

# DEPARTMENT OF HIGHER EDUCATION U.P. GOVERNMENT, LUCKNOW

National Education Policy-2020
Common Minimum Syllabus
for all U.P. State Universities and Colleges
For the first three years of
Higher Education (UG)

# **BOTANY**



**BOTANY** 

(FACULTY OF SCIENCE)

PROF. RAJENDRA SINGH (RAJJU BHAIYA) UNIVERSITY, MIRZAPUR ROAD, NAINI, PRAYAGRAJ-211010

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## **SUBJECT: BOTANY**

Name	Designation	Affiliation
<b>Syllabus Steering Committe</b>	ee	
Mrs. Monika S. Garg, (I.A.S.) Chairperson Steering Committee	Additional Chief Secretary	Dept. of Higher Education U.P., Lucknow
Prof. Poonam Tandan	Professor, Dept. of Physics	Lucknow University, U.P.
Prof. Hare Krishna	Professor, Dept. of Statistics	CCS University Meerut, U.P.
Dr. Dinesh C. Sharma	Associate Professor, Dept. of Zoology	K.M. Govt. Girls P.G. College Badalpur, G.B. Nagar, U.P.
<b>Supervisory Committee-Sci</b>	ence Faculty	1,49
Dr. Vijay Kumar Singh	Associate Professor, Dept. of Zoology	Agra College, Agra
Dr. Santosh Singh	Dean, Dept. of Agriculture	Mahatma Gandhi Kashi Vidhyapeeth, Varanasi
Dr. Baby Tabussam	Associate Professor, Dept. of Zoology	Govt. Raza P.G. College Rampur, U.P.
Dr. Sanjay Jain	Associate Professor, Dept. of Statistics	St. John's College, Agra

## **Syllabus Developed by:**

S.No.	Name	Designation	Department	College/University
1.	Dr Seema Bhadauria	Head &	Botany &	R B S College, Agra
		Associate Professor	Biotechnology	
2.	Dr Shweta Shekhar	Assistant Professor	Botany	DDU Gorakhpur University,
				Gorakhpur
3.	Dr Himshikha Yadav	Assistant Professor	Botany	VRALGM Degree College,
	1			Bareilly

		Year	-wise Titles of the Papers in B.Sc. (Botany)		
Year	Paper	Course Code	Paper Title	Theory/ Practical	Credits
		Certifi	icate Course In Microbial Technology & Applied Botany		
	I	B040101T	Microbiology & Plant Pathology	Theory	4
FIRST YEAR	II	B040102P	Techniques in Microbiology &Plant Pathology	Practical	2
YEAK	III	B040201T	Archegoniates &Plant Architecture	Theory	4
	IV	B040202P	Land Plants Architecture	Practical	2
		Diplon	na in Plant Identification, Utilization & Ethnomedicine		
GE GOVE	I	B040301T	Flowering Plants Identification & Aesthetic Characteristics	Theory	4
SECOND YEAR	II	B040302P	Plant Identification technology	Practical	2
ILAK	III	B040401T	Economic Botany, Ethnomedicine & Phytochemistry	Theory	4
	IV	B040402P	Commercial Botany & Phytochemical Analysis	Practical	2
			Bachelor of Science		
	I	B040501T	Plant Physiology, Metabolism & Biochemistry	Theory	4
	II	B040502T	Molecular Biology & Bioinformatics	Theory	4
THIRD YEAR	III	B040503P	Experiments in physiology, Biochemistry & molecular biology	Practical	2
	IV	B040504R	*Project-I	Project	Qualifying
	V	B040601T	Cytogenetics, Plant Breeding & Nanotechnology	Theory	4
	VI	B040602T	Ecology & Environment	Theory	4
	VII	B040603P	Cytogenetics, Conservation & Environment management	Practical	2
	VIII	B040604R	*Project-II	Project	Qualifying

## **Subject prerequisites:**

- 1. To study Botany, a student must have had the subject Biology/Biotechnology learnt at 10+2 level.
- 2. Keen interest in plants and plant-related research, Potential in mathematics, biology and chemistry
- 3. Skills and aptitude for scientific study and research
- 4. Creativity and good comprehension while working on scientific procedures and research
- 5. Computer aptitude.

## **COURSE INTRODUCTION**

The new curriculum of B.Sc. in Science (Botany) offers essential knowledge and technical skills to study plants in a holistic manner. Students would be trained in all areas of plant biology using a unique combination of core, elective and vocational papers with significant inter-disciplinary components. Students would be exposed to cutting-edge technologies that are currently used in the study of plant life forms, their evolution and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of plants and their relevance to the national economy.

B.Sc. Botany Programme covers academic activities within the classroom sessions along with practical concepts at laboratory sessions. Infield, outstation activities and projects are also required to be organized for real-life experience and learning.

Candidates who have curiosity in plants kingdom, ecosystem, love exploring exotic places and wish to work as researchers or professions like Botanist, Conservationist, Ecologist, etc. can choose B.Sc. Botany course.

<b>Programme</b>	outcomes	(POs)
I I UZI allilli	outcomes	(I OS).

Transformed curriculum shall develop educated outcome-oriented candidature, fostered with discovery-learning, equipped with practice & skills to deal practical problems and versed with recent pedagogical trends in education including e-learning, flipped class and hybrid learning to develop into responsible citizen for nation-building and transforming the country towards the future with their knowledge gained in the field of plant science.

	To or promo seremen.
PO 1	CBCS syllabus with a combination of general and specialized education shall introduce the concepts of breadth and depth in learning
PO2	Shall produce competent plant biologists who can employ and implement their gained knowledge in basic and applied aspects that will profoundly influence the prevailing paradigm of agriculture, industry, healthcare and environment to provide sustainable development.
PO 3	Will increase the ability of critical thinking, development of scientific attitude, handling of problems and generating solutions, improve practical skills, enhance communication skill, social interaction, increase awareness in judicious use of plant resources by recognizing the ethical value system.
PO 4	The training provided to the students will make them competent enough for doing jobs in Govt. and private sectors of academia, research and industry along with graduate preparation for national as well as international competitive examinations, especially UGC-CSIR NET, UPSC Civil Services Examination, IFS, NSC, FCI, BSI, FRI etc.
PO 5	Certificate and diploma courses are framed to generate self- entrepreneurship and self-employability, if multi exit option is opted.
PO 6	Lifelong learning be achieved by drawing attention to the vast world of knowledge of plants and their domestication.

# Programme specific outcomes (PSOs): B.Sc. I Year / Certificate course in Microbial Technology & Classical Botany

This Programme imparts knowledge on various fields of plant biology through teaching, interactions and practical classes. It shall maintain a balance between the traditional botany and modern science for shifting it towards the frontier areas of plant sciences with applied approach. This syllabus has been drafted to enable the learners to prepare them for self-entrepreneurship and employment in various fields including academics as well as competitive exams. Students would gain wide knowledge in following aspects:

- 1. Diversity of plants and microbes, their habitat, morphology, architecture and reproduction.
- 2. Plant disease causing microbes, symptoms & control.
- 3. Economic value of plants and their use in Human Welfare.

## **Programme specific outcomes (PSOs):**

B.Sc. II Year/ (Diploma in Plant Identification, Utilization & Ethnomedicine)

This course provides a broad understanding of identifying, growing and using plants. This course is primarily aimed to introduce people to the richness of plant diversity found in surrounding areas. Lecture sessions are designed to cover fundamental topics concerning classification of plants and their utilization required for understanding the flora and vegetation. Practical sessions are organized following theory for easy understanding of the various parts of the plants, structural organization of floral parts and diversity therein. Participants are taken to different locations covering a variety of habitats and forest types to acquaint them with the native flora. in the long run, will contribute towards building momentum for

people's participation in environmental conservation without compromising on academic rigor and our rich wealth of knowledge inherited over generations.

- 1. The course will cover conventional topics in Field Botany like Evolutionary History & Diversity of plants, Complete Morphology, Nomenclature of plants, Systems of Classification, Keys to important Families of Flowering Plants, Field Data Collection & Herbarium Techniques.
- 2. The course is designed to become a commercial crop grower, florist, protected cultivator, green belt plant advisor to industries, pharmacologist & taxonomist.

# Programme specific outcomes (PSOs): B.Sc. III Year / Bachelor of Science

The learning outcomes of a three years graduation course are aligned with programme learning outcomes but these are specific to-specific courses offered in a program. The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic excellence in the subject together with a multi-dimensional and multidisciplinary approach.

- 1. Understanding of plant classification systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms.
- 2. This course is suitable to produce expertise in conservation biology like ex-situ conservation, response to habitat change, genotype characterization and reproductive biology.
- 3. Understanding of various analytical techniques of plant sciences, use of plants as industrial resources or as a human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.
- **4.** Understanding of various life forms of plants, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology and use of bioinformatics tools and databases and the application of statistics to biological data.
- 5. Entrepreneurship Skill Development, Understand the issues of environmental contexts and sustainable development, Inculcation of human values,
- 6. Strengthen mathematical and computational skills. Enable students to use ICT & AI effectively.
- 7. Develop good skills in the laboratory such as observation and evaluation by the use of modern tools and technology.

Understanding the nature and basic concepts of all the plant groups, their metabolism, components at the molecular level, biochemistry, taxonomy and ecology.

PSO 1

The course will make them aware of natural resources and the environment and the importance of conserving it. Hands-on training in various fields will develop practical skills, handling equipment and laboratory use along with collection and interpretation of biological materials and data. Knowledge gained through theoretical and lab-based experiments will generate technical personnel in various priority areas such as genetics, cell and molecular biology, plant systematics and biotechnology.

PSO 2	Botanists are able to contribute to all these fields and therefore, are mainly employed with educational institutions, government or public sectors or companies in industries, such as agriculture or forestry, oil, chemical, biotechnology, geological survey, environmental protection, drugs, genetic research, plant resources laboratories, plant health inspection services, lumber and paper, food, fermentation, nursery, fruit and so on. Jobs available as a botanist: •Microbiologist, plant pathologist, Taxonomist • Plant Physiologist • Plant Biochemist • Researcher • Mycologist • Ecologist • Weed Scientist • Palaeobotanist • Conservationist • Fruit Grower • Morphologist • Cytologist • Ethnobotanist • Plant geneticists etc.
PSO 3	Inculcate strong fundamentals on modern and classical aspects of Botany, understand knowledge of Botany is an essential pre-requisite for the pursuit of many applied sciences. It will facilitate students for taking up and shaping a successful career in Botany and allied sciences.
PSO 4	Introduction of research project will inculcate research aptitude and passion for higher education and scientific research.

					wise Structure ELECTIVE CO		e. in Botany S & PROJECTS)				
					Subject: Bo	otany	,				Total Credits /hrs/
Course/ Entry –Exit levels	Year		Theory Paper	Credi t/ hrs	Theory Paper	Credit/ hrs	Practical Paper	Credit s/hrs	Research Project	Credit/	
Certificate Course In Microbial	I	/	Microbiology & Plant Pathology	4/60			Techniques in Microbiology & Plant Pathology	2/60	Nil	Nil	6/120
Technolog y & Applied Botany	1		Archegoniates & Plant Architecture	4/60			Land Plants Architecture	2/60	Nil	Nil	6/120
Diploma in Plant Identificatio n,	п		Flowering Plants Identification & Aesthetic Characteristics	4/60			Plant Identification technology	2/60	Nil	Nil	6/120
Utilization & Ethnomed icine			Economic Botany, Ethnomedicine & Phytochemistry	4/60			Commercial Botany & Phytochemical Analysis	2/60	Nil	Nil	6/120
Bachelor of Science			Plant Physiology, Metabolism & Biochemistry	4/60	Molecular Biology & Bioinformatics		Experiments in physiology, Biochemistry &	2/60	*Proje ct-I	Qual ifying	10/160

	III						molecular biology				
			Cytogenetics, Plant Breeding & nanotechnology	4/60	Ecology & Environment	4/60	Cytogenetics, Conservation & Environment management	2/60	*Proje ct- II	Qual ifyin g	10/160
Comments	creat Virtu	e Aca ıal/ IC	lits/Hrs. / lectures: demic Bank and 1: CT based as per cho ve List of Projects	5% o	of the topics of e of the Institution	ach pa 1)	per can be taught				46/800

Botany Course is One of the Major Subjects for Biology Students and Minor or Elective for students of other faculties

Second Major Subject Can be Zoology/ Biotechnology /Microbiology

Third Major Subject can be from Science or Any other faculty of UGC /AICTE – (Arts/ Agriculture/ Education/ law/ Commerce)

Fourth Subject is Minor or Elective to be selected from any one of other Faculties as per student's own interest One Vocational Course has to be opted from the list given in Syllabus as per NSDC guidelines One Co-curricular Course is compulsory

Internal Assessment & External Assessment						
Internal Assessment	Marks	External Assessment	Marks			
Class Interaction	5	Viva Voce on Practicals	10			
Quiz	5	Report of Botanical Excursion/ Lab Visits/Industrial training/ Survey/Collection/ Models	10			
Seminar	7	Table work / Experiments	45			
Assignments (Charts/ Flora/ Rural Service/ Technology Dissemination/ Botanical Excursion/ Lab Visits/Industrialtraining)	8	Practical Record File	10			
TOTAL  * Botanical Excursion/ Lab Visits/Industrial training Is compulsory	25		75			

DETAIL SYLLABUS FOR CERTIFICATE COURSE IN MICROBIAL TECHNOLOGY & CLASSICAL

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**BOTANY** 

OR

B.Sc.-I



Year: I

Paper-I

Programme: Certificate Course in Microbial Technology & Classical Botany

Course Code:	Course Title: Microbiology & Plant Pathology	
B040101T		
Course outcom	nes: After the completion of the course the students will be able to:	
	op understanding about the classification and diversity of different microbes including viruses, Algae, Fungi & Lichens &	:
	conomic importance.	
	op conceptual skill about identifying microbes, pathogens, biofertilizers & lichens.	
	nowledge about developing commercial enterprise of microbial products.	
	host –pathogen relationship and disease management.	
	Presentation skills (oral & writing) in life sciences by usage of computer & multimedia.	
	Knowledge about uses of microbes in various fields.	
	stand the structure and reproduction of certain selected bacteria algae, fungi and lichens	
	Knowledge about the economic values of this lower group of plant community.	
Credits: 4	Core Compulsory	
Max. Marks: 25	Min. Passing Marks:	
Γotal No. of Lec	ctures-Tutorials-Practical (in hours per week): 4-0-0	
Unit	Topic	0.
	-	of
	Le	ctu
	l r	es
		60
	h h	rs)

