# 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)



## PROPOSED STRUCTURE OF SYLLABUS BOTANY

(FACULTY OF SCIENCE)

	Semester-wise Titles of the Papers in B.Sc. (Botany)					
Year	Sem.	Course Code	Paper Title	Theory/ Practical	Credits	
		Certifi	icate Course In Microbial Technology & Applied Botany			
	I	B040101T	Microbiology & Plant Pathology	Theory	4	
FIRST YEAR		B040102P	Techniques in Microbiology &Plant Pathology	Practical	2	
IEAK	II	B040201T	Archegoniates &Plant Architecture	Theory	4	
		B040202P	Land Plants Architecture	Practical	2	
	•	Diplom	na in Plant Identification, Utilization & Ethnomedicine	•	•	
	III	B040301T	Flowering Plants Identification & Aesthetic	Theory	4	
GEGOND			Characteristics			
SECOND YEAR		B040302P	Plant Identification technology	Practical	2	
1 L/ IIC	IV	B040401T	Economic Botany, Ethnomedicine & Phytochemistry	Theory	4	
		B040402P	Commercial Botany & Phytochemical Analysis	Practical	2	
			Bachelor of Science			
	V	B040501T	Plant Physiology, Metabolism & Biochemistry	Theory	4	
		B040502T	Molecular Biology & Bioinformatics	Theory	4	
THIRD		B040503P	Experiments in physiology, Biochemistry & molecular	Practical	2	
YEAR			biology			
		B040504R	*Project-I	Practical	3	
	VI	B040601T	Cytogenetics, Plant Breeding & Nanotechnology	Theory	4	
		B040602T	Ecology & Environment	Theory	4	
		B040603P	Cytogenetics, Conservation & Environment	Practical	2	
			management			
		B040604R	*Project-II	Practical	3	

	SYLLABUS DEVELOPED BY						
S. N	Name & email	Designation	Department	College/ University			
1	Dr Seema Bhadauria	Head	Department of	No.			
	bhadauriaseema1@rediffmail.com	&	Botany				
		Associate	&				
		Professor	Biotechnology	69 TU. 1860			
				R B S College, Agra			
				(Dr. B.R.A. University, Agra)			
2	Dr Shweta Shekhar	Assistant	Department of	A SEC TRANSPORT			
	shekhar.shweta@gmail.com	Professor	Botany	The state of the s			
				DDU Gorakhpur University,			
				Gorakhpur			
3	Dr Himshikha Yadav	Assistant	Department of				
	himshikha021@gmail.com	Professor	Botany				
				VRALGM Degree College,			
				Bareilly (MJP Rohilkhand Univ.,			
				Bareilly)			

#### **SUBJECT: BOTANY**

#### **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) offer essential knowledge and technical skills to study plants in a holistic manner. Students would be trained in all areas of plant biology using 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 program 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.

#### **Programme outcomes (POs):**

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.

knowle	edge gained in the field of plant science.			
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 solution, improve practical skills, enhance communication skill,			
	social interaction, increase awareness in judicious use of plant resources by recognizing the			
	ethical value systemsystem.			
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 multiexit 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 rigour 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 three years graduation course are aligned with program 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 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 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 laboratory such as observation and evaluation by the use of modern tools and technology.

and technol	logy.
PSO 1	Understanding the nature and basic concepts of all the plant groups, their metabolism, components at the molecular level, biochemistry, taxonomy and ecology. The course will make them aware of natural resources and environment and the importance of conserving it. Hands on training in various fields will develop practical skills, handling equipments 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.

							f B.Sc. in Botany S & PROJECTS)				
			(00)		Subject: <b>B</b> o						Total Credits /hrs/
Course/ Entry –Exit levels	Year	Sem.	Paper 1	Credi t/ hrs	Paper 2	Credit/ hrs	Paper 3	Credit s/hrs	Research Project	Credit	
rtificate Course In Microbial Technology & Applied Botany	I	I	Microbiology & Plant Pathology	4/60	Techniques in Microbiology & Plant Pathology	2/60			Nil	Nil	6/120
Certificate Course In Microbial Technology & Applied Botany	1	II	Archegoniates & Plant Architecture	4/60	Land Plants Architecture	2/60			Nil	Nil	6/120
n Plant ttion, & icine	п	III	Flowering Plants Identification & Aesthetic Characteristics	4/60	Plant Identification technology	2/60			Nil	Nil	6/120
Diploma in Plant Identification, Utilization & Ethnomedicine		IV	Economic Botany, Ethnomedicine & Phytochemistry		Commercial Botany & Phytochemical Analysis	2/60	-		Nil	Nil	6/120
f Science	Ш	V	Plant Physiology, Metabolism & Biochemistry	4/60	Molecular Biology & Bioinformatics	4/60	Experiments in physiology, Biochemistry & molecular biology	2/60	*Proje ct-I	3/45	13/205
Bachelor of Science		VI	Cytogenetics, Plant Breeding & nanotechnology	4/60	Ecology & Environment	4/60	Cytogenetics, Conservation & Environment management	2/60	*Proje ct- II	3/45	13/205
Comments	Acad ICT I	emic based	lits/Hrs / lectures: (Bank and 15% of as per choice of the Vernice of the List of Projects)	the t	opics of each pa stitution)	per ca	n be taught by on				50/890

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

one co curricular course is compaisory	The Co culticular Course is comparisory				
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/Industrial training)	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 BOTANY OR B.Sc.-I

#### CERTIFICATE COURSE IN MICROBIAL TECHNOLOGY & CLASSICAL BOTANY / B.Sc.-I Year: I Semester: Programme: Certificate Course In Microbial Technology & Classical Botany I/Paper-I Subject: Botany Course Title: Microbiology & Plant Pathology Course Code: B040101T **Course outcomes:** After the completion of the course the students will be able to: Develop understanding about the classification and diversity of different microbes including viruses, Algae, Fungi & Lichens & their economic importance. Develop conceptual skill about identifying microbes, pathogens, biofertilizers & lichens. Gain knowledge about developing commercial enterprise of microbial products. Learn host –pathogen relationship and disease management. Learn Presentation skills (oral & writing) in life sciences by usage of computer of computer &multimedia Gain Knowledge about uses of microbes in various fields. Understand the structure and reproduction of certain selected bacteria algae, fungi and lichens Gain Knowledge about the economic values of this lower group of plant community. 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 (60 hrs) A. Introduction to Indian ancient ,Vedic and heritage Botany and contribution of Indian Ι 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.** Microbial Techniques & instrumentation Microscopy - Light, phase contrast, electron, scanning and transmission electron microscopy, staining techniques for light microscopy, sample preparation for electron microscopy. Common 8 equipments of microbiology lab and principle of their working - autoclave, oven, laminar air flow, centrifuge. Colorimetry and spectrophotometry, immobilization methods, fermentation and fermenters. II Microbial world Cell structure of Eukaryotic and prokaryotic cells, Gram positive and Gram negative bacteria, Structure of a bacteria; Bacterial Chemotaxis and Quorum sensing, Bacterial Growth curve, 8 factors affecting growth of microbes; measurement of growth; Batch culture, fed batch culture and continuous culture; Synchronous growth of microbes; Sporulation and reproduction and recombination in bacteria; Viruses, general characteristics, viral culture, Structure of viruses, Bacteriophages, Structure of λ-phage; Lytic and Lysogenic cycles, viroids, Prions & myco& phytoplasma, Actinomycetes & plasmids and their economic uses. III Range of thallus organization in Algae, Pigments, Reserve food -Reproduction - Classification and life cycle of - Nostoc; Chlorella, Volvox, Oedogonium, Chara; Sargassum, Ectocarpus, 7 Polysiphonia. Economic importance of algae - Role of algae in soil fertility- biofertilizer - Nitrogen fixation-Symbiosis; Commercial products of algae -biofuel, Agar. IV General characteristics, nutrition, life cycle, Economic importance of Fungi, Classification upto class. Distinguishing characters of Myxomycotina -General characters. Zygomycotina -

