DEPARTMENT OF BOTANY



SHIBLI NATIONAL COLLEGE

[V.B.S. PURVANCHAL UNIVERSITY]

AZAMGARH - 275 001 (INDIA)

2: 05462-221172, 226840

Date: 02.06.2021

To,
The Registrar
V.B.S. Purvanchal University
Jaunpur - U.P.

Subject: Regarding National Education Policy 2020 Common Minimum Syllabors for all state Universities and Colleges for U.G. Classes in Botany (Science Faculty).

Heat on 01.06.21, I was contacted by Asstt Registras (Academic) on my mobile no reporting the matter cited in the subject. Subsequently I contacted all the members of B.O.S of Betany on the same day. The members being - In B M sectle (98 97960830). Dr. Raj Kumar Yadar (9415973652), Dr. Nessaj, Kumar Dubey (94 5355 7814) and Dr. Ravendra Pandey (93354786). After a long discussion with all the members we came on conclusion that Syllabus is explomark and in the interest of B.Sc. student, it does not need any alteration. Therefore, it is as such forwarded to be discussed and approved in Academic Council.

Jus. Misza Zeeshan Beg V. B.S. Pursuanchal Clinicality

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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)

SUBJECT: BOTANY

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

Syllabus Developed by:

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

		Seme	ster-wise Titles of the Papers in B.Sc. (Botany)		
Year	Sem.	Course Code	Paper Title	Theory/ Practical	Credit
		Certifi	icate Course In Microbial Technology & Applied Botany		
	.1	B040101T	Microbiology & Plant Pathology	Theory	4
FIRST		B040102P	Techniques in Microbiology &Plant Pathology	Practical	2
YEAR II B040201T Archegoniates & Plant Architecture B040202P Land Plants Architecture Diploma in Plant Identification, Utilization & Ethnomedi III B040301T Flowering Plants Identification & Aesthetic		Theory	4		
B040202P Land Plants Architecture		Practical	2		
		Diplom	a in Plant Identification, Utilization & Ethnomedicine		
III B0403017		B040301T	Flowering Plants Identification & Aesthetic Characteristics	Theory	4
SECOND		B040302P	Plant Identification technology	Practical	2
YEAR	IV	B040401T	Economic Botany, Ethnomedicine & Phytochemistry	Theory	4
		B040402P	Commercial Botany & Phytochemical Analysis	Practical	2
	•		Bachelor of Science		W
	V	B040501T	Plant Physiology, Metabolism & Biochemistry	Theory	4
		B040502T	Molecular Biology & Bioinformatics	Theory	4
THIRD		B040503P Experiments in pl	Experiments in physiology, Biochemistry & molecular biology	Practical	2
STATE OF THE PARTY		B040504R	*Project-I	Practical	3
	VI	B040601T	Cytogenetics, Plant Breeding & Nanotechnology	Theory	4
		B040602T	Ecology & Environment	Theory	4
		B040603P	Cytogenetics, Conservation & Environment management	Practical	2
		B040604R	*Project-II	Practical	3

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
- Computer aptitude.

COURSE INTRODUCTION

The new curriculum of B.Sc. in Science (Botany) offers essential knowledge and technical skills to study plants in a holistic manner. Students would be trained in all areas of plant biology using a unique combination of core, elective and vocational papers with significant inter-disciplinary components.

Students would be exposed to cutting-edge technologies that are currently used in the study of plant life forms, their evolution and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of plants and their relevance to the national economy.

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

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

Programme	outcomes	(POs)

Transformed curriculum shall develop educated outcome-oriented candidature, fostered with discoverylearning, 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.

111 1110 110	nd 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 solutions, improve practical skills, enhance communication skill, social interaction, increase awareness in judicious use of plant resources by recognizing the ethical value system.
PO 4	The training provided to the students will make them competent enough for doing jobs in Govt, and private sectors of academia, research and industry along with graduate preparation for national as well as international competitive examinations, especially UGC-CSIR NET, UPSC Civil Services Examination, IFS, NSC, FCI, BSI, FRI etc.
PO 5	Certificate and diploma courses are framed to generate self-entrepreneurship and self- employability, if multi exit option is opted.
PO 6	Lifelong learning be achieved by drawing attention to the vast world of knowledge of plants and their domestication.

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

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

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

Programme specific outcomes (PSOs):

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

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

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

- 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.
- The course is designed to become a commercial crop grower, florist, protected cultivator, green belt plant advisor to industries, pharmacologist & taxonomist.

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

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

- 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.
- This course is suitable to produce expertise in conservation biology like ex-situ conservation, response to habitat change, genotype characterization and reproductive biology.
- 3.Understanding of various analytical techniques of plant sciences, use of plants as industrial resources or as a human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.
- 4. Understanding of various life forms of plants, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology and use of bioinformatics tools and databases and the application of statistics to biological data.
- 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.
- Develop good skills in the laboratory such as observation and evaluation by the use of modern tools and technology.

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

PSO 1

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

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	Botanists are able to contribute to all these fields and therefore, are mainly employed with
PSO 2	educational institutions, government or public sectors or companies in industries, such as agriculture or forestry, oil, chemical, biotechnology, geological survey, environmenta 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 geneticist 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. I 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.

		Proposed Year wise Structure of B.Sc. in Botany (CORE / ELECTIVE COURSES & PROJECTS)									
	Subject: Botany										
Course/ Entry -Exit	Year	Sem.	Paper I	Credi	t/ hrs				Credit Research Credit		
Certificate Course In Microbial Technolog y & Applied Botany	F	,	Microbiology & Plant Pathology	4/60	Techniques in Microbiology & Plant Pathology	2/60	**		Nil	Nii	6/120
		п	Archegoniates & Plant Architecture	4/60	Land Plants Architecture	2/60	et.		Nil	NB	6/120
Diploma in Plant Identificatio n, Utilization & Ethnomed icine	n	m	Flowering Plants Identification & Aesthetic Characteristics	4/60	Plant Identification technology	2/60	- 60		Nil	Nil	6/120
		IV	Economic Botany, Ethnomedicine & Phytochemistry		Commercial Botany & Phytochemical Analysis	2/60			Nil	XII	6/120
Bachelor of Science		v	Plant Physiology, Metabolism & Blochemistry	4/60	Molecular Biology & Bioinformatics	4/60	Experiments in physiology, Biochemistry &	2/60	*Proje ct-I	3/45	13/205

	m						molecular biology				
		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	creat Virtu	e Aca	dits/Hrs. / lectures: idemic Bank and 1 CT based as per ch ive List of Projects	5% o	of the topics of e of the Institution	ach pi	aper can be taught				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

Internal	Assessment	& External	Accesement

Internal Assessment	Marks	External Assessment	Marks
Class Intersection	5	Viva Voce on Practicals	10
Quiz	5	Report of Botanical Excursion/ Lub 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

CERTIFICA	TE COURSE IN MICROBIAL TECHNO	LOGY & CLASS	ICAL BOTANY	/ B.ScI
Programme: Certificat	e Course in Microbial Technology & Class	ical Botany	Year: I	Semester: I/Paper-I
	Subject: Botan			
Course Code: B040101T	Course Title: Microbie	logy & Plant Patholo	EV .	
their economic Develop conce Gain knowledg Learn host –pa Learn Presenta Gain Knowledg Understand the	tanding about the classification and diversity of diffi importance, or an about identifying microbes, pathogens, bio is about developing commercial enterprise of microbi hogen relationship and disease management, ion skills (oral & writing) in life sciences by usage of e about uses of microbes in various fields, structure and reproduction of certain selected bacter to about the economic values of this lower group of p	fertilizers & lichens. al products. f computer & multimed a algae, fungi and lich dant community.	dia.	ngi & Lichetts &
Credits: 4		Core C	ompulsory	
Max. Marks: 25+75		Min. Pr	ssing Marks:	
Total No. of Lectures-T	storials-Practical (in hours per week): 4-0-0			
Unit	Topic			No. of

ĭ	A. Introduction to Indian ancient, Vedic and heritage Botany and contribution of Indian Botanists, in context with the holistic development of modern science and technology, has to be taught, practiced and assessed via class interaction/assignments / self-study mentioned under Continuous Internal Evaluation (CIE). B. Microbial Techniques & instrumentation Microacopy - Light, phase contrast, electron, acaraning and transmission electron microscopy, staining techniques for light microscopy, sample preparation for electron microscopy. Common equipment of microbiology lab and principle of their working - autoclave, oven, laminar air flow, centrifuge, Colorimetry and spectrophotometry, immobilization methods, fermentation and fermenters.	
п	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, factors affecting growth of microbes; measurement of growth; Batch culture, fed batch culture and continuous culture; Synchronous growth of microbes; Spornlation and reproduction and recombination in bacteria. Viruses, general characteristics, viral culture, Structure of viruses, Bacteriophages, Structure of T4 & λ-phage; Lytic and Lysogenic cycles, viroid, Prioris & mycoplasma & phytoplasma, Actinomycetes & plasmids and their economic uses.	
111	Phycology Range of thallus organization in Algae, Pigments, Reserve food –Reproduction - Classification and life cycle of – Nostoc, Chlorella, Volvex, Hydrodictyon, Oedogonium, Chara; Sargassum, Ectocurpus, Polysiphonia. Economic importance of algae – Role of algae in soil fertility- biofertilizer – Nitrogen fixation- Symbiosis; Commercial products of algae –biofuel, Agar.	7
IV	Mycology General characteristics, nutrition, life cycle, Economic importance of Fungi, Classification upto class. Distinguishing characters of Myxomycota: General characters of Mastigomycotias, Zygomycota: Rhizopus, Ascomycota: Sacchuromyces, Penicillium, Pezizu. Basidiomycotiaa: Ustilago, Puccinia, Aguricus: Deuteromycotina: Fusarium, Alternaria. Heterothallism, Physiological specialization, Heterokaryosis & Parasexuality.	7
v	Mushroom Cultivation, Lichenology & Mycorrhiza Mushroom cultivation. General account of lichens, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.	7
VI	Plant Pathology 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 systemic fungicides- Bordeaux mixture, Lime Sulphur, Tobacco decoction, Neem cake & oil	7
VII	Diseases and Control Symptoms, Causal organism, Disease cycle and Control measures of — Early & Late Blight of Potato, False Smut of Rice' Brown spot of rice, Black Stem Rust of Wheat, Alternaria spot' and 'White rust of Crucifers, Red Rot of Sugarcane, Wilting of Arhar, Mosaic diseases on tobacco and encumber, yellow vein mosaic of blandi; Citrus Canker, Little leaf of brinjal; Damping off of seedlings, Disease management: Quarantine, Chemical, Biological, Integrated pest disease management	8

VIII Food fermentations an

Food fermentations and food produced by microbes, amino acids, Production of antibiotics, enzymes, vitamins, alcoholic beverages, organic acid & genetic recombinant vaccines. Mass production of bacterial biofertilizers, blue green algae, Azolla and mycorrhiza. Plant growth promoting rhizobacteria & biopesticides—Trichoderma sp. and Pseudomonas, Single cell proteins, Organic farming inputs, Microbiology of water, Bioploymers, Bioindicators, biosensors, Bioremediation, Production of biofucls, biodegradation of pollutants and biodeterioration of materials & Cultural Property.