Subject: Botany

Ι	A. Introduction to Indian ancient, Vedic and heritage Botany and contribution of Indian Botanists, in context with the holistic development of modern science and technology, has to be taught, practiced and assessed via class interaction/ assignments / self-study mentioned under Continuous Internal Evaluation (CIE).	
	<b>B. Microbial Techniques &amp; instrumentation</b> Microscopy – Light, phase contrast, electron, scanning and transmission electron microscopy, staining techniques for light microscopy, sample preparation for electron microscopy. Common equipment of microbiologylab and principle of their working – autoclave, oven, laminar air flow, centrifuge.	8
п	Microbial world Cell structure of Eukaryotic and prokaryotic cells, Gram positive and Gram-negative bacteria, Structure of a bacteria; Bacterial Growth curve, Sporulation and reproduction and recombination in bacteria. Viruses, general characteristics, Structure of viruses, Bacteriophages, Structure of T4 &, λ-phage; Lytic and Lysogenic cycles, viroid, Prions & mycoplasma & phytoplasma, Actinomycetes & plasmids and their economic uses.	8
Ш	Phycology Range of thallus organization in Algae, Pigments, Reserve food –Reproduction - Classification and life cycle of – Nostoc, Oscillatoria, Volvox, Oedogonium, Chara; Ectocorpus, Polysiphonia. Economic importance of algae.	7
IV	Mycology General characteristics, nutrition, life cycle, Economic importance of Fungi, Classification upto class. Distinguishing characters of Myxomycota: General characters of Mastigomycotina- Albugo, Zygomycota: Rhizopus, Ascomycota: Penicillium. Basidiomycotina: Ustilago, Puccinia, Agaricus; Deuteromycotina: Fusarium, Alternaria. Heterothallism, Heterokaryosis & Parasexuality.	7
V	<b>Lichenology &amp; Mycorrhiza</b> General account of lichens, reproduction and significance; <i>Mycorrhiza: ectomycorrhiza</i> and <i>endomycorrhiza</i> and their significance.	7
VI	Plant Pathology Disease concept, Symptoms, Primary and secondary inoculum, Infection, Pathogenicity and pathogenesis, Koch's Postulates. Disease cycle (monocyclic, polycyclic and polyetic).	7
VII	Diseases and Control Symptoms, Causal organism, Disease cycle and Control measures of – Early & Late Blight of Potato, Black Stem Rust of Wheat, <i>Alternaria</i> spot' and _White rust of Crucifers, Red Rot of Sugarcane, Mosaic diseases on tobacco i; Citrus Canker, Little leaf of brinjal.	8

VIII	<b>Applied Microbiology</b> Food fermentations and food produced by microbes, Mass production of bacterial biofertilizers, blue green algae,	
	Azolla and mycorrhiza. Single cell proteins, Microbiology of water.	8
<u> </u>		
Suggested	Readings:	

## Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

- - : वववव वववव , ववववव व वववववववव : ववववववव ववववववव ,वववव

- 4. वववव ववव ववववववव : वववव ववव वववव 2012
- 6. ववव व वववव व 2020. वव वव ववव वव वववव , कवका विव ववव ववव ववव ववव वव
- 8. Microbiology Fundamental and Applications (hindi) (pb)
- 9. ISBN: 9788188826230 Edition: 03Year : 2016Author : Dr. Purohit SS , Dr. Deo Publisher : Student Edition Language : Hindi
- 10. dddd ddd ddddddd dddddd -ddd : Definitional Dictionary of Plant Parthy Plant Pa
- 11. Modern Microbiology (hindi) (hb) ISBN: 9788177543599Edition : 1Year : 2018Author : Dr. Purohit SS , Dr. Singh T Publisher : Agrobios (India)
- 12. Suggested books -Plant pathology by R.S. Mehrotra, Tata McGraw-Hill Education are included in reading resources list

#### Unit-I A:

- i. <u>https://indianculture.gov.in/rarebooks/economic-botany-india</u>
   <u>https://www.infinityfoundation.com/mandala/t\_es/t\_es\_tiwar\_botany\_frameset.htm</u>
- ii. <a href="https://www.researchgate.net/publication/335715457">https://www.researchgate.net/publication/335715457</a> Ancient Indian rishi's Sages knowledge of botany and medicinal plants since Vedic period was much older than the period of Theophrast us A case study- who was the actual father of botany
- iii. https://www.scribd.com/presentation/81269920/Botany-of-Ancient-India
- iv. <a href="https://insa.nic.in/writereaddata/UpLoadedFiles/IJHS/Vol17\_2\_17\_PKBhattacharyya.pdf">https://insa.nic.in/writereaddata/UpLoadedFiles/IJHS/Vol17\_2\_17\_PKBhattacharyya.pdf</a>

v. <a href="http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri/wgbis\_info/botany\_history.pdf">http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri/wgbis\_info/botany\_history.pdf</a>

# vi Ancient Botany (Sciences of Antiquity) Paperback – 1 October 2015by Gavin Hardy (Author), Laurence Totelin (Author)

vii. https://www.plantsdiseases.com/p/symptoms.html

viii. https://www.plantsdiseases.com/p/pathogenic-diseases-in-plants.html

#### UNIT-I B.

- 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. Desikachari, T. V. 1959. Cyanophyta, ICAR, New Delhi.
- 10. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., NewDelhi.
- 11. Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press, London.
- 12. Kodo, C.I. and Agarwal, H.O.1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, New York.
- 13. Agrios, G.N. (1997). Plant Pathology, 4th edition. Cambridge, U.K.: Academic Press.
- 14. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, 4th edition. Singapore, Singapore: John Wiley & Sons,
- 15. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies. Noida, U.P.: Macmillan Publishers India Ltd.
- 16. Reven, F.H., Evert, R. F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Company.
- 17. Sharma, P.D. (2011). Plant Pathology. Meerut, U.P.: Rastogi Publication.
- 18. Webster, J., Weber, R. (2007). Introduction to Fungi, 3rd edition. Cambridge, U.K.: Cambridge University Press..
- 19. Pandey B.P. 2001. College Botany Volume 1, S Chand & Company Pvt.Ltd, New Delhi.
- 20. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
- 21. Pelzar, 1963. Microbiology, Tata Mc Graw Hill, New Delhi
- 22. Rangaswamy, G. 2009, Disease of Crop Plants in India, Prientice Hall of India, New Delhi.
- 23. Sambamurty. A.V.S.S. 2006, A Text book of Algae, I. K. International Publishing House, Pvt. Ltd., New Delhi.
- 24. Sharma, P. D. 2012, Microbiology and Plant Pathology, Rastogi Publication Pvt Ltd., Meerut, India.
- 25. Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, New Delhi.
- 26. Smith. G. M. 1996. Cryptogamic Botany Volume I, Tata Mc Graw Hill, New Delhi.
- 27. Sundar Rajan. S. 2010. College Botany Volume I, Himalaya Publications, Mumbai.
- 28. Vashishta, B.R. Sinha, A.K. and Singh, V. P. 1991. Algae, S. Chand and Company, Pvt. Ltd., New Delhi

## This course can be opted as an elective by the students of following subjects: Open to all but special for

B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS.

#### **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Course prerequisite	S:
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**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

**Facilities: Smart and Interactive Class** 

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

## **Suggested equivalent online courses:**

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

https://community.plantae.org/tags/mooc

futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science

https://www.coursera.org/courses?query=plants

http://egyankosh.ac.in/handle/123456789/53530

https://www.classcentral.com/tag/microbiology

https://www.edx.org/learn/microbiology

https://www.mooc-list.com/tags/microbiology

https://www.udemy.com/topic/microbiology/

https://ucmp.berkeley.edu/bacteria/bacteria.html

https://www.livescience.com/53272-what-is-a-virus.html

https://gclambathach.in/lms/Economic%20importance%20of%20Algae.pdf

https://www.slideshare.net/sardar1109/algae-notes-1

https://www.onlinebiologynotes.com/algae-general-characteristics-classification/

https://www.sciencedirect.com/topics/immunology-and-microbiology/fungus

https://ucmp.berkeley.edu/fungi/fungi.html

https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf

http://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293

http://www.hillagric.ac.in/edu/coa/ppath/lect/plpath111/Lect.%201%20%20Introduction-Pl%20Path%20111.pdf

http://www.jnkvv.org/PDF/11042020102651plant\_pathology.pdf

https://www.apsnet.org/edcenter/disimpactmngmnt/topc/EpidemiologyTemporal/Pages/ManagementStrategies.aspx

https://learn.saylor.org/course/view.php?id=23&sectionid=6821

https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy

http://physics.fe.uni-lj.si/students/predavanja/Microscopy\_Kulkarni.pdf

https://lipidnanostructuresgroup.weebly.com/

https://zoology4civilservices.wordpress.com/2016/06/18/65/

https://microbenotes.com/laminar-flow-hood/

#### CERTIFICATE COURSE IN MICROBIAL TECHNOLOGY & CLASSICAL BOTANY / B.Sc.-I

Year: I

Paner\_II

110gramme. Contificate Course In Microbial Technology & Classical Bolany			1 aper-11
Subject: <b>Botany</b>			
Course Code: B040102P Course Title: <b>Technique</b>	in Micro	obiolog	gy &Plant Pathology

**Course outcomes:** After the completion of the course the students will be able:

- 1. Understand the instruments, techniques, lab etiquettes and good lab practices for working in a microbiology laboratory.
- 2. Develop skills for identifying microbes and using them for Industrial, Agriculture and Environment purposes.
- 3. Practical skills in the field and laboratory experiments in Microbiology & Pathology.

Programme: Certificate Course In Microbial Technology & Classical Rotany

- 4. learn to identify Algae, Lichens and plant pathogens along with their Symbiotic and Parasitic associations.
- 5. Can initiate his own Plant & Seed Diagnostic Clinic
- 6. Can start own enterprise on microbial products

Credits:2	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-	0-2

Unit	<u>Topic * (Minimum Any three from each unit depending on facilities)</u>	No. of Lectu (60 hrs)
1.	<ol> <li>INSTRUMENTS &amp; TECHNIQUES</li> <li>Laboratory safety and good laboratory practices</li> <li>Principles and application of Laboratory instruments.</li> <li>Cleaning and Sterilization of glasswares</li> </ol>	7
II	BACTERIAL IDENTIFICATION  1. Isolation of bacteria.  2. Identification of bacteria.  3. Staining techniques: Gram's, Negative, Endospore, Capsule and Cell Wall.	8
III	MYCOLOGICAL STUDY:  1. Identification of fungi by lactophenol cotton blue method. <i>Rhizopus, Penicillium, Ustilago, Puccinia; Fusarium, Alternaria.</i> 2. Lichens: crustose, foliose and fruticose specimens.	8
IV	PHYCOLOGY:  1. Type study of algae and Cyanobacteria – Nostoc. Oscillatoria Chlorophyceae - Volvox, Oedogonium, and Chara; Xanthophyceae – Vaucheria; Phaeophyceae – Ectocarpus Rhodophyceae - Polysiphonia	7
V	EXPERIMENTAL PLANT PATHOLOGY  1. Isolation of pathogen from diseased leaf. Identification: Pathological specimens of Loose smut of wheat, Late blight of potato; Slides of uredial, telial, pycnial & aecial stages of <i>Puccinia</i> , Few viral and bacterial plant diseases.	8
VI	PRACTICALS IN APPLIED MICROBIOLOGY-1  1. Isolation of nitrogen fixing bacteria from root nodules of legumes.  2. Enumeration of rhizosphere to non rhizosphere population of bacteria.  3. Isolation of antagonistic Pseudomonas from soil.  4. Microscopic observations of root colonization by VAM fungi.	8
VII	PRACTICALS IN APPLIED MICROBIOLOGY-2  1. Wine production.  2. Isolation of lactic acid bacteria from curd.  3. Enzyme production and assay – cellulase, protease and amylase.	8
VIII	Visit to Culture Repository, biofertilizers, Mushroom cultivation, Alcohol production.     from Sugarcane Juice.and biopesticides unit	6

Suggested Re	eadings:	
Course Bo	ooks published in Hindi may be prescribed by the Universities.	
1. वववव	ववववववव ववववववव ववववववव ववव १ वववव वववव वववववव	
वववव	ववव ववववववव वववव	
2. ववववव	ववववव वववववव - I Dhankar - Sharma - Trivedi ISBN Code: 978-81-8142-697-0 <b>65</b> न	RBD
Publis	shing House Shivaji Nagar Civil Lines,Jaipur - 302006 ( Rajasthan )	

- 4. 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)
- Modern Mushroom Cultivation And Recipes (hindi) (hb)ISBN: 9788177545180Edition: 01Year: 2017Author: Singh Riti, Singh UCPublisher: Agrobios (India)
- 6. Biofertilizer Production Manual (hindi) (hb) ISBN: 9788177541274Edition: 01Year: 2014Author: Gehlot D Publisher: Agrobios (India)Language: Hindi
- 1. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
- 2. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., New Delhi.
- 3. Kodo, C.I. and Agarwal, H.O.1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, New York.
- 4. Madhavee Latha, P. 2012, A Textbook of Immunology, S. Chand & Company Pvt. Ltd., New Delhi.
- 5. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
- 6. Sambamurty, A.V.S.S. 2006, A Textbook of Algae, I. K. International Publishing House, Pvt. Ltd.,
- 7. Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, New Delhi.
- 8. <a href="https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf">https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf</a>
- 9. <a href="http://nhb.gov.in/pdf/Cultivation.pdf">http://nhb.gov.in/pdf/Cultivation.pdf</a>
- 10. https://www.k-state.edu/fungi/Greeting/Publications\_files/2006%20Handbook.pdf
- 11. Sen, Surjit, Acharya, Krishnendu, Rai, Manjula 2019 IBSN 978-93-88347-23-5 Biofertilizers and Biopesticides . Technoworld, Kolkata
- 12. <a href="http://www.kvkkendrapara.org/pdf/Bio%20Fertilizer%20Production%20and%20marketing.pdf">http://www.kvkkendrapara.org/pdf/Bio%20Fertilizer%20Production%20and%20marketing.pdf</a>
- 13. http://www.gbv.de/dms/tib-ub-hannover/751302945.pdf
- 14. Hochman, Gal, Zilberman, David 2014 IBSN-1461493285- Algae Farming and Its Bio-Products Springer
- 18. Gokare A. Ravishankar, Ranga Rao Ambati 2019 Handbook of Algal Technologies and Phytochemicals Volume II: Phycoremediation, Biofuels and Global Biomass Production Print ISBN: 9780367178192
- 19. Amos Richmond Ph.D., Prof. Emeritus, Qiang Hu Ph.D 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, Second Edition Print ISBN:9780470673898

This course can be opted as an elective by the students of following subjects; Open to all but special for

B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS.