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Rhizopus, Ascomycotina - Saccharomyces, Penicillium, Peziza, Basidiomycotina - Ustilago, Puccinia, Agaricus; Deuteromycotina - Fusarium, Alternaria, Heterothallism, Physiological

specialization, Heterokaryosis & Parasexuality

V	Mushroom Cultivation, Lichenology & Mycorrihza Mushroom cultivation.	7		
	General account of lichens, reproduction and significance; Mycorrhiza: ectomycorrhiza and	,		
	endomycorrhiza and their significance.			
VI	Plant Pathology	7		
	Disease concept, Symptoms, Etiology & causal complex, Primary and secondary inoculum,			
	Infection, Pathogenicity and pathogenesis, Koch's Postulates. Mechanism of infection (Brief idea			
	about Pre-penetration, Penetration and Post-penetration), Disease cycle (monocyclic, polycyclic			
	and polyetic). Defense mechanism with special reference to Phytoalexin, Resistance- Systemic acquired and Induced systemicfungicides- Bordeaux mixture, Lime sulphur, Tobacco decoction,			
	Neem cake & oil			
VII	Diseases and Control	8		
	Symptoms, Causal organism, Disease cycle and Control measures of – Early & Late blight of			
	Potato, Brown spot of rice, Black stem rust of wheat, Stem rot of Mustard, Red rot of			
	Sugarcane, Wilting of Arhar, mosaic diseases on tobacco and cucumber, yellow vein mosaic of			
	bhindi; citrus canker, little leaf of brinjal; damping off of seedlings, Disease management: -			
	Quarantine, Chemical, Biological, Integrated pest disease management			
3/111	Applied Microbiology			
VIII	Food fermentations and food produced by microbes, amino acids, Production of antibiotics,	8		
	enzymes, vitamins, alcoholic beverages, organic acid & genetic recombinant vaccines. Mass production of bacterial biofertilizers, blue green algae, Azolla and mycorrhiza. Plant growth	o		
	promoting rhizobacteria & biopesticides—Trichoderma sp. and Pseudomonas, Single cell			
	proteins, Organic framing inputs, Microbiology of water, Bioploymers, Bioindicators,			
	biosensors, Bioremediation, Production of biofuels, biodegradation of pollutants and			
	biodeterioration of materials& Cultural Property			

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

- 1. 1.वनस्पति विज्ञान (संपूर्ण ) शैवाल, कवक ,लाइकेन ,जीवाणु, विषाणु, ब्रायोफाइटा ,टेरिडोफाइटा , जिम्नोस्पर्म तथा पुरा- वनस्पति विज्ञान : लेखक - सिंह , पांडे व जैन प्रकाशन: रस्तोगी प्रकाशन ,मेरठ
- 2. सूक्ष्म जैविकी कवक एवं पादप रोग विज्ञान त्रिवेदी शर्मा एवं धनकर rbd publisher 2019
- 3. परिचयात्मक पादप रोग विज्ञान डॉ आशीष कुमार त्रिपाठी डॉ सनत कुमार त्रिपाठी 2018 एग्रोबॉयोस इंडिया पब्लिशर
- 4. पादप रोग विज्ञान : जिया लाल यादव 2012
- 5. डॉ आशीष कुमार त्रिपाठी डॉ सनत कुमार त्रिपाठी 2018. परिचयात्मक पादप रोग विज्ञान एग्रोबॉयोस इंडिया पब्लिशर
- 6. रीता वर्मा 2020. सुक्ष्म जैविकी, कवक एवं पादप रोग विज्ञान
- 7. प्रांजल आर्य 2020. पादप रोग: उत्पत्ति प्रसार एवं नियंत्रण
- 8. Microbiology Fundamental And Applications (hindi) (pb)
- 9. ISBN: 9788188826230Edition: 03Year: 2016Author: Dr. Purohit SS, Dr. Deo PPPublisher: Student Edition Language: Hindi
- 10. पादप रोग विज्ञान परिभाषा-कोश: Definitional Dictionary of Plant Pathology. Publisher Commission for Scientific and Technical Terminology.
- 11. Modern Microbiology (hindi) (hb) ISBN: 9788177543599Edition: 1Year: 2018Author: Dr. Purohit SS, Dr. Singh T Publisher: Agrobios (India)

12.

#### 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 Theophrastus A case study-who was the actual father of botany
- iii. https://www.scribd.com/presentation/81269920/Botany-of-Ancient-India
- iv. https://insa.nic.in/writereaddata/UpLoadedFiles/IJHS/Vol17 2 17 PKBhattacharyya.pdf
- v. http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri/wgbis\_info/botany\_history.pdf

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

#### 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 <u>B.Sc</u>. Biotech, <u>B.Sc</u>. 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//Research Orientation 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/ 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.berkelev.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-

P1%20Path%20111.pdf

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

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

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/

Course Code: B040102P

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

Year: I Semester: I/Paper-II Programme: Certificate Course In Microbial Technology & Classical **Botany** 

Subject: Botany

Course Title: Techniques in Microbiology & 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.
- 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

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

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

No. of Lectures Unit **Topic \* (Minimum Any three from each unit depending on facilities)** (60 hrs)

