

**DR. RAMMANOHAR LOHIA AVADH UNIVERSITY
AYODHYA, UTTAR PRADESH, INDIA**



Four Year Undergraduate Programme (FYUP)

BOTANY

Syllabus of

FOUR YEAR B.Sc. HONOURS/RESEARCH

OR

M.Sc. IN BOTANY

SESSION 2026-2027 ONWARDS

[Signature] *[Signature]* *[Signature]*
Rakha

**Dr. Rammanohar Lohia Avadh
University, Ayodhya**

**NEP Course structure
for
Four Year
Undergraduate Botany Programme
w.e.f.
Session 2026-2027**



**As Approved by
Board of Studies (Botany)
Dr. Rammanohar Lohia Avadh University, Ayodhya**

[Signature]
[Signature]

Manish

[Signature]

[Signature]

BOARD OF STUDY BOTANY
Dr. Rammanohar Lohia Avadh University, Ayodhya

S.No.	Name	Designation	Department	College/University
1.	Prof. (Dr.) Vinay Kumar Singh	Convener	Botany	K. S. Saket PG College, Ayodhya
2.	Prof. (Dr.) Munna Singh	Member	Botany	Lucknow University, Lucknow
3.	Prof. (Dr.) V. N. Pandey	Member	Botany	D. D. U. Gorakhpur University, Gorakhpur
4.	Prof. (Dr.) Satya Narayan	Member	Botany	Allahabad University, Prayagraj
5.	Prof. (Dr.) Manish Kumar Singh	Member	Botany	K. S. Saket PG College, Ayodhya
6.	Dr. Rekha Sharma	Member	Botany	L. B. S. PG College, Gonda

Invited Member:

1. Prof. Shailendra Kumar —



Manish




Semester-wise Titles of the Papers in B.Sc. (Botany)					
Semester	Course Code	Paper Title	Theory/ Practical	Credits	Degree
FIRST YEAR					
I	B040101T	Microbiology & Plant Pathology	Theory	4	Certificate Course in Microbial Technology & Classical Botany
	B040102P	Techniques in Microbiology & Plant Pathology	Practical	2	
II	B040201T	Archegoniates & Plant Architecture	Theory	4	
	B040202P	Land Plants Architecture	Practical	2	
SECOND YEAR					
III	B040301T	Flowering Plants Identification & Aesthetic Characteristics	Theory	4	Diploma in Plant Identification, Utilization & Ethnomedicine
	B040302P	Plant Identification technology	Practical	2	
IV	B040401T	Economic Botany, Ethnomedicinc & Phytochemistry	Theory	4	
	B040402P	Commercial Botany & Phytochemical Analysis	Practical	2	
THIRD YEAR					
V	B040501T	Plant Physiology, Metabolism & Biochemistry	Theory	4	Bachelor of Science (3 Year UG degree)
	B040502T	Molecular Biology & Bioinformatics	Theory	4	
	B040503P	Experiments in physiology, Biochemistry & molecular biology	Practical	2	
	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	

[Signature]

[Signature]

[Signature]

[Signature]

FOURTH YEAR

Semester	Type of Paper	Course Code	Course Title	Theory/Practical	Credit	Degree
VII	Core	B040701T	Microbiology	Theory	4	FYUP B.Sc. (Hons.) Or M.Sc. Previous
	Core	B040702T	Fungi and Plant Pathology	Theory	4	
	Core	B040703T	Algae and Bryophytes	Theory	4	
	Elective-I	B040704T	Bacteria, Virus and Lichen	Theory	4	
		B040705T	Environment and Plant Response	Theory	4	
	Elective-II	B040706P	Practical based on Core/Elective Course	Practical	4	
		B040707P	Field Visit/Botanical Excursion	Practical	4	
	Core	B040801T	Pteridophyta, Gymnosperms and Paleobotany	Theory	4	
	Core	B040802T	Angiosperms: Taxonomy	Theory	4	
	Core	B040803T	Angiosperms: Plant Development and Reproduction	Theory	4	
VIII	Elective-III	B040804T	Floriculture and Nursery	Theory	4	
		B040805T	Plant Resource Utilization and Applied Botany	Theory	4	
	Elective-IV	B040806P	Practical based on Core/Elective Course	Practical	4	
		B040807P	Industrial Training/Project Presentation	Practical	4	

OR

VII & VIII	12 Months Apprenticeship/ Internship through NATS or from equivalent organization/ Industry/ Institute	Duration: 1200 Hours	40	Apprenticeship/ Internship embedded UG Degree Programme
Comments	External Project/Dissertation for Semester VII & VIII will be carried out by the students in various recognized/established labs of Parent/Other Universities, of Institutes under CSIR, ICMR, IIT, ICAR, DST, DBT, Industry, Government Departments etc. (to be arranged by the students themselves, including whatever expenses become due in this regard).			
• Botany Course is one of the Major Subjects for Biology Students and Minor or Elective for students of other faculties.				

Dr. Manish D. Debha

Programme outcomes (POs):

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

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.

Subject prerequisites:

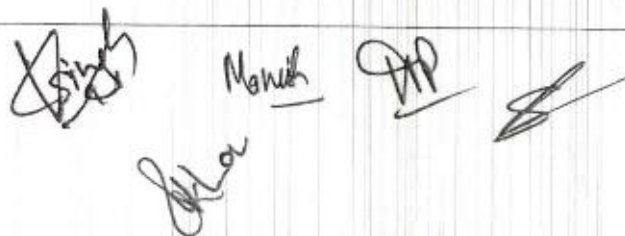
1. To study Botany, a student must have had the subject Biology/Biotechnology learnt at 10+2 level.
2. Keen interest in plants and plant-related research. Potential in mathematics, biology and chemistry
3. Skills and aptitude for scientific study and research
4. Creativity and good comprehension while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

COURSE INTRODUCTION

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

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

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



Programme specific outcomes (PSOs):

B.Sc. I Year / Certificate course in Microbial Technology & Classical Botany

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

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

Programme specific outcomes (PSOs):

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

This course provides a broad understanding of identifying, growing and using plants. This course is primarily aimed to introduce people to the richness of plant diversity found in surrounding areas. Lecture sessions are designed to cover fundamental topics concerning classification of plants and their utilization required for understanding the flora and vegetation. Practical sessions are organized following theory for easy understanding of the various parts of the plants, structural organization of floral parts and diversity therein. Participants are taken to different locations covering a variety of habitats and forest types to acquaint them with the native flora in the long run, will contribute towards building momentum for people's participation in environmental conservation without compromising on academic rigor and our rich wealth of knowledge inherited over generations.

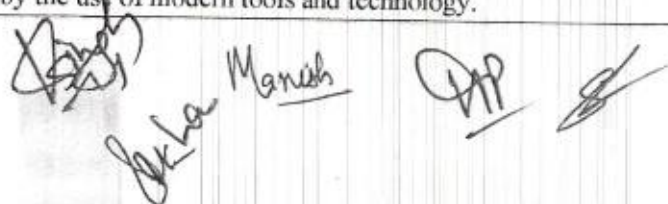
1. The course will cover conventional topics in Field Botany like Evolutionary History & Diversity of plants, Complete Morphology, Nomenclature of plants, Systems of Classification, Keys to important Families of Flowering Plants, Field Data Collection & Herbarium Techniques.
2. The course is designed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

Programme specific outcomes (PSOs):

B.Sc. III Year / Bachelor of Science

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

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


Jyoti Manish
DP

PSO 1	Understanding the nature and basic concepts of all the plant groups, their metabolism, components at the molecular level, biochemistry, taxonomy and ecology. The course will make them aware of natural resources and 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 generat technical personnel in various priority areas such as genetics, cell and molecular biology, plant systematics and biotechnology.
PSO 2	Botanists are able to contribute to all these fields and therefore, are mainly employed with educational institutions, government or public sectors or companies in industries, such as agriculture or forestry, oil, chemical, biotechnology, geological survey, environmental protection, drugs, genetic research, plant resources laboratories, plant health inspection services, lumber and paper, food, fermentation, nursery, fruit and so on. Jobs available as a Botanist: •Microbiologist, Plant pathologist, Taxonomist • Plant Physiologist • Plant Biochemist • Researcher • Mycologist • Ecologist • Weed Scientist • Palaeobotanist • Conservationist • Fruit Grower • Morphologist • Cytologist • Ethnobotanist • Plant geneticists etc.
PSO 3	Inculcate strong fundamentals on modern and classical aspects of Botany, understand knowledge of Botany is an essential pre-requisite for the pursuit of many applied sciences. It will facilitate students for taking up and shaping a successful career in Botany and allied sciences.
PSO 4	Introduction of research project will inculcate research aptitude and passion for higher education and scientific research.

Internal Assessment & External Assessment

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

Handwritten signature

Handwritten signature

Handwritten signature

Handwritten signature

Handwritten signature

**Proposed Year wise Structure of B.Sc. in Botany
(CORE / ELECTIVE COURSES & PROJECTS)**

Subject: Botany

Subject: Botany											Total Credits hrs
Course Entry-Exit levels	Year	Sem.	Paper 1	Credit hrs	Paper 2	Credit hrs	Paper 3	Credits hrs	Research Project	Credit	
Certificate Course In Microbial Technology & Applied Botany	I	I	Microbiology & Plant Pathology	4.60	Techniques in Microbiology & Plant Pathology	2.60	--		Nil	Nil	6.120
		II	Archegoniates & Plant Architecture	4.60	Land Plants Architecture	2.60	--		Nil	Nil	6.120
	II	III	Flowering Plants Identification & Aesthetic Characteristics	4.60	Plant Identification technology	2.60	--		Nil	Nil	6.120
		IV	Economic Botany, Ethnomedicine & Phytochemistry	4.60	Commercial Botany & Phytochemical Analysis	2.60			Nil	Nil	6.120
Bachelor of Science		V	Plant Physiology, Metabolism & Biochemistry	4.60	Molecular Biology & Bioinformatics	4.60	Experiments in physiology, Biochemistry &	2.60	*Project-I	3.45	13.205
	III						molecular biology				
		VI	Cytogenetics, Plant Breeding & nanotechnology	4.60	Ecology & Environment	4.60	Cytogenetics, Conservation & Environment management	2.60	*Project-II	3.45	13.205

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

DETAIL SYLLABUS FOR
CERTIFICATE COURSE IN MICROBIAL
TECHNOLOGY & CLASSICAL BOTANY
OR
B.Sc.-I YEAR

CERTIFICATE COURSE IN MICROBIAL TECHNOLOGY & CLASSICAL BOTANY / B.Sc.-I			
Programme: <i>Certificate Course in Microbial Technology & Classical Botany</i>		Year: I	Semester: I Paper-I
Subject: Botany			
Course Code: B040101T	Course Title: Microbiology & Plant Pathology		
Course outcomes: After the completion of the course the students will be able to:			
1. Develop understanding about the classification and diversity of different microbes including viruses, Algae, Fungi & Lichens & their economic importance. 2. Develop conceptual skill about identifying microbes, pathogens, biofertilizers & lichens. 3. Gain knowledge about developing commercial enterprise of microbial products. 4. Learn host-pathogen relationship and disease management. 5. Learn Presentation skills (oral & writing) in life sciences by usage of computer & multimedia. 6. Gain Knowledge about uses of microbes in various fields. 7. Understand the structure and reproduction of certain selected bacteria algae, fungi and lichens 8. Gain Knowledge about the economic values of this lower group of plant community.			
Credits: 4		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0			
Unit	Topic		No. of Lectures (60 hrs)

[Signature]

[Signature]

[Signature]

[Signature]

I	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 Microscopy – Light, phase contrast, electron, scanning 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.	8
II	Microbial world Cell structure of Eukaryotic and prokaryotic cells, Gram positive and Gram-negative bacteria, Structure of a bacteria; Bacterial Chemotaxis and Quorum sensing, Bacterial Growth curve, factors affecting growth of microbes; measurement of growth; Batch culture, fed batch culture and continuous culture; Synchronous growth of microbes; Sporulation and reproduction and recombination in bacteria. Viruses, general characteristics, viral culture, Structure of viruses, Bacteriophages, Structure of T4 & λ-phage; Lytic and Lysogenic cycles, viroid, Prions & mycoplasma & phytoplasma, Actinomycetes & plasmids and their economic uses.	8
III	Phycology Range of thallus organization in Algae, Pigments, Reserve food – Reproduction – Classification and life cycle of – <i>Nostoc</i>, <i>Chlorella</i>, <i>Volvox</i>, <i>Hydrodictyon</i>, <i>Oedogonium</i>, <i>Chara</i>; <i>Sargassum</i>, <i>Ectocarpus</i>, <i>Polysiphonia</i>. 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 Mastigomycotina, Zygomycota: <i>Rhizopus</i>, <i>Aseomycota</i>: <i>Saccharomyces</i>, <i>Penicillium</i>, <i>Peziza</i>. Basidiomycotina: <i>Ustilago</i>, <i>Puccinia</i>, <i>Agaricus</i>; <i>Deuteromycotina</i>: <i>Fusarium</i>, <i>Alternaria</i>. Heterothallism, Physiological specialization, Heterokaryosis & Parasexuality.	7
V	Mushroom Cultivation, Lichenology & Mycorrhiza Mushroom cultivation. General account of lichens, reproduction and significance; <i>Mycorrhiza</i>: <i>ectomycorrhiza</i> and <i>endomycorrhiza</i> 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, <i>Alternaria</i> spot and 'White rust of Crucifers, Red Rot of Sugarcane, Wilting of Arhar, Mosaic diseases on tobacco and cucumber, yellow vein mosaic of bhindi; Citrus Canker, Little leaf of brinjal; Damping off of seedlings, Disease management: Quarantine, Chemical, Biological, Integrated pest disease management	8

[Signature]

Manish

[Signature]

[Signature]

[Signature]

v. http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri/wgbis_info/botany_history.pdf

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

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

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

UNIT-I B.

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Aggarwal, S. K. 2009, Foundation Course in Biology, A one books Pvt. Ltd., New Delhi.
5. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
6. Annie Ragland, 2012. Algae and Bryophytes, Saras Publication, Kanyakumari, India
7. Basu, A. N. 1993. Essentials of Plant Viruses, Vectors and Plant diseases, New Age International, New Delhi.
8. Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut, India.
9. Desikachari, T. V. 1959. Cyanophyta, ICAR, New Delhi.
10. Dubey, R. C. and Maheshwari, D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., New Delhi.
11. Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press, London.
12. Kodo, C.I. and Agarwal, H.O. 1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, New York.
13. Agrios, G.N. (1997). Plant Pathology, 4th edition. Cambridge, U.K.: Academic Press.
14. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, 4th edition. Singapore, Singapore: John Wiley & Sons.
15. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies. Noida, U.P.: Macmillan Publishers India Ltd.
16. Reven, F.H., Evert, R. F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Company.
17. Sharma, P.D. (2011). Plant Pathology. Meerut, U.P.: Rastogi Publication.
18. Webster, J., Weber, R. (2007). Introduction to Fungi, 3rd edition. Cambridge, U.K.: Cambridge University Press.
19. Pandey B.P. 2001. College Botany Volume I, S Chand & Company Pvt. Ltd, New Delhi.
20. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
21. Pelzar, 1963. Microbiology, Tata Mc Graw Hill, New Delhi
22. Rangaswamy, G. 2009. Disease of Crop Plants in India, Prentice Hall of India, New Delhi.
23. Sambamurthy. A.V.S.S. 2006. A Text book of Algae, I. K. International Publishing House, Pvt. Ltd., New Delhi.
24. Sharma, P. D. 2012, Microbiology and Plant Pathology, Rastogi Publication Pvt Ltd., Meerut, India.
25. Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, New Delhi.
26. Smith. G. M. 1996. Cryptogamic Botany Volume I, Tata Mc Graw Hill, New Delhi.
27. Sundar Rajan. S. 2010. College Botany Volume I, Himalaya Publications, Mumbai.
28. Vashishta, B.R. Sinha, A.K. and Singh, V. P. 1991. Algae, S. Chand and Company, Pvt. Ltd., New Delhi

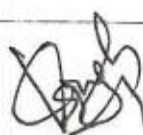
This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS.