## **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Minor field work/excursion/lab visit/technology dissemination etc.	8

Course prerequisites: Qualification: To study this course, a student must hav Diploma holder from ITI in (Biology/ Agriculture/ Biot Facilities: Smart and Interactive Class Other Requisites: Video collection, Books, CDs, Acc Lab Requisites: Microscopes, Stains, Dissection box, Oven, laminar flow cabinet, balances, Fermenter, An	ech/ Mic ess to Oi , Haemo	robiology/biomedica n-line resources, Dis cytometer, Specimen	l Science. play Charts ns, Permane	
Suggested equivalent online courses:				
https://community.plantae.org/tags/mooc futurelearn.com/courses/teaching-biology-inspiring-stud	donte wit	h plants in science		
ttps://microbiologysociety.org/publication/education-outreach			oiology-a-manu	ıal.html
ttps://microbiologyonline.org/file/7926d7789d8a2f7b20			norogy a mane	<del>341.11(1111</del>
ttp://allaboutalgae.com/benefits/		<u> </u>		
ttps://repository.cimmyt.org/xmlui/bitstream/handle/10883/32	19/64331.	<u>pdf</u>		
ttps://www.mooc-list.com/tags/microbiology				
ttp://www.agrifs.ir/sites/default/files/A%20text%20book%20o	of%20prac	tical%20botany%201%	20%7BAshok	%20Bendre%7D%20%5B8
71339239%5D%20%281984%29.pdf https://www.coursera.org/courses?query=plants				
http://egyankosh.ac.in/handle/123456789/53530				
https://www.classcentral.com/tag/microbiology				
https://www.edx.org/learn/microbiology				
https://www.mooc-list.com/tags/microbiology				
https://www.udemy.com/topic/microbiology/				
Programme /Class: B.ScI/ Certificate Cours	se In	Year: I		Paper-III
Microbial Technology & Classical Botany	,c 1n	Tear. I		1 apci-iii
Subject: <b>Botany</b>				
,				
Course Code: B040201T	Cou	rse Title: <b>Archegonia</b>	ates and Plar	nt Architecture
Course outcomes:  After the completion of the course the students  1. Develop critical understanding on morpho			ion of Bryonl	hytes Pteridonhytes and
Gymnosperms  2. Understanding of plant evolution and the 3. Understand morphology, anatomy, reproduction and the second control of t	ir transiti	on to land habitat.		
create a knowledge base in understanding the basis	s of plan	t diversity, economic	values & tax	
4. Understand the details of external and int Credits: <b>4</b>	ernai stru	uctures of flowering p	Core Con	npulsory
Max. Marks: 25+75			Min. Pass	ing Marks:
				ing warks.
Total No. of Lectures-Tut	torials-Pr	ractical (in hours per		

Unit	Topic	Lectures (60hrs)
I	Introduction to Archegoniates & Bryophytes Unique features of archegoniates, Bryophytes: General characteristics, adaptations to land habit, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of <i>Riccia</i> , <i>Marchantia and Anthoceros</i> . (Developmental details not to be included). economic importance of bryophytes.	7
II	<b>Pteridophytes</b> General characteristics, Early land plants ( <i>Rhynia</i> ). Classification (up to family) with examples, Heterospory and seed habit, stelar evolution, economic importance of Pteridophytes.	8
III	Gymnosperms Classification and distribution of gymnosperms; Salient features of Cycadales and Coniferales, their examples, structure and reproduction; economic importance	8
IV	Palaeobotany General account of Palaeobotany; Geological time scale; Brief account of process of fossilization & types of fossils; Contribution of Birbal Sahni	8
V	Angiosperm Morphology (Stem, Roots, Leaves & Flowers, Inflorescence)  Morphology and modifications of roots; Stem, leaf and bud. Types of inflorescences; flowers, flower parts, fruits and types of placentation; Definition and types of seeds.	7
VI	<b>Plant Anatomy:</b> Meristematic and permanent tissues, Organs (root, stem and leaf). Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica - Corpus theory. Secondary growth - Root and stem- cambium (structure and function) annular rings, Anomalous secondary growth - <i>Bignonia, Dracaena, Nyctanthes</i>	7
VII	Reproductive Botany Plant Embryology, Structure of microsporangium, microsporogenesis, , Structure of megasporangium and its types, megasporogenesis, Structure and types of female gametophyte, types of pollination, structure of male gametophyte, Fertilization, structure of dicot and monocot embryo, Endosperm, Double fertilization, Apomixis and polyembryony.	8
VIII	Palynology: Pollen structure, pollen morphology.	7

#### **Suggested Readings:**

#### Course Books published in Hindi may be prescribed by the Universities.

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- ,वववववववववव ,ववववववववववव ववव वववव -ववववववव ववववववव :वववव -ववव्वववव = ववव वववववव :वववववव वववववव .वववव
- ववववव ) वववव -वववव , ववववव ववव ववव ववववववव :ववववववव ववववववव , वववव 3. वववव वववववववव ववववववव ववववववव वव एसवव वववववव 2017 <del>व्यववावका</del>
- 4. ए.वव . ववववव & ववववववववव ववववव २०१८. वववववव वववववव वववववव वववववव ववववव व्यवकार वववववव व्यवकार वववववव व्यवकार
  - 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. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
  - 4. Rashid A (1999) An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi.
  - 5. Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi.
  - 6. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students Pteridophyta, S. Chand and Company,
  - 7. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students Gymnosperms, S. Chand and
  - 8. Parihar NS (1976) Biology and Morphology of Pteridophytes. Central Book Depot.
  - 9. Bhatnagar SP (1996) Gymnosperms, New Age International Publisher.
  - 10. Pandey BP (2010) College Botany Vol II S. Chand and Company, New Delhi
  - 11. Maheswari, P. 1971. An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London
  - 12. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
  - 13. Bhojwani, S.S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House,
  - 14. P.K.K. Nair- A textbook of Palynology.
  - 15. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verleg, Berlin.
  - 16. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
  - 17. E.J.Eames . Morphology of Vascular Plants, Standard University Press.
  - 18. Dickinson, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
  - 19. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
  - 20. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech,

B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

#### **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 4 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

Facilities: Smart and Interactive Class, wifi facility

Other Requisites: : Videos, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts

#### Suggested equivalent online courses:

https://www.anbg.gov.au/bryophyte/what-is-bryophyte.html

https://pteridoportal.org/portal/index.php https://www.conifers.org/zz/gymnosperms.php

http://www.mobot.org/MOBOT/research/APweb/

https://milneorchid.weebly.com/plant-id-for-beginners.html https://www.botany.org/PlantImages/PlantAnatomy.php

http://webapp1.dlib.indiana.edu/inauthors/view?docId=VAC0868&doc.view=print

https://palynology.org/

http://www2.estrellamountain.edu/faculty/farabee/biobk/Biobookflowers.html

https://www.sciencelearn.org.nz/resources/100-plant-reproduction

https://palaeobotany.org/

		lass: Certificate Course In Microbial & Classical Botany	Year: I	Paper-I	V (Practical)
Subje	ect: Bota	ny		·	
Cour	se Code:	B040202P	Course '	Title: Land Plants Architectu	ıre
		outcomes:			
1.	The stud	lents will be made aware of the group of p			
		field study they will be able to see these			
2.		s would learn to create their small digital			
2		as well as videos in case they are able to f			
3.		an understanding by observation and tab		ve members of phylogenetical	lly important
4.		o learn the process of evolution in a broad and morphology, anatomy, reproduction a		nges therein through typologic	al ctudy and
ч.		knowledge base in understanding plant di			
5.		and the composition, modifications, interr			
	Botanist	÷		8 r	8
	Credits:	2		Core Compulsory	
	Max. M	arks: <b>25</b> + <b>7</b> 5		Min. Passing Marks:	
				C	
		Total No. of Lectures-Tutori	als-Practical (in hours	per week): <b>0-0-2</b>	
	Unit	Topic			No. of Lectures
	I	Bryophytes:			
		Marchantia- morphology of thallus			8
		Gemma cup, W.M. gemmae (all ter		intheridiophore,	
		archegoniophore, L.S. sporophyte (	all permanent slides).		
	II	Pteridophytes:			
		Lycopodium: Habit, stem T. S. stob	oilus V. S., Selaginella	: Habit, rhizophore T. S.	7
		stem T. S, axis with strobilus, V.S			,
		microsporophyll.	, ,		
	III	Gymnosperms		T G G G G	
	- A	1. <i>Cycas</i> – seedling, coralloid root			8
		Rachis, micro and megasporophyll and V. S. of ovule. <i>Pinus</i> - Branch	, male cone v. S., mici	rosporophyll 1. S. entire	
		and v. S. of ovule. Finas - Branch and needle R.L.S and T. L. S. of ste			
		female cone.	oni, maic and icmaic c	one, v.s. of male and	
		Territaire cone.			
	IV	Palaeobotany & Palynology			
		1. Morphology of <i>Rhynia</i> and fossi			6
		2. Visit Birbal Sahni Institute of Pa	laeosciences or virtual	conference with their scientis	
		to learn fossilization.			
	V	Angiosperm Morphology			
	*	1. To study diversity in leaf shape, siz	e and other foliar feat	ires.	
		2. To study monopodial and sympodi		····	8
		3. Morphology of Fruits	<b>6</b> -		
		4. Inflorescence types- study from fre	sh/ preserved specime	ns	
		5. Flowers- study of different types fr			
		6. Fruits- study from different types fr			
		7. Study of ovules (permanent slides/		s)- types (anatropous,	
		orthotropous, amphitropous and ca			
		8. Modifications in Roots, stems, leave	es and inflorescences		

VI	Plant Anatomy: Normal & Anomalous secondary thickening - Bignonia, Dracaena, Nyctanthes Study of primary and secondary growth in the root and stem of monocots and dicots by section cutting and permanent slides. Study of internal structure of dicot and monocot leaves.	8
VII	Reproductive Botany  1. Structure of anther and pollen grains 2. Structure of ovule. 3. Vegetative propagation by means of cutting, budding and grafting exercises. 4. Study of seed germination. 5. Study of pollen morphology.	8
VIII	Commercial Uses 1. Azolla production 2. Resins, Ephedrine ,Taxol	7

## **Suggested Readings:**

## Course Books published in Hindi may be prescribed by the Universities.

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Pandey, BP and Trivedi, P.S. 1997. Botany Vol. I(10th edition). Vikas Publishing House.

Pandey, BP; Misra; Trivedi, P.S. 1997. Botany Vol. II. Vikas Publishing House.

Pandey, BP and Chadha. 1997. Botany Vol. III. Vikas Publishing House.

Santra, SC and Chatterjee. 2005. College Botany Practical Vol. I. New Central Book Agency (P) Ltd.

Kumar, S and Kashyap. 2003. Manual of Practical Algae. Campus Books International, New Delhi

Bendre and Kumar A text book of Practical Botany. Vol I,II., Rastogi Pub. Meerut.

Suresh Kumar, Amar Singh Kashyap Manual of Practical Algae.. Campus Books Internet, New Delhi.

Santra, SC. 2005. College Botany Practical Vol. II. New Central Book Agency (P) Ltd.

## This course can be opted as an elective by the students of following subjects:

Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A.

**Suggested Continuous Evaluation Methods:** Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	6
Field work /Virtual/E-learning /Participation in group discussions	7
Industrial or Central laboratory training of two weeks in summer/winter (Compulsory)	12
	25

#### **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

**Facilities: Smart and Interactive Class** 

Other Requisites: Microscopes, Stains, Dissection box, Haemocytometer, Specimens, Permanent slides, Autoclave, incubator, Oven, laminar flow cabinet, balance

## **Suggested equivalent online courses:**

https://www.easybiologyclass.com/topic-botany

http://www3.botany.ubc.ca/bryophyte/index.html

http://ecflora.cavehill.uwi.edu/bio courses/bl14apl/practical 3.1.htm

http://mydunotes.blogspot.com/p/botany.html

http://www.fao.org/3/a-v9236e.pdf

https://iinrg.icar.gov.in/library/nrg/nrg.pdf

https://agritech.tnau.ac.in/banking/nabard\_pdf/Azolla%20Cultivation/Model\_projct\_on\_Azolla\_cultivation.pdf

http://arnoldia.arboretum.harvard.edu/pdf/articles/1977-37-1-propagation-manual-of-selected-gymnosperms.pdf

https://www.fs.fed.us/rm/pubs other/wo AgricHandbook730/wo AgricHandbook727 153 175.pdf

Detail Syllabus of
B.Sc.-II Year
or
Diploma in
Plant Identification, Utilization & Ethnomedicine

## Diploma in Plant Identification, Utilization & Ethnomedicine

Plant Identification, Utilization o	x Einnomea	icine
dentification, Utilization & Ethnomedicine	Year: II	Paper-I
Course Title: Flowering Plants Identific	ation & Aesthetic	Characteristics
	Identification, Utilization & Ethnomedicine	,

#### **Course outcomes:**

After the completion of the course the students will be able to:

- 1. To gain an understanding of the history and concepts underlying various approaches to plant taxonomyand classification
- 2. To learn the major patterns of diversity among plants, and the characters and types of data used to classify plants.
- 3. To compare the different approaches to classification with regard to the analysis of data.
- 4. To become familiar with major taxa and their identifying characteristics, and to develop in depth knowledge of the current taxonomy of a major plant family.
- 5. To discover and use diverse taxonomic resources, reference materials, herbarium collections, publications.
- 6. For the entrepreneur career in plants, one can establish a nursery, Start a landscaping business, Set up a farm Or Run a plantation consultancy firm

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	Topic	No. of Lectures (60hrs)
I	Taxonomic Resources & Nomenclature Components of taxonomy (identification, nomenclature, classification); Taxonomic resources: Herbarium- functions & important herbaria, Botanical gardens, Principles and rules of Botanical Nomenclature according to ICBN (ranks and names; principle of priority, binomial system; type method, author citation, valid-publication).	7
П	Types of classification & Evidences Artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series). Introduction to taxonomic evidences from cytology & phytochemistry.	8
Ш	Identification of Angiospermic families -I: (Families can be chosen University wise as per local available flora)  A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system)  Malvaceae, Rutaceae, Fabaceae, Cucurbitaceae, Asteraceae, Apocynaceae, Asclepiadaceae, Solanaceae.	8
IV	Identification of Angiospermic families -II: (Families can be chosen University wise as per local available flora)  A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system)-Euphorbiaceae, Papaveraceae, Apiaceae, Lamiaceae, Poaceae.	7

V	Modern trends in Plant taxonomy: Brief idea on Phenetics, Cladistics (Monophyletic, polyphyletic and paraphyletic groups).	8
VI	TOOLS & SOFTWARES IN PLANT IDENTIFICATION- GIS (Mapping of (i) Patterns(ii) Features (iii) Quantities 0P02.010H11YLIP - Free Phylogenetic Software, Digital Taxonomy (e-flora), Description Language for Taxonomy – DELTA Internet directory for botany.	7
VII	Computer usage & Android Applications MS Office: PPT, Microsoft Excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media. GPS tagging, Plant Identification Apps.	7
VIII	Aesthetic Characteristics of Plants: Aesthetic characteristics of plants, English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Trees, shrubs and shrubberies, climbers and creepers, rockery, Flower beds, Shrubbery, Borders, Water garden). Some Famous gardens of India. Conservatory, green houses, Indoor garden, Roof garden, Topiary, Bonsai.	8