	77 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	
1.	INSTRUMENTS & TECHNIQUES	_
1.	Laboratory safety and good laboratory practices	7
	2. Principles and application of Laboratory instruments-microscope, incubator,	
	autoclave, centrifuge, LAF, filtration unit, shaker, pH meter.	
	3. Buffer preparation & titration	
	<ol> <li>Cleaning and Sterilization of glasswares</li> <li>Preparation of media- Nutrient Agar and Broth</li> <li>Inoculation and culturing of bacteria in Nutrient agar and nutrient broth</li> </ol>	
	4. Preparation of media- Nutrient Agar and Broth	
	6. Preparation of agar slant, stab, agar plate	
	7. Phenol Coefficient method to test the efficacy of disinfectants	
II	BACTERIAL IDENTIFICATION	
11	1. Isolation of bacteria.	
	2. Identification of bacteria.	8
	3. Staining techniques: Gram's, Negative, Endospore, Capsule and Cell Wall.	
	4. Cultural characteristics of bacteria on NA.	
	5. Pure culture techniques (Types of streaking).	
	6. Biochemical characterization :	
	IMViC, Carbohydrate fermentation test, Mannitol motility test, Gelatin liquefaction test,	
	Urease test, Nitrate reduction test, Catalase test, Oxidase test, Starch hydrolysis, Casein	
	hydrolysis.	
TTT	MYCOLOGICAL STUDY:	
III	1. Isolation of different fungi: Saprophytic, Coprophilous, Keratinophilic.	8
	2. Identification of fungi by lactophenol cotton blue method. <i>Rhizopus</i>	
	Saccharomyces, Penicillium, Peziza , Ustilago, Puccinia; Fusarium, Curvularia,	
	Alternaria.	
	3. Agaricus: Specimens of button stage and full grown mushroom; Sectioning of gills	
	of Agaricus.	
	4. Lichens: crustose, foliose and fruticose specimens.	
***	PHYCOLOGY:	
IV	1. Type study of algae and Cyanobacteria – Spirullina, Nostoc.	
	Chlorophyceae - Chlorella, Volvox, Oedogonium, Cladophora, and Chara;	7
	Xanthophyceae – Vaucheria; Bacillariophyceae – Pinnularia Phaeophyceae – Sargassum	
	Rhodophyceae - Polysiphonia	
**7	EXPERIMENTAL PLANT PATHOLOGY	
V	1. Preparation of fungal media (PDA) &Sterilization process.	8
	2. Isolation of pathogen from diseased leaf.	
	Identification: Pathological specimens of Brown spot of rice, Bacterial blight of rice, Loose	
	smut of wheat, Stem rot of mustard, Late blight of potato; Slides of uredial, telial, pycnial	
	& aecial stages of Puccinia ,Few viral and bacterial plant diseases.	
	PRACTICALS IN APPLIED MICROBIOLOGY-1	
VI	Isolation of nitrogen fixing bacteria from root nodules of legumes.	8
	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.	
	5. Isolation of Azospirillum sp. from the roots of grasses.	
	6. Isolation of phyllosphere microflora.	
	7. Isolation of P solubilizing microorganisms.	
****	PRACTICALS IN APPLIED MICROBIOLOGY-2	
VII	1. Wine production.	8
	2. Isolation of lactic acid bacteria from curd.	
	3. Isolation of lipolytic organisms from butter or cheese.	
	4. Immobilized bacterial cells for production of hydrolytic enzymes.	
	5. Enzyme production and assay – cellulase, protease and amylase.	
	6. Immobilization of yeast.	
	7. Isolation of cellulolytic and anaerobic sulphate reducing bacteria.	
	8. Isolation and characterization of acidophilic, alkalophilic and halophilic bacteria.	
	Cultivation of Spirulina, & Chlorella in lab for biofuel	
VIII	2. Visit to NBAIM,Mau,Varanasi(Kashi)/IMT,Chandigarh for viewing Culture	6
	Repository	v
	3. Visit to biofertilizers and biopesticides unit to understand about the Unit operation	
L	2	

	procedures	
4.	Mushroom cultivation for Protein	
5	Alcohol production from Sugarcane Juice	

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

- प्रयोगात्मक वनस्पति विज्ञान भाग 1 लेखक अशोक बेंद्रे तथा अशोक कुमार प्रकाशन रस्तोगी प्रकाशन मेरठ
- 2. प्रायोगिक वनस्पति विज्ञान-I Dhankar Sharma Trivedi ISBN Code: 978-81-8142-697-0 65, RBD Publishing House Shivaji Nagar Civil Lines, Jaipur 302006 (Rajasthan)
- 3. प्रायोगिक वनस्पति विज्ञान बी.एस-सी-1 एस बी अग्रवाल प्रकाशक : शिवलाल अग्रवाल एण्ड कम्पनी प्रकाशित वर्ष : 2018
- 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)
- 5. 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 Text book 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. <a href="https://www.k-state.edu/fungi/Greeting/Publications-files/2006%20Handbook.pdf">https://www.k-state.edu/fungi/Greeting/Publications-files/2006%20Handbook.pdf</a>
- 11. Sen, Surjit, Acharya, Krishnendu, Rai, Manjula 2019 IBSN 978-93-88347-23-5 Biofertilizers and Biopesticides . Technoworld, kolkatta
- 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 dessimination etc.	8

#### **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/ Microbiology/biomedical Science.

**Facilities: Smart and Interactive Class** 

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts Lab Requisites: Microscopes, Stains, Dissection box, Haemocytometer, Specimens, Permanent slides, Autoclave,

incubator, Oven, laminar flow cabinet, balances, Fermenter, Anaerobic jar and Spectrophotometer.

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

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

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

https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html

https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf

http://allaboutalgae.com/benefits/

https://repository.cimmyt.org/xmlui/bitstream/handle/10883/3219/64331.pdf

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

http://www.agrifs.ir/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%201%20%7BAshok%20Bendre%ides/A%20text%20botany%200%7BAshok%20Bendre%ides/A%20text%20botany%200%7BAshok%20Bendre%ides/A%20text%20botany%200%7BAshok%20Bendre%ides/A%20text%20botany%200%7BAshok%20Bendre%ides/A%20text%20botany%200%7BAshok%20Bendre%ides/A%20text%20botany%200%7BAshok%20Bendre%ides/A%20text%20botany

D%20%5B8171339239%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 Course In Microbial Technology & Classical Botany	year: I	Semester: II Paper-I
Subject: <b>Botany</b>		
Course Code: B040201T	Course Title: Archegoniates and Plant Architecture	

#### **Course outcomes:**

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

- 1. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms
  - 2. Understanding of plant evolution and their transition to land habitat.
- 3. Understand morphology, anatomy, reproduction and developmental changes therein through typological study and create a knowledge base in understanding the basis of plant diversity, economic values & taxonomy of plants

4. Understand the details of external and internal structures of flowering plants.

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	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	7
	reproduction of Riccia, Marchantia, Anthoceros and Sphagnum. (Developmental details not to	
	be included). economic importance of bryophytes.	
II	Pteridophytes	
	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, Ginkgoales,	8
	Coniferales and Gnetales, their examples, structure and reproduction; economic importance	
	Palaeobotany	8
IV	General account of Cycadofilicales, Bennettitales and Cordaitales; Geological time scale;	
	Brief account of process of fossilization & types of fossils and study techniques; Contribution	
	of Birbal Sahni	

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, Boerhaavia, Dracaena,Nyctanthus</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, Methods of pollination, Germination of pollen grain, structure of male gametophyte, Fertilization, structure of dicot and monocot embryo, Endosperm, Double fertilization, Apomixis and polyembryony.	8
VIII	<b>Palynology:</b> Pollen structure, pollen morphology, pollen allergy, Applied Palynology: Basic concepts, Palaeopalynology, Aeropalynology, Forensic palynology, Role in taxonomic evidences.	7

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

- 1. वनस्पति विज्ञान (संपूर्ण ) शैवाल, कवक ,लाइकेन ,जीवाणु, विषाणु, ब्रायोफाइटा ,टेरिडोफाइटा , जिम्नोस्पर्म तथा पुरा- वनस्पति विज्ञान : लेखक - सिंह , पांडे व जैन प्रकाशन: रस्तोगी प्रकाशन ,मेरठ
- 2. आवृत्तबीजी वनस्पति विज्ञान (टैक्स!नॉमी ,एनाटॉमी ,एंब्रियोलॉजी तथा इकोनामिक बॉटनी) लेखक -सिंह, पांडे तथा जैन प्रकाशन :रस्तोगी प्रकाशन, मेरठ
- 3. नवीन परिचयात्मक वनस्पति विज्ञान डॉ एस के गुप्ता 2017 केदारनाथ रामनाथ पब्लिशर्स
- 4. ए.के. शर्मा & राजेश्वरी शर्मा 2018. वनस्पति विज्ञान बीएससी प्रथम भाग एसआर साइंटिफिक पब्लिशर्स
  - 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//Research Orientation assignment)	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/

Programme/Class: : Certificate Course In Microbial	Year: I	Semester: II
Technology & Classical Botany		Paper-II (Practical)
Subject: Botany		
Course Code: B040202P	Course Title: Land Plants Architecture	

#### Course outcomes:

- 1. The students will be made aware of the group of plants that have given rise to land habit and the flowering plants. Through field study they will be able to see these plants grow in nature and become familiar with the biodiversity.
- 2. Students would learn to create their small digital reports where they can capture the zoomed in and zoomed out pictures as well as videos in case they are able to find some rare structure or phenomenon related to these plants.
- 3. Develop an understanding by observation and table study of representative members of phylogenetically important groups to learn the process of evolution in a broad sense.
- 4. Understand morphology, anatomy, reproduction and developmental changes therein through typological study and create a knowledge base in understanding plant diversity, economic values & taxonomy of lower group of plants
- 5. Understand the composition, modifications, internal structure & architecture of flowering plants for becoming a Botanist.