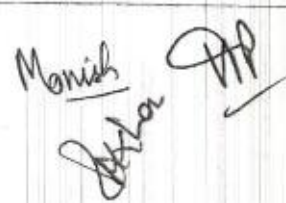
Suggested Continuous Evaluation Methods:

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

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

Course prerequisites:



Monish




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.udenry.com/topic/microbiology/>

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

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

<https://eclambathach.in/lms/Economic%20importance%20of%20Algae.pdf>

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

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

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

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

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

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

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

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

<https://www.apsnet.org/edcenter/disimpactnmgmt/topc/EpidemiologyTemporal/Pages/ManagementStrategies.aspx>

<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://lipidnanoststructuresgroup.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

Programme: *Certificate Course In Microbial Technology & Classical Botany*

Year: I Semester: I/Paper-II

Subject: Botany

Course Code: B040102P

Course Title: Techniques in Microbiology & Plant Pathology

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

1. Understand the instruments, techniques, lab etiquettes and good lab practices for working in a microbiology laboratory.
2. Develop skills for identifying microbes and using them for Industrial, Agriculture and Environment purposes.
3. Practical skills in the field and laboratory experiments in Microbiology & Pathology.
4. learn to identify Algae, Lichens and plant pathogens along with their Symbiotic and Parasitic associations.
5. Can initiate his own Plant & Seed Diagnostic Clinic
6. Can start own enterprise on microbial products

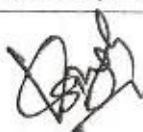
Credits:2

Core Compulsory

Max. Marks: 25+75

Min. Passing Marks:

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



Manish





Unit	Topic * (Minimum Any three from each unit depending on facilities)	No. of Lectures (60 hrs)
I.	INSTRUMENTS & TECHNIQUES 1. Laboratory safety and good laboratory practices 2. Principles and application of Laboratory instruments-microscope, incubator, autoclave, centrifuge, LAF, filtration unit, shaker, pH meter. 3. Buffer preparation & titration 4. Cleaning and Sterilization of glasswares 5. Preparation of media- Nutrient Agar and Broth 6. Inoculation and culturing of bacteria in Nutrient agar and nutrient broth 7. Preparation of agar slant, stab, agar plate - Phenol Coefficient method to test the efficacy of disinfectants	7
II	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, Nitrate reduction test, Catalase test, Oxidase test, Starch hydrolysis, Casein hydrolysis.	8
III	MYCOLOGICAL STUDY: 1. Isolation of different fungi: Saprophytic, Coprophilous, Keratinophilic. 2. Identification of fungi by lactophenol cotton blue method. <i>Rhizopus, Saccharomyces, Penicillium, Peziza, Ustilago, Puccinia, Fusarium, Curvularia, Alternaria</i>. 3. <i>Agaricus</i>: Specimens of button stage and full grown mushroom; Sectioning of gills of <i>Agaricus</i>. 4. Lichens: crustose, foliose and fruticose specimens.	8
IV	PHYCOLOGY: 1. Type study of algae and Cyanobacteria - <i>Spirulina, Nostoc</i>. Chlorophyceae - <i>Chlorella, Volvox, Oedogonium, Cladophora</i> and <i>Chara</i>; Xanthophyceae - <i>Vaucheria</i>; Bacillariophyceae - <i>Pinnularia</i> Phaeophyceae - <i>Sargassum</i> Rhodophyceae - <i>Polysiphonia</i>	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, pycnial & aecial stages of <i>Puccinia</i>, Few viral and bacterial plant diseases.	8
VI	PRACTICALS IN APPLIED MICROBIOLOGY-1 1. Isolation of nitrogen fixing bacteria from root nodules of legumes. 2. Enumeration of rhizosphere to non rhizosphere population of bacteria. 3. Isolation of antagonistic <i>Pseudomonas</i> from soil. 4. Microscopic observations of root colonization by VAM fungi. 5. Isolation of <i>Azospirillum</i> 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 sulphate reducing bacteria. 8. Isolation and characterization of acidophilic, alkalophilic and halophilic bacteria.	8
VIII	1. Cultivation of <i>Spirulina</i>, & <i>Chlorella</i> in lab for biofuel 2. Visit to NBRI, Mau, Varanasi (Kashi)/ IMTECH (Institute of Microbial Technology), Chandigarh for viewing Culture Repository 3. Visit to biofertilizers and biopesticides unit to understand about the Unit operation procedures 4. Mushroom cultivation for Protein	6

[Signature]

Manish

[Signature]

[Signature]

Suggested Readings:

1. [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED] [REDACTED]

- 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.

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

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

[Signature]

Manish

Sh Sh



Course prerequisites:

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

Facilities: Smart and Interactive Class

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

Lab Requisites: Microscopes, Stains, Dissection box, Haemocytometer, Specimens, Permanent slides, Autoclave, incubator, Oven, laminar flow cabinet, balances, Fermenter, Anaerobic jar and Spectrophotometer.

Suggested equivalent online courses:

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

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

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

<https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68e3175c.pdf>

<http://allaboutalgae.com/benefits/>

<https://repositorv.cimmyt.org/xmlui/bitstream/handle/10883/3219/64331.pdf>

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

<http://www.eprints.iiit.ac.in/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%207BAshok%20Bendre%7D%20%205B8171339239%5D%20%20281984%29.pdf>

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

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

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

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

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

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

Programme/Class: B.Sc.-I/ Certificate Course In Microbial Technology & Classical Botany		Year: I	Semester: II Paper-I
Subject: Botany			
Course Code: B040201T		Course Title: Archegoniates and Plant Architecture	
Course outcomes: After the completion of the course the students will be able to: 1. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms 2. Understanding of plant evolution and their transition to land habitat. 3. Understand morphology, anatomy, reproduction and developmental changes therein through typological study and create a knowledge base in understanding the basis of plant diversity, economic values & taxonomy of plants 4. Understand the details of external and internal structures of flowering plants.			
Credits: 4		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0			

Unit	Topic	Lectures (60hrs)
I	Introduction to Archegoniates & Bryophytes Unique features of archegoniates, Bryophytes: General characteristics, adaptations to land habit, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of <i>Riccia</i> , <i>Marchantia</i> , <i>Anthoceros</i> and <i>Sphagnum</i> . (Developmental details not to be included). economic importance of bryophytes.	7
II	Pteridophytes General characteristics, Early land plants (<i>Rhynia</i>). Classification (up to family) with examples, Heterospory and seed habit, stelar evolution, economic importance of Pteridophytes.	8
III	Gymnosperms Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, their examples, structure and reproduction; economic importance	8
IV	Palaeobotany 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 stem- cambium (structure and function) annular rings, Anomalous secondary growth - <i>Bignonia</i>, <i>Boerhaavia</i>, <i>Dracaena</i>, <i>Nyctanthes</i>	7
VII	Reproductive Botany Plant Embryology, Structure of microsporangium, microsporogenesis, , Structure of megasporangium and its types, megasporogenesis, Structure and types of female gametophyte, types of pollination, Methods of pollination, Germination of pollen grain, structure of male gametophyte, Fertilization, structure of dicot and monocot embryo, Endosperm, Double fertilization, Apomixis and polyembryony.	8
VIII	Palynology: Pollen structure, pollen morphology, pollen allergy , Applied Palynology: Basic concepts, Palaeopalynology, Aeropalynology, Forensic palynology, Role in taxonomic evidences.	7

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

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

3. ଉପରୋକ୍ତ ଶୁଦ୍ଧିକରଣ ପ୍ରକଳ୍ପର ଉଦ୍ଦେଶ୍ୟ ହେଉଛି ଏସପିଏ ପ୍ରକଳ୍ପର 2017 ଶୁଦ୍ଧିକରଣ ପ୍ରକଳ୍ପର ଉଦ୍ଦେଶ୍ୟକୁ ପୂରଣ କରିବା।

1. Gangulee H. S. and K. Kar 1992. College Botany Vol. I and II. (New Central Book Agency)
2. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
4. Rashid A (1999) An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi.
5. Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi.
6. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Pteridophyta, S. Chand and Company.
7. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Gymnosperms, S. Chand and
8. Parihar NS (1976) Biology and Morphology of Pteridophytes. Central Book Depot.
9. Bhatnagar SP (1996) Gymnosperms, New Age International Publisher.
10. Pandey BP (2010) College Botany Vol II S. Chand and Company, New Delhi
11. Maheswari, P. 1971. An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London
12. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
13. Bhojwani, S.S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House.
14. P.K.K. Nair- A textbook of Palynology.
15. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verlag, Berlin.
16. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
17. E.J.Eames. Morphology of Vascular Plants, Standard University Press.
18. Dickinson, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
19. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
20. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

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

Shish

Monist

[Signature]

Stefano



Course prerequisites:

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

Facilities: Smart and Interactive Class ,wifi facility

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

Suggested equivalent online courses:

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

<https://pteridportal.org/portal/index.php>

<https://www.conifers.org/22/gymnosperms.php>

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

<https://milneorchid.weebly.com/plant-id-for-beginners.html>

<https://www.botany.org/PlantImages/PlantAnatomy.php>

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

<https://palynology.org/>

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

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

<https://palaeobotany.org/>

[Signature]

Manish

[Signature]

[Signature]

[Signature]

Programme/Class: <i>Certificate Course In Microbial Technology & Classical Botany</i>		Year: I	Semester: II Paper-II (Practical)
Subject: Botany			
Course Code: B040202P		Course Title: Land Plants Architecture	
Course outcomes: 1. The students will be made aware of the group of plants that have given rise to land habit and the flowering plants. Through field study they will be able to see these plants grow in nature and become familiar with the biodiversity. 2. Students would learn to create their small digital reports where they can capture the zoomed in and zoomed out pictures as well as videos in case they are able to find some rare structure or phenomenon related to these plants. 3. Develop an understanding by observation and table study of representative members of phylogenetically important groups to learn the process of evolution in a broad sense. 4. Understand morphology, anatomy, reproduction and developmental changes therein through typological study and create a knowledge base in understanding plant diversity, economic values & taxonomy of lower group of plants 5. Understand the composition, modifications, internal structure & architecture of flowering plants for becoming a Botanist.			
Credits: 2		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-2			
Unit	Topic	No. of Lectures	
I	Bryophytes: <i>Marchantia</i> - morphology of thallus, W.M. rhizoids and scales, V.S. thallus through Gemma cup, W.M. gemmae (all temporary slides), V.S. antheridiophore, archegoniophore, L.S. sporophyte (all permanent slides). <i>Sphagnum</i> - morphology, W.M. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, L.S. capsule and protonema.	8	
II	Pteridophytes: <i>Lycopodium</i> : Habit, stem T. S. strobilus V. S., <i>Selaginella</i> : Habit, rhizophore J. S., stem T. S. axis with strobilus, V.S. of strobilus, Megasporophyll and microsporophyll. <i>Equisetum</i> - Habit, rhizome and stem T.S. and V. S. of strobilus. <i>Azolla</i> - Habitat & its structure	7	
III	Gymnosperms 1. <i>Cycas</i> - seedling, coralloid root and coralloid root T. S., T. S. of leaflet and Rachis, micro and megasporophyll, male cone V. S., microsporophyll T. S. entire and V. S. of ovule. <i>Pinus</i> - Branch of indefinite growth, spur shoot, T. S of old stem and needle R.L.S and T. L. S. of stem, male and female cone, V.S. of male and female cone. 2. <i>Ephedra</i> & <i>Thuja</i> : Habit, stem T. S (young and mature), leaf T. S, male and female strobilus, V. S. of male and female cone, ovule V. S. and seed.	8	
IV	Palaeobotany & Palynology 1. Morphology of <i>Rhynia</i> and fossils gymnosperms & other groups. 2. Visit Birbal Sahni Institute of Palaeosciences or virtual conference with their scientists to learn fossilization. 3. Mark and know about Indian geographical sites rich in plant fossils.	6	
V	Angiosperm Morphology 1. To study diversity in leaf shape, size and other foliar features. 2. To study monopodial and sympodial branching. 3. Morphology of Fruits 4. Inflorescence types- study from fresh/ preserved specimens 5. Flowers- study of different types from fresh/ preserved specimens 6. Fruits- study from different types from fresh/preserved specimens 7. Study of ovules (permanent slides/ specimens/photographs)- types (anatropous, orthotropous, amphitropous and campylotropous) 8. Modifications in Roots, stems, leaves and inflorescences	8	

Manish

VI	Plant Anatomy: Normal & Anomalous secondary thickening - <i>Bignonia</i> , <i>Dracaena</i> , <i>Boerhaavia diffusa</i> , <i>Nyctanthes</i> 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 stomata.	8
VII	Reproductive Botany 1. Structure of anther, microsporogenesis and pollen grains 2. Structure of ovule and embryo sac development (through slides). 3. Study of embryo development in monocots and dicots. 4. Vegetative propagation by means of cutting, budding and grafting exercises. 5. Study of seed germination. 6. Study of pollen morphology of the following plants – <i>Hibiscus</i> , <i>Vinca</i> , <i>Balsam</i> , <i>Ixora</i> , <i>Crotalaria</i> , <i>Bougainvillea</i> by microscopic observation. 7. Calculation of pollen viability percentage using in vitro pollen germination techniques.	8
VIII	Commercial Uses and Production technology 1. <i>Azolla</i> production 2. Production technology of Resins 3. Production and propagation of Ornamental <i>Pteris</i> , <i>Cycadales</i> , <i>Coniferales</i> for landscaping. 4. Lab method for qualitative testing/ extraction of Ephedrine, Taxol and Thuja oil.	7

Suggested Readings:
Course Books published in Hindi may be prescribed by the Universities.
 १. पाण्डेय, बी.पी. और त्रिवेदी, पी.एस. १९९७. बोटनी वॉल. I (१०वां संस्करण). विकास प्रकाशन हाउस.
 २. पाण्डेय, बी.पी.; मिश्रा, त्रिवेदी, पी.एस. १९९७. बोटनी वॉल. II. विकास प्रकाशन हाउस.
 ३. पाण्डेय, बी.पी. और चड्ढा. १९९७. बोटनी वॉल. III. विकास प्रकाशन हाउस.
 ४. सान्त्रा, एस.सी. और चटर्जी. २००५. कॉलेज बोटनी प्रैक्टिकल वॉल. I. न्यू सेंट्रल बुक एजेंसी (पी) लि. दिल्ली.
 ५. कुमार, एस. और काश्यप. २००३. मैन्युअल ऑफ प्रैक्टिकल आल्गै. कैम्पस बुक्स इंटरनेशनल, न्यू दिल्ली.
 ६. बंद्रे और कुमार. २००३. अ टेक्स्ट बुक ऑफ प्रैक्टिकल बोटनी. वॉल I, II., रास्तोगी पब. मेरुत.
 ७. सुरेश कुमार, अमर सिंह काश्यप मैन्युअल ऑफ प्रैक्टिकल आल्गै. कैम्पस बुक्स इंटरनेट, न्यू दिल्ली.
 ८. सान्त्रा, एस.सी. २००५. कॉलेज बोटनी प्रैक्टिकल वॉल. II. न्यू सेंट्रल बुक एजेंसी (पी) लि.