Suggested Readings:

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

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- 8. Microbiology Fundamental and Applications (hindi) (pb)
- ISBN: 9788188826230 Edition: 03Year: 2016Author: Dr. Purohit SS., Dr. Deo Publisher: Student Edition Language: Hindi
- DODD DODD DODD DODD DODD DODD DODD Definitional Dictionary of Plant Pathology. Publisher Commission for Scientific and Technical Terminology.
- Modern Microbiology (hindi) (bb) ISBN: 9788177543599Edition: 1 Year: 2018Author: Dr. Purohit SS, Dr. Singh T Publisher: Agrobios (India)
- Suggested books "Plant pathology by R.S. Mchrotra, Tata McGraw-Hill Education" are included in reading resources list

Unit-I A:

- https://indianculture.gov.in/rarebooks/economic-botany-india https://www.infinityfoundation.com/mandala/t_es/t_es_tiwar_botany_frameset.htm
- ii. https://www.researchgate.net/publication/335715457 Ancient Indian rishi's Sages knowledge of b otany and medicinal plants since Vedic period was much older than the period of Theophrast us A case study- who was the actual father of botany
- iii https://www.scribd.com/presentation/81269920/Botany-of-Ancient-India
- iv. 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)

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

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

Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West, Press Pvt. Ltd. Delhi. 2nd edition.
 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.

- Aggarwal, S. K. 2009. Foundation Course in Biology, A one books Pvt. Ltd., New Delhi.
 Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, NewDelhi.

Annie Ragland, 2012. Algae and Bryophytes, Saras Publication, Kanyakumari, India.

7. Basa, A. N. 1993. Essentials of Plant Viruses, Vectors and Plant diseases, New Ago International, New Delhi.

8. Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut, India.

- Desikachari, T. V. 1959. Cyanophytu, ICAR, New Delhi.
 Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., NewDelhi.

Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press, London.
 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., Mirrs, C.W., Blackwell, M. (1996). Introductory Mycology, 4th edition. 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, Moerut, U.P.: Rastogi Publication.
18. Webster, J., Weber, R. (2007). Introduction to Fungi, 3rd edition. Cambridge, U.K.: Cambridge University Press.

Pandey B.P. 2001. College Botany Volume 1, S Chand & Company Pvt.Ltd, New Delhi.
 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., Mecrut, India.
- Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, New Delhi.
 Smith. G. M. 1996. Cryptogamic Botany Volume I, Tata Mc Graw Hill, New Delhi.
- Sundar Rajan, S. 2010. College Botany Volume I, Himalaya Publications, Mumbai.
- 28. Vashishta, B.R. Sinha, A.K. and Singh, V. P. 1991. Algae, S. Chand and Company, Pvt. Ltd., New Delhi

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

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

Suggested Continuous Evaluation Methods:

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

Class Interaction Quiz	5
City	
Chie	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://indianculture.gov.in/rarebooks/economic-botany-india

https://community.plantae.org/tags/mooc futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science

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

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

https://www.edx.org/learn/microbiology https://www.mooc-list.com/tags/microbiology

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

https://ucmp.berkeley.edu/bacteria/bacteria.html https://www.livescience.com/53272-what-is-a-virus.html

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

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

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

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

https://uemp.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-PI%20Path%20111.pdf

http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf

https://www.apsnet.org/edeenter/disimpactmngmni/tope/EpidemiologyTemporal/Pages/ManagementStrategies.usgx

https://learn.saylor.org/course/view.php?id=23§ionid=6821

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

http://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf

https://lipidnanostructuresgroup.weebly.com/

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

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

CERTIFICATE COURSE IN MICROBIAL TECHNOLOGY & CLASSICAL BOTANY / B.Sc.-I Year: I Semester: I/Paper-II Programme: Certificate Course In Microbial Technology & Classical Botany

Subject: Botany

Course Title: Techniques in Microbiology &Plant Pathology Course Code: B040102P 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
- Develop skills for identifying microbes and using them for Industrial, Agriculture and Environment purposes. Practical skills in the field and laboratory experiments in Microbiology & Pathology.

learn to identify Algae, Lichens and plant pathogens along with their Symbiotic and Parasitic associations.

5. Can initiate his own Plant & Seed Diagnostic Clinic

6. Can start own enterprise on microbial products

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

Unit	Topic * (Minimum Any three from each unit depending on facilities)	No. of Lecture (60 hrs)
L	INSTRUMENTS & TECHNIQUES Laboratory safety and good laboratory practices Principles and application of Laboratory instruments-microscope, incubator, autoclave, centrifuge, LAF, filtration unit, shaker, pFI meter. Buffer preparation & titration Cleaning and Sterilization of glasswares Preparation of media- Nutrient Agar and Broth Inoculation and culturing of bacteria in Nutrient agar and nutrient broth Preparation of agar stant, stab, agar plate Phenol Coefficient method to test the efficacy of disinfectants	7
11	BACTERIAL IDENTIFICATION 1. Isolation of bacteria. 2. Identification of bacteria. 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, Nitrute reduction test, Catalase test, Oxidase test, Starch hydrolysis, Cascin hydrolysis.	8
m	MYCOLOGICAL STUDY: 1. Isolation of different fungi: Saprophytic, Coprophilous, Kerntinophilic. 2. Identification of fungi by lactophenol cotton blue method. Rhizopus, Saccharomyces, Penicillium, Peziza, Ustilago, Puccinia, Fusurium, Curvularia, Alternaria. 3. Agaricus: Specimens of button stage and ful grown mushroom; Sectioning of gills of Agaricus. 4. Lichens: crustose, foliose and fruitcose specimens.	8
IV	PHYCOLOGY: 1. Type study of algae and Cyanobacteria -Spirullina, Nostoe. Chlorophyceae - Chlorella, Volvax, Oedogonium, Cladophora, and Chara; Xunthophyceae - Vaucharia; Bacillariophyceae - Pinnularia Phaeophyceae - Sargussum Rhodophyceae - Polysiphonia	7
v	EXPERIMENTAL PLANT PATHOLOGY 1. Preparation of fungal media (PDA) & Sterilization process. 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, pyenial & aecial stages of Puccinia, Few viral and bacterial plant diseases.	8
VI	PRACTICALS IN APPLIED MICROBIOLOGY-1 1. Isolation of nitrogen fixing bacteria from root nodules of legumes. 2. Enumeration of rhizosphere to non rhizosphere population of bacteria. 3. Isolation of antagomistic 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.	8
VII	PRACTICALS IN APPLIED MICROBIOLOGY-2 1. Wine production. 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 salphate reducing bacteria. 8. Isolation and characterization of acidophilic, alkalophilic and halophilic bacteria.	8
VIII	 Cultivation of Spiralina, & Chlorella in lab for biofuel Visit to NBAIM, Mau, Varanasi (Kashi)/ IMTECH (Institute of Microbial Technology), Chandigarh for viewing Culture Repository Visit to biofertilizers and biopesticides unit to understand about the Unit operation procedures Mushroom cultivation for Protein 	6

	Alcohol production, from Sugarcane Juice.		
Suggest	ted Readings:		
Cour	rse Books published in Hindi may be prescribed by the U	niversities	
1.	000000000000000000000000000000000000000	300 0000000 000 0000	00000 0000000
	0000000 0000000 0000		
2	GODDOODOO DOODOOD DOODOO-I Dhankar - Sharma	a - Trivedi ISBN Code: 978-8	1-8142-697-0 65. RBD
1	Publishing House Shivaji Nagar Civil Lines, Jaipur - 302006 (Ra	aiasthan)	
3.	оолоорого опросто поросто режения таки	1 : 0000000 00000000 : 1	aaaaaa aaaaaaa
	ODDO 000000 00000:2018		
-	Practical Botany (Part I) ISBN #:81-301-0008-8 Sunii D Purol Apex Publishing House Durgs Nursery Road, Udaipur, Rajasthi	nit, Gotam K Kukda & Anamik	ta Singhvi Edition:2013
5. 1	Modern Mushroom Cultivation And Recipes (hindi) (hb)ISBN :	9788177545180Edition : 01Ye	ar : 2017Author : Singh
	Riti , Singh UCPublisher : Agrobios (India)		
6. E	Biofertilizer Production Manual (trindl) (hb) ISBN : 97881775412 : Agrobios (India)Language : Hindi	274Edition: 01Year: 2014Auth	or : Gehlot D Publisher
1. /	Aneja, K. R. 1993. Experiments in Microbiology, Pathology and	d Tissue Culture, Vishwa Praka	ashan, New Delhi.
2. I	Dubey, R. C. and Maheshwari, D.K. 2012. Practical Microbiology	ogy, 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 Y			
4,)	Madhavee Latha, P. 2012, A Textbook of Immunology, S. Char	nd & Company Pvt. Ltd., New	Delhi.
5. I	Pandey, B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand of Standard Pandey, (Vol-I) S. Chand of Standard Pandey, (Vol-II) S. Chand of Standard	and Company Pvt. Ltd., New D	Pelhi.
7.	Sambamurty, A.V.S.S. 2006, A Textbook of Algae, I. K. Intern Singh, R. P. 2007. Microbial Taxonomy and Culture Technique	national Publishing House, Pvt.	Ltd.,
	https://agrimoon.com/wp-content/uploads/Mashroom-culture.pc	ies, Kaiyani Publication, New 1	Jethi.
9. E	http://nhb.gov.in/pdf/Cultivation.pdf	1	
10. I	https://www.k-state.edu/fungi/Greeting/Publications_files/2006	%20Handbook ndf	
11. 5	Sen, Surjit, Acharya, Krishnendu, Rai, Manjula 2019 IBSN - 9	78-93-88347-23-5 - Biofertiliz	ers and Bionesticides
.Techn	oworld, Kelkata		
12. I	http://www.kvkkendrapara.org/pdf/Bio%20Fertilizer%20Produ	ction%20and%20marketing.nd	f
13. P	http://www.gbv.de/dms/tib-ub-hannover/751302945.pdf	Service American Service Servi	•
14. Ho	ochman, Gal, Zilberman, David 2014 IBSN-1461493285- Algae I	Farming and Its Bio-Products S	nringer
18. Gc	okare A. Ravishankar, Ranga Rao Ambati 2019 Handbook of	Aloni Technologies and Phytos	shamicale Volume II:
Phycor	remediation, Biofuels and Global Biomass Production Print ISB	N: 9780367178192	arcaments volume II.
19. An	nos Richmond Ph.D., Prof. Emeritus, Qiang Hu Ph.D 2013. He	andbook of Microalgal Culture	: Applied Phycology
and Big	otechnology, Second Edition Print ISBN:9780470673898		. Approx 1 my consty
This cou B.Sc. B	urse can be opted as an elective by the students of following subje- liotech, <u>B.Sc.</u> Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A.	cts: Open to all but special for Archaeology, B.A. Geology, B.A.	us.
uggeste	ed Continuous Evaluation Methods:		
Continu	ous Internal Evaluation shall be based on allotted Assignment and Ch	ass Tests. The marks shall be as fo	illows:
	Internal Assessment	Marks	1
	Class Interaction	5	1