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
I	Bryophytes:	
	Marchantia- morphology of thallus, W.M. rhizoids and scales, V.S. thallus through	8
	Gemma cup, W.M. gemmae (all temporary slides), V.S. antheridiophore,	
	archegoniophore, L.S. sporophyte (all permanent slides). Sphagnum- morphology,	
	W.M. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides);	
	permanent slides showing antheridial and archegonial heads, L.S. capsule and	
	protonema.	
II	Pteridophytes:	
	Lycopodium: Habit, stem T. S., stobilus V. S., Selaginella: Habit, rhizophore T. S,	7
	stem T . S, axis with strobilus, V .S. of strobilus, Megasporophyll and	
	microsporophyll.	
	Equisetum - Habit, rhizome and stem T.S. and V.S. of strobilus.	
	Azolla – Habitat & its structure	

	·	
III	Gymnosperms	
	1. Cycas – seedling, coralloid root and coralloid root T. S., T. S. of leaflet and	8
	Rachis, micro and mega sporophyll, male cone V. S., micro sporophyll T. S., entire	
	and V. S. of ovulePinus - Branch of indefinite growth, spur shoot, T. S of old stem	
	and needle R . L .S and T. L. S. of stem, male and female cone, V .S. of male and	
	female cone	
	Ephedra & Thuja -: Habit, stem T. S (young and mature), leaf T. S, male and	
	female strobilus, V. S. of male and female cone, ovule V. S. and seed.	
IV	Palaeobotany & Palynology	
	1. Morphology of Rhynia and fossils gymnosperms & other groups	6
	2. Visit to Birbal Sahni Institute of Palaeobotany or virtual conference with their	
	scientists to learn fossilization	
	3. Mark and know about Indian geographical sites rich in plant fossils	
V	.Angiosperm Morphology	
	1. To study of diversity in leaf shape, size and other foliar features.	
	2. To study monopodial and sympodial branching.	8
	3. Morphology of Fruits	
	4. Inflorescence types- study from fresh/ preserved specimens	
	5. Flowers- study of different types from fresh/ preserved specimens	
	6. Fruits- study from different types from fresh/preserved specimens	
	7. Study of ovules (permanent slides/ specimens/photographs)- types (anatropous,	
	orthotropous, amphitropous and campylotropous)	
	8. Modifications in Roots, stems, leaves and inflorescences	
	Plant Anatomy:	
VI	Normal & Anomalous secondary thickening - Bignonia, Dracaena, Boerhavia	8
	diffusa,Nyctanthus	
	Study of primary and secondary growth in root and stem of monocots and dicots by	
	section cutting and permanent slides.	
	Study of internal structure of dicot and monocot leaves.	
	Study of structure of stomata.	
	Reproductive Botany	
VII	1. Structure of anther, microsporogenesis and pollen grains	
	2. Structure of ovule and embryo sac development (through slides).	8
	3. Study of embryo development in monocots and dicots.	
	4. Vegetative propagation by means of cutting, budding and grafting exercises.	
	5. Study of seed germination.	
	6. Study of pollen morphology of the following plants – <i>Hibiscus, Vinca, Balsam, Ixora</i> ,	
	Crotalaria, Bougainvillea by microscopic observation.	
	7. Calculation of pollen viability percentage using in vitro pollen germination techniques.	
	Commercial Uses and Production technology	7
VIII	1. Azolla production	
	2. Production technology of Resins	
	3. Production and propagation of Ornamental Pteris, Cycadales, Coniferales for	
ı	landscaping.	
	4. Lab method for qualitative testing/ extraction of Ephedrine ,Taxol and Thuja oil.	
Suggested	Doodings	

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

प्रयोगात्मक वनस्पति विज्ञान भाग 1,II लेखक अशोक बेंद्रे तथा अशोक कुमार प्रकाशन रस्तोगी प्रकाशन मेरठ प्रायोगिक वनस्पति विज्ञान भाग I, II, III त्रिवेदी शर्मा बोहरा और धनखड़

प्रयोगात्मक वनस्पति विज्ञान भाग 2 लेखक :अशोक बेंद्रे तथा अशोक कुमार प्रकाशन :रस्तोगी प्रकाशन, मेरठ

प्रायोगिक वनस्पति विज्ञान बी.एस-सी-। ,॥ एस बी अग्रवाल प्रकाशक : शिवलाल अग्रवाल एण्ड कम्पनी

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

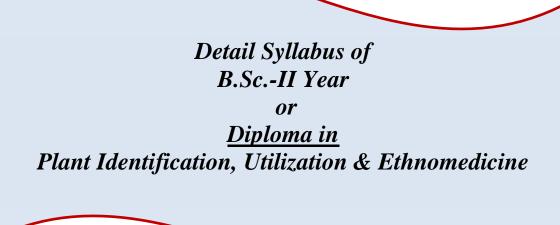
http://www.fao.org/3/a-v9236e.pdf

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



#### Diploma in Plant Identification, Utilization & Ethnomedicine

Diploma in Plant Identification, Utilization & Ethnomedicine			
Programme /Class: Diploma in Plant Identification, Utilization & Ethnomedicine Year: II Semester: III			
Subject: Botany			
Course Code: B040301T	Course Code: B040301T Course Title: Flowering Plants Identification & Aesthetic Characteristics		ic Characteristics

#### **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 taxonomy and 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	Торіс	No. of Lectures (60hrs)
I	Taxonomic Resources & Nomenclature Components of taxonomy (identification, nomenclature, classification); Taxonomic resources: Herbarium- functions& important herbaria, Botanical gardens, Flora, Keys- single access and multi-access. Botanical Nomenclature- Principles and rules of ICN (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) angiosperm phylogeny group (APG III) classification. Taxonomic evidences from palynology, cytology, phytochemistry & Molecular biology data (Protein and Nucleic acid homology).	8
III	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) Ranunculaceae, Malvaceae, Rutaceae, Fabaceae, Myrtaceae, Cucurbitaceae, Rubiaceae Asteraceae, Apocynaceae, Acanthaceae, Asclepiadiaceae, 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)-Amaranthaceae, Euphorbiaceae, Papaveraceae, Scrophulariaceae, Orchidaceae, Liliaceae Arecaceae, Poaceae	7
V	Modern trends in Plant taxonomy:  Phenetics and Cladistics: Brief idea on Phenetics, Numerical taxonomy- methods, Operational Taxonomic Units, Cladistics- construction of dendrogram and primary analysis; Monophyletic, polyphyletic and paraphyletic groups; Plesiomorphy and apomorphy.	8
VI	TOOLS & SOFTWARES IN PLANT IDENTIFICATION- GIS (Mapping of (i) Patterns(ii) Features (iii) Quantities 0P02.010H11YLIP - Free Phylogenetic Software, Digital Taxonomy, DEscription Language for TAxonomy – DELTA Internet directory for botany	7