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

[Signature]

Manish

[Signature]

[Signature]

[Signature]

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 project on Azolla cultivation.pdf](https://agritech.tnau.ac.in/banking/nabard_pdf/Azolla%20Cultivation/Model%20project%20on%20Azolla%20cultivation.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



Manish

WP
Sinha



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

Signature

Manish

DP
Sharma

Signature

Diploma in Plant Identification, Utilization & Ethnomedicine

Diploma in Plant Identification, Utilization & Ethnomedicine			
Programme /Class: <i>Diploma in Plant Identification, Utilization & Ethnomedicine</i>		Year: II	Semester: III Paper-I
Subject: Botany			
Course Code: B040301T		Course Title: Flowering Plants Identification & Aesthetic Characteristics	
Course outcomes: After the completion of the course the students will be able to:			
1. To gain an understanding of the history and concepts underlying various approaches to plant taxonomy and classification. 2. To learn the major patterns of diversity among plants, and the characters and types of data used to classify plants. 3. To compare the different approaches to classification with regard to the analysis of data. 4. To become familiar with major taxa and their identifying characteristics, and to develop in depth knowledge of the current taxonomy of a major plant family. 5. To discover and use diverse taxonomic resources, reference materials, herbarium collections, publications. 6. For the entrepreneur career in plants, one can establish a nursery, Start a landscaping business, Set up a farm Or Run a plantation consultancy firm			
Credits: 4		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0			
Unit	Topic		No. of Lectures (60hrs)
I	Taxonomic Resources & Nomenclature Components of taxonomy (identification, nomenclature, classification); Taxonomic resources: Herbarium- functions & important herbaria, Botanical gardens, Flora, Keys- single access and multi-access. Principles and rules of Botanical Nomenclature according to ICN (ranks and names; principle of priority, binomial system; type method, author citation, valid-publication).		7
II	Types of classification & Evidences Artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series) angiosperm phylogeny group (APG IV) classification. Introduction to taxonomic evidences from palynology, cytology, phytochemistry & Molecular biology data (Protein and Nucleic acid homology).		8
III	Identification of Angiospermic families -I: (Families can be chosen University wise as per local available flora) A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system) Ranunculaceae, Malvaceae, Rutaceae, Fabaceae, Myrtaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Apocynaceae, Acanthaceae, 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, Lamiaceae, Orchidaceae, Liliaceae, Musaceae, Poaceae.		7

[Signature]

Manish

[Signature]

[Signature]

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 OP02.010H11YLIP - Free Phylogenetic Software, Digital Taxonomy (e-flora), Description Language for Taxonomy – DELTA Internet directory for botany.	7
VII	Computer usage & Android Applications MS Office: PPT, Microsoft Excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media. GPS tagging, Plant Identification Apps.	7
VIII	Aesthetic Characteristics of Plants: Aesthetic characteristics of plants, English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Trees, shrubs and shrubberies, climbers and creepers, rockery, Flower beds, Shrubbery, Borders, Water garden). Some Famous gardens of India. Conservatory, green houses, Indoor garden, Roof garden, Topiary, Bonsai.	8

Suggested Readings:

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

1. **पौधों की व्यवस्थापना और वर्गीकरण (पौधों की व्यवस्थापना, पौधों की वर्गीकरण, पौधों की व्यवस्थापना और वर्गीकरण)** (पौधों की व्यवस्थापना, पौधों की वर्गीकरण, पौधों की व्यवस्थापना और वर्गीकरण) (पौधों की व्यवस्थापना, पौधों की वर्गीकरण, पौधों की व्यवस्थापना और वर्गीकरण)
2. **पौधों की व्यवस्थापना और वर्गीकरण (पौधों की व्यवस्थापना, पौधों की वर्गीकरण, पौधों की व्यवस्थापना और वर्गीकरण)** (पौधों की व्यवस्थापना, पौधों की वर्गीकरण, पौधों की व्यवस्थापना और वर्गीकरण)
3. **Propagation And Nursery Management (hindi) (hb) ISBN : 9788177546200 Edition : 01 Year : 2016 Author : Pandey S.K., Soni N. Publisher : Agrobios (India)**
4. **Dr. Amar Singh. पौधों की व्यवस्थापना (An Old and Rare Book) from the category Ayurveda in our Books collection. Uttar Pradesh Hindi Sansthan, Lucknow**
1. Plant Systematics, Arun K. Pandey & Shruti Kansana. 2020. Jaya Publishing House.
2. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay.
3. Brandis, D. (1906) Indian Trees (London, 5th edition, 1971). International Book Distributors; Dehra Dun.
4. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. <http://delta-intkey.com>
5. <https://www.naace.co.uk/school-improvement/ict-mark/>
6. <https://www.socitm.gov.uk>, (2002) Learning in the 21st century Executive briefing A Socitm Insight publication, July 2002 Socitm.
7. K. B. Anjaria, (2015) "Electronic Herbarium and Digital Database Preparation of Common Trees of Anand District, 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 (IJTER) Vol.2 No.1 January, 2013 ISSN: 2319- 4642
9. Pandey, B.P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd, New Delhi.
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.
13. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
14. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
15. Austin, R. 2002. Elements of planting design. New York: John Wiley & Sons.
16. Bertauski, T. 2005. Designing the landscape: An introductory guide for the landscape designer. Upper Saddle River, NJ: Pearson Prentice Hall.
17. Thomas, H., and S. Wooster. 2008. The complete planting design course: Plans and styles for every garden. London: Octopus Publishing Group.
18. Scarfone, S. 2007. Professional planting design: An architectural and horticultural approach for creating mixed bed plantings. New York: John Wiley & Sons.
19. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

[Signature]

Manish

[Signature]

[Signature]

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

Suggested Continuous Evaluation Methods:

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

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

Course prerequisites:

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

Facilities: Smart and Interactive Class

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

Suggested equivalent online courses:

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

<http://egvankosh.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.seneca.edu/pages/uploaded_files/Plant%20Classification.pdf

https://www.ladyskeanecollege.edu.in/files/userfiles/file/Dr_%20S_%20Nongbri%2011%20Sem%20ppt.pdf

<https://www.brainkart.com/article/Bentham-and-Hooker-s-classification-of-plants--Dicotyledonae,-Gymnospermae-and-Monocotyledonae-1000/>

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

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

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

Programme/Class : <i>Diploma in Plant Identification, Utilization & Ethnomedicine</i>		Year: II	Semester: III Paper-II (Practical)
Subject: Botany			
Course Code: B040302P		Course Title: Plant Identification technology	
Course outcomes: After the completion of the course the students will be able: 1. To learn how plant specimens are collected, documented, and curated for a permanent record. 2. To observe, record, and employ plant morphological variation and the accompanying descriptive terminology. 3. To gain experience with the various tools and means available to identify plants. 4. To develop observational skills and field experience. 5. To identify a taxonomically diverse array of native plants. 6. To recognize common and major plant families. 7. To Understand aesthetic characters of flowering plants by making-landscapes, gardens, bonsai, miniatures 8. Comprehend the concepts of plant taxonomy and classification of Angiosperms.			
Credits: 2		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-2			
Unit	Topic* *(Perform Any three experiments from each unit as per facility)		No. of Lecture (60Hrs)
I	Herbarium: Plant collecting, Preservation and Documentation: Stepwise Practicing Herbarium techniques: a. FIELD EQUIPMENTS, Global Positioning System (GPS) instrument & Collection of any wild 25 plant specimens b. Learn to handle Herbarium making tools c. Pressing and Drying of collected plant specimens d. Special treatments for all varied groups of plants e. Mount on standard herbarium sheets f. Label them using Standard method g. Organize them and give Index Register Number		7
II	Taxonomic Identification using plant structure a. Classify 25 plants on the basis of Taxonomic description (Plant Morphology, Anatomy, Reproductive parts, Habit, adaptation anomalies) according to Bentham and Hooker natural system of classification in the following families: Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Scrophulariaceae, Acanthaceae, Labiales (Lamiaceae), Rubiaceae.		8
III	Identification during excursions a. Conducting Spot identification (Binomial Family) of common wild plants from families included in the theoretical syllabus (list to be provided) and making FIELD NOTE BOOK and filling Sample of a page of field-book, used in Botanical Survey of India. b. Describe/compare flowers in semi-technical language giving V.S. of flowers, T.S. of ovaries, floral diagrams and Floral Formulae. Identify and assign them to their respective families giving reasons.		8
IV	COLLECTION, PRESERVATION AND STORAGE OF ALGAE, FUNGI BRYOPHYTES, PTERIDOPHYTES (Two each)		7
V	Botanical Nomenclature & reporting Method: a. Give nomenclature to collected plants as per ICN rules and prepare labels as per BSI b. Author Citation, Effective Publication and Principle of Priority: To show a specimen paper on Basic structure of a taxonomic Research published on a new species in taxonomic journal		7
VI	COMPUTERS 1. Learning to use EXCEL Microsoft PowerPoint and Word., WORKING WITH FOLDER AND WINDOWS UTILITY., CREATE AND MANAGE FILES AND FOLDER TREE,		7

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

Delhi.

19. Bridson, D. & L. Forman. eds. 1998. The Herbarium Handbook. 3rd ed. Royal Botanic Gardens, Kew (Reprinted 1999).
20. De Vogel, E.F. 1987. Manual of Herbarium Taxonomy: Theory and Practice. UNESCO, Jakarta.
21. Fosberg, F.R. & M.-H. Sachet. 1965. Manual for tropical herbaria. Int. Bur. Pl. Tax. & Nom., Regnum Vegetabile Vol. 39. Utrecht.
22. Jain, S.K. & R.R. Rao. 1977. A handbook of field and herbarium methods. Today & Tomorrow's Printer and Publishers, New Delhi.
23. Victor, J.E., M. Koekemoer, L. Fish, S.J. Smithies, M. Mossmer. 2004. Herbarium essentials: the South 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, Dryers, Grinder, Reference Flora

Suggested equivalent online courses:

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

Any Other :

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

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

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

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

	A project supported along with photographs taken during field study to be submitted giving comprehensive idea about different types of inflorescence, flowers and fruits/ At least three field excursions at hills/Oceans/Deserts including one Compulsory excursion to Botanical Garden, FRI/BSI and Central National Herbarium (CNH). Central Research Institutes/Hot Spots	
Programme /Class: <i>Diploma in Plant Identification, Utilization & Ethnomedicine</i>	Year: II	Semester: IV Paper-I
Subject: Botany		
Course Code: B040401T	Course Title: Economic Botany, Ethnomedicine and Phytochemistry	
Course outcomes: After the completion of the course the students will be able to: 1. Understand about the uses of plants –will know one plant-one employment 2. Understand phytochemical analysis related to medicinally important plants and economic products produced by the plants 3. know about the importance of Medicinal plants and its useful parts, economically important plants in our daily life and also about the traditional medicines and herbs, and its relevance in modern times.		
Credits: 4		Core Compulsory
Max. Marks: 25+75		Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0		
Unit	Topic	No. of Lectures (60hrs)
I	Origin and domestication of cultivated plants Centers of diversity of plants, origin of crop plants. Domestication and introduction of crop plants. Concepts of sustainable development; cultivation, production and uses of Cereals, legumes, Spices & beverages.	7
II	Botany of oils, Fibers, timber yielding plants & dyes Study of the plants with Botanical names, Family, part used, and economic uses yielding Edible & essential oils; Sugar, Starch; Fibers; Paper, Fumitories & Masticatories, Rubber, Dyes, Timber, biofuel crops.	7
III	Commercial production of Flowers, Vegetables, and fruits (To be Chosen area wise) Commercial greenhouse cultivation of rose, Gerbera, Gladiolus, Anthurium/lilium/lily, tomato, bell pepper, cucumber, strawberry & Exotic leafy vegetables using Hydroponics.	7
IV	IPR & Traditional Knowledge IPR and WTO (TRIPS, WIPO), Patent Act 1970 and its amendments, TIFAC, NRDC, Rights, Procedure of obtaining patents, Working of patents, Infringement, Copyrights, Trademarks, Geographical Indications, Traditional Knowledge Digital Library, Protection of Traditional Knowledge & Protection of Plant Varieties and Biotech inventions.	8
V	Ethnobotany Methodologies of ethnobotanical research: Field work, Literature, Herbaria and Musea and other aspects of ethnobotany. Importance of ethnobotany in Indian systems of medicine (Siddha, Ayurveda and Unani), Role of AYUSH, NMPB, CI-MAP and CARL. Tribal knowledge towards disease diagnosis, treatment, medicinal plants, plant conservation and cultivation.	8
VI	Medicinal aspects Study of common plants used by tribes (<i>Aegle marmelos</i> , <i>Ficus religiosa</i> , <i>Cynodon dactylon</i> , <i>Eclipta alba</i> , <i>Oxalis</i> , <i>Ocimum sanctum</i> and <i>Trichopus zeylanicus</i>) Ethnobotanical aspect of conservation and management of plant resources, Preservation of primeval forests in the form of sacred groves of individual species and Botanical uses depicted in our epics.	8

[Signature]

Manish

[Signature]

[Signature]

[Signature]

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

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

Suggested Continuous Evaluation Methods:

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

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

Course prerequisites:

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

Facilities: Smart and Interactive Class

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

Suggested equivalent online resources:

https://www.pnas.org/content/104/suppl_1/8641

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

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

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

https://www.brainkart.com/article/Economic-importance-Plants---Food,-Rice,-Oil,-Fibre,-Timber-yielding-plant_1095/

<https://www.loc.gov/r/s/citech/tracer-bullet/economic-botany.html>

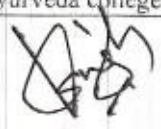
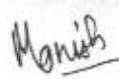
<http://nsdl.niscac.res.in/bitstream/123456789/127/1/Fibre%20crops%2C%20bamboo%2C%20timber%20-%20Final.pdf>

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

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

[Handwritten signatures: Singh, Manish, DP, Jaha]