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

Course prerequisites:	
Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill CourDiploma holder from ITI in (Biology/ Agriculture/ Biotech/ Microbiology/biomedical Science.	neils
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, incubato	r,
Oven, laminar flow cabinet, balances, Fermenter, Anaerobic jar and Spectrophotometer.	500
Suggested equivalent online courses:	
https://community.plantae.org/tags/mood	
futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science	
https://microbiologytociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html	
https://microbiologyonline.org/file/7926d7789d8e2f7b2075109f68c3175e.pdf	
http://allaboutalgae.com/benefits/	
https://repository.cimmyt.org/xmlui/bitstream/handie/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%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%201%20%7BAshok%20Bendre%7D%20botany%20%20%7BAshok%20Bendre%7D%20botany%20%20%20%20%20%20%20%20%20%20%20%20%20%	20945
1/1339239%5D%20%281984%29.pdf	KN-C Biol
https://www.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/	

Hicrobial Technology & Classical Botany	Year: I	Semester: II Paper-I
Subject: Botany		
Course Code: B040201T Cour	sc Title: Archegoni	lates and Plant Architecture
Course outcomes: After the completion of the course the students will be a 1. Develop critical understanding on morphology, an symmosperms 2. Understanding of plant evolution and their transiti 3. Understand morphology, anatomy, reproduction a reate a knowledge base in understanding the basis of plant 4. Understand the details of external and internal str	atomy and reproduct on to land habitat, and developmental chi diversity, economic	anges therein through typological study and
Credits: 4		Core Compulsory
Max. Marks: 25+75		Min. Passing Marks:
Total No. of Lectures-Tutorials-Pro		

Unit	Topic	Lectures (60hrs)
I	Introduction to Archegoniates, Bryophytes Unique features of archegoniates, Bryophytes: General characteristics, adaptations to land habit, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of Riccio, Marchantia, Anthoceros and Sphagnum. (Developmental details not to be included), economic importance of bryophytes.	7
п	Pteridophytes General characteristics, Early land plants (Rhymia), Classification (up to family) with examples, Heterospory and seed habit, stelar evolution, economic importance of Pteridophytes.	8
m	Gymnosperms Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Ginetales, their examples, structure and reproduction; economic importance	8
IV	Palacobotany 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	8
v	Angiosperm Morphology (Stem, Roots, Leaves & Flowers, Inflorescence) Morphology and modifications of roots; Stem, leaf and bud. Types of inflorescences; flowers, flower parts, fruits and types of placentation; Definition and types of seeds.	7
VI	Plant Anatomy: 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 stemcambium (structure and function) annular rings, Anomalous secondary growth - Bignonia, Boerhaavia, Dracuma Nycianthes	7
VII	Reproductive Botany Plant Embryology, Structure of microsporangium, microsporagesesis, , 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 memocot embryo, Endosperm, Double fertilization, Apomixis and polyembryony.	8
vm	Palynology: Policn structure, policn morphology, policn allergy, Applied Palynology: Basic concepts, Palacopalynology, Aeropalynology, Forensic palynology, Role in taxonomic evidences.	7

Suggested Readings:

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

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4. You added & acceptable beade 2018, because adecade accept acce

Gangulee H. S. and K. Kar 1992, College Botany Vol. I and II. (New Central Book Agency)

- Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
- Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

Rashid A (1999) An Introduction to Pteridophyta, Vilas Publishing House Pvt. Ltd. New Delhi.

Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi. 5.

- Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students Pteridophyta, S. Chand and Company,
- Vashishtha BR, Sinha AK and Kumur A (2010) Botany for Degree Students Gymnosperms, S. Chand and
- Parihar NS (1976) Biology and Morphology of Pteridophytes. Central Book Depot.

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.
- Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
 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:

Marks
5
5
7
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 IT1 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.ambg.gov.am/bryophyte/what-is-bryophyte.html
https://pteridoportal.org/portal/index.php
https://www.comifers.org/zz/zymnosperms.php
https://www.mobot.org/MOBOT/research/APwcb/
https://milnearchid.weebly.com/plant-id-for-beginners.html
https://www.botany.org/PlantImages/PlantAnatomy.php
http://webappl.dlib.indiana.edu/inauthors/view/docfd=VAC0868&doc.view=print
https://www2.cstrellameuntain.edu/faculty/farabeg/biobk/Biobookflowers.html
https://www2.cstrellameuntain.edu/faculty/farabeg/biobk/Biobookflowers.html
https://www.sciencelearn.org.oz/resources/100-plant-reproduction
https://palaeobotany.org/

https://palacobotany.org/

	Sass: Certificate Course In Microbial	Year: I	Semester: II
Subject: Bot	& Classical Botany any		Paper-II (Practical)
	D0402020	Course Title: Land Plants	Ambitostoro
1. The stu Throug 2. Studer picture 3. Develo groups 4. Unders create a	e B040202P contromes: sidents will be made aware of the group of plan the field study they will be able to see these plan this would learn to create their small digital rep is as well as videos in case they are able to find in an understanding by observation and table is to learn the process of evolution in a broad ser tand morphology, anatomy, reproduction and is knowledge base in understanding plant diver- tand the composition, modifications, internal is	ts that have given rise to land habit and grow in nature and become familia orts where they can capture the zooms some rare structure or phenomenon rudy of representative members of physics. See developmental changes therein throughty, economic values & taxonomy of	ad the flowering plants, ar with the biodiversity, ad in and zoomed out elated to these plants, ylogenetically important th typological study and lower group of plants
Credits	: 2	Core Comp	ulsory
Max. N	farks: 25+75	Min. Passing	g Marks:
	Total Ne. of Lectures-Tutorials-	Practical (in hours per week): 0-0-2	
Unit	Topie		No. of Lectures
1	Bryophytes: Marchantia-morphology of thalius, W Gemma cup, W.M. gemmae (all tempo archegoniophore, L.S. sporophyte (all W.M. leaf, rhizoids, operculum, periste permanent slides showing antheridial a protonema.	rary slides), V.S. antheridiophore, permanent slides). <i>Sphagmum</i> -morphome, annulus, spores (temporary slide	ology,
П	Pteridophytes: Lycopodium: Habit, stem T. S. stobilus stem T. S. axis with strobilus, V.S. of microsporophyll. Equivetum - Habit, thizome and stem T Azolla - Habitat & its structure	strobilus, Megasporophyll and	ът. S, 7
Ш	Gymnosperms 1. Cyeas – seedling, coralloid root and Rachis, micro and megasporophyll, ma and V. S. of ovule. Pinus – Branch of a and needle R.L.S and T. L. S. of stam, female cone. 2. Ephedra & Thujar, Habit, stem T. S. female strobilus, V. S. of male and fem	the cone V. S., microsporophyll T. S. a definite growth, spur shoot, T. S of o male and female cone, V.S. of male a (young and mature), leaf T. S. male a	entire old stem nd
IV	Palaeobotany & Pulynology 1. Morphology of Rhysia and fossils g 2. Visit Birbal Sahni Institute of Palae to learn fossilization. 3. Mark and know about Indian geogra	ymnosperms & other groups, osciences or virtual conference with the	6 heir scientis
v	Angiosperm Morphology 1. To study diversity in leaf shape, size a 2. To study monopodial and sympodial b: 3. Morphology of Fruits 4. Inflorescence types- study from fresh/ 5. Flowers- study of different types from 6. Fruits- study from different types from 7. Study of ovules (permanent slides/ speorthotropeus, amphitropeus and earney 8. Modifications in Roots stems, leaves an	nd other foliar features, ranching, preserved specimens fresh/preserved specimens fresh/preserved specimens cimens/photographs)- types (anatropo lotropous)	8 ous,

VI	Plant Anatomy: Normal & Anomalous secondary thickening - Bignonia, Drucaena, Boerhaavia diffusa, Nyctanther Study of primary and secondary growth in the root and stem of monocots and dicots by section cutting and permanent slides. Study of internal structure of dicot and monocot leaves. Study of structure of stormata.	8
VII	Reproductive Botany Structure of anther, microsporogenesis and pollen grains Structure of ovule and embryo sac development (through slides). Study of embryo development in monocots and dicots. Vegetative propagation by means of cutting, budding and grafting exercises. Study of seed germination. Study of pollen morphology of the following plants — Hibiacus, Vinca, Balsam, Ixora, Crotalaria, Bougainvillea by microscopic observation. Calculation of pollen viability percentage using in vitro pollen germination techniques.	8
VIII	Commercial Uses and Production technology 1. Azolla production 2. Production technology of Resins 3. Production and propagation of Ornamental Pteris, Cycadales, Coniferales for landscaping. 4. Lab method for qualitative testing/extraction of Ephedrine, Taxol and Titula oil.	7

