiency in major crops, Minerals absorption and their transport across the cell membrane, Ascent of sap, Phloem transport	12
II	**Carbon metabolism:** **Enzymes:** Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; mechanism of action (activation energy, lock and key hypothesis, induced- fit theory), enzyme inhibition and factors affecting enzyme activity, Allosteric enzymes & Abzymes. **Photosynthesis**: structure of chloroplast, Pigments, Absorption and Action spectra, Emerson's Enhancement effect, Photosystems, Electron transport system (Z-Scheme) and Photophosphorylation, Carbon fixation- the Calvin cycle, Photorespiration, C4 and CAM cycle. **Respiration**-structure of mitochondria, aerobic and anaerobic respiration and fermentation, glycolysis, Krebs cycle, and electron transport system, ATP-synthase, RQ, Factors affecting respiration, Pentose phosphate pathway	12

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III	**Nitrogen and Lipid Metabolism:** Physical and biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Nitrate and ammonia assimilation, reductive amination and transamination, amino acid synthesis. **Lipid Metabolism:** Synthesis and breakdown of triglycerides, alfa and beta - oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination **Plant Development, Movements, Dormancy & Responses:** Plant growth curve, developmental roles of phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene), Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery,structure and functions), Seed and bud Dormancy, Vernalization &Senescence, Plant movements	12
IV	**Natural resources & Sustainable utilization: Ecology & Ecosystem:** Definition of Ecology, Ecological Factors, Positive and negative interactions. Ecosystem– Concept of structure and function of an ecosystem- trophic levels, food chain, food web, Ecological pyramids Abiotic and biotic components,-Energy flow in an ecosystem Ecological Succession-Definition & types. Processes and types (autogenic, allogenic,autotrophic, heterotrophic, primary & secondary), Hydrosere and Xerosere. Ecological Adaptations – Hydrophytes, Xerophytes	12
V	**Biodiversity**: alfa, beta and gamma diversity, social, ethical and aesthetic values; hotspots of biodiversity, threats to biodiversity, biotic communities and populations and their characteristics and dynamics. Endemic and endangered species of plants in India. Ecological niche, ecotypes, Ecotone , ecological indicators. **Conservation of Biodiversity:** Ex-situ and in-situ conservation, Red data book, botanical gardens, National park,Sanctuaries, hot & hottest spots and Bioreserves.	12
Keywords: Mineral nutrition, Carbon assimilation, Nitrogen and lipid metabolism, Natural resource management, Ecological succession, biodiversity conservation		

Part C -Learning Resources

Text Books, Reference Books, Other Resources

1. Plant Physiology and Biochemistry ISBN #:81-301-0035-5Sunil D Purohit, K. Ahmed & Gotam K Kukda Edition: 2013Pages: 368 + VIII Text Book (Hindi)
2. Hopkins, W.G. &Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
3. A Handbook On Mineral Nutrition And Diagnostic Techniques For Nutritional Disorders of Crops (pb)ISBN :9788177543377Edition : 01Year : 2011Author : Pathmanabhan G , Vanangamudi M , Chandrasekaran CN ,Sathyamoorthi K , Babu CR , Babu RC , BoopathiPNPublisher : Agrobios (India)
4. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.
5. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 19992, Wadsoworth Publishing Company.
6. Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
7. Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.
8. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New CentralBook. Agencies.