#### **Suggested Readings:**

#### Course Books published in Hindi may be prescribed by the Universities.

- 1. aaaaaaaaaa aaaaaaa aaaaaaa (ववववव १वववव ,ववववववव aaaaa aaaaaaaaaaaaa ववववव ) वववव -वववव , ववववव ववव ववव वववववव :aaaaaaa aaaaaaa , वववव 2. वववव वव aaaaa aaaaaaa ववववव भवनववव . क.स.वववववव aaaaa aaaa aaaaa
- 3. Propagation And Nursery Management (hindi) (hb) ISBN: 9788177546200Edition: 01Year: 2016Author: Pandey S.K., Soni N.Publisher: Agrobios (India)
- 4. Dr. Amar Singh. ाउ रंग ी- Plant Taxonomy (An Old and Rare Book) from the category Ayurveda in our Books collection. Uttar Pradesh Hindi Sansthan, Lucknow
  - 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 I ndia. 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. https://www.socitm.gov.uk, (2002) Learning in the 21st century Executive briefing A Socitm Insight publication, July 2002 Socitm.
  - 7. K. B. Anjaria, (2015)-Electronic Herbarium and Digital Database Preparation of Common Trees of Anand District, Gujaratl MRP submitted to UGC, WRO, Pune 2015 (unpublished)
  - 8. Lizeron Eremias and R. Subash.(2013) -E-Content Development: A Milestone In The Dynamic Progress Of E-Learning International Journal of Teacher Educational Research (IJTER) Vol.2 No.1 January, 2013 ISSN: 2319-4642
  - 9. 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.
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  - 13. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
  - 14. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
  - 15. Austin, R. 2002. Elements of planting design. New York: John Wiley & Sons.
  - 16. Bertauski, T. 2005. Designing the landscape: An introductory guide for the landscape designer. Upper Saddle River, NJ: Pearson Prentice Hall.
  - 17. Thomas, H., and S. Wooster. 2008. The complete planting design course: Plans and styles for every garden. London: Octopus Publishing Group.
  - 18. Scarfone, S. 2007. Professional planting design: An architectural and horticultural approach for creating mixed bed plantings. New York: John Wiley & Sons.
  - 19. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

This course can be opted as an elective by the students of the following subjects: Open to all but special for B.Sc. Biotech B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

## **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

**Facilities: Smart and Interactive Class** 

Other Requisites: : Video collection, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts

Suggested equivalent online courses:

https://www.easybiologyclass.com/topic-botany/

http://egyankosh.ac.in/handle/123456789/53530 https://www.delta-

intkey.com/www/desc.htm https://milneorchid.weebly.com/plant-id-for-

beginners.html https://plants.usda.gov/classification.html

https://www.senecahs.org/pages/uploaded\_files/Plant%20Classification.pdf

https://www.ladykeanecollege.edu.in/files/userfiles/file/Dr %20S %20Nongbri%20III%20Sem%20ppt.pdf

https://www.brainkart.com/article/Bentham-and-Hooker-s-classification-of-plants---Dicotyledonae,-

Gymnospermae-and-Monocotyledonae 1000/

https://libguides.rutgers.edu/c.php?g=336690&p=2267037

https://www.delta-intkey.com/

	c/Class: : Diploma in Plant on, Utilization & Ethnomedicine	Year: II	Paper-I	I (Practical)
	,	Subject: <b>Botany</b>		
Course	Code: B040302P	Course Title: Pl	ant Identification technolog	gy
	e outcomes:			
	he completion of the course the students w		1 C	1
	rn how plant specimens are collected, serve, record, and employ plant morph		*	
2. To obtermin		ological variation at	id the accompanying descr	триче
	n experience with the various tools and	d means available to	identify plants.	
_	velop observational skills and field exp		7 F	
5. To ide	ntify a taxonomically diverse array of	native plants.		
	ognize common and major plant famil			
	derstand aesthetic characters of flower			ai,miniatures
	rehend the concepts of plant taxonomy	and classification o	<u> </u>	
Credit	S: Z		Core Compulsory	
Max. I	Marks: 25+75		Min. Passing Marks:	
	Total No. of Lectures-Tutor	rials-Practical (in hour	s per week): <b>0-0-2</b>	
Unit		Topic*		No. of Lect
	*(Perform Any three ex			(60Hrs)
I	Herbarium: Plant collecting, Preservat Stepwise Practicing Herbarium technique			7
	System (GPS) instrument & Collection of			1
	Herbarium making tools c. Pressing and I			
	treatments for all varied groups of plants			
TT I	them using Standard method g. Organize <b>Taxonomic Identification using plant s</b>		Register Number	0
II	a. Classify 25 plants on the basis of Taxo		ant Morphology, Anatomy,	8
. /	Reproductive parts, Habit, adaptation an			
(1)	system of classification in the following	families: Malvaceae,	Fabaceae (Papilionaceae),	
	Solanaceae, Labiatae (Lamiaceae).			
III	Identification during excursions			8
	a.Conducting Spot identification (Binomi included in the theoretical syllabus (list			
	and filling Sample of a page of field-boo			
			•	
	b. Describe/compare flowers in semi-tectovaries, floral diagrams and Floral Form			
	families giving reasons.	iuiae. Identify and ass.	igh them to then respective	
IV	COLLECTION, PRESERVATION AN	ND STORAGE OF A	LGAE, FUNGI	7
	BRYOPHYTES, PTERIDOPHYTES	(Two each)	,	
V	<b>Botanical Nomenclature &amp; reporting</b>			_
	a. Give nomenclature to collected plants			7
	<b>b. Author Citation, Effective Publicat</b> paper on Basic structure of a taxonomic			
	journal	paononea o		
VI	COMPUTERS			
	1. Learning to use EXCEL Micros			7
	WITH FOLDER AND WIND		REATE AND MANAGE	
	FILES AND FOLDER TREE,	,		

	<ol> <li>Practice browsing different sites using search engines. practice and understand different E-Mail services – Outlook, Yahoo mail, rediffmail etc. Practice Creating E-Mail accounts, Sending, Receiving &amp; Storing of mails.</li> <li>Create and Participate in virtual conferencing in an interactive Zoom Meeting</li> </ol>	
VII	Computer Application in taxonomy  1. Use Taxonomic Softwares (Dichotomous Key)  2. Practicals on Phylogenetic analysis  3. Make line drawing of Plants for description  4. Using of plant identification apps on android phones	8
VIII	<ol> <li>Create a Bonsai of any plant</li> <li>Develop a miniature garden</li> <li>Draw Layouts of various types of gardens</li> <li>Plant Propagation methods practice</li> </ol>	8

## Suggested Readings:

## Course Books published in Hindi may be prescribed by the Universities.

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<u>वववववववव ववववववव वव .एस-वव -1,II,IIIएसवव वववववववव ववववववववव</u>

ववववववव : वववववव ववववववव वववव वववववव

वववववववव ववववववव II Author Name: - Dhankar - Sharma - Trivedi RBD Publication H

- 1. Day, S.C. (2003)A Art of Miniature Plant Culture. Agrobios. Jodhpur, India.
- $2.\ Practical\ Taxonomy\ of\ Angiosperms\ By:\ R\ K\ Sinha\ ISBN:9789386768520\ I.K\ International\ Publishing\ House\ Pvt.$  Ltd.
- 1. Day, S.C. (2003)Complete Home Gardening. (2003) Agrobios, Jodhpur, India.
- 2. Dhopte, A.M. (2003) Principles and Techniques for Plant Scientists. Agrobios, Jodhpur, India.
- 3. Khan, M.R. (1995) Horticulture and Gardening.- NiraliPrakashan, Pune. India.
- 4. PramilaMehra Gardening for everyone-. Hind pocket book private limited, New Dehli.
- 5. Kumarsen V. Horticulture ,Saras Publication
- 6. Ramesh Bangia Learning Computer Fundamentals.,,, Khanna Book Publishers
- 7. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH PublishingCo., New Delhi.
- 8. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
- 9. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.
- 10. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay.
- 11. Womersley, J. S. 1981. Plant collecting and herbarium development: A manual.
- 12. Brandis, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors; DehraDu
- 13. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://delta-intkey.com

#### https://www.naace.co.uk/school-improvement/ict-mark/

- 14. Manilal, K. S. and M. S. Muktesh Kumar (ed.) (1998) A Hand book of Taxonomy Training, DST,N. Delhi
- 15. Naik, V. N. (1984) Taxonomy of Angiosperms Tata McGrow-Hill Publication Com. Ltd., New Delhi
- 16. Primak, R. B. (2004) A Primer of Conservation Biology. Sinauer Associates, Inc. Publishers
- 17. Quicke, Donald, L. J. (1993) Principles and Techniques of Commemoratory Taxonomy. Blakie,

#### Academic

and Professional, London

18. Singh, G (2004) Plant Systematics: Theory and practice Oxford and YBH Publishing Co. Pvt. Ltd., New

Delhi.

- 19. Bridson, D. & L. Forman. eds. 1998. The Herbarium Handbook. 3rd ed. Royal Botanic Gardens, Kew (Reprinted 1999).
- 20. De Vogel, E.F. 1987. Manual of Herbarium Taxonomy: Theory and Practice. UNESCO, Jakarta.
- 21. Fosberg, F.R. & M.-H. Sachet. 1965. Manual for tropical herbaria. Int. Bur. Pl. Tax. & Nom., Regnum Vegetabile Vol. 39. Utrecht.
- 22. Jain, S.K. & R.R. Rao. 1977. A handbook of field and herbarium methods. Today & Tomorrow's Printer and Publishers, New Delhi.
- 23. Victor, J.E., M. Koekemoer, L. Fish, S.J. Smithies, M. Mossmer. 2004. Herbarium essentials:the Southe African Herbarium user manual. Southern African Botanical Diversity Network Report No. 25. SABONET, Pretoria.

This course can be opted as an elective by the students of the following subjects: Open to all but special for B.S Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

#### **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Botanical Excursion- compulsory	12
Assignment	8
	25

Course prerequisites:

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

**Facilities: Smart and Interactive Class** 

Other Requisites: : Video collection, Books, CDs, Flora, Herbarium, Access to On-line resources, Display

Lab Requisites: Microscopes (Compound, Stereo) Dissection box, stain, Herbarium, Herbarium press, Dryers, Grinder, Reference Flora

#### Suggested equivalent online courses:

- 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

#### **Any Other:**

**Botanical Excursions:** One teacher along with a batch not more than 7 students be taken for botanical excursion to places of Botanical interest, one in each term. If there are female students in a batch of 7 students, one additional lady teacher is permissible for excursion.

Each excursion will not be more than SEVEN days during college working days. T.A. and D.A. for teachers and non-teaching staff participating in excursions should be paid as per rules. Tour report duly certified by tour in charge teacher and Head of the Department should be submitted at the time of practical examination. For every study tour take the prior permission of the head of the department and Principal.

The marks will be counted under Internal assessment and external assessment both. In external assessment student will have to present his excursion report along with industrial training/central labs visits and BSI or Museum visits. In internal assessment he shall have to label the campus plants with botanical details/develop herbal/floristic garden/conserve plants in botanical garden/contribute specimens via collection .

A project supported along with photographs taken during field study to be submitted giving comprehensive idea

about different types of inflorescence, flowers and fruits/

At least three field excursions at hills/Oceans/Deserts including one Compulsory excursion to Botanical Garden, FRI/BSI and Central National Herbarium (CNH). Central Research Institutes/Hot Spots

Programme /Class: <i>Diploma in Plant Identification, Utilization &amp; Ethnomedicine</i>	Year: II	Paper-III
	Subject: Botany	
Course Code: B040401T	Course Title: Economic Botany	, Ethnomedicine and Phytochemistry

#### **Course outcomes:**

After the completion of the course the students will be able to:

- 1. Understand about the uses of plants –will know one plant-one employment
- 2. Understand phytochemical analysis related to medicinally important plants and economic products produced by the plants
- 3. know about the importance of Medicinal plants and its useful parts, economically important plants in our daily life and also about the traditional medicines and herbs, and its relevance in modern times.

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	Topic	No. of Lectures (60hrs)
I	Origin and domestication of cultivated plants Centers of diversity of plants, origin of crop plants. Domestication and introduction of crop plants. cultivation, production and uses of Cereals, legumes, Spices & beverages.	7
II	Botany of oils, Fibers, timber yielding plants & dyes Study of the plants with Botanical names, Family, part used, and economic uses of oils, Fibers, timber yielding plants, dyes & biofuel crops.	7
III	Commercial production of Flowers, Vegetables, and fruits (To be Chosen area wise) Commercial greenhouse cultivation of rose, Gerbera, Gladiolus, Anthurium/lilium/lily, tomato, bell pepper, cucumber, strawberry & Exotic leafy vegetables using Hydroponics.	7
IV	IPR & Traditional Knowledge IPR and WTO (TRIPS, WIPO), Patent Act 1970 and its amendments, TIFAC, NRDC, Rights, Procedure of obtaining patents, Working of patents, Infringement, Copyrights, Trademarks, Geographical Indications, Traditional Knowledge Digital Library, Protection of Traditional Knowledge & Protection of Plant Varieties and Biotech inventions.	8
V	Ethnobotany Methodologies of ethnobotanical research: Field work, Literature, Herbaria and Musea and other aspects of ethnobotany. Importance of ethnobotany in Indian systems of medicine (Siddha, Ayurveda and Unani).  Tribal knowledge towards disease diagnosis, treatment, medicinal plants.	8
VI	Medicinal aspects Study of common plants used by tribes.	8

VII	Pharmacognosy	8
	Preparation of drugs for commercial market - Organoleptic evaluation of drugs - Microscopic	
	evaluation of drugs - Physical evaluation of drugs - Active and inert constituents of drugs -	
	Classification of drug plants - individual drugs - drug adulteration. Sources of crude drugs -	
	roots, rhizome, bulb, corm, leaves, stems, flowers, fruits and seeds;	
	organoleptic study of Adhatoda vasica, Andrographis paniculata, Azadirachta indica,	
	Coriandrum sativum, Datura metel, Eclipta alba, Emblica officinalis, Ocimum sanctum,	
	Phyllanthus amarus, Ricinus communis, Vinca rosea and Zingiber officinale.	
	Herbal Preparations & Phytochemistry:	7
VIII	Collection of wild herbs - Capsules - compresses - Elixirs - Glycerites - Hydrotherapy or Herbal	
	bath - Herbal oils - Liquid extracts or Tincture - Poultices - Salves - Slippery elm slurry and gruel	
	- Suppositories - Teas. Plant natural products, general detection, extraction and characterization	
	procedures. Glycosides and Flavonoids and therapeutic applications. Anthocyanins and	
	Coumarins and therapeutic applications, Lignans, Terpenes, Volatile oils and Saponins,	
	Carotenoids and Alkaloids Carotenoids and pharmacological activities.	