	Computer Applications	7
VII	Introduction to Computers – classification, computer generation, low, medium and high	
	level languages, software and hardware, operating systems, compilers and interpreters,	
	personal, mini, main frame and super computers, characteristics and application,	
	computer memory and its types, data representation and storage.	
	Microsoft excel, data entry, graphs, aggregate functions, formulas and functions,	
	number systems, conversion devices, secondary storage media.	
	Aesthetic Characteristics of Plants:	8
VIII	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	

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

- 1. आवृत्तबीजी वनस्पति विज्ञान (टैक्स!नॉमी ,एनाटॉमी ,एंब्रियोलॉजी तथा इकोनामिक बॉटनी) लेखक -सिंह, पांडे तथा जैन प्रकाशन :रस्तोगी प्रकाशन. मेरठ
- 2. भारत की संपदा,विज्ञान संचार भवन डू. क.स. कृष्णन मार्ग पूसा कॅंपस
- 3. Propagation And Nursery Management (hindi) (hb) ISBN: 9788177546200Edition: 01Year: 2016Author: Pandey S.K., Soni N.Publisher: Agrobios (India)
- 4. Dr. Amar Singh. पादपवर्गिकी- Plant Taxonomy (An Old and Rare Book) from the category Ayurveda in our Books collection. Uttar Pradesh Hindi Sansthan, Lucknow
  - 1. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay.
  - 2. Brandis, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors; Dehra Dun.
  - 3. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://delta-intkey.com
  - 4. https://www.naace.co.uk/school-improvement/ict-mark/
  - 5. https://www.socitm.gov.uk, (2002) Learning in the 21st century Executive briefing A Socitm Insight publication, July 2002 Socitm.
  - 6. K. B. Anjaria, (2015) "Electronic Herbarium and Digital Database Preparation of Common Trees of Anand District, Gujarat" MRP submitted to UGC, WRO, Pune 2015 (unpublished)
  - 7. 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
  - 8. 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.
  - 9. Stace, C. A. 1989. Plant Taxonomy and Biostatistics (2nd Ed.), Edward Arnold, London.
  - 10. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
  - 11. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
  - 12. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
  - 13. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
  - 14. Austin, R. 2002. Elements of planting design. New York: John Wiley & Sons.
  - 15. Bertauski, T. 2005. Designing the landscape: An introductory guide for the landscape designer. Upper Saddle River, NJ: Pearson Prentice Hall.
  - 16. Thomas, H., and S. Wooster. 2008. The complete planting design course: Plans and styles for every garden. London: Octopus Publishing Group.
  - 17. Scarfone, S. 2007. Professional planting design: An architectural and horticultural approach for creating mixed bed plantings. New York: John Wiley & Sons.
  - 18. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

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//Research Orientation 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

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/

Programme/Class: : Diploma in Plant	Year: II	Semester: III
Identification, Utilization & Ethnomedicine		Paper-II (Practical)
	Subject: <b>Botany</b>	
Course Code: B040302P	Course Title: Plant Identific	eation technology
Course outcomes		

#### **Course outcomes:**

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

- 1. To learn how plant specimens are collected, documented, and curated for a permanent record.
- 2. To observe, record, and employ plant morphological variation and the accompanying descriptive terminology.
- 3. To gain experience with the various tools and means available to identify plants.
- 4. To develop observational skills and field experience.
- 5. To identify a taxonomically diverse array of native plants.
- 6. To recognize common and major plant families.
- 7. To Understand aesthetic characters of flowering plants by making-landscapes,gardens,bonsai,miniatures

8. Comprehend the concepts of plant taxonomy and classification of Angiosperms.

Credits: 2	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:
Total No. of Lectures Tutorials Practical (in hours per week): 0.0.2	

	Total No. of Lectures-Tutorials-Practical (in nours per week): 0-0-2		
Unit	Topic*	No. of	
	*(Perform Any three experiments from each unit as per facility)	Lectures	

		(60Hrs)
I	Herbarium: Plant collecting, Preservation and Documentation: Stepwise Practicing Herbarium techniques: a. FIELD EQUIPMENTS, Global Positioning System (GPS) instrument & Collection of any wild 25 plant specimens b.Learn to handle Herbarium making tools c. Pressing and Drying of collected plant specimens d. Special treatments for all varied groups of plants e. Mount on standard herbarium sheets f. Label then using Standard method g. Organize them and give Index Register Number	7
П	Taxonomic Identification using plant structure  a. Classify 25 plants on the basis of Taxonomic description (Plant Morphology, Anatomy, Reproductive parts, Habit, adaptation anomalies) according to Benthum Hooker system of classification in the following families: Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Scrophulariaceae, Acanthaceae, Labiatae (Lamiaceae), Rubiaceae.	8
Ш	<ul> <li>Identification during excursions</li> <li>a.Conducting Spot identification (Binomial, Family) of common wild plants from families included in the theoretical syllabus (list to be provided) and making FIELD NOTE BOOK and filling Sample of a page of field-book, used in Botanical Survey of India.</li> <li>b. Describe/compare flowers in semi-technical language giving V.S. of flowers, T.S. of ovaries, floral diagrams and Floral Formulae. Identify and assign them to their respective families giving reasons.</li> </ul>	8
IV	COLLECTION, PRESERVATION AND STORAGE OF ALGAE, FUNGI BRYOPHYTES, PTERIDOPHYTES (Two each)	7
V	Botanical Nomenclature & reporting Method:  a. Give nomenclature to collected plants as per ICN rules and prepare labels as per BSI  b. Author Citation, Effective Publication and Principle of Priority: To show a specimen paper on Basic structure of a taxonomic Research published on a new species in taxonomic journal	7
VI	COMPUTERS	
	<ol> <li>Learning to use EXCEL Microsoft PowerPoint and Word., WORKING WITH FOLDER AND WINDOWS UTILITY., CREATE AND MANAGE FILES AND FOLDER TREE,</li> <li>Practice browsing of different sites using search engine. 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>	7
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	1. Create a Bonsai of any plant 2. Develop a miniature garden 3. Draw Layouts of various types of gardens	8

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

प्रयोगात्मक वनस्पति विज्ञान भाग 2 लेखक :अशोक बेंद्रे तथा अशोक कुमार प्रकाशन :रस्तोगी प्रकाशन, मेरठ प्रयोगात्मक वनस्पति विज्ञान भाग 3 लेखक :अशोक बेंद्रे तथा अशोक कुमार प्रकाशन :रस्तोगी प्रकाशन ,मेरठ प्रायोगिक वनस्पति विज्ञान बी.एस-सी-1,II,IIIएस बी अग्रवालएस बी अग्रवाल प्रकाशक : शिवलाल अग्रवाल एण्ड कम्पनी प्रायोगिक वनस्पति विज्ञान II Author Name: - Dhankar - Sharma - Trivedi RBD Publication House

1. Day, S.C. (2003)A Art of Miniature Plant Culture. - Agrobias. 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) Agrobias, 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 every one-. Hind pocket book private limited, NewDehli.
- 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; Dehra Dun.
- 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 Associales, 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 Printers and Publishers, New Delhi.
- 23. Victor, J.E., M. Koekemoer, L. Fish, S.J. Smithies, M. Mossmer. 2004. Herbarium essentials:the Southern 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 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
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. <a href="https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp18.pdf">https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp18.pdf</a>
- 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	Semester: IV Paper-I
Subject: Botany		
Course Code: B040401T	Course Title: Economic Botany, Ethnomedicine and Phytochemistry	

#### **Course outcomes:**

I

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

legumes, Spices & beverages.