Suggested Readings:

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

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Pandey, BP and Trivedi, P.S. 1997. Botany Vol. I(10th edition). Vikas Publishing House, Pandey, BP Misra: Trivedi P.S. 1997. Botany Vol. II. Vilas Bublishing 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_projet_on_Azolla_cultivation.pdf

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

https://www.fs.fed.us/rm/pubs_other/wo_AgricHandbook730/wo_AgricHandbook727_153_175.pdf

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

Diploma in Plant Identification, Utilization & Ethnomedicine

	Diploma in P	lant Identification, Utilization &	k Ethnome	dicine
THE STATE OF T	PENNELSES WALLES OF VIOLENCES	lentification, Utilization & Ethnomedicine	Year: II	Semester: III Paper-I
Subject:	MONTH AND REPORT OF THE PARTY O	C	and the second	
0.4 0.4455.44	ode: B040301T	Course Title: Flowering Plants Identific	ation & Aesthe	etic Characteristics
After the 1. To gain classifi 2. To lear 3. To con 4. To bee current 5. To disc 6. For the Run a	completion of the course the an understanding of the hi- cation. In the major patterns of diversions of the different approach one familiar with major that taxonomy of a major plant tover and use diverse taxons entrepreneur cureer in plantation consultancy firm	story and concepts underlying various approa- ensity among plants, and the characters and typ- ues to classification with regard to the analysis as and their identifying characteristics, and to family, omic resources, reference materials, herbarium tst, one can establish a nursery, Start a landsca	pes of data used s of data, develop in dept m collections, p	to classify plants. h knowledge of the ablications.
Credits: 4	9	Core Compulsory		
Max. Ma	rks: 25+75	Min. Passing Marks:		
	Total No. of Le	ctures-Tutorials-Practical (in hours per week)): 4-0-0	
Unit		Topic	2.574.74.5	No. of Lectur
I	Taxonomic Resources & Nomenclature Components of taxonomy (identification, nomenclature, classification): Taxonomic resources: Herbarium-functions & important herbaria, Botanical gardens, Flora, Keys-single access and multi-access. Principles and rules of Botanical Nomenclature according to ICN (ranks and names; principle of priority, binomial system; type method, author citation, valid-publication).		7	
Ц	Types of classification & Evidences Artificial, natural and phylogenetic. Beatham and Hooker (upto series), Engler and Pranti (upto series) angiosperm phylogeny group (APGTV) classification. Introduction to taxonomic evidences from palynology, cytology, phytochemistry & Molecular biology data (Protein and Nucleic acid homology).		n. 8	
ш	Identification of Angiospermic families -1: (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, Asclepiadaceae, Solanaceae.		8	
IV	Identification of Angiospermic families -II: (Families can be chosen University wise as per local available flora) A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system)-Amaranthaceae, Euphorbiaceae, Papaveraceae, Apiaceae, Laminceae, Orchidaceae, Liliaceae, Musaccae, Posceae.		7	

V	Modern trends in Plant taxonomy: Brief idea on Phenetics, Biometrics, Cladistics (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 (e-flora), Description Language for Taxonomy - DELTA Internet directory for botany.	7
VII	Computer usage & Android Applications MS Office: PPT, Microsoft Excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media. GPS tagging, Plant Identification Apps.	7
VШ	Aesthetic Characteristics of Plants: Aesthetic characteristics of plants, English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Feneing, Steps, Hedge, Edging, Lawn, Trees, shrubs and shrubberies, climbers and creepers, rockery, Flower beds, Shrubbery, Borders, Water garden). Some Famous gardens of India. Conservatory, green houses, Indoor garden, Roof garden, Topiary, Bonsai.	8

Suggested Readings:

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

- agannana apadan abada -0000, saana aga aga aganana :nnannan anadana, caga
- 2. DODD GC 30500,3000000 00000 \$60000, 53 000000 00000 00000
- 3. Propagation And Nursery Management (hindi) (hb) ISBN: 9788177546200Edition: 01Year: 2016Author: Pandey S.K., Soni N.Publisher: Agrobios (India)
- 4. Dr. Amer Singh, पाइपवर्गिकी-Plant Taxonomy (An Old and Rare Book) from the category Ayurveda in our Books collection. Uttar Pradesh Hindi Sanathan, Lucknow
- 1. Plant Systematics. Arun K. Pandey & Shruti Kansana. 2020. Jaya Publishing House.
- 2, Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay.
- 3. Brandis, D. (1906) Indian Trees (London, 5th edition, 1971). International Book Distributors; Dehra Dun.
- 4. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://delta-intery.com
- 5. https://www.maace.co.uk/school-improvement/ict-mark/
- 6. https://www.socitm.gov.uk, (2002) Learning in the 21st century Executive briefing A Socitm Insight publication, July
- 7. 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)
- 8. Lizeron Eremias and R. Subash. (2013) "E-Content Development: A Milestone In The Dynamic Progress Of E-Learning" International Journal of Teacher Educational Research (UTER) Vol.2 No.1 January, 2013 ISSN: 2319-4642
- 9. Pandey, B.P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants, S. Chand & Company Ltd, New Delhi.
- 10. Stace, C. A. 1989, Plant Taxonomy and Biostatistics (2nd Ed.). Edward Arnold, London.
- 11. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
- 12. Dutta A.C. 2016. Botany for Degree Students, Oxford University Press.
- Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
 Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
- 15. Austin, R. 2002. Elements of planting design. New York: John Wiley & Sons.
- 16, Bertauski, T. 2005. Designing the landscape: An introductory guide for the landscape designer. Upper Saddle River, NJ: Pearson Prentice Hall
- 17. Thomas, H., and S. Wooster. 2008. The complete planting design course: Plans and styles for every garden. London:
- Octopus Publishing Group.

 18. Scarfone, S. 2007. Professional planting design: An architectural and horticultural approach for creating mixed bed plantings. New York: John Wiley & Sons. 19. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

This course can be opted as an elective by the students of the following subjects: Open to all but special for B.Sc. Biotech B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curutors), 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)	В
	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.ladykeanecolloge.cdu.in/files/userfiles/file/Dr_%20S_%20Nongbri%20H1%20Sem%20ppt.pdf https://www.brainkart.com/article/Bentham-and-Hooker-s-classification-of-plants—Dieotyledonae_ Gymoospermae-and-Monecotyledonae_1000/

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

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

	Class: : Diploma in Plant on, Utilization & Ethnomedicine	Year: II	Semester Paper-II	(Practical)
acmeg-cus	on, Chiefanor & James Chief	Subject: Botany	1	
Cours	Code: B040302P	Course Title: Pla	ant Identification technolog	y
Cours After 1 1. To lea 2. To ob termin 3. To ga 4. To de 5. To ide 6. To rec	e outcomes: the completion of the course the students wirn how plant specimens are collected, diserve, record, and employ plant morpho tology. In experience with the various tools and velop observational skills and field experiently a taxonomically diverse array of mognize common and major plant familiaters and nesthetic characters of flowers rehend the concepts of plant taxonomy and the concepts of plant taxonomy.	ocumented, and cur logical variation an means available to crience. sative plants. es. ng plants by making	d the accompanying descri identify plants. g-landscapes,gardens,bons	ptive
2000	Marks: 25+75		Min. Passing Marks:	
DV141AC)	CONTRACTOR OF THE CONTRACTOR O		.com.com.com.com.com.com.com.com.com.com	
	Total No. of Lectures-Tutori	als-Practical (in hours	per week): 8-0-2	
Unit	*(Perform Any three exp	Topic* eriments from each	unit as per facility)	No. of Lectu (60Hrs)
1	Herbarium: Plant collecting, Preservati Stepwise Practicing Herbarium techniques System (GPS) instrument & Collection of Herbarium making tools c. Pressing and D treatments for all varied groups of plants of them using Standard method g. Organize of	e a. FIELD EQUIPM any wild 25 plant spe brying of collected plant Mount on standard	ENTS, Global Positioning cimens b. Learn to handle at specimens d. Special perharium sheets f. Labei	7
п	Taxonomic Identification using plant st a. Classify 25 plants on the basis of Taxon Reproductive parts, Habit, adaptation an system of classification in the following: Solanaceae, Scrophulariaceae, Acanthace	ructure comic description (Pla conulies) according to families: Malvaceae,	nt Morphology, Anatomy, Bentham and Hooker natura Fabaceae (Papilionaceae),	8
ш	Identification during excursions a Conducting Spot identification (Binomia included in the theoretical syllabus (list to and filling Sample of a page of field-boo b. Describe/compare flowers in semi-tech ovaries, floral diagrams and Floral Form families giving reasons.	o be provided) and m k, used in Botanical S mical language giving	iking FIELD NOTE BOOK covey of India. V.S. of flowers, T.S. of	8
īv	COLLECTION, PRESERVATION AN BRYOPHYTES, PTERIDOPHYTES		LGAE, FUNGI	7
v	Botanical Nomenclature & reporting 8 a. Give nomenclature to collected plants b. Author Citation, Effective Publicati paper on Basic structure of a taxonomic journal	Method: as per ICN rules and on and Principle of I	Priority: To show a specime	7
VI	I. Learning to use EXCEL Micro WITH FOLDER AND WINDO FILES AND FOLDER TREE.			7

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

Suggested Readings

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

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DDBBDDD : DDBDDD DDBDDD B GOOD GOODGO H Author Name: - Dhankar - Sharma - Trivedi RBD Publication House

Day, S.C. (2003)A Art of Miniature Plant Culture. - Agrobios. Jodhpur, India.
 Practical Taxonomy of Angiosperms By: R.K. Sinha ISBN: 9789386768520 LK. International Publishing House Py.

 Practical Taxonomy of Angiosperms By: R.K. Sinha ISBN: 9789386768520 LK. International Publishing House Pvt. Ltd.