#### **Suggested Readings:**

#### Course Books published in Hindi may be prescribed by the Universities.

- 1. वववववववववव aaaaaaa aaaaaaa (aaaaa laaaa 'aaaaaaa ववववव ) वववव -aaaa .aaaaa ada ada adadada ·aaaaaaa aaaaaaa . वववव 2. वववव वव ਰਕਰਕਰ aaaaaaa aaaaa भवनववव . क.स.वववववव aaaaa वववव ववववव
- 3. वववववववववव ववव ववववव ववववव Dhankar Sharma Trivedi
- 4. Aushdhiye Poudhe (Hindi) by R.P. Sharma | 1 January 2013 YKING BOOKS
- 1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
- 2. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. New Delhi.
- 3. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency, India.
- 4. Reddy P. Parvatha. 2016. Sustainable crop protection under protected cultivation. Springer, Singapore.
- 5. Amit Deogirikar. 2019. A Text Book on Protected Cultivation and Secondary Agriculture. Rajlaxmi Prakashan, Aurangabad, India.
- 6. Singh, B., B. Singh, N. Sabir and M Hasan. 2014. Advances in protected cultivation. New India Publishing Agency, India.
- 7. Sharma, OP. 1996. Hill's Economic Botany (Late Dr. AF Hill, adopted by OP Sharma). Tata McGraw Hill Co. Ltd., New Delhi
- 8. Joe J. Hanan. 1997. Greenhouses: Advanced Technology for protected horticulture. CRC Press.
- 9. Krishnamurthy, K.V. (2004). An Advanced Text rbook of Biodiversity Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
- 10. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
- 11. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003)
- 12. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).
- 13. Arthur Raphael Miller, Micheal H.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
- 14. Jayashree Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.
- 15. Jain, S. K. and V. Mudgal. 1999. A Handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehradun.
- 16. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.London.
- 17. Joshi, S. G. 2000. Medicinal Plants. Oxford and IBH, New Delhi.
- 18. Kokate, C. and Gokeale-Pharmocognacy-Nirali Prakashan, NewDelhi.
- 19. Lad, V. 1984. Ayurveda The Science of Self-healing. Motilal Banarasidass, New Delhi.
- 20. Lewis, W. H. and M. P. F. Elwin Lewis. 1976. Medical Botany. Plants Affecting Man's Health. A
- a. Wiley Inter science Publication. John Wiley and Sons, New York.
- 21. Farooqui, A. A. and Sreeraman, B. S. 2001. Cultvation of medicinal and aromatic crops. Universities Press.
- 22. Harborne, J. B. 1998. Phytochemical methods a guide to modern techniques of plant analysis 3 rd edition, Chapman and Hall.
- 23. Yesodha, D., Geetha, S and Radhakrishnan, V. 1997. Allied Biochemistry. Morgan publications, Chennai.1. Gurdeep Chatwal, 1980. Organic chemistry of natural productis. Vol. I. Himalaya Publishing house.
- 24. Kalsi, P. S. and Jagtap, S., 2012. Pharmaceutical medicinal and natural product chemistry. N.K. Mehra for Narosa Publishing House Pvt. Ltd. New Delhi.
- 25. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.

- 26. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
- 27. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
- 28. Sharol Tilgner, N. D. 1999. Herbal medicine From the heart of the earth.Edn. 1, Printed in the USA by Malloy Lithographing Inc.
- 29. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.
- 30. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizoms drugs. Bulletin No.1 Ministry of Health, Govt. of India.
- 31. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
- 32. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
- 33. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today& Tomorrow's printers and publishers, New Delhi.
- 34. Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand & Co. Ltd.
- 35. K. Wilson and J. Walker Eds. 2005. Biochemistry and Molecular Biology. Cambridge University Press.
- 36. k. Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry. (3 edn Edward Arnold, London.

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

#### **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### Course prerequisites:

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

**Facilities: Smart and Interactive Class** 

Other Requisites: : Video collection, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts

## Suggested equivalent online resourses:

https://www.pnas.org/content/104/suppl 1/8641

https://www.journals.uchicago.edu/doi/pdfplus/10.1086/659998

https://bsi.gov.in/page/en/ethnobotany

http://www.legalserviceindia.com/article/198-Intellectual-Property-and-Traditional-knowledge.html

https://www.brainkart.com/article/Economic-importance-Plants---Food,-Rice,-Oil,-Fibre,-Timber-yielding-plant 1095/

https://www.loc.gov/rr/scitech/tracer-bullets/economic-botanytb.html

http://nsdl.niscair.res.in/bitstream/123456789/127/1/Fibre%20crops%2C%20bamboo%2C%20timber%20-%20Final.pdf

https://www2.palomar.edu/users/warmstrong/econpls.htm

https://www.longdom.org/proceedings/phytochemistry-and-phytoconstituents-of-herbal-drugs-and-formulations-1668.html

Programme: Diploma in Plant Identification, U	tilization & Ethnomedicine	Year: II	Paper-IV (Practical)	
Subject: <b>Botany</b>				
Course Code: B040402P	Course Title: Commercial B	otany & P	Phytochemical Analysis	

**Course outcomes:** After the completion of the course the students will be able to:

- 1. Know about the commercial products produced from plants.
- 2. Gain the knowledge about cultivation practices of some economic crops.
- 3. Understand about the ethnobotanical details of plants.
- 4. Learn about the chemistry of plants &herbal preparations
- 5. Can become a protected cultivator, aromatic oil producer, Pharmacologist or quality analyst in drugcompany.

Credits: 2	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-2

Unit	Topic N	
	(Perform minimum any three experiments from each unit)	(60hrs)
I	Economic Botany & Microtechnique:	
1	Cereals: Wheat (habit sketch, L.S./T.S. of grain, starch grains, micro-chemical tests); rice	8
	(habit sketch, study of paddy and grain, starch grains, micro-chemical tests)	
	Legume: Pea or ground nut (habit, fruit, seed structure, micro-chemical tests)	
	Source of sugars and starches: Sugarcane (habit sketch; cane juice- micro-chemical	
	tests); potato (habit sketch, tuber morphology, T.S. of tuber to show localization of	
	starch grains, W.M. of starch) grains, micro-chemical tests.	
	Tea- tea leaves, tests for tannin	
	Mustard- plant specimen, seeds, tests for fat in crushed seeds	
	Timbers: section of young stem.	
	Jute- specimen, transverse section of stem, tests for lignin on T.S. of stem and study of	
	fiber following maceration technique.	
	Study of specimens of economic importance mentioned in Unit I-& II	
II	Commercial Cultivation	8
	Field visit to Green houses for understanding Floriculture & vegetables production	
	Development of hydroponics nutrient solutions & running models for cultivation of	
	vegetables	
	Development of hydroponics nutrient solutions & running models for cultivation of fodder	7
III	Cultivating Medicinal and aromatic plants & Essential oil extraction	
	a. Lemon grass/ Neem/ Zinger /Rose/Mint	_
IV	Documentation from Traditional Knowledge Digital Library,	7
	Mark the Geographic Indications on Map,	
	Understand –Nakshtra Vatika, Navgrah vatika and develop in your college	
	To extract the names of the plants and Botanical uses depicted in our epics.	
V	Visit NISCAIR, New Delhi	
V	Ethnobotany	
	Study of common plants used by tribes. Aegle marmelos, Ficus religiosa, Cynodon	7
	dactylon. Vioit a tribal area and collect information on their traditional mathed of treatment using	/
	Visit a tribal area and collect information on their traditional method of treatment using crude drugs.	
	Familiarize with at least 5 folk medicines and study the cultivation, extraction and its	
	medicinal application.	
	Observe the plants of ethnobotanical importance in your area.	
	Visit to an Ayurveda college or Ayurvedic Research Institute / Hospital	
	visit to an Ayurveua conege of Ayurveure Research histitute / hospital	

VI	Instrumentation and herbal Preparations	
	Develop Capsules of herbs/ Develop Herbal oils/ Develop Poultice/cream	8
	Analyse some active ingredients using chromatography /Spectrophotometry	
VII	Pharmacognosy	8
	Organoleptic studies of plants mentioned in the theory:	
	1. Morphological studies of vegetative and floral parts.	
	2. Microscopic preparations of root, stem and leaf.	
	3. Stomatal number and stomatal index.	
	4. Vein islet number.	
	5. Palisade ratio.	
	6. Fibres and vessels (maceration).	
	7. Starch test	
	8. Proteins and lipid test	
	Phytochemistry:	7
VIII	Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves.	
	Dimensions of Calcium oxalate crystals in powdered crude drug.	
	Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins	
	& resins.	
	Any 5 herbal preparations.	

Suggested Readings: Course Books published in Hindi may be prescribed by the Universities.

- 1. Plant Ecology And Economic Botany by Dhankar Sharma Trivedi, RBD Publication
- 2. ddddddddddddd Shiva Kant, Pankaj Kumar Brahmiya: Thakur Publication
- 3. PHARMACOGNOSY ...Hindi Edition (Paperback, Hindi, Dr. Akancha Rashi, KHUSHALJASWANI), RM Publication
- 1. Wallis, T. E. 1946. Textbook of Pharmacognosy, J & A Churchill Ltd.
- 2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
- 3. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
- 4. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Nava Prakash Publishers, Calcutta.
- 5. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health, Govt. of India.
- 6. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
- 7. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
- 8. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1,Today& Tomorrow's printers and publishers, New Delhi.
- 9. Khasim S.M Botanical Microtechniques: Principles and Practice-
- 10. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. ew Delhi.
- 11. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency

This course can be opted as an elective by the students of the following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Arch, BAMS

## **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

**Facilities: Smart and Interactive Class** 

**Other Requisites:** Video collection, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts **Lab requisites:** Repository of economic products, Microscopes/ Botanical /Herbal Garden, TLC, Spectrophotometer.

Suggested equivalent online courses:

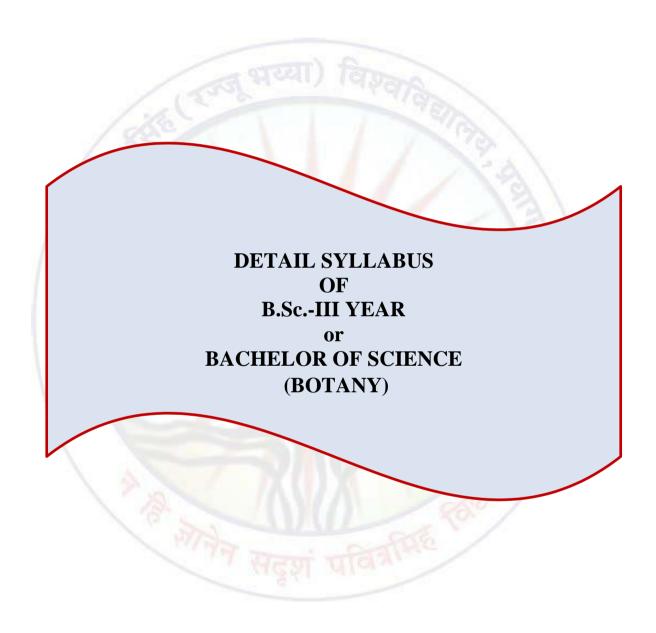
https://www.entrepreneurindia.co/Document/Download/pdfanddoc-144615-.pdf

http://nopr.niscair.res.in/handle/123456789/45825

https://www.wipo.int/export/sites/www/tk/en/resources/pdf/medical\_tk.pdf

https://www.bentoli.com/commercial-farming-agriculture/





BACHELOR OF SCIENCE (BOTANY)		
Programme/Class: Bachelor of Science	Year: III	Paper-I
Su	bject: BOTANY	
Course Code: B040501T	Course Title: Plant Physiology, Me	tabolism & Biochemistry

## **Course outcomes:**

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. Know the role of plants in development of natural products, nutraceuticals, dietary supplements, antioxidants

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week) 4-0-0

Unit	Торіс	No. of Lectures(60hrs)
I	Plant water relation, Mineral Nutrition, Transpiration and translocation in phloem Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Composition of phloem sap, girdling experiment; Pressure flow model.	7
II	Carbon Oxidation Krebs cycle, Glycolysis, fate of pyruvate- aerobic and anaerobic respiration and fermentation, mitochondrial electron transport, oxidative phosphorylation.	7
III	Nitrogen Metabolism  Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes),  Ammonia assimilation.	8
IV	Lipid Metabolism & Photosynthesis Lipid Metabolism: Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle. Photosynthesis: Pigments, Electron transport system and Photophosphorylation, C3 & C4 photosynthesis, CAM- Reaction and Significance	7
V	Plant Development, Movements, Dormancy & Responses Developmental roles of Phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene.) autonomic & paratonic movements, Photoperiodism (SDP, LDP, Day neutral plants). Vernalization	8

VI	Biomolecules  Carbohydrates: Nomenclature and classification; Role of monosaccharides, Disaccharides, Oligosaccharides and polysaccharides.  Lipids: Storage lipids: Fatty acids structure and functions.	8
VII	Proteins: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quaternary.  Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleic acids.	7
VIII	<b>Enzymes:</b> Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; mechanism of action (activation energy, lock and key hypothesis, induced- fit theory).	8

#### **Suggested Readings:**

### Course Books published in Hindi may be prescribed by the Universities.

- 3. वेववेव वेववेववेववे वेववे जननवेववेववेवे . Madan Kumar. 2020.
- Plant Physiology and BiochemistryISBN #:81-301-0035-5Sunil D Purohit, K. Ahmed & Gotam K Kukda Edition: 2013Pages: 368 + VIII Text Book (Hindi)
- 5. वववव ववववववव ववव वववव Dhankar Sharma Trivedi RBD Publishing
- 1. Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
- 2. 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, Boopathi PNPublisher: Agrobios (India)
- 3. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.
- 4. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 19992, Wadsoworth Publishing Company.
- 5. Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
- 6. Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.
- 7. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New Central Book. Agencies.
- 8. Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.
- 9. Mathews, C.K., Van Holder, K.E. & Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.
- 10. Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan.
- 11. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.
- 12. Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.
- 13. Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biology of plants, 2000, I.K. International.
- 14. Ramesh Gupta. Efficacy, Safety and Toxicity brings together all current knowledge regarding nutraceuticals and their potential toxic effects. 2016. Elsevier.
- 15. Harborne, J.B. 1973. Phytochemical Methods. John Wiley & Sons, New York.
- 16. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
- 17. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017

This course can be opted as an elective by the students of following subjects: Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech,

**Suggested Continuous Evaluation Methods:** Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

### **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech//Gardening)

**Facilities: Smart and Interactive Class** 

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

### Suggested equivalent online courses:

https://www.classcentral.com/course/swayam-plant-physiology-and-metabolism-17732

https://www.wiziq.com/course/3249-plant-physiology-in-10-live-online-classes

https://www.easybiologyclass.com/plant-physiology-free-lecture-notes-online-tutorials-lecture-notes-ppts-mcqs/

https://onlinecourses.swayam2.ac.in/cec19\_bt09/preview

Programme/Class: Bachelor of Science	Year: III	Paper-II
	Subject: BOTANY	
Course Code: B040502T	Course Title: Molecular Biology &	Bioinformatics

### **Course outcomes:**

After the completion of the course the students will be able to:

- 1. Understand nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.
- 2. Know about Processing and modification of RNA and translation process, function and regulation of expression.
- 3. Gain working knowledge of the practical and theoretical concepts of bioinformatics

Credits: 4	CC / Elective
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week) 4-0-0

Unit	Торіс	No. of Lectures(60hrs)
Ι	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.	7

II	Transcription & Regulation of gene expression  Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types;  Translation, (Prokaryotes and eukaryotes), genetic code. Regulation of gene expression in Prokaryotes: Lac operon and Tryptophan operon.	7
III	Principles & Techniques of genetic engineering Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; PCR. Hybridoma and monoclonal antibodies.	8
IV	Applications of Genetic engineering Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products, Biosafety concerns	7
v	Bioinformatics & its applications Historical background. Scope of bioinformatics, Applications and Limitations of bioinformatics.	8
VI	Biological databases: Introduction to biological databases - primary, secondary and composite databases.	8
VII	Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)	7
VIII	Phylogenetic analysis Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.	8

### **Suggested Readings:**

Course Books published in Hindi may be prescribed by the Universities.