- 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): <b>4-0-0</b>
Unit	Торіс	No. of Lectures (60hrs)
-	Origin and domestication of cultivated plants	(2.1)

Centers of diversity of plants, origin of crop plants. Domestication and introduction of crop plants. Concepts of sustainable development; cultivation, production and uses of Cereals,

II	Botany of oils, Fibers, timber yielding plants & dyes Study of the plants with Botanical names, Family, part used, and economic uses yielding Edible & essential oils; Sugar, Starch; Fibers; Paper, Fumitories & Masticatories, Rubber, Dyes,	7
	Timber, biofuel crops	
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), Role of AYUSH, NMPB, CIMAP and CARI. Tribal knowledge towards disease diagnosis, treatment, medicinal plants, plant conservation and cultivation.	8
VI	Medicinal aspects Study of common plants used by tribes( Aegle marmelos, Ficus religiosa, Cynadon dactylon, Eclipta alba, Oxalis, Ocimum sanctum and Trichopus zeylanicus) Ethnobotanical aspect of conservation and management of plant resources, Preservation of primeval forests in the form of sacred groves of individual species and Botanical uses depicted in our epics.  Plants in primary health care: common medicinal plants: Tinospora, Acorus, Ocimum, Turmeric and AloeIndian Pharmacopeia, Quality Evaluation of crude drugs & adulteration	8
VII	Pharmacognosy 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 metal, Eclipta alba, Emblica officinalis, Ocimum sanctum, Phyllanthus amarus, Ricinus communis, Vinca rosea and Zingiber officinale.	8
VIII	Herbal Preparations & Phytochemistry:  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.	7

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

- 1. आवृत्तबीजी वनस्पति विज्ञान (टैक्स!नॉमी ,एनाटॉमी ,एंब्रियोलॉजी तथा इकोनामिक बॉटनी) लेखक -सिंह, पांडे तथा जैन प्रकाशन :रस्तोगी प्रकाशन. मेरठ
- 2. भारत की संपदा,विज्ञान संचार भवन ड्र. क.स. कृष्णन मार्ग पूसा कॅपस
- 3. पारिस्थितिकी एवं आर्थिक वनस्पति विज्ञान 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//Research Orientation 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 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

 $\underline{http://nsdl.niscair.res.in/bitstream/123456789/127/1/Fibre\%\,20crops\%\,2C\%\,20bamboo\%\,2C\%\,20timber\%\,20-\%\,20Final.pdf}$ 

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	Itilization & Ethnomedici	ne Year: II	Semester: IV Paper-II		
Subject: Botany					
Course Code: B040402P Course Title: Commercial Botany & Phytochemical Analyst			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 drug company.					
Credits: 2 Core Compulsory					
Max. Marks: 25+75			Passing Marks:		

Total No.	of Lect	urec_Tute	rialc_Dr	actical	(in h	oure ner	week).	$0_{-}0_{-}2$
TOTALINO.	or Lect	ures-ruic	mais-Pr	actical	(m n)	iours ber	week):	U-U-Z

Unit	Topic (Perform minimum any three experiments from each unit)	No. of Lectures (60hrs)
I	Economic Botany & Microtechniques: Cereals: Wheat (habit sketch, L.S./T.S. of grain, starch grains, micro-chemical tests); rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests)	8
	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	
П	Commercial Cultivation 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	8
III	Cultivating Medicinal and aromatic plants & Essential oil extraction a. Lemon grass/ Neem/ Zinger /Rose/Mint	7

173	Documentation from Traditional Knowledge Digital Library,			
1 1	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.			
	Visit NISCAIR,New Delhi			
V	Ethnobotany			
	Study of common plants used by tribes. Aegle marmelos, Ficus religiosa, Cynadon			
	dactylon.,	7		
	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 ethno botanical importance in your area.			
	Visit to an Ayurveda college or Ayurvedic Research Institute / 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		8		
	Organoleptic studies of plants mentioned in the theory:			
	1. Morphological studies of vegetative and floral parts.			
I	2. Microscopic preparations of root, stem and leaf.			
	<ul><li>2. Microscopic preparations of root, stem and leaf.</li><li>3. Stomatal number and stomatal index.</li></ul>			
	3. Stomatal number and stomatal index.			
	<ul><li>3. Stomatal number and stomatal index.</li><li>4. Vein islet number.</li></ul>			
	<ul><li>3. Stomatal number and stomatal index.</li><li>4. Vein islet number.</li><li>5. Palisade ratio.</li></ul>			
	<ul><li>3. Stomatal number and stomatal index.</li><li>4. Vein islet number.</li><li>5. Palisade ratio.</li><li>6. Fibres and vessels (maceration).</li></ul>			
	<ul> <li>3. Stomatal number and stomatal index.</li> <li>4. Vein islet number.</li> <li>5. Palisade ratio.</li> <li>6. Fibres and vessels (maceration).</li> <li>7. Starch test</li> </ul>	7		
VIII	<ul> <li>3. Stomatal number and stomatal index.</li> <li>4. Vein islet number.</li> <li>5. Palisade ratio.</li> <li>6. Fibres and vessels (maceration).</li> <li>7. Starch test</li> <li>8. Proteins and lipid test</li> </ul>	7		
VIII	<ul> <li>3. Stomatal number and stomatal index.</li> <li>4. Vein islet number.</li> <li>5. Palisade ratio.</li> <li>6. Fibres and vessels (maceration).</li> <li>7. Starch test</li> <li>8. Proteins and lipid test</li> <li>Phytochemistry:</li> </ul>	7		
VIII	<ul> <li>3. Stomatal number and stomatal index.</li> <li>4. Vein islet number.</li> <li>5. Palisade ratio.</li> <li>6. Fibres and vessels (maceration).</li> <li>7. Starch test</li> <li>8. Proteins and lipid test</li> <li>Phytochemistry:</li> <li>Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves.</li> </ul>	7		
VIII	<ol> <li>Stomatal number and stomatal index.</li> <li>Vein islet number.</li> <li>Palisade ratio.</li> <li>Fibres and vessels (maceration).</li> <li>Starch test</li> <li>Proteins and lipid test</li> <li>Phytochemistry:</li> <li>Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves.</li> <li>Dimensions of Calcium oxalate crystals in powdered crude drug.</li> <li>Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins &amp; resins.</li> </ol>	7		
VIII	<ul> <li>3. Stomatal number and stomatal index.</li> <li>4. Vein islet number.</li> <li>5. Palisade ratio.</li> <li>6. Fibres and vessels (maceration).</li> <li>7. Starch test</li> <li>8. Proteins and lipid test</li> <li>Phytochemistry:</li> <li>Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves.</li> <li>Dimensions of Calcium oxalate crystals in powdered crude drug.</li> <li>Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins</li> </ul>	7		

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. फार्माकोग्नॉसी Shiva Kant, Pankaj Kumar Brahmiya: Thakur Publication
- 3. PHARMACOGNOSY ...Hindi Edition (Paperback, Hindi, Dr. Akancha Rashi, KHUSHAL JASWANI), RM Publication
- 4. प्रयोगात्मक वनस्पति विज्ञान भाग 2 लेखक अशोक बेंद्रे तथा अशोक कुमार प्रकाशन रस्तोगी प्रकाशन मेरठ
- 1. Wallis, T. E. 1946. Text book 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. Naya 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. Jew 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 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.