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9. Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.
10. Mathews, C.K., Van Holder, K.E. &Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.
11. Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan.
12. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.
13. Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.
14. Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biology of plants, 2000,I.K. International.
15. Chapman and Riss. Ecology: Principles and Applications, Latest Ed., Cambridge University Press
16. Shukla, R.S. & Chandel, P.S. Plant Ecology, Latest Ed., S. Chandel and Co.
17. Kumar, H.D. Modern Concept of Ecology, Latest Ed. Vikas Publishing House
18. Begon, M., Herper, J.L. and Townsend, C.R. Ecology- Individuals, Populations and Communities (3rd ed.), Oxford Blackwell Science
19. Verma, P.S. & Agarwal, U.K. Concept of Ecology, Latest Ed., S. Chand & Company
20. Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders
21. Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications
22. Ambasht, R.S. &Ambasht, N.K. A Text Book of Plant Ecology, Latest Ed., CBS Publication & Distributors
23. Mani, M.S. Bio-Geography of India, Latest Ed., Springer-Verlag.
24. Mackenzie et al. Ecology, Latest Ed., Viva Books.
25. Gurevitch, J. (et al.)., The Ecology of plants, 2002, Sinauer Associates
26. . Kimar, U. &Asija, M.J. Bio-diversity: Principles & Conservation, 2005, Student Edition, Agrobios (India)
27. Krishnamurthy, K.V. An Advanced Text Book on Biodiversity, 2003, Oxford & IBH Publishing Co. Ltd.
28. Mitra, D., Guha, J.K., Chowdhury, S.K. Studies in Botany, Vol. II (7th ed.) Moulik Library.
29. Primack, R.B. Essentials of Conservation Biology, 1993, Sinauer Associates.
30. Lo, C.P. & Yeung, A.K.W. Concepts and Techniques of Geographic Information Systems, 2002, Printice-Hallof India.
31. Cain, Bowman, Hacker. Ecology. 2014. 3rd Ed. Sinauer Associates
32. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
33. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. AnamayaPublications, New Delhi.
34. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall ofIndia Private Limited, New Delhi.
35. Abbasi, S. A. (1998). Environmental Pollution and its Control. Cogent International, Pondicherry.
36. Abbasi, S. A. and Ramasamy, E. V. (1999). Biotechnological Methods of Pollution Control. Universities Press(India) Limited, Hyderabad.
37. Peavy, H. S., Rowe, D. R. and Tchobanoglaus, G. (1985). Environmental Engineering, Mc Graw Hill BookCompany, Singapore.
38. Rand, M. C., Greenberg, A. E. and Taras, M. J. (Ed.) (1995). Standard methods for the examination of water andwastewater: 19th edition, American Public Health association (APHA), Washington, D.C.
39. Scragg, A. (1999). Environmental Biotechnology, Addison Wesley Longman, Singapore.
40. Tchobanoglaus, G. (1988). Wastewater Engineering: Treatment, Disposal, Reuse. Tata Mc Graw Hill, NewDelhi.
41. Aarve, V. P., William, A. W. and Debra, R. R. (2002). Solid waste engineering. Cengage reading, USA.
42. George, T., Hilary, T. and Samuel, A. V. (1993). Integrated solid Waste Management, Engineering Principlesand Management Issues, Mc Graw Hills.

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43. George, T. and Frank, K. (2002). Handbook of solid waste management: (Second edition). Mc Graw Hills.
44. Kanthi, L. S. (2000). Basics of Solids and hazardous waste management Technologies. Prentice Hall.
45. Anonymous. 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureauof Plant Genetic Resources, New York.
46. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentarieswith Policy and Science Considerations. MartinusNijhoff Publishers.
47. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
48. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
49. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
50. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
51. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future.Columbia UniversityPress.
52. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India.Universities Press, India.
53. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition).Sage Publications.
54. Demers, M.N. 2005. Fundamentals of Geographic Information System. Wiley & Sons.
55. Richards, J. A. & Jia, X. 1999. Remote Sensing and Digital Image Processing. Springer.
56. Sabins, F. F. 1996. Remote Sensing: Principles an Interpretation. W. H. Freeman.
57. Gaston, K J. & Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London.
58. Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53:80-192.
59. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. Conservation Biology for All. Oxford University Press.
60. Sodhi, N.S., Gibson, L. & Raven, P.H. 2013. Conservation Biology: Voices from the Tropics. Wiley-Blackwell, Oxford, UK.

Suggested equivalent online courses:

1. https://www.classcentral.com/course/swayam-plant-physiology-and-metabolism-17732
2. https://www.wiziq.com/course/3249-plant-physiology-in-10-live-online-classes
3. https://www.easybiologyclass.com/plant-physiology-free-lecture-notes-online-tutorials-lecture-notes-ppts-mcqs/
4. https://onlinecourses.swayam2.ac.in/cec19_bt09/preview
5. https://community.plantae.org/tags/moocuturelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
6. https://www.coursera.org/courses?query=plants
   http://egyankosh.ac.in/handle/123456789/53530

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50

Continuous Comprehensive Evaluation (CCE):As per rule

University Exam(UE): 50Marks

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Part A: Introduction				
Program: **B.Sc.**		Class: B.Sc. **III Year**	Year: **2024**	Session:**2024-2025**
1.	Course Code	**BOT-6T**		
2.	Course Title	**Cytogenetics, plant tissue culture and biometry**		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	NO		
5.	Course Learning. Outcomes (CLO)	After the completion of the course the students will be able to: • Acquire knowledge on cell ultrastructure. • Understand the structure and chemical composition of chromatin and concept of cell division. • Interpret the Mendel's principles, acquire knowledge on cytoplasmic inheritance and sex-linked inheritance • Understand the concept of 'one gene one enzyme hypothesis' along with the molecular mechanism of mutation. • students will be familiar with data handling.		
6.	**Credit Value**	**Theory: 4**		
7.	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 17**	