- 1. Dr Pooja Rai. addadad add addadad add addadad ,Bhopal
- 2. Sharma Trivedi Molecular Biology And Biotechnology (বৰবৰৰ বৰবৰৰৰ বৰবৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰৰ বৰবৰৰ বৰবৰৰ বৰবৰৰৰ বৰবৰৰ বৰবৰ বৰবৰৰ বৰবৰ বৰব
- **3.** Plant Physiology and Biochemistry ISBN #: 81-301-0035-5Author: Sunil D Purohit, K. Ahmed & Gotam K KukdaEdition: 2013Pages: 368 + VIIIType: Text Book (Hindi)
- **4.** Molecular Biology Biotechnology ISBN #: 81-301-0033-9Author: Sunil D Purohit & Gotam K Kukda Edition: 2013Pages: 366 + XType: Text Book (Hindi) Apex Publishing House, Udaipur, Rajasthan
- 5. Bioinformatics Paperback 1 January 2015 by Dr Archana Pandeya (Author), Santosh Choubey (Editor), & 2 More Hindi AISECT Ltd.
- 6. BIOTECHNOLOGY AND GENETIC ENGINEERING (Hindi, Hardcover, Dr. Archna Nigam)

- 1. Primrose, SB. 1995. Principles of Genome Analysis. Blackwell Science Ltd.Oxford, UK..
- 2. E.J. Gardner and D.P. Snustad. PRINCIPAL OF GENETICS (1984), John Wiley & Sons, Ney York.
- 3. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
- 4. Freifelder Molecular Biology.
- 5. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017.
- 6. Ghosh, Z., Mallick, B. (2008). Bioinformatics Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press.
- 7. Baxevanis, A.D. and Ouellette, B.F., John (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
- 8. Roy, D. (2009). Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House.
- 9. Andreas, D., Baxevanis, B.F., Francis, Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons.
- 10. Pevsner J. (2009). Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell.
- 11. Xiong J. (2006). Essential Bioinformatics,1st edition. Cambridge, U.K.: Cambridge University Press
- 12. A Textbook Of Basic And Molecular Genetics (pb)ISBN: 9788188826193Edition: 01Year: 2018Author: Dr. Parihar

### This course can be opted as an elective by the students of following subjects:

Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture.

Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech)

**Facilities: Smart and Interactive Class** 

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

#### **Suggested equivalent online courses:**

https://www.edx.org/learn/molecular-biology

https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering

https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090

https://www.coursera.org/courses?query=genetics

https://www.coursera.org/courses?query=molecular%20biology

https://www.edx.org/learn/genetic-engineering

https://www.mooc-list.com/tags/genetic-engineering

https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907

https://nptel.ac.in/courses/102/103/102103013/

Programme/Class: Bachelor of Science	Year: III	Paper-III
	Subject: Botany	
Course Code: B040503P	Course Title: Experiments in physiology, Biochemistry & molecular biology	

### **Course outcomes:**

After the completion of the course the students will be able to:

- 1. Know and authentic the physiological processes undergoing in plants along with their metabolism
- 2. Identify Mineral deficiencies based on visual symptoms
- 3. Understand and develop skill for conducting molecular experiments for genetic engineering

Credits: 2	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week) 0-0-2

Unit	Topic*	No. of Lectures(60
	*(Perform any three from each unit based on facility)	hrs)
I	Plant water relation, Mineral Nutrition and translocation in phloem	8
1	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. Experiment for demonstration of Transpiration by Four-Leaf Experiment:	
	6. Structure of stomata (dicot & monocot)	
	7. Determination of rate of transpiration using cobalt chloride method.	
	8. Experiment to measure the rate of transpiration by using Farmer's Potometer	
	9. Experiment to measure the rate of transpiration by using Ganong's potometer	
	10. Effect of Temperature on membrane permeability by colorimetric method.	
	11. Study of mineral deficiency symptoms using plant material/photographs.	
II	Nitrogen Metabolism, Photo Synthesis & Respiration	
	1. A basic idea of chromatography: Principle, paper chromatography and column	
	chromatography; demonstration of column chromatography.	8
	2. Separation of plastidial pigments by solvent and paper chromatography.	
	3. Estimation of total chlorophyll content from different chronologically aged leaves (young, mature and senescence) by Arnon method.	
	4. Effect of HCO <sub>3</sub> concentration on oxygen evolution during photosynthesis in an aquatic plant and to find out the optimum and toxic concentration (either by volume measurement or bubble counting).	
	5. Measurement of oxygen uptake by respiring tissue (per g/hr.)	
	6.Determination of the RQ of germinating seeds.	
	7. Effect of light intensity on oxygen evolution in photosynthesis using Wilmott' bubble	
	Plant Development, Movements, Dormancy & Responses	
III	1. Geotropism and phototropism — Klinostàt	8
	2. Hydrotropism	
	a. Measurement of growth — Arc and Liver Auxonometer	
	3. To study the phenomenon of seed germination (effect of light).	
	4. To study the induction of amylase activity in germinating grains.	

	5 That of and a lab live by TTC and a lab	
	5. Test of seed viability by TTC method.	
	6. To study the effect of different concentrations of IAA on <i>Avena</i>	
	coleoptile elongation (IAA bioassay)	
	Techniques for biochemical analysis	o
IV	1. Weighing and Preparation of solutions -percentage, molar & normal	8
	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	
	8. Quantitative Analysis of Nucleic Acids,	
	9. Analysis of dietary supplements, nutraceuticals & antioxidants	
	10. Testing of adulterants in food items.	
$\mathbf{v}$	Genetic material	7
•	1. Instruments and equipments used in molecular biology.	
	2. Preparation of LB medium and cultivating E.coli on it.	
	3. Isolation of Genomic DNA	
	4. Isolation of DNA from plants	
	5. Examination of the purity of DNA by agarose gel electrophoresis.	
	6. Quantification of DNA by UV-spectrophotometer	
	7. Estimation of DNA by diphenylamine method.	
	7. Estimation of DIVA by diplicity failing method.	
VI	Preparation of models/ charts:	
, ,	1. Study of experiments establishing nucleic acid as genetic material (Avery et al,	
	Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)through	7
	photographs	-
	2. Numericals based on DNA re-association kinetics (melting profiles and Cot	
	curves)	
	3. Study of DNA replication through photographs: Modes of replication - Rolling	
	circle, Theta and semi-discontinuous; Semiconservative model of replication	
	(Messelson and Stahl's experiment); Telomerase assisted end-replication of linear	
	DNA	
	4. Study of structures of : tRNA (2D and 3D); prokaryotic RNA polymerase and	
	eukaryotic RNA polymerase II through photographs	
	5. Study of the following through photographs: Assembly of Spliceosome	
	machinery; Splicing mechanism in group I & group II introns; Ribozymes and	
	Alternative splicing	
	6. Understanding the regulation of lactose (lac) operon (positive & negative	
	regulation) and tryptophan (trp) operon (Repression and De-repression &	
	Attenuation) through photographs.	
	7. Understanding the mechanism of RNAi by photographs	
VII	Genetic Engineering	
	1. Isolation of protoplasts.	7
	2. Construction of restriction map of circular and linear DNA from the data	
	provided.	
	3. Isolation of plasmid DNA.	
	4. Restriction digestion and gel electrophoresis of plasmid DNA (demonstration/	
	photograph).	
	5. Calculate the percentage similarity between different cultivars of a species	
	using RAPD profile. Construct a dendrogram and interpret results.	

	6. Agarose gel analysis of plasmid DNA	
	7. Restriction digestion of plasmid DNA -Demonstration of PCR	
	Applications of Genetic engineering	7
	1. ELISA Test,	
VIII	2. Viability tests of cells	
	3. Study of methods of gene transfer through photographs: Agrobacterium-	
	mediated, direct gene transfer by electroporation, microinjection, microprojectile	
	bombardment.	
	4. Study of steps of genetic engineering for production of Bt cotton, Golden rice,	
	FlavrSavr tomato through photographs.	

### **Suggested Readings:**

### Course Books published in Hindi may be prescribed by the Universities.

- - 1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
  - 2. A Laboratory Manual Of Plant, Physiology, Biochemistry And Ecology ISBN: 9788177544589Edition: 01Year: 2012Author: Akhtar InamPublisher: Agrobios (India)
  - 3. Advanced Methods In Physiology And Biochemistry (pb)ISBN: 9789381191132Edition: 01Year: 2016Author: Padmanaban G, Chandrasekaran CN, Thangavelu AU, Dr. Sivakumar R, Kalimuthu N, Dr. Boominathan P, Dr. Anbarasan P, Agrobios.
  - 4. Methods in Plant Biochemistry and Molecular Biology. 1997. Dashek, WV (ed.). CRC Press.
  - 5. Wilson and Walker .Practical Biochemistry: Principles and Techniques. Cambridge University Press.U.K.
  - 6. Thimmaiah, SR. 2004. Standard Methods of Biochemical Analysis. Kalyani Publishers.
  - 7. Henry, RJ. 1997. Practical Application of Plant Molecular Biology. Chapman & Hall, London

### This course can be opted as an elective by the students of following subjects:

Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture.

### **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ /Gardening)

**Facilities: Smart and Interactive Class** 

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Lab requisites: Electrophoresis units, Gelrocker, UV-transilluminator, Vortex Mixer, Shaker, CVT,

HiMedia Biotechnology & Molecular biology Kits/Chemicals, Micropippettes, Elisa reader/Microtitre Reader

### Suggested equivalent online courses:

https://www.edx.org/learn/molecular-biology

https://krishikosh.egranth.ac.in/handle/1/5810039999

 $\underline{https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090}$ 

https://www.coursera.org/courses?query=genetics

https://www.coursera.org/courses?query=molecular%20biology

https://www.edx.org/learn/genetic-engineering

https://www.mooc-list.com/tags/genetic-engineering

https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907



Programme/Class: Bachelor of Science	Year: <b>III</b>	Paper-IV Project-I
	Subject: <b>BOTANY</b>	
Course Code: - B040504R	Course Title: Project in	Botany for Pre-graduation

#### Course outcomes:

- Project work will supplement field experimental learning and deviations from classroom and laboratory transactions.
- project work will enhance the capability to apply gained knowledge and understanding for selecting, solving and decision-making processes.
- It will promote creativity and the spirit of enquiry in learners.
- They will learn to consult Scientists, libraries, laboratories and herbariums and learn importance of discussions, Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation in form of dissertation writing.
- It will enhance their abilities, enthusiasm, and interest.

Credits: 03	Core: Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-3**.

### **Suggestive List Of PROJECTS**

- 1. Rural Areas: Flora of a city/ village, Biodiversity of Village, Soil & seed testing service provisionto farmers,
- 2. Industrial waste management
- 3. water pollution status of rural water & promotion of WASH in villages
- 4. Plant Disease identification in farms, nurseries and orchards.
- 5. Digital portal for plants: Campus, city or particular area
- 6. Rare and endangered plants & their conservation & domestication
- 7. Air pollution tolerance index (APTI): Screening of sensitive/tolerant plant species at various locations in particular area
- 8. Science Communication by Creating science documentaries of innovators, Internet Science (Social media, Websites, Blogs, Youtube, Podcast etc.)
- 9. Science Outreach Talks and Public Sensitization for plant biodiversity conservation sensitization of public.
- 10. Phytochemistry of medicinal plants & their antimicrobial, nutraceutical and antioxidant properties
- 11. Study of pollen grains in different flowers
- 12.Study of stomata in different plants
- 13.Study of various types of secretory and special tissues in plants.

Refer: libraries, journals, Memoirs, encyclopaedias, herbaria, Museums, etc.

This course can be opted as an elective by the students of following subjects: **Open to all** 

### **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Seminar	10
Thesis/dissertation	10
	25

**Course prerequisites:** 

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

Facilities: Smart and Interactive Class

Other Requisites: All listed under all papers of the course.

### Suggested equivalent online courses:

https://ndl.iitkgp.ac.in/

 $\underline{https://asia foundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiwA-hX5J-number and the state of the control of the control$ 

QhBITSyPnvj3r8yeio-L9f5uTy1a6oEoALCLa9Ebu0pyz858yQZxoC5wkQAvD\_BwE

http://www.dli.ernet.in/

http://www.ulib.org/

http://www.tkdl.res.in/

http://www.vigyanprasar.gov.in/digilib

Directory of Open Access Repositories (DOAR)http://www.opendoar.org

Registry of Open Access Repositories (ROAR)http://roar.eprints.org/

http://www.iscnagpur.ac.in/knowledge learning files/5.7 General Open Access e-Resources.pdf

Programme/Class: Bachelor of Science	Year: III	Paper-V
	Subject: <b>Botany</b>	
Course Code: B040601T	Course Title: Cytogenetics, Plant	Breeding & Nanotechnology

**Course outcomes:** After the completion of the course the students will be able:

- 1. Acquire knowledge on cell ultrastructure.
- 2. Understand the structure and chemical composition of chromatin and concept of cell division.
- 3. Interpret the Mendel's principles, acquire knowledge on cytoplasmic inheritance and sex-linked inheritance.
- 4. Understand the concept of \_one gene one enzyme hypothesis' along with the molecular mechanism of mutation.