Programme: <i>Diploma in Plant Identification, Utilization & Ethnomedicine</i>		Year: II	Semester: IV Paper-II
Subject: Botany			
Course Code: B040402P		Course Title: Commercial Botany & Phytochemical Analysis	
Course outcomes: After the completion of the course the students will be able to:			
1. Know about the commercial products produced from plants.			
2. Gain the knowledge about cultivation practices of some economic crops.			
3. Understand about the ethnobotanical details of plants.			
4. Learn about the chemistry of plants &herbal preparations			
5. Can become a protected cultivator, aromatic oil producer, Pharmacologist or quality analyst in drug company.			
Credits: 2		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-2			
Unit	Topic (Perform minimum any three experiments from each unit)		No. of Lectures (60hrs)
I	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
II	Commercial Cultivation Field visit to Green houses for understanding Floriculture & vegetables production Development of hydroponics nutrient solutions & running models for cultivation of vegetables Development of hydroponics nutrient solutions & running models for cultivation of fodder		8
III	Cultivating Medicinal and aromatic plants & Essential oil extraction a. Lemon grass/ Neem/ Zinger /Rose/Mint		7
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 tribes. <i>Aegle marmelos</i> , <i>Ficus religiosa</i> , <i>Cynodon dactylon</i> . Visit a tribal area and collect information on their traditional method of treatment using crude drugs. Familiarize with at least 5 folk medicines and study the cultivation, extraction and its medicinal application. Observe the plants of ethnobotanical importance in your area. Visit to an Ayurveda college or Ayurvedic Research Institute / Hospital		7




VI	Instrumentation and herbal Preparations Develop Capsules of herbs/ Develop Herbal oils/ Develop Poulitice/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 (maceration). 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 oxalate 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. ~~XXXXXXXXXXXXXXXXXXXX~~ ~~XXXXXXXXXXXXXXXXXXXX~~ : Thakur Publication
3. PHARMACOGNOSY ...Hindi Edition (Paperback, Hindi, Dr. Akancha Rashi, KHUSHAL JASWANI), RM Publication
4. ~~XXXXXXXXXXXX XXXXXX XXXXXXX XXX 2 XXXX XXXX XXXXXXX XXX XXXX~~
~~XXXXX XXXXXXX XXXXXXX XXXXXXX XXXX~~

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.
5. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health, Govt. of India.
6. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
7. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
8. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today & Tomorrow's printers and publishers, New Delhi.
9. Khasim S.M Botanical Microtechniques: Principles and Practice-
10. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. ew Delhi.
11. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency

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

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

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

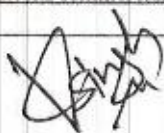
[Signature]

Manish

[Signature]

[Signature]

	Course prerequisites: Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry). Facilities: Smart and Interactive Class Other Requisites: Video collection, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts Lab requisites: Repository of economic products, Microscopes/ Botanical /Herbal Garden, TLC, Spectrophotometer.
	Suggested equivalent online courses: https://www.entrepreneurindia.co/Document/Download/pdfanddoc-144615-.pdf http://nopr.niscair.res.in/handle/123456789/45825 https://www.wipo.int/export/sites/www/tk/en/resources/pdf/medical_tk.pdf https://www.bentoli.com/commercial-farming-agriculture/



Manish




DETAIL SYLLABUS
OF
B.Sc.-III YEAR
OR
BACHELOR OF SCIENCE
(BOTANY)

[Signature]

Monish

[Signature]
[Signature]

[Signature]

BACHELOR OF SCIENCE (BOTANY)		
Programme/Class: <i>Bachelor of Science</i>	Year: III	Semester: V Paper-I
Subject: BOTANY		
Course Code: B040501T	Course Title: Plant Physiology, Metabolism & Biochemistry	
Course outcomes: After the completion of the course the students will be able to: 1. Understand the role of Physiological and metabolic processes for plant growth and development. 2. Learn the symptoms of Mineral Deficiency in crops and their management. 3. Assimilate Knowledge about Biochemical constitution of plant diversity. 4. Know the role of plants in development of natural products, nutraceuticals, dietary supplements, antioxidants		
Credits: 4	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week) 4-0-0		
Unit	Topic	No. of Lectures(60hrs)
I	Plant water relation, Mineral Nutrition, Transpiration and translocation in phloem Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Criteria of essentiality of elements; Role of essential elements; Symptoms of mineral deficiency in major crops, Transport of ions across cell membrane, active and passive transport, Composition of phloem sap, girdling experiment; Pressure flow model.	7
II	Carbon Oxidation Krebs cycle, Glycolysis, fate of pyruvate- aerobic and anaerobic respiration and fermentation, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Krebs cycle, mitochondrial electron transport, oxidative phosphorylation, ATP-Synthetase, Chemiosmotic mechanism, P/O ratio, cyanide-resistant respiration, factors affecting respiration.	7
III	Nitrogen Metabolism Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT), reductive amination and transamination, amino acid synthesis.	8
IV	Lipid Metabolism & Photosynthesis Lipid Metabolism: Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, -oxidation. ; Photosynthesis: Pigments, Action spectra and Enhancement effect, Electron transport system and Photophosphorylation, C3 & C4 photosynthesis, CAM- Reaction and Significance	7
V	Plant Development, Movements, Dormancy & Responses Developmental roles of Phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene.) autonomic & paratonic movements, Control and Coordination in plants, Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red-light responses on photomorphogenesis, Seed physiology & Dormancy, Vernalization & Senescence	8

VI	Biomolecules Carbohydrates: Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols – mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage – starch, inulin). Lipids: Storage lipids: Fatty acids structure and functions, Structural lipids: Phosphoglycerides; Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers	8
VII	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

Suggested Readings:

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

1. **पौधों की शारीरिक क्रियाएँ** (Plant Physiology) : डॉ. एचएस. राय
पौधों की शारीरिक क्रियाएँ (Plant Physiology) : डॉ. एचएस. राय
2. **पौधों की शारीरिक क्रियाएँ** (Plant Physiology) : डॉ. एचएस. राय
पौधों की शारीरिक क्रियाएँ (Plant Physiology) : डॉ. एचएस. राय
3. **पौधों की शारीरिक क्रियाएँ** (Plant Physiology) : डॉ. एचएस. राय
पौधों की शारीरिक क्रियाएँ (Plant Physiology) : डॉ. एचएस. राय
4. Plant Physiology and Biochemistry ISBN #:81-301-0035-5 Sunil D Purohit, K. Ahmed & Gotam K Kukda Edition: 2013 Pages: 368 + VIII Text Book (Hindi)
5. **पौधों की शारीरिक क्रियाएँ** (Plant Physiology) : डॉ. एचएस. राय
पौधों की शारीरिक क्रियाएँ (Plant Physiology) : डॉ. एचएस. राय
1. Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
2. A Handbook On Mineral Nutrition And Diagnostic Techniques For Nutritional Disorders Of Crops (pb) ISBN : 9788177543377 Edition : 01 Year : 2011 Author : Pathmanabhan G , Vanangamudi M , Chandrasekaran CN , Sathyamoorthi K , Babu CR , Babu RC , Boopathi PNPublisher : Agrobios (India)
3. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.
4. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 19992, Wadsoworth Publishing Company.
5. Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
6. Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.
7. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New Central Book. Agencies.
8. Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.
9. Mathews, C.K., Van Holder, K.E. & Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.
10. Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan.
11. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.
12. Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.
13. Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biology of plants, 2000, I.K. International.
14. Ramesh Gupta. Efficacy, Safety and Toxicity brings together all current knowledge regarding nutraceuticals and their potential toxic effects. 2016. Elsevier.
15. Harborne, J.B. 1973 .Phytochemical Methods. John Wiley & Sons, New York.
16. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
17. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017

Handwritten signature

Handwritten signature

Handwritten signature

Handwritten signature

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

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

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

Course prerequisites:

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

Facilities: Smart and Interactive Class

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

Suggested equivalent online courses:

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

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

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

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

Programme/Class: <i>Bachelor of Science</i>		Year: III	Semester: V Paper-II
Subject: BOTANY			
Course Code: B040502T		Course Title: Molecular Biology & Bioinformatics	
Course outcomes:			
After the completion of the course the students will be able to:			
1. Understand nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.			
2. Know about Processing and modification of RNA and translation process, function and regulation of expression.			
3. Gain working knowledge of the practical and theoretical concepts of bioinformatics			
Credits: 4		CC / Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week) 4-0-0			
Unit	Topic		No. of Lectures(60hrs)
I	Genetic material Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase, bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): semi-conservative, DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi-conservative, semi discontinuous RNA priming, θ (theta) mode of replication, replication of linear, dsDNA, replicating the 5 end of linear chromosome including replication enzymes.		7

[Signature]

[Signature]

Manish
[Signature]

[Signature]

II	Transcription & Regulation of gene expression Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation, (Prokaryotes and eukaryotes), genetic code. Regulation of gene expression in Prokaryotes; Lac operon and Tryptophan operon; and in Eukaryotes	7
III	Principles & Techniques of genetic engineering Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Antibody Engineering.	8
IV	Applications of Genetic engineering Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products, Biosafety concerns..	7
V	Bioinformatics & its applications Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology, Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.	8
VI	Biological databases : Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem,)	8
VII	Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)	7
VIII	Phylogenetic analysis Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.	8

Suggested Readings:

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

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

[Handwritten signatures and initials]

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

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

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

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

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

Course prerequisites:

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

Facilities: Smart and Interactive Class

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

Suggested equivalent online courses:

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

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

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

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

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

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

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

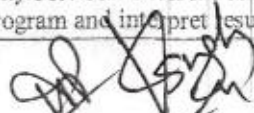
<https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907>

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

[Handwritten signatures and initials]

Programme/Class: <i>Bachelor of Science</i>		Year: III	Semester: V Paper-III
Subject: Botany			
Course Code: B040503P		Course Title: <i>Experiments in physiology, Biochemistry & molecular biology</i>	
Course outcomes: After the completion of the course the students will be able to: 1. Know and authentic the physiological processes undergoing in plants along with their metabolism 2. Identify Mineral deficiencies based on visual symptoms 3. Understand and develop skill for conducting molecular experiments for genetic engineering			
Credits: 2		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week) 0-0-2			
Unit	Topic* <i>*(Perform any three from each unit based on facility)</i>		No. of Lectures(60 hrs)
I	Plant water relation, Mineral Nutrition and translocation in phloem 1. Determination of osmotic potential of plant cell sap by plasmolytic method using leaves of Rhoeo / Tradescantia. 2. Osmosis – by potato osmoscope experiment 3. Effect of temperature on absorption of water by storage tissue and determination of Q ₁₀ . 4. Experiment to demonstrate the transpiration phenomenon with the bell jar method 5. Experiment for demonstration of Transpiration by Four-Leaf Experiment: 6. Structure of stomata (dicot & monocot) 7. Determination of rate of transpiration using cobalt chloride method. 8. Experiment to measure the rate of transpiration by using Farmer's Potometer 9. Experiment to measure the rate of transpiration by using Ganong's potometer 10. Effect of Temperature on membrane permeability by colorimetric method. 11. Study of mineral deficiency symptoms using plant material/photographs.		8
II	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 chronologically aged leaves (young, mature and senescence) by Arnon method. 4. Effect of HCO ₃ concentration on oxygen evolution during photosynthesis in an aquatic plant and to find out the optimum and toxic concentration (either by volume measurement or bubble counting). 5. Measurement of oxygen uptake by respiring tissue (per g/hr.) 6. Determination of the RQ of germinating seeds. 7. Effect of light intensity on oxygen evolution in photosynthesis using Wilmott's bubble		8
III	Plant Development, Movements, Dormancy & Responses 1. Geotropism and phototropism — Klinostat 2. Hydrotropism a. Measurement of growth — Arc and Liver Auxonometer 3. To study the phenomenon of seed germination (effect of light). 4. To study the induction of amylase activity in germinating grains.		8

	5. Test of seed viability by TTC method. 6. To study the effect of different concentrations of IAA on <i>Avena</i> coleoptile elongation (IAA bioassay)	
IV	Techniques for biochemical analysis 1. Weighing and Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution etc. 2. Separation of amino acids by paper chromatography. 3. Detection of organic acids: citric, tartaric, oxalic and malic from laboratory samples., 4. Qualitative Analysis of carbohydrates, 5. Estimation of reducing sugar by anthrone method, 6. Qualitative Analysis of Lipids 7. Qualitative analysis of Amino acids and Proteins 8. Quantitative Analysis of Nucleic Acids, 9. Analysis of dietary supplements, nutraceuticals & antioxidants 10. Testing of adulterants in food items.	8
V	Genetic material 1. Instruments and equipments used in molecular biology. 2. Preparation of LB medium and cultivating E.coli on it. 3. Isolation of Genomic DNA 4. Isolation of DNA from plants 5. Examination of the purity of DNA by agarose gel electrophoresis. 6. Quantification of DNA by UV-spectrophotometer 7. Estimation of DNA by diphenylamine method.	7
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 2. Numericals based on DNA re-association kinetics (melting profiles and Cot curves) 3. Study of DNA replication through photographs: Modes of replication - Rolling circle, Theta and semi-discontinuous ; Semiconservative model of replication (Messelson and Stahl's experiment); Telomerase assisted end-replication of linear DNA 4. Study of structures of : tRNA (2D and 3D); prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs 5. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozymes and Alternative splicing 6. Understanding the regulation of lactose (lac) operon (positive & negative regulation) and tryptophan (trp) operon (Repression and De-repression & Attenuation) through photographs. 7. Understanding the mechanism of RNAi by photographs	7
VII	Genetic Engineering 1. Isolation of protoplasts. 2. Construction of restriction map of circular and linear DNA from the data provided. 3. Isolation of plasmid DNA. 4. Restriction digestion and gel electrophoresis of plasmid DNA (demonstration/ photograph). 5. Calculate the percentage similarity between different cultivars of a species using RAPD profile. Construct a dendrogram and interpret results.	7


 Manish

 Anshu

	6. Agarose gel analysis of plasmid DNA 7. 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

Suggested Readings:

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

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

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

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

Suggested Continuous Evaluation Methods:

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

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

Course prerequisites:

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

Facilities: Smart and Interactive Class

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

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

(Signatures)

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

Suggested equivalent online courses:

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

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

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

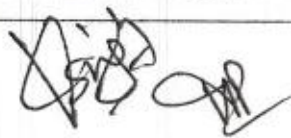
<https://www.coursera.org/courses?query=genetics>

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

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

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

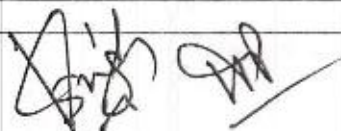
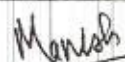
<https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907>