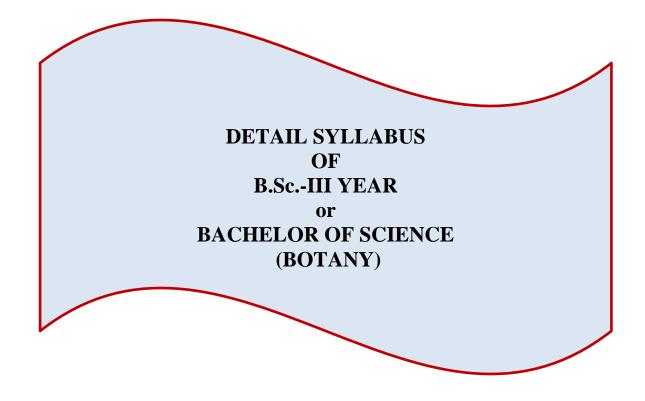
Suggested equivalent online courses:

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 Semester: V Paper-I				
Subject: BOTANY				
Course Code: B040501T	Cour	rse Title: <b>Plant Physiology,</b> I	Metabolism & 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

L	unitoriiduito				
	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. Criteria of essentiality of elements; Role of essential elements; Symptoms of mineral deficiency in major crops, Transport of ions across cell membrane, active and passive transport, 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, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Kerbs cycle, mitochondrial electron transport, oxidative phosphorylation, ATP-Synthetase, Chemiosmotic mechanism, P/O ratio, cyanide-resistant respiration, factors affecting respiration.	7
III	Nitrogen Metabolism Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT), reductive amination and transamination, amino acid synthesis.	8
IV	Lipid Metabolism & Photosynthesis Lipid Metabolism: Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, -oxidation.; Photosynthesis: Pigments, Action spectra and Enhancement effect, 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, Control and Coordination in plants, Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red-light responses on photomorphogenesis, Seed physiology & Dormancy, Vernalization & Senescence	8

VI	Biomolecules  Carbohydrates: Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols – mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage – starch, inulin).  Lipids: Storage lipids: Fatty acids structure and functions, Structural lipids: Phosphoglycerides; Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers	8	
VII	<b>Proteins:</b> Structure of amino acids: Pentide bonds: Levels of protein structure-primary.		
VIII	Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), enzyme inhibition and factors affecting enzyme activity, Allosteric enzymes & Abzymes.  Phytonutrients, Nutraceuticals, dietary supplements and antioxidants.	8	

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

- 1. पादप शरीर क्रिया विज्ञान तथा जैव रसायन लेखक :डॉ एच एस श्रीवास्तव प्रकाशन: रस्तोगी प्रकाशन .मेरठ
- 2. पादप शरीर क्रिया विज्ञान एवं जैव रसायन लेखक सिंह .पांडे तथा जैन प्रकाशन :रस्तोगी प्रकाशन .मेरठ
- 3. पादप कार्यिकी एवं जनन विज्ञान. Madan Kumar. 2020.
- 4. Plant Physiology and BiochemistryISBN #:81-301-0035-5Sunil D Purohit, K. Ahmed & Gotam K Kukda Edition: 2013Pages: 368 + VIII Text Book (Hindi)
- 5. पादप कार्यिकी एवं जैव रसायन 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: <b>III</b>	Semester: V Paper-II
	Subject: BOTANY	
Course Code: B040502T	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)
I	Genetic material Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase, bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): semiconservative. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi-conservative, semi discontinuous RNA priming, Ø (theta) mode of replication, replication of linear, dsDNA, replicating the 5 end of linear chromosome including replication enzymes.	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; and in Eukaryotes	7
I I I	Principles & Techniques of genetic engineering Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Antibody Engineering.	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  Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.	8
VI	Biological databases: Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem, )	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

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

- 1. Dr Pooja Rai. आण्विक जीव विज्ञान एवं जैव तकनीकी, Bhopal
- 2. Sharma Trivedi Molecular Biology And Biotechnology (आण्विक जीव विज्ञान एवं जैव प्रौधोगिकि) by RBD Publisher
- 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 <u>Dr Archana Pandeya</u> (Author), <u>Santosh Choubey</u> (Editor), <u>& 2 More</u> 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 P

#### 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	Semester: V 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)
_	Plant water relation, Mineral Nutrition and translocation in phloem	8
I	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.	
I	Nitrogen Metabolism, Photo Synthesis & Respiration	
I	1. A basic idea of chromatography: Principle, paper chromatography and column	
	chromatography; demonstration of column chromatography.	8
	<ul><li>2. Separation of plastidial pigments by solvent and paper chromatography.</li><li>3. Estimation of total chlorophyll content from different chronologically aged leaves</li></ul>	
	(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.)	
	<ul><li>6.Determination of the RQ of germinating seeds.</li><li>7. Effect of light intensity on oxygen evolution in photosynthesis using Wilmott' bubble</li></ul>	
III	Plant Development, Movements, Dormancy & Responses	
111	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. 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	
TX7	1. Weighing and Preparation of solutions -percentage, molar & normal	8
IV	solutions, dilution from stock solution etc.	
	2. Separation of amino acids by paper chromatography.	

	2. Detection of annuity cities to the cities and and in the contract of	
	3. Detection of organic acids: citric, tartaric, oxalic and malic from laboratory	
	samples., 4. Qualitative Analysis of carbohydrates,	
	<ul><li>4. Qualitative Analysis of carbohydrates ,</li><li>5. Estimation of reducing sugar by anthrone method,</li></ul>	
	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.	
	Genetic material	7
$\mathbf{V}$	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.	
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.	
X7X	7. Understanding the mechanism of RNAi by photographs	
VI	Genetic Engineering	-
Ι	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. Postriction digastion of plasmid DNA. Domonstration of PCP	
	7. Restriction digestion of plasmid DNA -Demonstration of PCR  Applications of Genetic engineering	7
	1. ELISA Test, 2 Viability tests of cells	/
VII	3. Study of methods of gene transfer through photographs: Agrobacterium-	
I	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.	
	r tavi 5avi tomato unougn photograpus.	

#### **Suggested Readings:**

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

- 1. प्रयोगात्मक वनस्पति विज्ञान भाग 3 लेखक अशोक बेंद्रे तथा अशोक कुमार प्रकाशन रस्तोगी प्रकाशन मेरठ
  - 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

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: III	Semester:V
		Paper-IV
Subject: BOTANY		
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 provision to 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
The sis/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/

 $\underline{https://asia foundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiwA-hX5J-https://asia foundation.org/what-we-do/books-for-asia foundation.or$ 

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) <a href="http://roar.eprints.org/">http://roar.eprints.org/</a>

http://www.iscnagpur.ac.in/knowledge\_learning\_files/5.7\_General\_Open\_Access\_e-Resources.pdf

Programme/Class: Bachelor of Science	Year: III	Semester: VI Paper-I
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 ultrastructure of cell.
- 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 molecular mechanism of mutation.
- 5. Interpret the concept of Lemarkism, Neo Lamarkism, Darwinism and also understand the concept of natural selection.