1. Day, S.C. (2003) Complete Home Gardening. (2003) Agrobios, Jodhpur, India.

2. Dhopte, A.M. (2003) Principles and Techniques for Plant Scientists. - Agrobios, Jodhpur, India.

3. Khan, M.R. (1995) Horticulture and Gardening - NiraliPrakashan, Pune. India.

4. PramilaMehra Gardening for everyone-. Hind pocket book private limited, New Dehli.

5. Kumarsen V. Horticulture ,Saras Publication

6. Ramesh Bangia Learning Computer Fundamentals..., Khanna Book Publishers

7. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH PublishingCo., New Delhi.

8. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.

9. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

 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; DehraDut

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/

 Manilal, K. S. and M. S. Muktesh Kumar (ed.) (1998) A Hand book of Taxonomy Training, DST,N. Deihi

15. Naik, V. N. (1984) Taxonomy of Angiosperms Tata McGrow-Hill Publication Com. Ltd., New Delhi

16. Primak, R. B. (2004) A Primer of Conservation Biology. Sinauer Associates, Inc. Publishers

 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.

- 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.
- Fosberg, F.R. & M.-H. Sachet. 1965. Manual for tropical herbaria. Int. Bur. Pl. Tax. & Nom., Regnum Vegetabile Vol. 39. Utrecht.
- Jain, S.K. & R.R. Rao. 1977. A handbook of field and herbarium methods. Today & Tomorrow's Printer and Publishers, New Delhi.
- Victor, J.E., M. Kockemoer, L. Fish, S.J. Smithies, M. Mossmer. 2004. Herbarium essentials: the Souther African Herbarium user manual. Southern African Botanical Diversity Network Report No. 25. SABONET, Pretoria.

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

Suggested Continuous Evaluation Methods:

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

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

Course prerequisites:

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

Facilities: Smart and Interactive Class

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

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

Suggested equivalent online courses:

- http://egyankosh.ac.in/bitstream/123456789/13096/1/Unit-5.pdf
- https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp18.pdf
- 3. https://www.researchgate.net/publication/267510854 The Flowering Plants Handbook

Any Other:

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

Each excursion will not be more than SEVEN days during college working days. T.A. and D.A. for teachers and non-teaching staff participating in excursions should be paid as per rules. Tour report daly 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 dea

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: Diploma in Plant Identification, Utilization & Ethnomedicine	Year, H	Semester: IV Paper-I
	Subject: Botany	
Course Code: B040401T	Course Title: Reonomic Botany, I	thnomedicine and Phytochemistry

Course outcomes:

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

- . Understand about the uses of plants -will know one plant-one employment
- Understand phytochemical analysis related to medicinally important plants and economic products produced by the plants
- 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 Compulso	ry
	Max. Marks: 25+75	Min. Passing Mar	ios:
	Total No. of Lectures-Tutorials-Practical (in hours pe	er week): 4-0-0	
Unit	Topic		No. of Lectures (60hrs)
1	Origin and domestication of cultivated plants 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, legumes, Spices & beverages.		7
п	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, Timber, biofuel crops.		7
m	Commercial production of Flowers, Vegetables, and fruits (To be Chosen area wise) Commercial greenhouse cultivation of rose, Gerbern, Gladiolus, Anthurium/lilium/lily, tomato, bell pepper, cucumber, strawberry & Exotic leafy vegetables using Hydroponies.		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, CI-MAP 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 Eclipta alba, Oxalis, Ocimum sanctum and Trichopus zeylan, conservation and management of plant resources, Preservation of sacred groves of individual species and Botanical uses depicts	of principal forests in the form	8

	Plants in primary health care: common medicinal plants: Tinospora, Acorus, Ocimum, Turmeric and Aloe. Indian Pharmacopeia, Quality Evaluation of crude drugs & adulteration	
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, thizome, bulb, corm, leaves, stems, flowers, fruits and seeds; organoleptic study of Adhatoda vasica, Andrographia pameulata, Azadirachia indica, Coriandrum sativum, Datura metel, Ectipta 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 hath - Herbal oils - Liquid extracts or Tincture - Poultices - Saives - Slippery elm sturry 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

Suggested Readings:

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

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- 2, 0000 00 00000,0000000 00000 **164** 000000 00000 00000 00000
- 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 & Subruhmanyam, 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.
- 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,
- 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
- 8. Joe J. Hanun, 1997. Greenhouses: Advanced Technology for protected horticulture. CRC Press.
- 9. Krishnamurthy, K.V. (2004). An Advanced Text rhook 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. Ruo, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications
- 12.P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).
- 13. Arthur Raphael Miller, Micheel 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.
- Lad, V. 1984. Ayurveda The Science of Self-healing. Motital Banarasidass, New Delhi.
 Lewis, W. H. and M. P. F. Elwin Lewis. 1976. Medical Botany. Plants Affecting Man's Health. A
- Wiley Inter science Publication. John Wiley and Sons, New York.
- 21. Farooqui, A. A. and Sreeraman, B. S. 2001. Cultivation 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.
- Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.

Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.

27. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.

 Sharol Tilgner, N. D. 1999. Herbal medicine - From the heart of the earth Edn. 1, Printed in the USA by Malloy Lithographing Inc.

Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.

 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.
- Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today& Tomorrow's printers and publishers, New Delhi.

Bujpai, 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.
- k. Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry. (3 edn Edward Arnold, London.

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

Suggested Continuous Evaluation Methods:

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

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

Course prerequisites:

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

Facilities: Smart and Interactive Class

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

Suggested equivalent online resourses:

https://www.pnos.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-vielding-plant_1095/ https://www.loc.gov/m/scitech/tracer-bullets/economic-botanyth.html

http://nscil.niscair.res.in/bitstream/123456789/127/1/Fibre%20crops%2C%20bamboo%2C%20timber%20-%20Final.pdf https://www2.palomar.edu/users/warmstrong/ecoupls.htm

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

		Subject: Botany		
Cour	se Code: B040402P	Course Title, Commercial	Botany & Phytochemical	Analysis
1. Know a 2. Gain th 3. Unders 4. Learn a	utcomes: After the completion of shout the commercial products produce e knowledge about cultivation practice tand about the ethnobotanical details of bout the chemistry of plants &herbal prometer come a protected cultivator, aromatic of	d from plants, s of some economic crops, plants, reparations		pany,
	Credits: 2		Core Compulsory	
	Max. Marks: 25+75		Min. Passing Marks	81
	Total No. of Lectures-Tutoria	ds-Practical (in hours per week	k): 0-0-2	
Unit	(Perform minimum a	Topic	ach unit)	No. of Lectures (60hrs)
.1	Economic Botany & Microtechnique: 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) 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		8	
п	Commercial Cultivation Field visit to Green houses for und Development of hydroponics nut vegetables Development of hydroponics nutric	rient solutions & running n	nodels for cultivation of	8
m	Cultivating Medicinal and aroma a. Lemon grass/ Neem/ Zinger /Ro	tic plants & Essential oil ex		7
iv	Documentation from Traditional Knowledge Digital Library, 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			7
v	Ethnobotany Study of common plants used by t dactylon. Visit a tribal area and collect infor crude drugs. Familiarize with at least 5 folk me medicinal application. Observe the plants of ethnobotanic Visit to an Ayurveda college or A:	mation on their traditional mation on their traditional mations and study the cultivated importance in your area.	ethod of treatment using	7

VI	Instrumentation and herbal Preparations Develop Capsules of herbal Develop Herbal oils/ Develop Poultice/cream Analyse some active ingredients using chromatography /Spectrophotometry	8
VII	Pharmacognosy Organoleptic studies of plants mentioned in the theory: 1. Morphological studies of vegetative and floral parts. 2. Microscopic preparations of root, stem and leaf. 3. Stomatal number and stomatal index. 4. Vein islet number. 5. Palisade ratio. 6. Fibres and vessels (maccration). 7. Starch test 8. Proteins and lipid test	8
VIII	Phytochemistry: Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves. Dimensions of Calcium exalate crystals in powdered crude drug. Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins & resins. Any 5 herbal preparations.	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. DODDDDDDDDDDDDDDDDShiva Kant, Pankaj Kumar Brahmiya: Thakur Publication
- PHARMACOGNOSY ... Hindi Edition (Paperback, Hindi, Dr. Akancha Rashi, KHUSHAL JASWANI), RM Publication
- 1. Wallis, T. E. 1946. Textbook of Pharmacognosy, J & A Churchill Ltd.
- 2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
- 3. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
- 4. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.
- 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.
- 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-
- Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. Sew Delhi.
- 11. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency

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

Suggested Continuous Evaluation Methods:

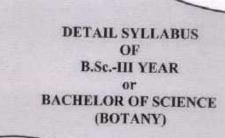
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

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

Course prerequisites:
Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).
Facilities: Smart and Interactive Class
Other Requisites: Video collection, Books, CDa, Flora, Herbarium, Access to Ou-line resources, Display Charts
Lab requisites: Repository of economic products, Microscopes/ Botanical /Herbal Garden, TLC, Spectrophotometer.

Suggested equivalent online courses:

https://www.entrepreneur.india.co/Document/Download/pdfanddoc-144615-.pdf http://nopr.niscair.res.in/bandle/123456789/45825 https://www.wipo.int/export/sites/www/tk/en/resources/pdf/medical_tk.pdf https://www.benfoli.com/commercial-farming-agriculture/



		R OF SCIE	INCE (BOTANY)	
Program	me/Class: Bachelor of Science		Year: III	Semester: V
		Subject: BO	TANY	Paper-I
C	ourse Code: B040501T	Course	Title: Plant Physiology, Metabolis	m & Biochemistr
After th 1. Und 2. Lea 3. Ass	outcomes: the completion of the course the stude erstand the role of Physiological and the symptoms of Mineral Deficien milate Knowledge about Biochemic the role of plants in developmedants	metabolic pr icy in crops as al constitution	ocesses for plant growth and developed their management.	
	Credits: 4		Core Compulsor	у
	Max. Marks: 25+75		Min. Passing Mark	9;
	Total No. of Lectures-Tuto	orials-Practical	in hours per week) 4-0-0	
Unit		No. of Lectures (60hrs		
1	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; Roof 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
п	Carbon Oxidation Krebs cycle. Glycolysis, fate of pyruvate- nerobic and anacrobic respiration and fermentation, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Krebs cycle, mitochondrial electron transport, oxidative phosphorylation, ATP-Synthetase, Chemiosmotic mechanism, P/O ratio, cyanide-resistant respiration, factors affecting respiration.			7
Ш			8	
rv	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, Dorm Developmental roles of Phytohormones (autonomic & paratonic movements, Com (SDP, LDP, Day neutral plants); Phytoch responses on photomorphogenesis, Seed 1 Senescence.	ancy & Respon auxins, gibberell rol and Coordina	ses ins, cytokinins, ABA, ethylene.) ition in plants, Photoperiodism	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, hilayers	8
VII	Proteins: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, Ramchandran plot, tertiary and quaternary; Isoelectric point; Protein denaturation and biological roles of proteins Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleic acids, Nucleic acid denaturation & Re-naturation, MiRNA	7
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.