Mamsh



Programme/Class: Bachelor of Science	Year: III	Semester: V Paper-IV
Subject: BOTANY		
Course Code: - B040504R	Course Title: Project in Botany for Pre-graduation	
Course outcomes: • Project work will supplement field experimental learning and deviations from classroom and laboratory transactions. • project work will enhance the capability to apply gained knowledge and understanding for selecting, solving and decision-making processes. • It will promote creativity and the spirit of enquiry in learners. • They will learn to consult Scientists, libraries, laboratories and herbariums and learn importance of discussions, Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation in form of dissertation writing. • It will enhance their abilities, enthusiasm, and interest.		
Credits: 03	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-3.		
Suggestive List Of PROJECTS		
1. Rural Areas: Flora of a city/ village, Biodiversity of Village, Soil & seed testing service provision to farmers, 2. Industrial waste management 3. water pollution status of rural water & promotion of WASH in villages 4. Plant Disease identification in farms, nurseries and orchards. 5. Digital portal for plants: Campus, city or particular area 6. Rare and endangered plants & their conservation & domestication 7. Air pollution tolerance index (APTI) : Screening of sensitive/tolerant plant species at various locations in particular area 8. Science Communication by Creating science documentaries of innovators , Internet Science (Social media, Websites, Blogs, Youtube, Podcast etc.) 9. Science Outreach Talks and Public Sensitization for plant biodiversity conservation sensitization of public. 10. Phytochemistry of medicinal plants & their antimicrobial, nutraceutical and antioxidant properties 11. Study of pollen grains in different flowers 12. Study of stomata in different plants 13. Study of various types of secretory and special tissues in plants.		
Refer: libraries, journals, Memoirs, encyclopaedias, herbaria, Museums, etc.		
This course can be opted as an elective by the students of following subjects:		Open to all
Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:		
Internal Assessment		Marks
Class Interaction		5
Seminar		10
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://ndi.iitkcp.ac.in/>

https://asiafoundation.org/what-we-do/books-for-asia?gclid=CiwKCAiA7939BRBMEiwA-hX5J-QhBITSyPnvi3r8ycio-L9f5uTy1a6oEoALCLa9Ebu0pyz858yOZxoC5wkQAvD_BwE

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

<http://www.ulib.org/>

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

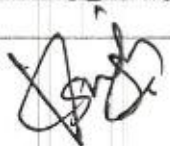
<http://www.vigyanprasar.gov.in/digilib>

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

Directory of Open Access Repositories (DOAR)<http://www.openoar.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



Manish



Programme/Class: <i>Bachelor of Science</i>		Year: III	Semester: VI Paper-I
Subject: Botany			
Course Code: B040601T		Course Title: Cytogenetics, Plant Breeding & Nanotechnology	
Course outcomes: After the completion of the course the students will be able:			
1. Acquire knowledge on cell ultrastructure.			
2. Understand the structure and chemical composition of chromatin and concept of cell division.			
3. Interpret the Mendel's principles, acquire knowledge on cytoplasmic inheritance and sex-linked inheritance.			
4. Understand the concept of 'one gene one enzyme hypothesis' along with the molecular mechanism of mutation.			
Credits: 4		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0			
Unit	Topic		No. of Lectures (60hrs)
I	Cell biology Structure and function of cell wall, plasma membrane, ribosomes, Endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and cell inclusions - Organization of nucleus: nuclear envelope, nucleoplasm and nucleolus. Chromosomal nomenclature- chromatids, centromere, telomere, satellite, 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 closed mitosis – amitosis - meiosis. Variation in Chromosome number (Numerical aberrations)- aneuploidy and Euploidy-haploidy, polyploidy- significance (Structural aberrations) - deletion, duplication, inversion and translocation.		3
II	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
III	Plant breeding Plant introduction. Agencies of plant introduction in India, Procedure of introduction - Acclimatization – Achievements, Selection - mass selection, pure line selection and clonal selection. Genetic basis of selection methods, Hybridization: Procedure of hybridization, inter generic, inter specific, inter varietal hybridization with examples. Composite and synthetic varieties, Male 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.		8
IV	Biostatistics: Definition, statistical methods, basic principles, variables- measurements, functions, limitations and uses of statistics. Biometry: Data, Sample, Population, random sampling, Frequency distribution- definition only, Central tendency– Arithmetic Mean, Mode and Median; Measurement of dispersion–Coefficient of variation, Standard Deviation, Standard error of Mean; Test of significance: chi- square test for goodness of fit. Computer application in biostatistics - MS Excel and SPSS		7
V	Plant tissue culture		8

Dr. Singh

Manish

Singh

Singh

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

Suggested Readings:

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

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

[Signature]

[Signature]

Manish

[Signature]

[Signature]

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

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

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

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

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

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

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

Course pre-requisites:

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

Facilities: Smart and Interactive Class

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

Suggested equivalent online courses:

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

https://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspx

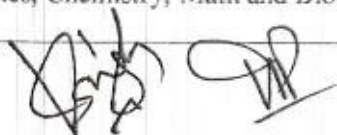
<https://www.mooc-list.com/tags/genetics>

<https://www.coursera.org/learn/genetics-evolution>

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

Further Suggestions:

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



Manish





Programme/Class: <i>Bachelor of Science</i>		Year: III	Semester: VI Paper-II
Subject: Botany			
Course Code: B040602T		Course Title: Ecology & Environment	
Course outcomes: 1. acquaint the students with complex interrelationship between organisms and environment; 2. make them understand methods for studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography. 3. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.			
Credits: 4		Core Compulsory/Elective	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0			
Unit	Topic		No. of Lectures (60 hrs)
	Natural resources & Sustainable utilization: Land Utilization, Soil degradation and management strategies; Restoration of degraded lands. Water , Wetlands; Threats and management strategies, Ramsar sites ,Forests: Major and minor forest products; Depletion, Biological Invasion, Energy: Renewable and non-renewable sources of energy , Contemporary practices in resource management : EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting.		7
II	Ecology & Ecosystem Definition of Ecology, Ecological Factors, Positive and negative interactions. Ecosystem – Concept of an ecosystem-structure and function of an ecosystem. Abiotic and biotic com-Energy flow in an ecosystem Ecological Succession-Definition & types. Processes and types (autogenic, allogenic, autotrophic, heterotrophic, primary & secondary), Hydrosere and Xerosere. Food chains and food webs, Ecological pyramids, production and productivity; And components. Types of ecosystems: Forest Ecosystem, Grassland, Crop land, aquatic Ecosystems Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites.		8
III	Soil Formation, Properties & Conservation Soil: Origin, Formation, composition, Soil types, Soil Profile, Soil Microorganisms, soil processes, Soil Erosion, Biogeochemical cycles, Soil Conservation: Biological– Contour farming, Mulching, Strip cropping, Terracing and Crop rotation. Mechanical–Basin Listing, Construction of dams, Watershed Management, Soil reclamation		7
IV	Biodiversity and its conservation: Definition -genetic, species, and ecosystem diversity. Value of biodiversity: social, ethical, aesthetic and option values; hotspots of Biodiversity threats to biodiversity, Biotic communities and populations, their characteristics and dynamics. Endemic and endangered species of plants in India. Ecological niche, ecotypes, ecological indicators. Conservation of Biodiversity: Ex-situ and in-situ conservation, Red data book, botanical gardens, National park, Sanctuaries, hot & hottest spots and Bioreserves. Role of Seed Bank and Gene Bank Valuing plant resources, ecotourism, Role of NBPGR, FAO, BSI.		7



Manish




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

Suggested Readings:

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

1. Environmental Studies (Hindi) ISBN 81-301-0004-5B. L. Chaudhary & Jitendra Pandey Edition: 2013 Pages: 340 + XII Apex Publishing House
2. Soil and Water Conservation ISBN #: 978-81-301-0071-5S. C. Mahnot & P. K. Singh Apex Publishing House
3. Ecology And Environmental Biology (पर्यावरण और वातावरण विज्ञान) by RBD Publisher Author: Bhatia - Jain - Kohli - Shrivastava - Singh - Verma
5. पर्यावरण और वातावरण विज्ञान (पर्यावरण और वातावरण विज्ञान) : 2013 Edition: 2013
6. Paryavaran Evam Paristhiti Se (Hindi) Paperback – 20 February 2020 Majid Husain
7. Environmental Biology and Phytogeography ISBN #: 978-81-301-0064-7B. L. Chaudhary, Gotam K Kukda & Jitendra Kumar Joshi
8. Ugc Unified: Environmental Sciences (hindi) (pb) ISBN: 9788177545814 Edition : 01 Year : 2015 Author : Dr. Purohit SS, Dr. Deo PP, Dr. Agrawal Ashok K Publisher : Agrobios (India)
1. Chapman and Riss. Ecology: Principles and Applications, Latest Ed., Cambridge University Press
2. Shukla, R.S. & Chandel, P.S. Plant Ecology, Latest Ed., S. Chandel and Co.
3. Kumar, H.D. Modern Concept of Ecology, Latest Ed. Vikas Publishing House
4. Begon, M., Herper, J.L. and Townsend, C.R. Ecology- Individuals, Populations and Communities (3rd ed.), Oxford Blackwell Science
5. Verma, P.S. & Agarwal, U.K. Concept of Ecology, Latest Ed., S. Chand & Company

Handwritten signature

Manish

Handwritten signature

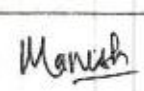
Handwritten signature

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

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

Suggested Continuous Evaluation Methods:

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



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

Course prerequisites:

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

Facilities: Smart and Interactive Class

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

Suggested equivalent online courses:

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

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

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

<http://cgvankosh.ac.in/handle/123456789/53530>

Programme/Class: <i>Bachelor of Science</i>		Year: III	Semester: VI Paper-III
Subject: Botany			
Course Code: B040603P		Course Title: Lab on Cytogenetics, Conservation & Environment management	
Course outcomes: After the completion of the course the students will be able:			
1. To perform all experiments related to the semester-i.e. Plant tissue cultured plants, conducting breeding on field, conserving and depolluting the environment. 2. Can be employed in environment impact assessment companies & start his own venture			
Credits: 2		Core Compulsory	
Max. Marks: 25+75		Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-2			
Unit	Topic		No. of Lectures(60hrs)
I	Cell biology 1. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo/Crinum 2. Measurement of cell size by the technique of micrometry. 3. Counting cells per unit volume with the help of haemocytometer (Yeast/pollen grains) 4. Determination of mitotic index and frequency of different mitotic stages in pre-fixed root tips of Allium cepa.		7

Handwritten signature

Monish

Handwritten signature
Sinha

Handwritten signature

II	Genetics 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.	8
III	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 1. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper) 2. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests. 3. Determination of organic matter of different soil samples by Walkley & Black rapid titration method. 4. Soil Profile study 5. Soil types of India-Map	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

[Signature]

Manish

[Signature]

[Signature]

	3. 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 from polluted and less polluted areas. 4. Measurement of dissolved O₂ by azide modification of Winkler's method. 5. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. 6. Microbiological assessment of drinking water using MPN technique- water from well, river, water supply department and packaged drinking water 7. Making kitchen waste from compost/vermicompost by Enzymes/Bio decomposer/ Whey with dung. Climate Change, Carbon Credits & Role of GIS 1. Conducting Waste Audit of your Institution -Demo 2. Green auditing of the College/University -Demo	7

Suggested Readings: as in papers above:

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

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

<http://vidyamitra.inlibnet.ac.in/index.php/home/subject?domain=Life+Science&subdomain=Botany>

<http://heecentent.upsdc.gov.in/Home.aspx>

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

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

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

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

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

[Signature]

Manish

[Signature]

[Signature]

[Signature]

--

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.asct.com/ASCTWeb/Content/Cytopreparation%20Online%20Course.aspx)

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

<https://www.coursera.org/learn/genetics-evolution>

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

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

Programme/Class: Bachelor of Science	Year: III	Semester: VI /Project-II/ Paper-IV
Subject: BOTANY		
Course Code: - B040604R	Course Title: Project in Botany for Graduation	
Course outcomes: After completing this course a student will have: • Project work will supplement field experimental learning and deviations from classroom and laboratory transactions. • project work will enhance the capability to apply gained knowledge and understanding for selecting, solving and decision-making processes • It will promote creativity and the spirit of enquiry in learners. • They will learn to consult Scientists, libraries, laboratories and herbariums and learn importance of discussions, Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation in form of dissertation writing • It will enhance their abilities, enthusiasm, and interest.		
Credits: 03	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-3.		
SUGGESTIVE LIST OF PROJECTS		

JP

Manish

Shishu

Sekhar

S

Prepare beds for growing nursery for herbs, shrubs and trees.
 Develop Green house facility in college and grow plants
 Develop hydroponics facility in college and grow plants.
 Develop botanical garden in the college with labelling
 Vertical gardens, roof gardens.
 Culture & art of making bonsai.
 Computer Aided Designing (CAD) for outdoor and indoor scaping Exposure to CAD (Computer Aided Designing)
 Phytochemical Analysis of Medicinal plants
 Bio composting and Vermicomposting.
 Performing Aromatherapy by essential Oils

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

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

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

Suggested Continuous Evaluation Methods:

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

Course prerequisites:

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

Facilities: Smart and Interactive Class

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

Suggested equivalent online courses:

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

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

<http://epathshala.nic.in/>, <http://epathshala.gov.in/>

nptel.iitm.ac.in

https://asiafoundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiwA-hX5J-OhBITSVlnvi3r8vejo-L9F5u1yJa6oJ:oaALCLa9Ebu0pyz858vQZxoC5wkQAVU_BwE

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

<http://www.tkd.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](http://www.iscnagpur.ac.in/knowledge%20learning%20files/5.7%20General%20Open%20Access%20e-Resources.pdf)

Handwritten signature

Manish

Signature

Signature

DETAIL SYLLABUS FOR
B.Sc.-4 YEAR (B.Sc. RESEARCH)
Semester VII & VIII
OR
M.Sc. PREVIOUS (Sem. I & II)

DJP

Manish

Satish

Singh

S

Course Code: B040701T	Year: First	Semester : First
Course Title: Microbiology		

Unit I

Introduction to microbiology, history and scope of microbiology, Microbial evolution, Systematics and taxonomy of microorganisms. Primitive organisms, their metabolic strategies and molecular coding. Microbes of the extreme environment and their metabolic strategies. The microbial cell: general organization of cell and cell wall of prokaryotes, eukaryotes and Archaea, prokaryotic and eukaryotic cell structure and function,

Unit II

Enrichment culture techniques, Isolation of Pure cultures, culture media (defined/synthetic, complex, selective, differential, enriched), Microbes and their preservation methods, Sterilization techniques, Inoculation methods (spread-plate, streak-plate, pour plate), The definition of growth, growth curve, measurement of growth (batch and continuous culture), Culture collection and maintenance of cultures

Unit III

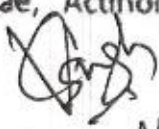
Microbiology of food, food spoilage and preservation processes, microbiology of fermented foods, oriental foods, dairy foods, wine, beer and other fermented alcoholic beverages, bread and other fermented plant products, Microbial production of organic acids, antibiotics, amino acids, vitamins, recombinant products, microorganisms as source of foods.