Credits: 4		Core Co	mpulsory
Max. Marks: 25+75 Min. Pass		ing Marks:	
	Total No. of Lectures-Tutorials-Practical (in hours	s per week): <b>4-0-0</b>	
Unit	Торіс		No. of Lectures (60hrs)
I	Cell biology Structure and function of cell wall, plasma membrane, ribosom golgi apparatus, mitochondria, chloroplast, lysosomes, peroxise Organization of nucleus: nuclear envelope, nucleoplasm and nucl Chromosomal nomenclature- chromatids, centromere, telor constriction. Organization of chromosomes- Nucleic acid classification. Lampbrush chromosomes and polytene chromidiogram. Cell cycle: G0, G1, S and G2 phases — mitosis: open and meiosis. Variation in Chromosome number (Numerical aber Euploidy-haploidy, polyploidy- significance (Structural aberration inversion and translocation.	omes and cell inclusions - eolus. mere, satellite, secondary and histones- types and mosomes- Karyotype and d closed mitosis - amitosis - errations)- anueploidy and	8
II	Genetics Chromosome theory of inheritance, crossing over and linkage; Incodominance; Interaction of Genes; Multiple alleles, Lethal allele Polygenic inheritance; Extra-nuclear Inheritance, Linkage, crossing determination and Sex chromosomes; Patterns of Sex determination	es, Epistasis, Pleiotropy, ng over, Concept of sex	7
Ш	Plant breeding Plant introduction. Agencies of plant introduction in India, P Acclimatization – Achievements, Selection - mass selection, pu selection. Genetic basis of selection methods, Hybridization: Proc generic, inter specific, inter varietal hybridization with example varieties, Male sterility, Heterosis and its exploitation in plant bre Breeding (use of DNA markers in plant breeding), achievements pathogenic diseases and stress resistance.	re line selection and clonal edure of hybridization, inter s. Composite and synthetic eding, Mutation, Molecular	8
IV	Biostatistics: Definition, statistical methods, basic principles, variables-limitations and uses of statistics. Biometry: Data, Sample, Poperquency distribution- definition only, Central tendency— Ar Median; Measurement of dispersion—Coefficient of variation, Staterror of Mean; Test of significance: chi- square test for goodness in biostatistics - MS Excel and SPSS	oulation, random sampling, ithmetic Mean, Mode and ndard Deviation, Standard	7
V	Plant tissue culture	-	8

	Principles, components and techniques of <i>in vitro</i> plant cultures, Callus cultures, Cell culture, cell suspension cultures, Embryogenesis and organogenesis, Protoplast isolation 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.	
VI	Nanotechnology Fundamentals of nanoscale self-assembly process involved in important functional biomolecules such as Nucleic acid (DNA and RNA), Proteins, Enzymes. Cell structure and organelles, nanoscale assembly of cellular components (cell membrane and liposomes). Nanoscale assembly of microorganisms (virus). Nano-particles synthesis, Biological synthesis of Nanoparticles, Advantages and applications of biologically synthesized nanomaterials. Introduction to biological nanomaterials. Biomineralization, Magnetosomes, nano-pesticides, nano-fertilizers, nano-sensors.	7
VII	Artificial Intelligence in Plant Sciences Big Data Analytics, Blockchain Technology, 3-D Printing, Machine learning, Algorithms of Machine Learning, Expert systems and Fuzzy logic, Artificial Neural Networks and Genetic algorithms, Predictive Analytics, Agents and Robotics, IoT Sensors, Object Image capture & analysis; Applications of Artificial Neural Networks in Plant Science.	8
VIII	Introduction to use of Digital technologies – AI, IoT & ICT in Botany Educational software- INFLIBNET, NICNET, BRNET, internet as a knowledge repository- google scholar, science direct. resource management, weather forecasting. IoT Database management, IoT platforms, IoT Graphical user interface • IoT application development for Android Mobile phones, ICT Applications for different crops and horticulture	7

### **Suggested Readings:**

Course Books published in Hindi may be prescribed by the Universities.

- 3. Cell Biology And Genetics (Hindi) 2/e PB ... Gupta P K (Hindi) rastogi Publications
- 4. PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas University
- 5. Biotechnology: Fundamentals And Application (hindi) (hb) ISBN: 9788177544732Edition: 03Year: 2018Author: Dr. Purohit SS, Mathur S
- 6. Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani Pubishers ISBN: 9789327246070, 9327246071
- 7. Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-0066-1Sunil D Purohit & Gotam K Kukda, Apex Publishing House
- 8. Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House
- 9. Padap Prajanan (Hindi) Hardcover 1 January 2016 by Chandra Prakash Shukl (Author) Pointer Publishers, Jaipur
- 10. PLANT BREEDING: PRINCIPLE AND METHODS B D SINGH INHINDI
- 11. adadad adadadadad adad -adadad Commission for Sfand Technical Terminology (CSTT)
- 12. adad adadadad adadadad adad Commission for Scientific arlling Terminology (CSTT)
- 1. G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
- 2. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of Cell. 6th Edition. WW. Norton & Co.
- 3. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.
- 4. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
- 5. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nd ed., W.H.Freeman.
- 6. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) Biochemistry, W.H.Freeman and Company

- 7. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
- 8. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
- 9. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8<sup>th</sup> edition.Pearson Education Inc. U.S.A.)
- 10. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th e
- 11. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India.5thedition.
- 12. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A..
- 13. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
- 14. M K Raxdan An Introduction to Plant Tissue Culture -; Oxfird & IBH Publishing Co.Pvt. Ltd., New Delhi
- 15. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
- 16. Allard RW (1960) Principles of Plant Breeding. John willey and Sons. Inc. NewYork
- 17. BD Singh (2003) Plant Breeding. Kalyani Publishers
- 18. Cohn, N.S. (1964) Elements of Cytology. Brace and World Inc, New Delhi
- 19. Darnel, J.Lodish, Hand Baltimore, D. (1991) Cell and molecular biology. Lea and Fibiger, Washington.
- 20. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology Scientific American books.
- 21. Dobzhansky, B (1961) Genetic and origin of species, Columbia university Press New York
- 22. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
- 23. Gerald Karp (1985) Cell biology, Mc Graw Hill company..
- 24. Lewin, B, (1994) Genes, Oxford University Press, New York.
- 25. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
- 26. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd
- 27. Roy S.C. and Kalayan kumar De (1997) Cell biology. New central Boos Calcutta
- 28. Sandhya Mitra,(1998) Elements of molecular biology. Macmillan, India Ltd.
- 29. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi
- 30. Sharma, A.K and Sharma A (1980) Chromosome technique Theory and practice, Aditya Books, New York
- 31. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, NewYork.
- 32. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd
- 33. Twymann, R.M. (1998) Advanced molecular biology Viva books NewDelhi.
- 34. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd
- 35.A. J. Nair . Basics of Biotechnology- Laxmi Publications, New Delhi.
- 36.S S Purohit and S K Mathur; Biotechnology-Fundamentals and Application- Agrobotanica, India.
- 37.A. J. Nair Introduction to Genetic Engineering & Biotechnology. Jones & Bartlett Publishers, Boston, USA.
- 38.H S Chawla Introduction to Plant Biotechnology-; Oxford & IBH publishing Co.Pvt.Ltd., New Delhi.
- 39.H D Kumar Modern concept of Biotechnology, Vikas Publishing House, Pvt. Ltd., New Delhi.
- 40.P C Trivedi ,Plant biotechnology, Recent Advances Panima Publishing Corporation, New Delhi.
- 41. Du, C., and S. A. Jackson. 2019. Machine learning and complex biological data. Genome Biology 20: 76. https://doi.org/10.1186/s13059-019-1689-0
- 42. Alexis and Mathew Leon., Fundamentals of Information Technology Leon Vikas
- 43. Plant R. E., Stone N. D. (1991). Knowledge-based systems in agriculture. McGraw-Hill, Inc. 1221 Avenue of the Americas, New York, NY 10020.
- 44. Han S., Steward B.L., Tang L. (2016). Intelligent agricultural machinery and field robots. In Zhang Q. Precision agriculture technology for crop farming (pp.133-176). CRC Press, Taylor&Francis Group, New York.
- 45. Lucci S., Kopec D. (2013). Artificial intelligence in the 21st century. 22841 Quicksilver Drive Dulles, VA 20166.
- 46. V.Rajaraman Introduction to Information Technology,., Prentice Hll.
- 47. Ramesh Bangia Learning Computer Fundamentals., Khanna Book Publishers
- 48. Bass, Joel,E and et. al., Allyn & Bacon, 2009 .Methods for Teaching Science as Inquiry, The truth of science, Newton R.G.,
- 49.R. Rangaswami (2009) A Text book of Agriculture Statistics .New Age International (P) Limited, Hyderabad.
- 50. Nageshwar Rao G.(2007)Statistics for Agriculture Sciences BS Publications. New Delhi
- 51. NigamA.K. andGupta, V.K.(1979) Hand book on Analysis of Agricultural Experiments.. IASRI Publication, New Delhi.

- 52. Panse V.G. Sukhatme P.V. (1985) Statistical methods for Agricultural workers . Indian Council of Agricultural Research. New Delhi
- 53. Snedecor GW. & Cochran WG. (1989) Statistical Methods . Iowa State University Press.
- 54. Design and Analysis of Experiments by Das M.N. and Giri N.C. (1986). Wiley Eastern Ltd., New Delhi.
- 55. Gomez, A.A. and Gomez, A.A.(1984) Statistical Procedures for Agricultural Research John Wiley and Sons. New York.
- 56. Gupta, S.C. (2016) Fundamentals of Statistics .Himalaya Publishing House Mumbai 400004, Maharashtra, India.
- 57. V.K. Kapoor (2007) Fundamentals of Applied statistics by Sultan Chand and Sons, New Delhi- 110 002
- 58. Yubing Xie. 2012. Nanotechnology. CRC Press. The Nanobiotechnology Handbook. CRC Press.
- 59. Sulabha K. Kulkarni. 2014 Nanotechnology: Principles and Practices. CP publishing, New Delhi.
- 60.B S Murty, P Shankar, Baldev Raj, B B Rath, James Murday. 2012. Textbook of Nanoscience and Nanotechnology. Springer
- 61. K. K. Chattopadhyay and A. N. Banarjee. 2009. Introduction to Nanoscience and Nanotechnology. PHI Publication.
- 62. Sharma A.K. 2005. Text Book Of Biostatistics I, Discovery Publishing House.
- 63. Annadurai, B. 2007. Text Book of Biostatistics. New Age International.
- 64. Gurumani, N. 2010. An Introduction to Biostatistics (2nd Edn). MJP Publishers.
- 65. David S. Goodshell. 2004. Bionanotechnology-Lessons from nature. John Wiley Publications.
- 66.R. Stephen Crespi, Tibtech, Patenting in Biotechnology Part I, Vol. 9, 117-122, 1991.
- 67. Pattnaik, P.K., Kumar, R., Pal, S., Panda, S.N. (Eds.)IoT and Analytics for Agriculture,2020
- 68. https://www.springer.com/gp/book/9789811391767
- 69. https://www.springer.com/gp/book/9789811550720
- 70. Petersen Roger G. (1994) Agricultural Field Experiments Design and Analysis by Marcel Dekker, NewYork.

### This course can be opted as an elective by the students of following subjects:

Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.Sc. Food Science, B.A. (Curators), B.A. Geology.

**Suggested Continuous Evaluation Methods:** Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

### **Course pre-requisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ Math/Statistics/Chemistry/ Computer Science)

**Facilities: Smart and Interactive Class** 

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:

https://www.cytology-iac.org/educational-resources/virtual-slide-library

https://www.asct.com/ASCTWeb/Content/Cytopreparation Online Course.aspx

https://www.mooc-list.com/tags/genetics

 $\underline{https://www.coursera.org/learn/genetics-evolution}$ 

https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/

### **Further Suggestions:**

Access to Statistics, Chemistry, Math and Biotechnology resources will be required

Programme/Class: Bachelor of Science	Year: III	Paper-VI
	Subject: Botany	
Course Code: B040602T	Course Title: Ecology & Environm	ent
Course outcomes:  1. acquaint the students with complex interrelationship between organisms and environment; 2. make them understand methods for studying vegetation, community patterns and processes,		

- ecosystem functions, and principles of phytogeography.
- 3. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

Credits: 4	Core Compulsory/Elective
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Unit	Торіс	No. of Lectures (60 hrs)
]	<b>Natural resources &amp; Sustainable utilization</b> : Land Utilization, Soil degradation and management strategies; Restoration of degraded lands. Water, Wetlands; Threats and management strategies, Ramsar sites ,Forests: Major and minor forest products; Depletion, Biological Invasion, Energy: Renewable and non-renewable sources of energy.	7
п	Ecology & Ecosystem  Definition of Ecology, Ecological Factors, Positive and negative interactions. Ecosystem  - Concept of an ecosystem-structure and function of an ecosystem.  Abiotic and biotic com-Energy flow in an ecosystem  Ecological Succession-Definition & types. Processes and types (autogenic, allogenic, autotrophic, heterotrophic, primary & secondary), Hydrosere and Xerosere.  Food chains and food webs, Ecological pyramids, production and productivity; And components.  Types of ecosystems: Forest Ecosystem, Grassland, Crop land, aquatic Ecosystems  Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and  Parasites.	8
III	Soil Formation, Properties & Conservation  Soil: Origin, Formation, composition, Soil types, Soil Profile, Soil Microorganisms, soil processes, Soil Erosion, Biogeochemical cycles, Soil Conservation: Biological—Contour farming, Mulching, Strip cropping, Terracing and Crop rotation.	7
IV	Biodiversity and its conservation:  Definition -genetic, species, and ecosystem diversity. Value of biodiversity: social, ethical, aesthetic and option values; hotspots of Biodiversity threats to biodiversity, Biotic communities and populations, their characteristics and dynamics. Endemic and endangered species of plants in India. Ecological niche, ecotypes, ecological indicators. Conservation of Biodiversity:  Ex-situ and in-situ conservation, Red data book, botanical gardens, National park, Sanctuaries, hot & hottest spots and Bioreserves. Role of Seed Bank and Gene Bank Valuing plant resources, ecotourism, Role of NBPGR, FAO, BSI.	7

V	Phytogeography: Biogeographic regions of India & world, Agroecological & Floristic zones of India. Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, Phytogeographical regions of India, Vegetational types in Uttar Pradesh.	7
VI	Environmental audit & Sustainability	
	Concept of environmental audit; Guidelines of environmental audit; Methodologies adopted along with some industrial case studies; Environmental standards: ISO 14000 series; Scheme of labelling of environment friendly products (Ecomark); Life cycle analysis; Concept of energy and green audit, Strategies and debates on sustainable development; Concept of Sustainable Agriculture; India's environment action programme: issues, approaches and initiatives towards Sustainability; Sustainable development in practice.	8
VII	Pollution, Waste management & Circular Economy	
	Environmental pollution, Environmental protection laws, Bioremediation, Activated Sludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors, membrane bioreactor, neutralization, ETP sludge management; digesters, up flow anaerobic sludge blanket reactor, fixed film reactors, sequencing batch reactors, hybrid reactors, bioscrubbers, biotrickling filters; regulatory framework for pollution monitoring and control; case study: Ganga Action Plan; Yamuna Action Plan; implementation of CNG; Waste- Types, collection and disposal, Recycling of solid wastes (hazardous & non-hazardous) - classification, collection and segregation, Incineration, Pyrolysis and gasification, Sanitary landfilling; composting, Biogas production, Circular Economy & sustainability.	8
VIII	Environmental ethics, Carbon Credits & Role of GIS	8
	Carbon credit: concept, exchange of carbon credits. Carbon sequestration, importance, meaning and ways.	
	Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and	
	holocaust.	
	Wasteland reclamation. Consumerism and waste products.	
	Clean development mechanism.  Geographical Information Systems: definitions and components; spatial and non-spatial	
	data; GIS software packages; GPS survey, data import, processing, and mapping.	
	Applications and case studies of remote sensing and GIS in land use planning, forest resources & agriculture studies.	
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### Suggested Readings:

### Course Books published in Hindi may be prescribed by the Universities.

- 1. Environmental Studies (Hindi)ISBN 81-301-0004-5B. L. Chaudhary & Jitendra Pandey Edition: 2013Pages: 340 + XII Apex Publishing House
- 2. Soil and Water Conservation ISBN #: 978-81-301-0071-5S. C. Mahnot & P. K. Singh Apex Publishing
- 3. House