- 0000, concesso accesso; cocesso
- 3. വരാന വരാവരാവാന വാന **ചെല്**നുവരാവ. 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)
- Hopkins, W.G. & Hiller, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
- 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.
- Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
 Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.
- Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New Central Book. Agencies.
- Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons,
 Mathews, C.K., Vati 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. Piant 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.
- Harborne, J.B. 1973. Phytochemical Methods. John Wiley & Sons, New York.
- 16. Watson, J. D., Baker T.A., Bell, S. P., Gunn, 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

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.essybiologyclass.com/plant-physiology-free-lecture-potes-unline-totorials-lecture-notes-ppts-megs/

https://onlinecourses.swayam2.ac.in/cec19_bt09/preview

Programme	c/Class: Bachelor of Science	- 110: 444	emester: V Paper-II
		Subject: BOTANY	
Cour	rse Code: B040502T	Course Title: Molecular Biology & Bioinforma	tics
After the 1. Underst and transci 2. Know a	bout Processing and modification of	Idents will be able to: NA in prokaryotes and Eukaryotes, DNA replication med RNA and translation process, function and regulation of el theoretical concepts of bioinformatics	
	Credits: 4	CC / Elective	
	Max. Marks: 25+75	Min. Passing Marks:	
	Total No. of Lectures-T	Futorsals-Practical (in hours per week) 4-0-0	
Unit		Topic	No. of Lectures(60hrs)
Genetic material Misscher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments. Hershey-Chase, bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): semi-conservative. DNA replication (Prokaryotes and eukaryotes): semi-conservative, semi-discontinuous RNA priming, Θ (theta) mode of replication, replication of linear, dsDNA, replicating the S end of linear chromosome including replication enzymes.		7	

п	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
In	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.	*
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	Biainformatics & 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 (Bankir, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data refrieval 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, GGGGGG GGG GGGGGGG GGG GGG GGGGGGG,Bhopal
- 000 0000000000) by RBD Publisher
- 3. Plant Physiology and Biochemistry ISBN# Gotam K KukdaEdition:
 - 2013Pages:
- 81-301-0035-5Author: Sunil D Purchit, K. Ahmed & 368 + VIIIType: Text Book (Hindi)
- Molecular Biology Biotechnology ISBN #: Udaipur, Rajasthan
 - 81-301-0033-9Author: Sunil D Purohit & Gotam K Kukda Edition: 2013Pages: 366 + XType: Text Book (Hindi) Apex Publishing House,
- Bioinformatics Paperback I January 2015 by Dr Archana Pandeya (Author), Santosh Choubey (Editor), & 2 More Hindi AISECT Ltd.
- BIOTECHNOLOGY AND GENETIC ENGINEERING (Hindi, Hardcover, Dr. Archna Nigam)

1. Primrose, SB. 1995. Principles of Genome Analysis. Blackwell Science Ltd.Oxford, UK...

E.J. Gardner and D.P. Smistad, 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. Ghosh, Z., Mallick, B. (2008). Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press.

7. Baxevanis, A.D. and Onellette, 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). Bieinformatics, 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.

Pevsner J. (2009). Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell.
 Xiong J. (2006). Essential Bioinformatics, 1st edition. Cambridge, U.K.: Cambridge University Press

12. A Textbook Of Basic And Molecular Genetics (pb)ISBN: 9788188826193Edition: 01Year: 2018Author: Dr. Parihar

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

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

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

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

Course prerequisites:

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

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

Suggested equivalent online courses:

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

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

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

https://www.coursera.ora/courses?query_genetics

https://www.courseta.org/courses?query-molecular%20biology

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

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

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

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

rogra	mme/Class: Bachelor of Science	Year: III	Semester: V Paper-III
		Subject: Botany	
	Course Code: B040503P	Course Title: Experiments in phy molecular biology	sialogy, Biochemistry &
CHARLE	their metabolism 2. Identify Mineral deficience	physiological processes undergoing	
	Credits: 2	Core C	ompulsory
	Max. Marks: 25+75	Min. Pas	sing Marks:
	Total No. of Lectures-Tutor	rials-Practical (in hours per week) 0-0-2	
Unit	Topic* *(Perform ony three from each unit based on facility) Plant water relation, Mineral Nutrition and translocation in phloem		
	2. Osmosis – by potato osmoscope e 3. Effect of temperature on absorptio Q10, 4. Experiment to demonstrate the tra 5. Experiment for demonstration of 1 6. Structure of stomata (dicot & mon 7. Determination of rate of transpirat 8. Experiment to measure the rate of 9. Experiment to measure the rate of 10. Effect of Temperature on memb 11. Study of mineral deficiency syn	n of water by storage tissue and determ respiration phenomenon with the bell just franspiration by Four-Leaf Experiment ocot) ion using cobalt chloride method, transpiration by using Farmer's Potom transpiration by using Ganong's poton mane permeability by colorimetric met- uotoms using plant material/photograph	rinution of remethod t:
11	Nitrogen Metabolism, Photo Synthesis & Respiration 1. A basic idea of chromatography: Principle, paper chromatography and column chromatography; demonstration of column chromatography. 2. Separation of plastidial pigments by solvent and paper chromatography. 3. Estimation of total chlorophyll content from different chromologically aged leaves (young, mature and senescence) by Arnon method. 4. Effect of HCO ₂ concentration on oxygen evolution during photosynthesis in an aquatic plant and to find out the optimum and toxic concentration (either by volume measurement or bubble counting). 5. Measurement of oxygen uptake by respiring tissue (per g/hr.) 6. Determination of the RQ of germinating seeds. 7. Effect of light intensity on oxygen evolution in phytosynthesis using Wilmott' bubble.		d column 8 res (young, an squatic arement or
1	Geotropism and phototropism Hydrotropism Measurement of grov To study the phenomenon of	mancy & Responses	8

	Test of seed vinbility by TTC method.	
	6. To study the effect of different concentrations of IAA on Avena	
_	coleoptile elongation (IAA bioassay) Techniques for biochemical analysis	
rv	 Weighing and Preparation of solutions -percentage, molar & normal 	8
	solutions, dilution from stock solution etc.	
	Separation of amino acids by paper chromatography.	
	3. Detection of organic acids: citric, tartaric, oxalic and malic from laboratory	
	samples., 4. Qualitative Analysis of carbohydrates,	
	Estimation of reducing sugar by anthrone method,	
	Qualitative Analysis of Lipids	
	7. Qualitative analysis of Amino acids and Proteins	
	Quantitative Analysis of Nucleic Acids.	
	Analysis of dietary supplements, nutraceuticals & antioxidants	
	 Testing of adulterants in food items. 	
v	Genetic material	7
	Instruments and equipments used in molecular biology.	
	2. Preparation of LB medium and cultivating E.coli on it.	
	Isolation of Genomic DNA	
	Isolation of DNA from plants	
	Examination of the purity of DNA by agarose gel electrophoresis.	
	Quantification of DNA by UV-spectrophotometer	
	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 photographs	7
	2. Numericals based on DNA re-association kinetics (melting profiles and Cot curves)	
	Snudy of DNA replication through photographs: Medes 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.	
VII	7. Understanding the mechanism of RNAi by photographs	
	Genetic Engineering 1. Isolation of protoplasts.	22
	Construction of restriction map of circular and linear DNA from the data	7
	provided.	
	3. Isolation of plasmid DNA.	
	Restriction digestion and gel electrophoresis of plasmid DNA (demonstration/	
	photograph).	
	5. Calculate the percentage similarity between different cultivars of a species	

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

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

- 0000 00000 000000 000000 00000 00000
- 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.
- Thimmaiah, SR. 2004. Standard Methods of Biochemical Analysis. Kalyani Publishers.
- 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.edv.org/learn/molecular-biology
https://www.classcontral.com/course/swayam-genetic-engineering-theory-and-application-14090
https://www.classcontral.com/courses/query-geneticshttps://www.coursera.org/courses/query-molecular%20hiology
https://www.coursera.org/courses/query-molecular%20hiology
https://www.mooc-list.com/tags/genetic-engineering
https://www.classcontral.com/course/edx-molecular-biology-part-1-dna-replication-and-repuir-2907

Programme/Class: Bachelor of Science	Year: III	Semester: V
	sibject: BOTANY	Paper-IV
SALL DAY SHALL DESCRIPTION OF THE SALL DAY OF	nojeci: BOLAINY	
Course Code: - B040504R	Course Title: Pre	eject in Botany for Pre-graduation
Course outcomes: Project work will supplement field experim transactions. project work will enhance the capability to app decision-making processes. It will promote creativity and the spirit of enqui They will learn to consult Scientists, libraries, Botanical & field trips, print and electronic in analysis & representation in form of dissertation. It will enhance their abilities, enthusiasm, and in	oly gained knowledge and un iry in learners. Inhoratories and herbariums nedia, internet etc. along w	derstanding for selecting, solving and
Credits: 03	nterest.	Core: Compulsory
Max. Marky: 25+75		
		Min. Passing Marks:
Total No. of Lectures-Tutorials-Pract		-3.
I. Rural Areas: Flora of a city/ village, Biodive	stive List Of PROJECTS	
2. Industrial waste management 3. water pollution status of rural water & prom 4. Plant Disease identification in farms, aurser 5. Digital portal for plants: Campus, city or p 6. Rare and endangered plants & their conserv 7. Air pollution tolerance index (APTI): Sci particular area 8. Science Communication by Creating science Websites, Blogs, Youtube, Podeast etc.) 9. Science Outreach Talks and Public Sensitiza 10. Phytochemistry of medicinal plants & their 11. Study of pollen grains in different flowers 12. Study of various types of secretory and spec	ries and orchards, uticular area ution & domestication receiving of sensitive/tolerant e documentaries of innovate tion for plant biodiversity cor antimicrobial, nutraceutical tissues in plants.	ors , Internet Science (Social media,
Refer: libraries, journals, Memoirs, encyclopaedias, This course can be opted as an elective by the stude	herbaria, Museums, etc.	
Suggested Continuous Evaluation Methods:	its of following subjects:	Open to all
Continuous Internal Evaluation shall be based on follows:	allotted Assignment and Cla	ss Tests. The marks shall be as
Internal Assessmen	nt	Marks
Class Interaction		5
Seminar		10
Thesis/dissertation		20
		25