Unit IV

Water-borne pathogenic microbes; role of microbes in wastewater treatment with special reference to activated sludge, Basic design of a fermentor; biosensors; bioremediation of hydrocarbon and metal polluted waters

Unit V

Rhizosphere, Phyllosphere, Mycorrhizae, Actinorrhizae, Tripartite associations, PGPRS, microbes in agriculture

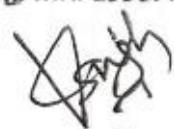

Manish





Suggested readings:

1. Madigan, M.T., Martinko, J.M., Dunlap, P.V., Clark, D.P., 2011. Brock Biology of Microorganiss. 13th edition, Pearson Education Inc.
2. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., Painter, P.R., 1987. General Microbiology. Fifth edition. MacMillan.
3. Atlas, RM. 1995. Principles of Microbiology. Mobsy.
4. Lim, DV: 2003. Microbiology. Kendall/Hunt.
5. Boundless. 2013. Microbiology. Boundless Learning, Incorporated.
6. Comelissen, CN, Harvey, RA and Fisher, BD. 2012. Microbiology. Lippincott Williams & Wilkins.
7. Talaro, K.P., Chess, B. 2011, Foundations in Microbiology, 8th edition. McGraw-Hill.
8. Willey, J.M., Sherwood, L, Woolverton, C.J., 2010. Prescott's Microbiology. 8 edition, McGraw-Hill.
9. Agrios, G. N., 1988. Plant Pathology, Academic Press.
10. John A Lucas, 1998. Plant Pathology and Plant Pathogens, Wiley-Blackwell, CRC Press. and Laboratory Exercises, CRC Press.
11. Dickinson, C. M., 2003. Molecular Plant Pathology, Bios Scientific Publisher
12. Robert, N., Trigiano, Windham, M. T. and Windham, A.S., 2003. Plant Pathology: Concepts and Laboratory Exercises, CRC Press.
13. Bridge, P.D and Clarkson, J.M., 1998. Molecular Variability of Fungal Pathogens, CAB, International
14. Singh, R. S., 2008. Plant Diseases, Oxford and IBH Publishing Co. Pvt Ltd
15. Pelczar, JM, Chan, ECS and Krieg, MR. 1993. Microbiology. Tata McGraw Hill.

   
Manish

Unit I

General characteristics, Thallus organization and cell structure, Nutritional types of fungi: biotrophs, hemibiotrophs, symbionts and necrotrophs, Reproduction, hormonal mechanism of sexual reproduction, Heterothallism, Heterokaryosis, Physiological specialization parasexuality, Fungal systematics and phylogeny

Unit II

Systematic study of structure and reproduction, life cycle, phylogeny and affinities of main groups of fungi with special reference to following.

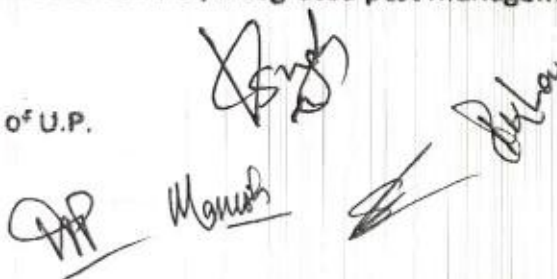
- (i) Myxomycetes
- (ii) Plasmodiophoromycetes- (Plasmodiophorales).
- (iii) Oomycetes :Saprolegniales (Saprolegnia, Achlya) Peronosporales (Pythium, Phytophthora, Albugo, Peronospora).
- (iv) Chytridiomycetes: Chytridiales, Mucorales (Pilobolus).
- (v) Zygomycetes: Entomophthorales.
- (vi) Ascomycetes: Protomycetales, (Protomyces), Endomycetales (Saccharomyces), Taphrinales (Taphrina), Urotiales (Aspergillus, Xylaria) Erysiphales (Erysiphæ, Phyllactenia, Pezizales (Peziza, Morche'la).
- (vii) Basidiomycetes: Ustilaginales (Ustilago, Urocystis) Uredinales (Puccinia, Melampsora Uromyces).
- (viii) Deuteromycetes: Melanconiales (Colletotrichum), Moniliales (Alternaria, Cercospora, Fusarium).

Unit III

General introduction to Plant Pathology, History of Plant Pathology, Classification of Plant Diseases, Plant disease diagnosis: Koch's postulates, chemical weapons of pathogens - Enzymes and toxins; Role of growth hormones in plant diseases, Preexisting structural and chemical defense, induced structural and chemical defense. Parasitism and disease development, symptoms, Effect of environmental factors on the plant disease development, plant disease epidemiology. Control of plant diseases, quarantines and inspection, physical, chemical, cultural and biological methods of disease control, integrated pest management.

Unit IV

Study of following diseases of principal crops of U.P.



- (i) Rust: (Wheat, Unseed) (ii) Smut: (Wheat, Sugarcane) (iii) Bunt: (Rice, wheat) (iv) Blight: (Potatoes, cucurbits). (v) Wilt: (Sugarcane, Pigeon-pea) (vi) Leaf Spot: (Rice, ground-nut) (vii) Mildews: (Pea) (viii) Cankers: citrus, white rust of crucifers and stem gall of coriander (ix) Viral diseases of Potato, Tomato, Papaya and Bhindi (x) Diseases caused by mycoplasma

Unit V

Rapid methods for diagnosis of plant diseases caused by Viruses, Bacteria and Fungi with reference to ELISA and PCR.)

Suggested readings:

1. Webster, John, 1980, Introduction to Fungi, Cambridge University Press
2. Alexopoulos, CL, Mims, CW. and Blackwell, M. 1996, Introductory Mycology, Wiley
3. Carlile, M.J., Watkinson S.C. and Booday, G.W., 2001, The Fungi, Academic Press
4. Deacon, J.W., Blackwell, M, 1997, Introduction to Modern Mycology, Oxford
5. Webster, John and Roland, W.S., 2007, Introduction to Fungi, Cambridge University Press.
6. Willey, J.M., Sherwood, L, Woolverton, C.J., 2010. Prescott's Microbiology. 8th edition, McGraw-Hill.
7. Agrios, G. N., 1988. Plant Pathology, Academic Press.
8. John A Lucas, 1998. Plant Pathology and Plant Pathogens, Wiley-Blackwell, CRC Press.
9. Dickinson, C. M., 2003. Molecular Plant Pathology, Bios Scientific Publisher
10. Bridge, P.D and Clarkson, J.M., 1998. Molecular Variability of Fungal Pathogens, CAB, International
11. Singh, R. S., 2008. Principles of Plant Pathology, Oxford and IBH Publishing Co. Pvt Ltd.
12. Dhingra, O.D. and James, B. Sinclair, 1995. Basic Plant Pathology Methods, CRC Press
13. Pelczar, JM, Chan, ECS and Krieg, MR. 1993. Microbiology. Tata McGraw Hill.



Manish



Course Code: B040703T	Year: First	Semester : First
Course Title: Algae and Bryophytes		

Unit I

Introduction to Phycology, Principles and systems of classification of algae, Comparative account of algal pigments, food reserves, cell wall, flagellation, chloroplasts and eye-spots, their phylogenetic and taxonomic importance

Unit II

Cyanophyceae: Cyanophyta: cell structure, heterocyst and akinete development, chromatic adaptation, thallus organization and reproduction, Salient features of Gloeocapsa, Microcystis, Anabaena, Gloeotrichia, Nostoc, Rivularia, Scytonema.

A brief account of thallus organization, structure and reproduction in Chlorophyta, Phaeophyta and Rhodophyta; alternation of generation in Phaeophyta and post-fertilization development and site of meiosis in Rhodophyta.

Unit III

A brief account of Protochlorophyta, Chlorophyta, Xanthophyta, Bacillariophyta,

Phaeophyta: Ectocarpales (Ectocarpus); Laminariales (Laminaria); Dictyotales (Dictyota, Padina); Fucales (Fucus and Sargassum)

Rhodophyta: Bangioideae (Porphyra); Florideae (Batrachospermum, Polysiphonia)

Economic Importance of algae

(Algae as food, biofertilizers and source of phycocolloids.)

UNIT IV

Classification of Bryophytes, Comparative account of gametophyte structure, Sporophytic structure and evolution; Peristome structure and its significance in the classification of Mosses

Unit V

Morphology, structure reproduction, life history, distribution and phylogeny of bryophytes based on following:

(A) Hepaticopsida (1) Sphaerocarpales (Sphaerocarpus.), (ii) Marchantiales (Riccia, Marchantia, Cyathodium, Plagiochasma, Lunularia, Asterella), (iii) Monocleales (Monoclea)

DP Singh *Monish* *Arora* *S*

(iv) Jungermanniales (Pellia, Porella, Fossombronia), (v) Calobryales (Calobryum): (vi) Takakiales (Takakia). (B) Anthocerotopsida: Anthocerotales (Anthoceros and Notothyris).

(C) Bryopsida: Sphaginales (Sphagnum), Andreales (Andreaea), Bryales (Funaria) Buxbaumiales (Buxbaumia).

Suggested Readings:

1. Phycology, 5th Ed., Robert Edward Lee, Publisher-Cambridge University Press, 2018.
2. Introduction to the Algae, 2 Ed., Bold and Wynne, 1984.
3. Introductory Phycology, H. D. Kumar, 1990.
4. Algae, 1st Ed, O. P. Sharma, 2011.
5. Principles and Techniques of Biochemistry and Molecular Biology, 8 Ed., Wilson and Walker, 2018
6. Biology of Bryophytes. - R.N. Chopra and P.K. Kumra. New Age International (P) Limited, New Delhi 1988
7. An Introduction to Bryophyta. (Diversity, Development and Differentiation). - A.Rashid. Vikas Publication House Pvt. Ltd., 1998.
8. Bryophytes-A Broad Perspective. - Prem Puri. Atma Ram & Sons, Delhi & Lucknow, 1985.
9. Cryptogamic Botany. Bryophytes and Pteridophytes. Vol.II.G.M. Smith. Tata McGraw-Hill Publishing Company Limited, New Delhi, 1972.
10. The Structure and Life of Bryophytes.-E.V. Watson, BI publications, 1964.



Course Code: B040704T	Year: First	Semester : First
Course Title: Bacteria, Virus and Lichen		

Unit I

Bacterial Identification, nomenclature and classification, New approaches to bacterial taxonomy /classification including ribotyping and ribosomal RNA sequencing.

Genetics of bacteria: Genetic recombination- an overview; mechanisms of transformation, conjugation and transduction in bacteria; role of microorganisms in genetic engineering.

Unit II

Different modes of nutrition in bacteria, Sulfate reduction, Nitrogen metabolism – nitrate reduction, nitrifying and denitrifying bacteria, Nitrogen fixation and Microbes used as biofertilizer. Rhizobium-legume symbiosis and mycorrhiza

Unit III

Archaea : Archaeobacteria and extremophilic microbes – their biotechnological potentials, Anoxygenic photosynthesis with special reference to light reaction in purple bacteria; methanogenesis

Unit IV

Nomenclature and classification of plant viruses, Hypersensitivity in host-virus interaction, Molecular aspects of virus-vector relationship in transmission, Virus detection by serological and nucleic acid hybridization methods, Structure, replication and pathogenicity of viroids, Life cycle of lytic and lysogenic bacteriophage, Prions.

Purification of plant viruses, Bioassay Test for viral purity, Quantification, Ultracentrifugation, Density gradient centrifugation

Unit V

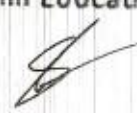
Introduction to lichens, the symbiotic relationship and classification of lichens, methodology for lichens taxonomy, morphology and anatomy of thallus, reproduction, physiology, ecological aspects and chemistry, conservation, culture, bioprospection and economic importance of lichens.

Suggested Readings:

1. Matthew's Plant Virology, R. Hull, 4 edition, 2003, Elsevier.
- 2 Prescott's Microbiology, J. Willey, L. Sherwood, 10 edition, 2017, McGraw-Hill Education.




Manish

3. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Edited by A. Hofmann, S. Clokie, 8th edition, 2018, Cambridge University Press.
4. Plant Pathology, G.N. Agrios, 5th edition, 2005, Elsevier.
5. Alcamo's Fundamentals of Microbiology, J.C. Pommerville, 2nd edition, 2013, Jones and Bartlett Learning.
6. Microbiology: An Introduction, GJ. Tortora, B.R. Funke, C.L. Case, 11 edition, 2016, Pearson India Education.
7. Hale, M.E. (1983). The biology of lichens (3rd ed.). Edward Arnold.
8. Hawksworth, DL & Hill, DJ 1984: The Lichen-Forming Fungi. - Blackie, Glasgow and London. 158 pp
9. Galun, M. (ed.) (1988) CRC Handbook of Lichenology. Volume III CRC Press, Inc., Boca Raton
10. Brown D. H., Hawksworth D. L. & Bailey R. H. 1976, Lichenology: Progress & problems, Academic Press. London.



Manish



Course Code: B040705T	Year: First	Semester : First
Course Title: Environment and Plant Response		

Unit I

1. Soil Environment: Soil composition, organic matter input and decomposition, soil nutrient storage and accumulation in plants, agrochemical residues and their pollutive effect.

Unit II

Water Environment: Hydrological cycle, primary production and productivity of different aquatic weeds, distribution, adaptation and dynamics of fresh water and wetland plant communities water pollution due to sewage, agrochemicals, industrial wastes and urban solid wastes.

Unit III

Air environment and its ecological perspective with reference to rural, urban and industrial areas.

Effect of air pollutants e.g. SO₂, Fluoride, photo-chemical, suspended particulates on vegetation of local area.

Unit IV

Indexing of sensitivity and resistance to pollutants of plants.

Nuclear power-energy and its environmental effect.

Unit V

Environmental planning strategies criteria for environmental standard, monitoring techniques, control of air pollution through plants and microbes. Control of pollution of water bodies.

Dr. Singh *DP* *Manish* *Sharma* *S*

Unit I

Morphology, anatomy and reproduction, phylogenetic relationships with emphasis on detailed study of following:

- (i) Psilopsida - (Psilophytales, Psilotales)
- (ii) Lycopsidea- (Lycopodiales, Sellageneales, Lepidodendrales, Isoetales, Pleuromiales)
- (iii) Sphenopsida- (Equisetales, Hyeniales, Sphenophyllales and Calamitales).
- (iv) Pteropsida- (A general account)
- (v) Filicinae- A general account
- (vi) Eusporangiate ferns- (Ophioglossales, Marattiales).
- (vii) Leptosporangiate ferns-Filicales.

Unit II

Telome concept, apogamy and apospory, Sex organs and embryogeny in Pteridophytes. Ecology of pteridophytes, Economic Importance of the pteridophytes, Cytogenetics of pteridophytes.; heterospory and seed habit Evolution of stele in pteridophytes.

Classification and economic Importance of Pteridophytes.

Unit III

General introduction of gymnosperms with special reference to its salient features, similarities and dissimilarities with other groups like pteridophytes and angiosperms. Classifications of gymnosperms. Origin and Evolution of gymnosperms with special reference to Progymnosperms, Devonian pre ovules and origin of seed.

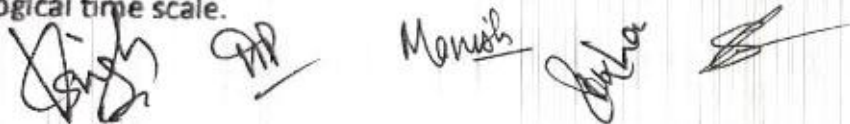
Unit IV

Brief Account of the families of Pteridospermales (Lyginopteridaceae, Medullosaceae, Caytoniaceae, and Glossopteridaceae). Comparative study of Cycadales, Ginkgoales, Coniferales (Pinaceae, Cupressaceae, Araucariaceae, Podocarpaceae, Cephalotaxaceae, Taxodiaceae), Taxales and Gnetales (Gnetaceae, Ephedraceae and Welwitschiaceae) etc.