- 6. Paryavaran Evam Paristhitiki 5e (Hindi) Paperback 20 February 2020 Majid Husain
- 7. Environmental Biology and Phytogeography ISBN #: 978-81-301-0064-7B. L. Chaudhary, Gotam K Kukda & Jitendra Kumar Joshi
- 8. Ugc Unified: Environmental Sciences (hindi) (pb) ISBN: 9788177545814 Edition: 01Year: 2015Author: Dr. Purohit SS, Dr. Deo PP, Dr. Agrawal Ashok KPublisher: Agrobios (India)
- 1. Chapman and Riss. Ecology: Principles and Applications, Latest Ed., Cambridge University Press
- 2. Shukla, R.S. & Chandel, P.S. Plant Ecology, Latest Ed., S. Chandel and Co.
- 3. Kumar, H.D. Modern Concept of Ecology, Latest Ed. Vikas Publishing House
- 4. Begon, M., Herper, J.L. and Townsend, C.R. Ecology- Individuals, Populations and Communities (3rd ed.), Oxford Blackwell Science
- 5. Verma, P.S. & Agarwal, U.K. Concept of Ecology, Latest Ed., S. Chand & Company

- 6. Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders
- 7. Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications
- 8. Ambasht, R.S. & Ambasht, N.K. A Text Book of Plant Ecology, Latest Ed., CBS Publication & Distributors
- 9. Mani, M.S. Bio-Geography of India, Latest Ed., Springer-Verlag.
- 10. Mackenzie et al. Ecology, Latest Ed., Viva Books.
- 11. Gurevitch, J. (et al.)., The Ecology of plants, 2002, Sinauer Associates.
- 12. Kimar, U. & Asija, M.J. Bio-diversity: Principles & Conservation, 2005, Student Edition, Agrobios (India)
- 13. Krishnamurthy, K.V. An Advanced Text Book on Biodiversity, 2003, Oxford & IBH Publishing Co. Ltd.
- 14. Mitra, D., Guha, J.K., Chowdhury, S.K. Studies in Botany, Vol. II (7th ed.) Moulik Library.
- 15. Primack, R.B. Essentials of Conservation Biology, 1993, Sinauer Associates.
- Lo, C.P. & Yeung, A.K.W. Concepts and Techniques of Geographic Information Systems, 2002, Printice-Hall of India.
- 17. Cain, Bowman, Hacker. Ecology. 2014. 3rd Ed. Sinauer Associates
- 18. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
- 19. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
- 20. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
- 21. Abbasi, S. A. (1998). Environmental Pollution and its Control. Cogent International, Pondicherry.
- 22. Abbasi, S. A. and Ramasamy, E. V. (1999). Biotechnological Methods of Pollution Control. Universities Press (India) Limited, Hyderabad.
- 23. Peavy, H. S., Rowe, D. R. and Tchobanoglaus, G. (1985). Environmental Engineering, Mc Graw Hill Book Company, Singapore.
- 24. Rand, M. C., Greenberg, A. E. and Taras, M. J. (Ed.) (1995). Standard methods for the examination of water and wastewater: 19th edition, American Public Health association (APHA), Washington, D.C.
- 25. Scragg, A. (1999). Environmental Biotechnology, Addison Wesley Longman, Singapore.
- Tchobanoglaus, G. (1988). Wastewater Engineering: Treatment, Disposal, Reuse. Tata Mc Graw Hill, New Delhi.
- 27. Aarve, V. P., William, A. W. and Debra, R. R. (2002). Solid waste engineering. Cengage reading, USA.
- 28. George, T., Hilary, T. and Samuel, A. V. (1993). Integrated solid Waste Management, Engineering Principles and Management Issues, Mc Graw Hills.
- 29. George, T. and Frank, K. (2002). Handbook of solid waste management: (Second edition). Mc Graw Hills.
- 30. Kanthi, L. S. (2000). Basics of Solids and hazardous waste management Technologies. Prentice Hall.
- 31. Anonymous. 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New York.
- 32. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries
- 33. with Policy and Science Considerations. Martinus Nijhoff Publishers.
- 34. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
- 35. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
- 36. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
- 37. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
- 38. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
- 39. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India. Universities Press, India.
- 40. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition). Sage Publications.
- 41. Demers, M.N. 2005. Fundamentals of Geographic Information System. Wiley & Sons.
- 42. Richards, J. A. & Jia, X. 1999. Remote Sensing and Digital Image Processing. Springer.
- 43. Sabins, F. F. 1996. Remote Sensing: Principles an Interpretation. W. H. Freeman.
- 44. Gaston, K J. & Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London,
- 45. Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53:80-192.
- 46. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. Conservation Biology for All. Oxford University Press.
- 47. Sodhi, N.S., Gibson, L. & Raven, P.H. 2013. Conservation Biology: Voices from the Tropics. Wiley-Blackwell Oxford, UK.

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology

### **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

### **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

**Facilities: Smart and Interactive Class** 

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

### Suggested equivalent online courses:

https://community.plantae.org/tags/mooc

uturelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science

https://www.coursera.org/courses?query=plants http://egyankosh.ac.in/handle/123456789/53530

Programme/Class: Bachelor of Science	Year: III	Paper-VII
	Subject: Botany	
Course Code: B040603P  Course Title: Lab on Cytogenetics, Conservation & Environment management		
Course outcomes: After the completion of the course the students will be able:		

- 1. To perform all experiments related to the semester-i.e. Plant tissue cultured plants, conducting breedingon field, conserving and depolluting the environment.
- 2. Can be employed in environment impact assessment companies & start his own venture

Credits: 2	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
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Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-2

Unit	Торіс	No. of Lectures(60hrs)
I	Cell biology	
	1. Study of plant cell structure with the help of epidermal peal mount of	
	Onion/Rhoeo/Crinum	
	2. Measurement of cell size by the technique of micrometry.	7
	3. Counting cells per unit volume with the help of haemocytometer	
	(Yeast/pollen grains)	
	4. Determination of mitotic index and frequency of different mitotic stages	
	in pre-fixed root tips of Allium cepa.	

II	Genetics	
"	1. Monohybrid cross (Dominance and incomplete dominance)	
	2. Dihybrid cross (Dominance and incomplete dominance)	8
	3. Gene interactions (All types of gene interactions mentioned in the	
	syllabus)	
	a. Recessive epistasis 9: 3: 1.	
	b. Dominant epistasis 12: 3: I	
	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, case studies of	
	mutation, polyploidy, emasculation experiment.	
III	Biostatistics:	
111	1. Univariate analysis of statistical data: Statistical tables, mean, mode,	7
	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 Mendellian and modified mono-and	
	dihybrid ratios (3:1, 1:1, 9:3:3:1, 1:1:1:1, 9:7, 13:3, 15:1) by Chi-square	
	analysis and comment on the nature of inheritance.	
	3. Computer application in biostatistics - MS Excel and SPSS	
IV	Plant tissue culture	
	Familiarization of instruments and special equipments used in the plant	8
	tissue culture experiments	
	2. Preparation of plant tissue culture medium, and sterilization, Preparation of	
	stock solutions of nutrients for MS Media.	
	3. Surface sterilization of plant materials for inoculation (implantation in the	
	medium)	
	4. Micropropagation of potato/tomato/ - Demonstration	
	5.Protoplast isolation and culturing – Demonstration	
	Ecology & Environment	7
V	1. Ecological Adaptations: Hydrophytes, Xerophytes, Halophytes,	8
	Epiphytes and Parasites	/
	2. Study of morphological adaptations of hydrophytes and xerophytes	
	(four each).	
	3. Study of biotic interactions of: Stem parasite (Cuscuta), Root parasite	
	(Orobanche) Epiphytes, Predation (Insectivorous plants).	
	4. Observation and study of different ecosystems mentioned in the	
	syllabus.	
	5. Field visit to familiarize students with ecology of different sites	
VI	Soil Formation, Properties & Conservation	8
	1. Determination of pH of various soil and water samples (pH meter,	
	universal indicator/Lovibond comparator and pH paper)	
	2. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter	
	and base deficiency from two soil samples by rapid field tests.	
	3. Determination of organic matter of different soil samples by Walkley	
	& Black rapid titration method.	
	<ul><li>4. Soil Profile study</li><li>5. Soil types of India-Map</li></ul>	
	Biodiversity and Phytogeography:	
VII	1. Study of community structure by quadrat method and determination	7
VIII	of (i) Minimal size of the quadrat, (ii) Frequency, density and	<b>'</b>
	abundance of components (to be done during excursion/field visit).	
	2. Marking of vegetation types of India, World & Uttar Pradesh on maps	
	2. Marking of regention types of india, world & Ottal I ladesh off fliaps	<u> </u>

3. Phytogeographical areas of India	
VIII Pollution &Waste management	7
1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter	
2. Estimation of chloride and dissolved oxygen content in water sample	
3. Comparative anatomical studies of leaves form polluted and less polluted areas.	
4. Measurement of dissolved O2 by azide modification of Winkler's method.	
5. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.	
6. Microbiological assessment of drinking water using MPN technique- water from well, river, water supply department and packaged drinking water	
7. Making kitchen waste from compost/vermicompost by Enzymes/Bio decomposer/ Whey with dung.	
Climate Change, Carbon Credits & Role of GIS	
1. Conducting Waste Audit of your Institution -Demo	
2. Green auditing of the College/University -Demo	

### Suggested Readings: as in papers above:

### Course Books published in Hindi may be prescribed by the Universities.

- 1. Practical Botany (Part III) Author: Sunil D Purohit, Anamika Singhvi & Kiran Tak 2013 Apex Publishing House, Raj.
- 2. Practical Botany (Part II) Author: N. C. Aery, Sunil D Purohit & Gotam K Kukda 2013 Apex Publishing House, Raj.
- 4. A Handbook Of Soil, Fertilizer And Manure (2nd Ed.) (pb) ISBN: 9788177544152Edition: 02Year: 2017Author: Gupta PKPublisher: Agrobios (India)
- 5. Green Technology: An Approach For Sustainable Environment ISBN: 9788177543438Edition: 01Year: 2021Author: Dr. Purohit SSPublisher: Agrobios (India)
- 6. Laboratory Manual Of Chemical And Bacterial Analysis Of Water And SewageISBN: 9788177540802Edition: 01Year: 2011Author: Theroux FR, Eldridge EF, Mallmann WLPublisher: Agrobios (India)
- 7. Methods In Environmental Analysis: Water Soil And Air (2nd Ed.) ISBN: 9788177543087Edition: 02Year: 2021Author: Gupta PKPublisher: Agrobios(India)
- 8. Water Treatment And Purification Technology ISBN: 9788177540024Edition: 01Year: 2009Author: Ryan WJPublisher: Agrobios (India

http://vidyamitra.inflibnet.ac.in/index.php/home/subjects?domain=Life+Science&subdomain=Botany

http://heecontent.upsdc.gov.in/Home.aspx

(http://epathshala.nic.in/, http://epathshala.gov.in/)

### This course can be opted as an elective by the students of following subjects:

Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.Sc. Food Science, B.A. (Curators), B.A. Geology.

**Suggested Continuous Evaluation Methods:** Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Course pre-requisites:				
Qualification: To study this course, a s from Sector Skill Councils / Diploma he Math/Statistics/Chemistry/ Computer S Facilities: Smart and Interactive Clas Other Requisites: Video collection, Be Lab requisites: Biotech instruments,	older fron cience) ss ooks, CD	n ITI in (Biolog s, Access to Or	y/ Agricu -line res	lture/ Forestry/ Biotech/
Suggested equivalent online courses:	environin	entai iab ilistr	uments.	
https://www.cytology-iac.org/education	al-resour	es/virtual-slide	-library	
https://www.asct.com/ASCTWeb/Content/Cyto	preparation	Online Course.a	<u>spx</u>	
https://www.mooc-list.com/tags/genetics https://www.coursera.org/learn/genetics-evoluti	ion_			
https://www.my-mooc.com/en/mooc/introduction	on-to-genet	cs-and-evolution/		
Further Suggestions: Access to Statistic required	es, Chemis	try, Math and I	siotecnno	logy resources will be
Programme/Class: Bachelor of Science		Year: III		Paper-VIII Project- II/
	Subjec	t: BOTANY	 	
Course Code: - B040604R	Cour	se Title: <b>Project i</b>	n Botany fo	or Graduation
Course outcomes: After completing this course a student wi	ill hove			
<ul> <li>Project work will supplement field experim transactions.</li> </ul>		ng and deviations	from classr	oom andlaboratory
<ul> <li>project work will enhance the capability to decision-making processes</li> </ul>			ınderstandi	ng for selecting, solvingand
<ul> <li>It will promote creativity and the spirit of e</li> <li>They will learn to consult Scientists, librari Botanical &amp; field trips, print and electronic</li> </ul>	es, laborato media, inte	ries and herbarium rnet etc. along wit		
<ul> <li>analysis &amp; representation in form of dissert</li> <li>It will enhance their abilities, enthusiasm, a</li> </ul>				
Credits: 03		Core: Com	pulsory	
Max. Marks: 25+75		Min. Passir	g Marks: .	•••••
Total No. of Lectures-Tutorials-Practical	(in hours p	er week): <b>0-0-3</b> .		
SUGGEST	IVE LIST (	OF PROJECTS		

Prepare beds for growing nursery for herbs, shrubs and trees.

Develop Green house facility in college and grow plants

Develop hydroponics facility in college and grow plants.

Develop botanical garden in the college with labelling

Vertical gardens, roof gardens.

Culture & art of making bonsai.

Computer Aided Designing (CAD) for outdoor and indoor scaping Exposure to CAD (Computer

Aided Designing)

Phytochemical Analysis of Medicinal plants

Bio composting and Vermicomposting.

Performing Aromatherapy by essential Oils

Refer: libraries, journals, Memoirs, encyclopaedias, herbaria, Museums, etc.

This course can be opted as an elective by the students of following subjects:

This course can be opted as an elective by the students of following subjects: Open to all

**Suggested Continuous Evaluation Methods:** 

Internal Assessment	Marks
Class Interaction	5
Seminar	10
Thesis/dissertation	10
	25

### Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from

Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/

Microbiology/Gardening /biomedical Science.

Facilities: Smart and Interactive Class

Other Requisites: All listed under all papers of the course.

### Suggested equivalent online courses:

https://ndl.iitkgp.ac.in/

http://heecontent.upsdc.gov.in/Home.aspx

(http://epathshala.nic.in/, http://epathshala.gov.in/)

nptel.iitm.ac.in

https://asiafoundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiwA-hX5J-

QhBITSyPnvj3r8yeio-L9f5uTy1a6oEoALCLa9Ebu0pyz858yQZxoC5wkQAvD\_BwE

http://www.dli.ernet.in/, http://www.ulib.org/

http://www.tkdl.res.in/, http://www.vigyanprasar.gov.in/digilib

Directory of Open Access Repositories (DOAR)http://www.opendoar.org

Registry of Open Access Repositories (ROAR)http://roar.eprints.org/

http://www.iscnagpur.ac.in/knowledge learning files/5.7 General Open Access e-Resources.pdf