Credits: 4		Core Co	mpulsory
	Max. Marks: 25+75	Min. Pass	ing Marks:
	Total No. of Lectures-Tutorials-Practical (in hours	per week): <b>4-0-0</b>	
Unit	Торіс		No. of Lectures (60hrs)
I	Cell biology Structure and function of cell wall, plasma membrane, ribosomes golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisor Organization of nucleus: nuclear envelope, nucleoplasm and nucleochromosomal nomenclature- chromatids, centromere, telomic constriction. Organization of chromosomes- Nucleic acid and 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.	mes and cell inclusions - colus. here, satellite, secondary nd histones- types and hosomes- Karyotype and d closed mitosis – amitosis here, satellite, secondary nosomes- types and hosomes- Karyotype and d closed mitosis – amitosis here, satellite, secondary historical properties of the seco	8
II	Genetics Chromosome theory of inheritance, crossing over and linkage; Incocodominance; Interaction of Genes; Multiple alleles, Lethal alleles Polygenic inheritance; Extra-nuclear Inheritance, Linkage, crossing determination and Sex chromosomes; Patterns of Sex determination	s, Epistasis, Pleiotropy, g over, Concept of sex	7
Ш	Plant breeding Plant introduction. Agencies of plant introduction in India, Pro Acclimatization – Achievements, Selection - mass selection, pure selection. Genetic basis of selection methods, Hybridization: Pro inter generic, inter specific, inter varietal hybridization with e synthetic varieties, Male sterility, Heterosis and its exploitation in Molecular Breeding (use of DNA markers in plant breeding) Breeding for pest, pathogenic diseases and stress resistance.	rocedure of introduction - e line selection and clonal rocedure of hybridization, examples. Composite and a plant breeding, Mutation,	8
V	Biostatistics: Definition, statistical methods, basic principles, variables- measure limitations and uses of statistics. Biometry: Data, Sample, Populati Frequency distribution- definition only, Central tendency- Arithme Median; Measurement of dispersion-Coefficient of variation, Standerror of Mean; Test of significance: chi- square test for goodness of application in biostatistics - MS Excel and SPSS	ion, random sampling, etic Mean, Mode and dard Deviation, Standard	7
V	Plant tissue culture Principles, components and techniques of in vitro plant cultures, Culture, cell suspension cultures, Embryogenesis and organogenesis and culturing of protoplast- principle and application, regeneration fusion and somatic hybridization- selection of hybrid cells, Somaclary metabolisms and the literature for the lit	is , Protoplast- isolation of protoplasts, protoplast	8

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secondary metabolites production.

	Nanotechnology	
VI	Fundamentals of nanoscale self-assembly process involved in important functional	7
	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.	
	Artificial Intelligence in Plant Sciences	
VII	Big Data Analytics, Blockchain Technology, 3-D Printing, Machine learning,	8
	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.	
	Introduction to use of Digital technologies – AI, IoT & ICT in Botany	
VIII	Educational software- INFLIBNET, NICNET, BRNET, internet as a knowledge repository-	7
	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	

#### **Suggested Readings:**

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

- 1. कोशिका विज्ञान अनुवांशिकी ,विकास एवं पारिस्थितिकी लेखक :पीके गुप्ता प्रकाशन :रस्तोगी प्रकाशन मेरठ
- 2. कोशिका जैविकी , आनुवंशिकी, जैव प्रौधोगिकी Sharma and Trivedi by RBD Publisher
- 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 IN HINDI
- 11. कोशिका तथा अणुजैविकी शब्द-संग्रह Commission for Scientific and Technical Terminology (CSTT)
- 12. पादप आनुवंशिकी परिभाषा कोश Commission for Scientific and Technical 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, 5<sup>th</sup> 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.5th edition.

- 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. New York
- 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, New York.
- 32. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd
- 33. Twymann, R.M. (1998) Advanced molecular biology Viva books New Delhi.
- 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

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	Semester: VI Paper-II
Subject: <b>Botany</b>		
Course Code: B040602T Course Title: Ecology & Environment		

## **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: <b>25+75</b>	Min. Passing Marks:

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

T7 .4	No. of Lecture		
Unit	Торіс	(60 hrs)	
I	Natural resources & Sustainable utilization: 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, Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting.	7	
ш	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, Grass land, Crop land, aquatic Ecosystems Ecological Adaptations — Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites.  Soil Formation, Properties & Conservation	8	
	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. Mechanical—Basin Listing, Construction of dams, Water Shed Management, Soil reclamation	7	
V	Biodiversity and its conservation:  Definition -genetic, species, and ecosystem diversity.  Value of biodiversity: : social, ethical, aesthetic and option values hot spots 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	

	Phytogeography:		
v	Biogeographic regions of India & world, Agroecological & Floristic zones of India.	7	
	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.		
V	Environmental audit & Sustainability		
I	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, Sustainability indices; 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; Urbanization; Concept and characteristics of smart city; Urban resources and environmental problems; Carrying		
v	capacity analysis; Concept of ecological footprints.  Pollution ,Waste management & Circular Economy		
I	Environmental pollution, Environmental protection laws, Bioremediation, Activated	8	
11	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.		
V	Environmental ethics, Carbon Credits &Role of GIS	8	
II	Carbon credit: concept, exchange of carbon credits.		
I	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.		
Sugges	ted Readings:		

#### **Suggested Readings:**

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

- 1. Environmental Studies (Hindi)ISBN81-301-0004-5B. 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 House
- 3. Ecology And Environmental Biology (पारिस्थितिकी एवं पर्यावरण जैविकी) by RBD Publisher Author: Bhatia Jain Koh - Shrivastava - Singh – Verma
- 4.पर्यावरणीय वनस्पति एवं पादप व्याधिकी लेखक :डॉ पी डी शर्मा प्रकाशन: रस्तोगी प्रकाशन मेरठ
- 5. Paryavaran Evam Paristhithiki 5e (Hindi) Paperback 20 February 2020 Majid Husain
- 6. Environmental Biology and Phytogeography ISBN #: 978-81-301-0064-7B. L. Chaudhary, Gotam K Kukda & Jitendra Kumar Joshi
- 7. Ugc Unified: Environmental Sciences (hindi) (pb) ISBN: 9788177545814Edition: 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.
- 16. 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.
- 26. Tchobanoglaus, G. (1988). Wastewater Engineering: Treatment, Disposal, Reuse. Ta ta 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 dition). 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	Semester: VI
		Paper-III
Subject: <b>Botany</b>		
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 breeding on		
field, conserving and depolluting the environment.		
2. Can be employed in environment impact assessment companies & start his own venture		
Credits: 2 Core Compulsory		Core Compulsory

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

Unit	Lonic	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	
11	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	Ü
	• • • •	
	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:	
	1.Univariate analysis of statistical data: Statistical tables, mean, mode, median,	7
	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	
	1.Familiarization of instruments and special equipments used in the plant tissue	8
	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	
V	1. Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes,	8
	Epiphytes and Parasites	
	2. (a). Study of morphological adaptations of hydrophytes and	
	xerophytes (four each).	
	3. (b). 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.	
	4. Soil Profile study	
	5. Soil types of India-Map	
	Biodiversity and Phytogeography:	
VII	1. Study of community structure by quadrat method and determination	7
V 11	of (i) Minimal size of the quadrat, (ii) Frequency, density and	,
	abundance of components (to be done during excursion/field visit).	
	2. Marking of vegetation types of India, World & Uttar Pradesh on	
	maps 3. Phytogeographical areas of India	
	5. r nytogeographicai areas of filidia	

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 Singhyi & 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.
  3. प्रयोगात्मक वनस्पति विज्ञान भाग 3 लेखक अशोक बेंद्रे तथा अशोक कुमार प्रकाशन रस्तोगी प्रकाशन
- 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 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 Lab requisites: Biotech instruments, environmental lab instruments.

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

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	Semester: VI /Project- II/ Paper-IV
Subject: BOTANY		
Course Code: - B040604R	Course Title: <b>Project in</b>	Botany for Graduation

#### **Course outcomes:**

After completing this course a student will have:

- 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 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

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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