Global distribution of gymnosperms with special reference to Indian plants. Endangered gymnosperms, their conservation and present status. Cytogenetics of Gymnosperms; Economic importance and biotechnology of gymnosperms.

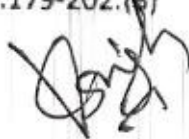
Unit V

Study of fossils: Methods of preservation, investigation and importance in stratigraphy. Continental drift and geological time scale.

The block contains five handwritten signatures in black ink, likely belonging to the faculty members who prepared the syllabus. The signatures are stylized and vary in length and complexity.

Suggested readings:

1. Rashid, A. 2011. An Introduction to Pteridophyta, 2nd edition, (Reprint), Pub. Vikas Publishing House Pvt. Ltd., Noida.
2. Gifford, Ernest, M., Foster, Adriance.S.; 1989, Morphology and Evolution of vascular plant. W. H. Freeman; Third Edition.
3. Ogura, Yuzuru., 1972, Comparative Anatomy of Vegetative Organs of The Pteridophytes. Gebr. Borntraeger; 2nd edition.
4. Rashid, A.1999, An Introduction to Pteridophyta: Diversity, Development, Differentiation. Vikas Publishing House Pvt Ltd.
5. Parihar, Narayan Singh., 1977, The Biology and Morphology of The Pteridophyte. Central Book Depot.
6. Eames, A.J. (1936) Morphology of Vascular plant-lower group. Tata Mc Graw Hill, New Delhi.
7. Chamberlain, Charles Joseph, b.(1863), Gymnosperm; Structure and Evolution. Chicago, Ill., The University of Chicago Press
8. Chhaya Biswas and B.M.Johri. The Gymnosperm. Springer; 1997, edition (16 April 2014) Bhatnagar, S.P. Moltra, Alok. (1996). Gymnosperms. New Age International.
9. Pant DD. (2002), An Introduction to Gymnosperms, Cycas, and Cycadales, Birbal Sahni Institute of Palaeobotany.
10. Steward W.N., Palaeobotany and evolution of plant. Cambridge University Press, New York.405 p.(1)
11. Stewart, W.N., and G.W.Rothwell. (1993) Palaeobotany and the evolution of plant. 2nd ed. Cambridge University Press, New York.521 p.(1)
12. Andrews,H.N.Jr.1974 Palaeobotany (1947-1972) Annals of the Missouri Botanical Garden 61:179-202.(8)



Mansh



Course Code: B040802T	Year: First	Semester : Second
Course Title: Angiosperms : Taxonomy		

Unit I

Latin diagnosis, definition and use of Taxonomic terms, History of Plant Taxonomy in India, History of Plant Classification, Need and aim of classification, Units of classification, delimitations of taxa and their practical consideration, Artificial, Natural and Phylogenetic system of classification, a critical study of Takhtajan, Modern system of classification, An introduction of angiosperm Phylogeny Group (APG), Characteristics and phylogeny of orders

Unit II

Need and aim of nomenclatures, International rules of Botanical Nomenclature, Concept of species, genus and family with special reference to the type concept

Unit III

Interrelationship of plant taxonomy with morphology, anatomy, embryology, palynology, cytology, genetics, Biosystematics, biochemical and molecular systematics, Numerical taxonomy, Phytogeography and phytochemistry

Unit IV

A general knowledge of Herbarium, and Botanical garden of the world and India, BSI and Identification keys

Unit V

General knowledge of distinguishing features of important families with special reference to local flora.

(a) Dicotyledons: Magnoliaceae, Ranunculaceae, Papaveraceae, Anacardiaceae, Fabaceae, Rosaceae, Myrtaceae, Apiceae, Rubiaceae, Cucurbitaceae, Capparidaceae, Carryophyllaceae, Malvaceae, Rutaceae, Meliaceae, Asteraceae, Scrophulariaceae, Primulaceae, Asclepiadaceae, Convolvulaceae, Verbenaceae, Bignoniaceae, Lamiaceae, Acanthaceae, Polygonaceae, Euphorbiaceae.

(b) Monocotyledons: Orchidaceae, Liliaecae, Musaceae, Palmae, Cyperaceae, Graminae (Poaceae) etc.

1. J. Harborne, B.L. Turner and D. Boulter-Chemotaxonomy of Leguminosae, Academic Press, London, 1971.
2. John Firminger Duthie- Flora of Upper Gangetic Plains, Shiva offset Press, vol. I, 1903, vol.II, 1911.
3. John Hutchinson- The Families of Flowering Plants, Clorendon Press, 1959.
4. Arthur John Cronquist- The Evolution and Classification of Flowering Plants, Shiva offset Press, 1981.
5. P.H. Davis and B.H. Heywood- Principles of Angiosperm Taxonomy, Princeton Press, 1963.
6. Alfred Barton Randle- The Classification of Flowering Plants, Harvard University, 1904.
7. Gurcharan Singh- Plant Systematic, Oxford & IBH Publishing Company Pvt. Ltd., 1999.
8. Tod F. Stuessy-Plant Taxonomy, Shiva offset Press, 2002.
9. Peter H.A. Sneath and Robert R. Sokal- Numerical Taxonomy, Wayne State University Press, 1973.
10. T. Pullaiah- Taxonomy of Angiosperms, Regency Publications, New Delhi, 1998.

  Manish  

Course Code: B040803T	Year: First	Semester : Second
Course Title: Angiosperm : Plant Development & Reproduction		

Unit I

Introduction of morphology and anatomy including brief historical account; External and internal organization of higher plants; Morphology of root and stem and their modifications, Ergastic substances; Microscopic and sub-microscopic structure and organization of cell wall

Meristems: Organization of root apical meristem (RAM) and shoot apical meristem (SAM) differentiation; Quiescent center, Xylem and phloem: Ontogeny and structure of components and phylogeny, transfer cells.

Secretory and excretory structures; Primary structure of root and stem, Origin of lateral roots, root-stem transition, nodal anatomy and its evolutionary significance; Leaf -structure and function with special reference to epidermis. Systematic significance of trichomes and stomata;

Unit II

Vascular cambium and its derivatives, Primary anomalies in stem and anomalous secondary growth, Floral morphology and anatomy, fruits and seeds

Periderm, Wood structure, Sapwood and Heartwood, Growth rings

Unit III

Experimental and applied embryology

Morphogenetic Phenomenon-Symmetry, Polarity, Correlation, Differentiation, Totipotency and Regeneration and Phyllotaxy

Factors affecting Morphogenetic Phenomenon: Genetic, Physical and Chemical

Unit IV

Introduction to life history of angiosperms, brief history of plant embryology; Anther: Structure and development wall layers and their role; Microsporogenesis; Cytoplasmic reorganization during microsporogenesis, Pollen wall morphogenesis and anther dehiscence; Pollen morphogenesis, Development of male gametophyte, ultrastructure, abnormal male gametophyte, Pollen germination

Unit V

[Handwritten signatures and initials]

Pollen-pistil interaction: Role of pollen wall proteins and stigma surface proteins, pollen tube growth in pistil, fertilization and apomixis: Endosperm: Major types, ultrastructure and histochemistry; Embryo: major types, polyembryony Embryology in relation to Taxonomy

Suggested readings

1. Carlquist, S. (1961), Comparative Plant Anatomy, Holt, Rinehart and Winston, New York Press
2. Cutter, Elizabeth (1969), Plant Anatomy part -I Cells and Tissues IInd edition, Edward Arnold, London
3. Cutter, Elizabeth (1971), Plant Anatomy Part-II Organs, Edward Arnold London
4. Dickison William C. (2000), Integrative Plant Anatomy. Academic Press
5. Eames, A. J. & Mac Daniels Laurence H. (1951), An Introduction To Plant Anatomy, Mc Graw Hill.
6. Eames A.J (1961), Morphology of Angiosperms, Mc Graw-Hill, New York.
7. Esau, Katherine (1965), Plant Anatomy, John Wiley and Sons. Inc, New York.
8. Esau, Katherine, Anatomy of seed Plants (1960), Wiley, New York.
9. Evert, Ray.F. (1960), Esau's Plant Anatomy. John Wiley & Sons.
10. Fahn, A. (1982), Plant Anatomy Vol I and Vol II Pergamon Press. Oxford New York
11. Mauseth, James D. (1988) Plant Anatomy. Benjamin/Cummings.
12. Bhojwani, S.S. and Bhatnagar, S.P. (1985), Embryology of Angiosperms, Vikash Publishing House, New Delhi
13. Johri, B.M (1984) Embryology of Angiosperms. Springer-Verlag Berlin Heidelberg.
14. Maheshwari, P. (1950) An Introduction to the Embryology of Angiosperms. Tata McGraw Hill.

Course Code: B040804T	Year: First	Semester : Second
Course Title: Floriculture and Nursery		

Unit I

Commercial floriculture: scope & importance in India.

Techniques of producing ornamental plants like Rose, Marigold, Chrysanthemum, Orchid, Gladiolus etc.

Orchards: Importance, objectives, merits and demerits

Horticultural crops and their nutritive value

Unit II

Vermicomposting, green manuring

Biofertilizers and use of biocontrol agents

Biopesticides, pheromones

Organic food and human health

Unit III

Vegetative propagation, Gootee, layering, grafting

Micropropagation & Its Industry

Seed propagation & Its limitation

Plant Quarantine

Unit IV

Scope and objectives of gardening, style of gardens: Formal, Informal, Types of gardens: English, Mughal and Japanese.

Components of garden, Planning of outdoor gardens: Small, Residential, Larger Home Garden, Roof Garden, Terrace Garden, Children's garden, School and Institutional Garden, Park, Industrial garden, Housing complex, Indoor gardening

DP

Monish

Saha

S

Singh

Unit V

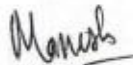
Principles of landscape design, elements, planning and layout Plant material for landscaping, symbols and tools

Landscape design for specific areas: residence, commercial buildings, educational institutes and hotels

Computer applications in landscape design

Suggested readings:

1. Lyndy J. McGaw et.al Medicinal Plants for holistic healing.
2. Bhani Ram, Mamta Dail and Anil Sharma. Plantation Crops.
3. Roy A. Larson- Introduction to Floriculture.
4. S.Prashad- Commercial Floriculture.
5. Dr. R. K. Bishwas- Organic farming in India. (N D publication).
6. Bijan Bihari Dutta-A Handbook of Plant Resource Utilization and Conservation
7. Peter McHoy- Garden planning & garden design. (Southwater Publication).
8. Deborah L. Martin- Rodale's basic gardening. (Rodale Books Publication).
9. Brian Capon- Botany for Gardeners. (3rd edition)
10. Harry Tomlinson- A complete book of Bonsai.
11. Elizabeth Barlow Rogers- Landscape Design: A cultural and Architectural History.
12. Chris Young- Encyclopedia of Landscape design. (DK Publication).
13. Anupam Tiwari, Anil K. Singh et.al- Computer aided designing for Landscape gardening. Global journal of pharmaceutical research 5(5):386-388.
14. Stephen Erwin and Hope Nasdrouck- Landscape Modelling.



Course Code: B040805T	Year: First	Semester : Second
Course Title: Plant Resource Utilization and applied Botany		

Unit I

Plant diversity and sustainable development: basic concepts and status in India.

Unit II

Cultivation and uses of economically important plants (with special reference to origin, evolution, cultivation and uses).

Food, forage and fodder crops: Cereals, legumes, nuts and general account of fodder crops.

Fibre yielding crops: Textile fibre plants and their products, its uses and cultivation in India.

Medicinal Plants and Aromatic plants: Plants of medicinal importance and general account of aromatic plants as source of essential oil.

Important fire wood and timber yielding plants: A general account.

Non-wood forest products (NWFPs): Bamboo, rattans, raw material of paper industry, gums, tannins, dyes, resins, rubber and latex-products: A general account.

Fumigatories and masticatories: A general account.

Unit III

Green revolution: Benefits and adverse conditions, innovation for meeting world food demands.

Unit IV

Conservation Biology: Principles of conservation, strategies for conservation *In situ* conservation (a general account of sanctuaries, national parks, biosphere reserves, wetlands, mangroves, for conservation of wild biodiversity), *Ex-situ* conservation (Principle and practices, A general account of the activities of B.S.I., National Bureau of Plant Genetic resource (NBPGR), Indian Council of Agricultural research (ICAR) for conservation of plants and non formal conservation efforts.

Unit V

Organisms of conservation concern: Rare, endangered species. Bioremediation, phytoremediation, and biosensor



Manish



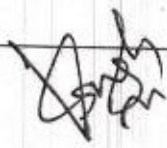
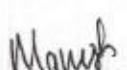




OR

*Apprenticeship/ Internship embedded UG
Degree Programme*

Programme/Class: 4 Year UG degree (Honours)	Year: IV	Semester: VII & VIII
Subject: Botany		
Course Code:	Course Title: Major Research Project/Dissertation	
Course Outcome Full Year (fourth year / Semester VII & Semester VIII) External Project/Dissertation is designed to ensure that the student is able to apply the knowledge gained in the previous semesters in specific areas of interest in a problem solving environment, gaining bench-experience, to serve as a springboard for a professional future.		
Credits: 40		
External Project/Dissertation 12 Months Apprenticeship/ Internship through NATS or from equivalent organization/ Industry/ Institute. External Project/Dissertation for Semester VII & VIII will be carried out by the students in various recognized established labs of Parent/Other Universities, of Institutes under CSIR, ICMR, IIT, ICAR, DST, DBT, Industry, Government Departments etc. (to be arranged by the students themselves, including whatever expenses become due in this regard).		

XXXXXXXXXXXXXX

DETAIL SYLLABUS FOR
M.Sc. Final (Semester-III & IV)
or
Semester: IX & X

High

DP

Manish

Saha

[Signature]

Course Code: B040901T	Year: Second	Semester : Third
Course Title: Plant Physiology and Biochemistry		

Unit I

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C3, C4 and CAM pathways.

Respiration and photorespiration: glycolysis, Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Nitrogen metabolism: Nitrogen cycle and biological nitrogen fixation, nitrate and ammonium assimilation, amino acid biosynthesis.

Metabolism of lipids, amino acids, nucleotides.

Unit II

Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Growth and Development Aspects: Metabolic changes during seed germination, factors affecting seed germination and dormancy, breaking of dormancy, biochemistry of flowering: initiation and development of flower, induction of flowering- vernalization, physiology and biochemistry of leaf abscission and senescence.

Unit III

Solute transport and photoassimilate translocation - uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration;

mechanisms of loading and unloading of photoassimilates.