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.iitkep.ac.in/

https://asiafoundation.org/what-we-do/books-for-asia/gelid=CjwKCAiA7939BRBMErwA-hX5J-

QhBITSvPnvi3r8veio-L9f5uTv1a6oEoALCLa9Ebu0pvz858vQZxoC5wkQAvD_BwF

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

http://www.nlib.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

5.55	ogramme/Class: Bachelor of Science	I udr. III	Semester: VI Paper-I
		Subject: Botany	
	Course Code: B040601T	Course Title: Cytogenetics, Plant Breeding &?	Vanotechnolog
Course	e outcomes: After the completion of the cou	rse the students will be able:	
2. Un 3. Int	terpret the Mendel's principles, acquire know	ation of chromatin and concept of cell division. vledge on cytoplasmic inheritance and sex-linked in me hypothesis* along with the molecular mechanism	heritance.
	Credits: 4	Core C	ompulsory
	Max. Marks: 25+75	Min. Pa	sing Marks:
	Total No. of Lectures-Tute	orials-Practical (in hours per week): 4-0-0	- State Black Comments
Unit	1	Горіє	No. of Lectures (60hrs)
1	Cell biology Structure and function of cell wall, plasma membrane, ribosomes, Endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and cell inclusions - Organization of nucleus: nuclear envelope, nucleoplasm and nucleolus. Chromosomal nomenclature- chromasids, centromere, telomere, satellite, secondary constriction. Organization of chromosomes- Nucleic acid and histones- types and classification. Lampbrush chromosomes and polytene chromosomes- Karyotype and idiogram. Cell cycle: G0, G1, S and G2 phases - mitosis: open and clased mitosis - amitosis - meiosis. Variation in Chromosome number (Numerical aberrations) - anueploidy and Euploidy-haploidy, polyploidy- significance (Structural aberrations) - deletion, duplication, inversion and translocation.		
п	Genetics Chromosome theory of inheritance, crossing over and linkage; Incomplete dominance and codominance; Interaction of Genes; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Polygenic inheritance; Extra-nuclear Inheritance, Linkage, crossing over, Concept of sex determination and Sex chromosomes; Patterns of Sex determination in plants		7
п	Plant breeding Plant introduction. Agencies of plant introduction in India, Procedure of introduction Acclimatization — Achievements, Selection — mass selection, pure line selection and clona selection. Genetic basis of selection methods, Hybridization: Procedure of hybridization, integeneric, inter specific, inter varieties, hale sterility. Heterosis and its exploitation in plant breeding. Mutation, Molecular Breeding (use of DNA markers in plant breeding), achievements in India, Breeding for pest pathogenic diseases and stress resistance.		100
v	Biostatistics: Definition, statistical methods, basic limitations and uses of statistical Biomet Frequency distribution- definition only.	principles, variables- measurements, functions, try: Data, Sample, Population, random sampling, Central tendency- Arithmetic Mean, Mode and	7
	median; Measurement of dispersion-Coel error of Mean; Test of significance: chi-sq in biostatistics - MS Excel and SPSS Plant tissue culture	fficient of variation, Standard Deviation, Standard quare test for goodness of fit. Computer application	

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

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

- 0.000
- 3. Cell Biology And Genetics (Hindi) 2/e PB....Gupta P K (Hindi) rastogi Publications
- PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors: H. R. Dagla Jai Narain Vyas University
- Biotechnology: Fundamentals And Application (hindi) (hb) ISBN: 9788177544732Edition: 03Year: 2018Author: Dr. Purohit SS, Mathur S
- Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani Publishers ISBN: 9789327246070, 9327246071
- Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-0066-1Sunil D Purohit & Gotam K Kukda, Apex Publishing House
- Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House
- Padap Prajanan (Hindi) Hardcover 1 January 2016 by Chandra Prakash Shuki (Author) Pointer Publishers, Jaipur
- 10. PLANT BREEDING: PRINCIPLE AND METHODS B D SINGH IN HINDI
- 11. 000000 000 00000000 0000-000000 Commission for Scientific and Technical Terminology (CSTT)
- 12. DUDU DELL'ORDO DELL'OR
- 1. G.M. Cooper. (2015). The cell: A Molecular Approach, 7th Edition. Sinauer Associates.
- Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of Cell. 6th Edition. WW. Norton & Co.
- 3. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.
- 4. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
- 5. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nd ed., W.H.Freeman.
- 6. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) Biochemistry, W.H.Freeman and Company

- 7. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
- 8. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
- Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8th edition. Pearson Education Inc. U.S.A.)
- 10. Gardner, E.J., Simmons, M.J., Smustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th c
- 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.,
- 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. Sandhyn Mitra, (1998) Elements of molecular biology. Macmillan, India Ltd.
- 29. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi
- 30. Sharma, A.K and Sharma A (1980) Chromosome technique Theory and practice, Aditya Books, New York
- 31. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, NewYork.
- 32. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd.
- 33. Twymann, R.M. (1998) Advanced molecular biology Viva books New Delhi.
- 34. Veer Baia 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, Vilos Publishing House, Pvt. Ltd., New Delhi.
- 40. P.C. Trivedi ,Plant biotechnology, Recent Advances Panima Publishing Corporation, New Delhi.
- 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
- 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.
- 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 Hill.
- 47. Ramesh Bangiu Learning Computer Fundamentals., Khanna Book Publishers
- 48 Bass, Joel E and et. al., Allyn & Bacon, 2009 Methods for Teaching Science as Inquiry, The troth 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 Sciencea BS Publications. New Delhi
- 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

Gupta, S.C. (2016) Fundamentals of Statistics . Himulaya Publishing House Mumbai - 400004, Maharashtra, India.

V.K. Kapoor (2007) Fundamentals of Applied statistics by Sultan Chand and Sons, New Delhi- 110 002
 Yubing Xie. 2012. Nanotechnology. CRC Press The Nanobiotechnology Handbook. CRC Press.

Sulabha K, Kulkumi. 2014 Nanotechnology: Principles and Practices. CP publishing, New Dethi.
 B S Murty, P Shankar, Baldev Raj, B B Rath, James Murday. 2012. Textbook of Nanoscience and Nanotechnology.

61.K. K. Chattopadhyny and A. N. Banarjee. 2009. Introduction to Nanoscience and Nanotechnology. PHI

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.

R. Stephen Crespi, Tibtech, Patenting in Biotechnology - Part 1, Vol. 9, 117-122, 1991.

Pattnaik, P.K., Kumar, R., Pal, S., Panda, S.N. (Eds.) loT and Analytics for Agriculture, 2020
 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. Blotech, 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.aset.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

Progr	rumme/Class: Bachelor of Science	Year: III	Semeste	
		Subject: Betany	Paper-I	
	Potecoar			
	ourse Code: B040602T se outcomes:	Course Title: Ecology & E	invironment	
1. 2. 3.	acquaint the students with complex is make them understand mothods for ecosystem functions, and principles. This knowledge is critical in evolving and biodiversity conservation.	studying vegetation, commu- of phytogeography.	aity patterns and proc	resses,
	Credits: 4		Core Compulsor	y/Elective
	Max. Marks: 25+75		Min. Pa	ssing Marks:
	Total No. of Lectures-T	utorials-Practical (in hours per	r week): 4-0-0	
Unit		Topic		No. of Lecture
1	Natural resources & Sustainable management strategies; Rentoration management strategies, Ramsar a Depletion, Biological Invasion, E energy, Contemporary practices a Resource Appraisal, Ecological For Accounting.	n of degraded lands, Water, Water, Water, Water, Forests: Major and min inergy: Renewable and non-re- in resource management: ELA	etlands; Threats and nor forest products; mewable sources of GIS Participatory	7
п	Ecology & Ecosystem Definition of Ecology, Ecological F. - Concept of an ecosystem-structur Abiotic and biotic com-Energy flow Ecological Succession-Definition of autotrophic, heterotrophic, primary Food chains and feod webs, Ecolog And components. Types of ecosystems: Forest Ecos Ecological Adaptations - Hydro Parasites.	e and function of an ecosystem in an ecosystem & types. Processes and types (, & secondary), Hydrosere and 3 ical pyramids, production and p system. Grassland. Crop. land.	nutogenic, allogenic, terosere, productivity;	8
ш	Soil Formation, Properties & Cons- Soil: Origin, Formation, composition processes, Soil Erosion, Biogoochem farming, Mulching, Strip cropping, Listing, Construction of dams, Water	Soil types, Soil Profile, Soil Mical cycles, Soil Conservation: Terracing and Crop rotation	Biological Contour	7
IV	Biodiversity and its conservation: Definition—genetic, species, and e- ethical, aesthetic and option values; hi- communities and populations, the endangered species of plants in India. Conservation of Biodiversity. Ex-situ and in-situ conservation, R Sanctuaries, hot & hottest spots and B Valuing plant resources, ecotourism,	cosystem diversity. Value of otspots of Biodiversity threats to ir characteristics and dynam Ecological niche, ecotypes, eco ed data book, botanical gard hiereserves. Role of Seed Bank	biodiversity: social, biodiversity, Biotic nics. Endemic and ological indicators.	7