Part B: Content of the Course		
Total Periods: 60		
Unit	**Topics**	**No. ofPeriod**
I	**Cell biology:** Structure and function of cell wall, plasma membrane, ribosomes, Endoplasmic reticulum, Golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and cell inclusions. Organization of nucleus: nuclear envelope, nucleoplasm and nucleolus. Chromosomal nomenclature- chromatids, centromere, telomere, satellite, secondaryconstriction.Organization of chromosomes- Nucleic acid and histones-types andclassification. Lampbrush chromosomes and polytene chromosomes-Karyotype andidiogram.Cell cycle: G0, G1, S and G2 phases –mitosis: open and closed mitosis –amitosis and meiosis. Chromosomal aberrations (Structural and Numerical)	12
II	**Genetics:** History of Genetics and Mendelian inheritance, Chromosome theory of inheritance, crossing over and linkage; Incomplete dominance andcodominance; Interaction of Genes; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy,Polygenic inheritance; Extra-nuclear Inheritance, Linkage, crossing over, Concept of sexdetermination and Sex chromosomes; Patterns of Sex determination in plants Sex linked inheritance.	12
III	**Genetic material:** Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase, bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): semi– conservative. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi– conservative, semi discontinuous RNA priming, Ó (theta) mode of replication, replication of linear, dsDNA, replicating the 5′end of linear chromosome including replication enzymes.	12

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IV	**Gene mutation and mutagens** – substitution- transition and transversion, DNA damage and repairs, physical (ionizing and non- ionising) and chemical mutagens **Transcription & Regulation of gene expression** Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation, (Prokaryotes and eukaryotes), genetic code-. deciphering and properties. Regulation of gene expression inProkaryotes: Lac operon **Plant tissue culture:** Principles, components and techniques (preparation of culture media: liquid and solid medium, basal and supplemented media) and culturing of protoplast- principle and application, regeneration of protoplasts, protoplast fusion and somatic hybridization- selection of hybrid cells, Somaclonal variation, Plant secondary metabolites production. Artificial seeds	12
V	**Biostatistics:** Definition, statistical methods, basic principles, variables-measurements, functions,limitations and uses of statistics. Biometry: Data, Sample, Population, random sampling,Frequency distribution- definition only, Central tendency–Arithmetic Mean, Mode andMedian; Measurement of dispersion–Coefficient of variation, Standard Deviation, Standarderror of Mean; Test of significance: chi- square test for goodness of fit. Computer applicationin biostatistics - MS Excel and SPSS	12
Keywords: Mineral nutrition, Carbon assimilation, Nitrogen and lipid metabolism, Natural resource management, Ecological succession, biodiversity conservation		

Part C -Learning Resources

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Suggested Readings:

1. Cell Biology And Genetics (Hindi) 2/e PB....Gupta P K (Hindi) Rastogi Publications
2. PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle DirectPublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas University
3. Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 9788177544732Edition :03Year : 2018Author : Dr. Purohit SS , Mathur S
4. Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani PubishersISBN: 9789327246070, 9327246071
5. Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-0066-1SunilD Purohit &Gotam K Kukda, Apex Publishing House
6. Genetics and Biotechnology Sunil D Purohit, K. Ahmed &Gotam K KukdaApexPublishing House
7. PadapPrajanan (Hindi)
8. G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
9. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology ofCell. 6th Edition. WW. Norton & Co.
10. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.
11. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
12. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nd ed., W.H.Freeman.
13. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) Biochemistry, W.H.Freeman and Company
14. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
15. . Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
16. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8th edition.Pearson Education Inc.U.S.A.)
17. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th e
18. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India.5th edition.
19. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A..
20. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freemanand Co., U.S.A. 10th edition.
21. M K Raxdan An Introduction to Plant Tissue Culture –; Oxfird& IBH Publishing Co.Pvt. Ltd.,New Delhi
22. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
23. Allard RW (1960) Principles of Plant Breeding. John willey and Sons. Inc. New York
24. BD Singh (2003) Plant Breeding. Kalyani Publishers
25. Cohn, N.S. (1964) Elements of Cytology. Brace and World Inc, New Delhi
26. Darnel, J.Lodish, Hand Baltimore, D. (1991) Cell and molecular biology. Lea and Fibiger, Washington.
27. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology Scientific American books.
28. Dobzhansky, B (1961) Genetic and origin of species, Columbia university Press New Yor
29. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
30. Gerald Karp (1985) Cell biology, Mc Graw Hill company..
31. Lewin, B, (1994) Genes, Oxford University Press, New York.
32. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
33. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd
34. Roy S.C. and Kalayan Kumar De (1997) Cell biology. New central Books,Calcutta

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Part D: Assessment and Evaluation
Suggested Continuous Evaluation Methods: Maximum Marks: 50 Continuous Comprehensive Evaluation (CCE):As per rule University Exam(UE): 50Marks

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