	E- Inches de Control d	
v	Phytogeography: Biogeographic regions of India & world, Agroecological & Fioristic zones of India. Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, Phytogeographical regions of India, Vegetational types in Utar Fradesh.	7
VI	Environmental audit & Sustainability	
	Concept of environmental audit; Guidelines of environmental audit; Methodologies adopted along with some industrial case studies, Environmental standards: ISO 14000 series; Scheme of labelling of environment friendly products (Ecomark); Life cycle analysis; Concept of energy and green audit, Strategies and debates on austainable development; Concept of Sunninable Agriculture; India's cuvironment action programme: issues, approaches and initiatives towards Sustainability; Sustainable development in practice.	8
VII	Pollution, Waste management & Circular Economy Environmental pollution, Environmental protection laws, Bioremediation, Activated Sludge Process (ASP) — Trickling Filters — oxidation ponds, fluidized bed reactors, membrane bioreactor, neutralization, ETP sludge management; digesters, up flow annerobic 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 (hazardom & non-bacardous) - classification, collection and segregation, Incineration, Pyrolysis and gasification, Sanitary landfilling; composting, Biogas production, Circular Economy & sustainability.	8
VIII	Environmental ethics, Carbon Credits & Role of GIS Carbon credit: concept, exchange of carbon credits. Carbon sequestration, importance, meaning and ways. Climate change, global warming, acid rain, exone 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 peckages, GPS survey, data import, processing, and mapping. Applications and case studies of remote sensing and GIS in land use planning, forest resources & agriculture studies.	8
Sugges	ted Readings:	
1. 2. 3. 4.	Course Books published in Hindi may be prescribed by the Universities. Environmental Studies (Hinds)(SBN 81-301-0004-5B, L. Chaudhary & Jitendra Part 2013Pages: 340 + XII Apex Publishing House Soil and Water Conservation ISBN #: 978-81-301-0071-5S, C. Mahnot & P. K. Singh Ap House Ecology And Environmental Biology (UUUUUUU000000000000000000000000000000	ocx Publishing
	ner Author: Bhatia - Jain - Kohli - Shrivastava - Singh — Verma 19900000 0000000 000 0000 00000000 0000 :00 00	Particulario
	1000 0000000 0000	and during
6.	Paryawaran Evam Pariathitiki Se (Hindi) Panerback - 20 February 2020 Maild Honore	

- Paryawaran Evam Paristhitiki Se (Hindi) Paperback 20 February 2020 Majid Husain
- Environmental Biology and Phytogeography ISBN #.978-81-301-0064-7B, L. Chaudhary, Gotam K Kukda & Jitendra Kumar Joshi
- Uge Unified: Environmental Sciences (hindi) (pb) ISBN: 9788177545814 Edition: 01Year: 2015Author: Dr. Purohit SS, Dr. Deo PP, Dr. Agrawul Ashok KPublisher: Agrobios (India)

- Chapman and Riss. Ecology: Principles and Applications, Latest Ed., Cambridge University Press
 Shukla, R.S. & Chandel, P.S. Plant Ecology, Latest Ed., S. Chandel and Co.
 Kumar, H.D. Modern Concept of Ecology, Latest Ed. Vikas Publishing House
 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

Sharma, P.D. Elements of Ecology, Latest Ed., Rastogs Publications
 Ambasht, R.S. & Ambasht, N.K. A Text Book of Plant Ecology, Latest Ed., CBS Publication & Distributors

Mani, M.S. Bio-Geography of India, Latest Ed., Springer-Verlag.
 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. Sinsuer 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 Ramssamy, 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.

Scragg, A. (1999). Environmental Biotechnology. Addison Wesley Longman, Singapore.

- 26.Tchobinoglaus, G. (1988). Wastewater Engineering: Treatment, Disposal, Reuse. Tata Mc Graw Hill, New
- 27. Aarve, V. P., William, A. W. and Debra, R. R. (2002). Solid waste engineering. Cengage residing, USA.
- 28. George, T., Hilary, T. and Samuel, A. V. (1993). Integrated solid Waste Management, Engineering Principles and Management Issues, Mc Graw Hills.
- 29. George, T. and Frank, K. (2002). Handbook of solid waste management: (Second edition). Mc Graw Hills.
- 30. Kanthi, L. S. (2000). Basics of Solids and hazardous waste management Technologies. Prentice Hall.
- 31. Anonymous. 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New York.
- 32. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries

33, with Policy and Science Considerations, Martinus Nijhoff Publishers.

34 Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.

35. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.

36. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.

37. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.

- 38, Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
- 39. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India. Universities Press, India.
- Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition). Sage Publications.
- . Demers, M.N. 2005. Fundamentals of Geographic Information System. Wiley & Sons.
- Richards, J. A. & Jia, X. 1999. Remote Sensing and Digital Image Processing. Springer.
- Sabins, F. F. 1996. Remote Sensing: Principles an Interpretation. W. H. Freeman. 43.
- Gaston, K.J. & Spicer, J.J. 1998. Biodiversity: An Introduction. Blackwell Science, London,
- Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53:80-192.
- 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. (Curntors), B.A. Archneology, 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/moce
uturelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
https://www.coursen.org/courses/query-plants
http://egyunkosh.ae.in/handic/123456789/53530

Programn	ne/Class: Bachelor of Science	Year: III	Semester: VI Paper-III
		Subject: Botany	
	Code: B040603P	Course Title: Lab on Cytogenetics, Conserv. Environment management	stion &
 To p field, 	conserving and depolluting the er	he semester-i.e. Plant tissue cultured plants, conduct	ing breeding on
	Credits: 2		Compulsory
	Max. Marks: 25+75		Passing Marks:
	Total No. of Lectures-	Tutorials-Practical (in hours per week): 0-0-2	
Unit		Tupic	No. of Lectures(60hrs)
I	Measurement of cell si Counting cells per unit (Yeast/pollen grains)	ze by the technique of micrometry. volume with the help of haemocytometer ic index and frequency of different mitotic stage.	7

п	Genetics	1
	1. Monohybrid cross (Dominance and incomplete dominance) 2. Dihybrid cross (Dominance and incomplete dominance) 3. Gene interactions (All types of gene interactions mentioned in the syllabus) a. Recessive epistasis 9: 3: 1. b. Dominant epistasis 12: 3: 1 c. Complementary genes 9: 7 d. Duplicate genes with cumulative effect 9: 6: 1 e. Inhibitory genes 13: 3 4. Observe the genetic variations among inter and intra specific plants. 5. Demonstration of Breeding techniques-Hybridization, case studies of mutation, polyploidy, emasculation experiment.	
m	Biostatistics: 1. Univariate analysis of statistical data: Statistical tables, mean, mode, median, standard deviation and standard error (using seedling population / leaflet size). 2. Calculation of correlation coefficient values and finding out the probability. 3. Determination of goodness of fit in 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	7
IV	Plant tissue culture 1. Familiarization of instruments and special equipments used in the plant tissue culture experiments 2. Preparation of plant tissue culture medium, and sterilization, Preparation of stock solutions of nutrients for MS Media. 3. Surface sterilization of plant materials for inoculation (implantation in the medium) 4. Micropropagation of potato/tomato/ - Demonstration 5. Protoplast isolation and culturing — Demonstration	8
v	Ecology & Environment 1. Ecological Adaptations: Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites 2. Study of morphological adaptations of hydrophytes and xerophytes (four each). 3. Study of biotic interactions of: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants). 4. Observation and study of different ecosystems mentioned in the syllabus. 5. Field visit to familiarize students with ecology of different sites.	8
VI	Soil Formation, Properties & Conservation Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper) Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests. Determination of organic matter of different soil samples by Walkley & Black rapid titration method. Soil Profile study Soil types of India-Map	8
VII	Biodiversity and Phytogeography: 1. Study of community structure by quadrat method and determination 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	7

	Phytogeographical areas of India	
viii	Pollution & Waste management 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.	7
	6. Microbiological assessment of drinking water using MFN 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	

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

- 1. Practical Botany (Part III) Author: Sunil D Purohit, Anamika Singhvi & Kiran Tak 2013 Apex Publishing House, Raj.
- 2. Practical Botany (Part II) Author: N. C. Aery, Sunil D Purohit & Gotam K Kukda 2013 Apex Publishing House, Raj.
- 4. A Handbook Of Soil, Fertilizer And Manure (2nd Ed.) (pb) ISBN: 9788177544152Edition: 02Year : 2017Author : Gupta PKPublisher : Agrobios (India)
- 5. Green Technology: An Approach For Sustainable Environment ISBN: 9788177543438Edition: 01Year : 2021Author : Dr. Purchit 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.uc.in/index.php/home/subjects?domain=Life+Science&subdomain=Botuny http://heecontent.upsdc.gov.in/Home.uspx

(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. (Cumters), B.A. Geology.

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

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	В
	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/tage/genetics https://www.coursen.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- H/ Paper-IV
	Subject: BOTANY	
Course Code: - B040604R	Course Title: Project in Bo	stany for Graduation
transactions. project work will enhance the capability decision-making processes It will promote creativity and the spirit They will learn to consult Scientists, li	ty to apply gained knowledge and under to fenquiry in learners. thraries, laboratories and herbariums an- tonic media, internet etc. along with dat issertation writing	estanding for selecting, solving and
Crodits: 03	Core: Compuls-	ory
Max. Marks: 25+75	Min. Passing M.	arks:
Total No. of Lectures-Tutorials-Prac	tical (in hours per week): 0-0-3.	
SUGGE	ESTIVE LIST OF PROJECTS	

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

Develop Green house facility in college and grow plants. Develop hydroponics facility in college and grow plants.

Develop botanical garden in the college with labelling

Vertical gardens, roof gardens.

Culture & art of making bonsai.

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

Aided Designing)

Phytochemical Analysis of Medicinal plants

Bio composting and Vermicomposting. Performing Aromatherapy by essential Oils

Refer: libraries, journals, Memoirs, encyclopaedias, herburia, 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

arted Continuous Evaluation Mathoda

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.uspx

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

aptel.iitm.ac.in

https://asiafoundation.org/what-we-do/books-for-asia/gelid=CiwKCAiA7939BRBME;wA-hX5J-QhBITSyPnvj3r8yeio-L9f5uTyla6oEoALCLa9Ebs0pyz858yQZxoC5wkQAvD_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.iscnaepur.ac.in/knowledge_learning_files/5.7_General_Open_Access_e-Resources.pdf