Stress physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Sensory photobiology: Phytochromes and cryptochromes and their photochemical and biochemical properties, photo physiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression

[Handwritten signatures and names]
 Manish

Secondary metabolites: Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Programmed Cell Death (PCD)

Unit IV

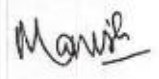
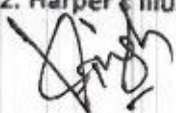
Bioenergetics: Law of thermodynamics, concept of enthalpy and entropy and their significance in biological systems, Water biochemistry, high energy molecules, redox potential; Amino acids and proteins: Structure and physicochemical properties of amino acids; Proteins: Primary, secondary, tertiary and quaternary structure of proteins, physical and chemical properties of proteins and biological significance. Enzymes: Classification, physicochemical nature, enzyme kinetics, mechanism of action and regulation, allosteric enzyme, isoenzyme, zymogen

Unit V

Carbohydrates: Structure and physico-chemical properties of carbohydrates, biological significance, important glycoprotein, Lipids: Classification, structure and properties of important lipids, biological significance of glycolipids, fatty acid biosynthesis and storage lipids and their catabolism, Vitamins and Coenzymes: Structure and general biochemistry.

Suggested readings:

1. Taiz and Zeiger, 2010, Plant Physiology, 5th Edition. Sinauer Associates
2. Hopkins, W.G. and Huner N.P.A., 2009, Introduction to Plant Physiology, 4th Edition Wiley International Edition, John Wiley & Sons, USA
3. Jones, Russell L. Buchanan, Bob B. Guissem, Wilhelm., 2002, Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists.
4. Peter Scott, Physiology and Behaviour of Plants. Wiley-Blackwell.
5. Frank Boyer Salisbury and Cleon Ross, 1991, Plant Physiology, CA
6. Wilson, K. and Walker, J., 2000, Practical Biochemistry: principles & techniques. Cambridge University Press. ISBN 0521799651.
7. Buchanan, B., Gruissem, W., & Jones, R.L., 2002, Biochemistry and Molecular Biology of Plants. American Society of PlantBiologists, USA.
8. Watson, JD, Baker, TA, Bell, SP, Gann, A, Levine, M and Richard, L. 2008. Molecular Biology of the Gene. Pearson Education Inc.
9. Nelson, D.L. and Cox, M.M., 2008, Lehninger Principles of Biochemistry, W. H. Freeman & Co, New York, USA
10. Murray, R, Murray, RK, Bender, D, Gotham, KM, Kennelly, PJ, Rodwell, V and Weil, PA. 2012. Harper's Illustrated Biochemistry McGraw Hill



Course Code: B040902T	Year: Second	Semester : Third
Course Title: Cytogenetics and Biostatistics		

Unit I

Basic concept and organization: Chromosome structure, special type of chromosomes- Polytene chromosomes, lamp brush chromosomes, B chromosomes. Gene concept; allele concept, multiple alleles, isoalleles, Pseudoalleles, Cell division,

Unit II

Inheritance Genetics: Principles of Mendelian Inheritance, Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex determination in plants and sex linkage, sex limited and sex influenced characters.

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers.

Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Unit III

Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Population genetics: Populations, Gene pool, Gene frequency; Hardy Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift.

Unit IV

Mutation: Types, causes and detection, mutant types - lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants,, physical and chemical mutagens, insertional mutagenesis. DNA damage and repair mechanism.

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

Unit V

Biostatistics: General Concept of statistics and biometry.

DP

Mamsh

Johna

Signature

Signature

Measurement of central tendencies (mean, mode, median), measurement of deviation (standard deviation, standard error).

Significance test (chi square test & t-test).

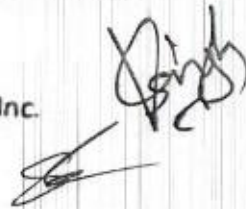
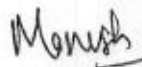
Diagrammatic representation of statistical data.

Correlation

Types of statistical software and their application in analysis of data

Suggested reading:

1. Clark, M.S. and Wall, W.J. 1996, Chromosomes: The Complex Code. Chapman & Hall, London.
2. Stebbins, G.L. 1950, Variation and Evolution in Plants. Columbia Univ. Press, New York.
3. Swanson, C. P., Mertz, T.F. and Young, W.J. Cytogenetics: The Chromosomes in Division, Inheritance and Evolution (2nd Edn). Englewood Cliff, Prentice-Hall, New Jersey.
4. Sharma, A.K. and Sharma, Archana. 1985. Advances in Chromosome and Cell Genetics. Oxford & IBH Publishing Co., Calcutta.
5. Schnedl, W.. Banding patterns in chromosomes. In: International Review of Cytology (Suppl. 4).
6. Lewine, Benjamin, Jones and Bartlet, Genes X, Sudbury, Masschusetts
7. Gupta, P.K., Cytogenetics, Rastogi Publication, Meerut
8. Peter, D, Snustand and Simmons, M.J., John Wiley and Sons Inc.



Course Code: B040903T	Year: Second	Semester : Third
Course Title: Ecology, Soil Science and Phytogeography		

Unit I

Introduction to ecology, and environmental terminology, population dynamics, vegetation organization and development: population characteristics, population growth forms, density dependent and density independent controls, population structure (distribution, aggregation, isolation territoriality) energy partitioning, r- and k-selection, concept of carrying capacity: Wild life sanctuaries, botanical gardens

Concepts of community and continuum, analysis of communities (analytical and synthetic characters), community coefficients, competition, ecological niche, succession, mechanism of ecological succession (relay floristic and initial floristic composition facilitation, tolerance and inhibition models), concept of climax

Unit II

Ecosystem organization, structure and function: primary production (methods of measurement), energy dynamics (trophic organization, energy flow pathway, energy quality, ecological efficiencies), biogeochemical cycles

Unit III

Pollution and climate change: kinds, sources and effects of pollution, heavy metals (Pb, Cd, Hg), green house gases (CO₂, CH₄, NO, CFCs), Green-house effect and global warming, ozone layer depletion and ozone hole, acid rain

Unit IV

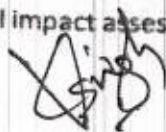
Soil types, soil profile, soil formation (gleization, Podzolization and Laterization), soil texture, soil humans.

Soil moisture constants.

Soil erosion and conservation.

Unit V

Phytogeography: Distribution pattern, barriers, endemism and age- area hypothesis. Environmental impact assessment, threatened and endangered plant species, role of diversity



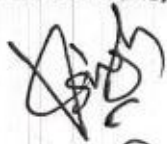

Manish



in ecosystem stability, general account of remote sensing and its application, sustainable development. Major terrestrial biomes, biogeographical area of India, major vegetations

Suggested reading:

1. Odum, E. P. and Barret G. W. 2005. Fundamentals of Ecology. Cengage publication
2. Odum, E.P., 1983. Basic Ecology, Saunders College Publishing
3. Singh, J.S., Singh S.P. and Gupta S.R. 2006. Ecology Environment and Resource Conservation. Anamaya Publishers
4. The nature and properties of soils, Nyle C. Brady and Ray R. Weil, Pearson Education Pvt. Ltd., 2002




Mamish

Course Code: B040904T	Year: Second	Semester : Third
Course Title: Plant Breeding and Crop Improvement		

Unit I

Importance, scope and major achievements of plant breeding.

Germplasm; kinds of germplasm, collection, evaluation and organizations concerned with germplasm, *in-situ* and *ex-situ* conservation. Modes of reproduction in crop plants; sexual and asexual reproduction, apomixis, identification of apomictic plants.

Incompatibility; genetic, physiological and biochemical basis of incompatibility, utility of self incompatibility. Male sterility, genetic and cytoplasmic male sterility and its applications.

Unit II

Plant introduction; types of introduction, procedure, uses of plant introduction and organizations

associated with introduction.

Pure line selection, mass and progeny selection, procedure and achievements.

Pedigree selection, recurrent selection and their applications.

Unit III

Role of mutation in plant breeding, isolation of useful mutants and major achievements.

Role of polyploidy in crop improvement.

Unit IV

Hybridization- kinds of hybridization, procedure of hybridization, types of hybridization and utility of hybridization.

Hybrid breeding in self- and cross-pollinated crops.

Back cross breeding

DP

Mamish

Handwritten signature

Handwritten signature

Handwritten signature

Types of hybrids-single cross hybrid, three way cross hybrid, double cross hybrid, synthetic and composite crosses.

Heterosis; theories of heterosis, inbreeding depression.

Unit V

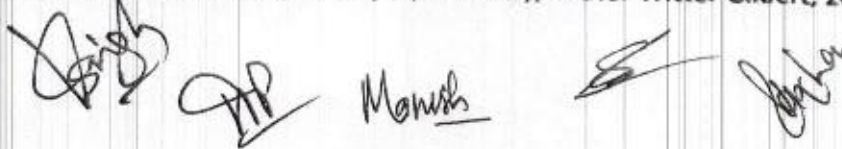
Protoplast fusion and somatic hybrids.

Method of gene transfer and transgenics. Marker assisted selection.

Breeding for disease resistance, salinity tolerance and quality traits.

Suggested Readings:

1. Introduction to Plant Breeding, R.C. Chaudhary, Oxford & IBH Publishers, 1982.
2. Plant Breeding, V. Kumaresan, Saras Publication, 2015.
3. Plant Breeding Principles & Methods, B.D.Singh, Kalyani Publishers, 1983.
4. Fundamentals of Plant Breeding, Phundan Singh, Kalyani Publishers, 2017.
5. Principles of Plant Breeding, I.D.Tyagi, Jain brothers, 2015
6. Plant Breeding Methods, Mahabal Ram, PHI Learning Pvt. Ltd., 2014.
7. Principles of Plant Breeding, Robert W. Allard, John Wiley & sons, 1960.
8. Plant Breeding: Scholar Select, Liberty Hyde Bailey, Arthur Witter Gilbert, 2018.



Course Code: B040905T	Year: Second	Semester : Third
Course Title: Instrumentation and Analytical Technique		

Unit I

Techniques of Collection, fixation, embedding, dehydration and Staining.

Unit II

Microscopy: Simple, Compound, Phase-contrast, Fluorescence, Electron (SEM and TEM) microscopy, Micrometry and Camera lucida

Unit III

Centrifugation:-Rotors, Benchtop, Low speed, High speed, Cooling, Ultracentrifuge. Electrophoresis:-Native, Denaturing, Isoelectric focusing, 2-D Electrophoresis; Spectroscopy:- UV, Visible, IR, Raman, Spectro fluimetry, Mass, AAS, NMR

Unit IV

ESR Radioactivity- GM counting, Scintillation counting, Autoradiography; Chromatography:- Paper, TLC, Column, Gel Filtration, Ion Exchange, HPLC, GC

Unit V

Microtomy; DNA Chip technology and Microarrays, Mass Spectrometry for genome and proteome analysis

[Handwritten signatures and marks]

Course Code: B041001T	Year: Second	Semester : Fourth
Course Title: Plant Molecular Biology and Molecular Techniques		

Unit I

Structure and conformation of nucleic acids; Replication of DNA; DNA damage and repair, Gene structure; Transcription of gene; Structure of mRNA, rRNA and tRNA, Regulation of transcription, Post-transcriptional modification of RNA, RNA editing; Transport of RNA

Unit II

Protein synthesis: Genetic code, Mechanism of translation (initiation, elongation and termination); Post-translational modification; Protein sorting in the cell, Regulation of protein synthesis in prokaryotes and eukaryotes.

Unit III

Signal transduction: Overview of receptors and G-proteins, phospholipids signifying role of cyclic nucleotides, calcium calmodulin cascade diversity in protein kinase and phosphates specific signaling mechanism, Secondary messengers; Gene silencing mechanisms, Epigenetics

Unit IV

Isolation and Purification of Nucleic Acids, Electrophoresis and quantification of nucleic acids, DNA Sequencing Sanger's Dideoxy Method, Maxam and Gilbert Method. High throughput sequencing, Nuclear run-on assay, Nucleic acid blotting techniques, DNA Synthesis, Chromatin remodeling

Unit V

Isolation and purification of protein, Electrophoresis and quantification of proteins, Western Blotting. Protein-nucleic acid interaction analysis, Protein-protein interaction analysis; ELISA, RIA; Protein immunoprecipitation, Protein sequencing strategies. Radioactive isotope labeling, Mass spectrometry

Suggested Readings:

Buchanan, B., Gruissem, W., & Jones, R.L., 2002, Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists, USA.

Lodish, Harvey, Berk, Arnold, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira Molecular

Mamsh

Course Code: B041002T	Year: Second	Semester : Fourth
Course Title: Plant Biotechnology and Bioinformatics		

Unit I

A brief introduction to Biotechnology; Recombinant DNA technology: Restriction endonucleases, DNA Modifying enzymes, DNA polymerases; Vectors, Markers and reporter genes, Cloning, Screening of recombinant clone; Polymerase chain reaction: Principle, method, variants and practical applications.

Unit II

Gene cloning and Identification: Genomic and cDNA library, Hybridization techniques: Southern, northern and western hybridization; FISH; Molecular markers: RFLP, RAPD, AFLP, SSR, SNP; Functional genomics: Quantitative Real Time PCR, Microarray, RNA interference, Mutagenesis and Genome editing, Protein Production strategies in Expression System; Metagenomics

Unit III

Methods of gene transfer, Agrobacterium mediated genetic transformation of plants, Regeneration methodologies and Screening of transformants; Genetic engineering and its applications in Agriculture: Genetic manipulation of pest resistance, abiotic and biotic stress tolerance, Molecular farming; Transformation of chloroplast genome and its advantage; Biosafety concerns in Plant Biotechnology

Unit IV

Bioinformatics: Introduction, Databases (Genomic and Protein Database), Similarity Searching: BLAST and FASTA; Tools for DNA, RNA and Protein sequence analysis, ExPASy-PROSITE, Sequence Retrieval Methods, Primer Designing tools, Gene Prediction, Restriction Site Annotation, ORF Finder, Sequence Alignment; Molecular evolution and analysis methods

Unit V

Bio fertilizers, organic farming, Biotechnology in pollution control and phytoremediation, Ethics in biotechnological research.

Suggested readings:

1. J.D. Watson, T. A. Baker, S. P. Bell, A. Gann, M. Levine & R. Losick Molecular Biology of the Gene, Cold Spring Harbor Laboratory
2. Bernard R. Glick and Jack J. Pasternak, Molecular Biotechnology: Principles and application of recombinant DNA ASM Press, Washington, D.C
3. T. A. Brown, Genomes - Garland Science (Taylor & Francis Group), New York & London
4. Alberts Bruce, Johnson Alexander, Lewis Julian, Raff Martin, Roberts Keith and Walter Peter Molecular Biology of the Cell - Garland Science
5. Lodish, Harvey, Berk Arnold, et. al., -Molecular Cell Biology.
6. Introduction to plant biotechnology by H S Chawla

 Manish





Course Code: B041003T	Year: Second	Semester : Fourth
Course Title: Research Methodology and IPR		

Unit i

Meaning, Object & Basic Principles of Research Legal Research In India, Evaluation and Development, Problems & Challenges

Unit II

Tools and Techniques of Legal Research Doctrine and Empirical Research, Interview Techniques, Scaling Techniques of Socio Legal Research Research Design, Sampling Designs, Data Collection and Analysis Creativity, Innovation, Originality and Advancement of Knowledge and Application to the Society

Unit iii

Report writing and the writing of research papers; Lay out, chaptering, preparation of introduction and Conclusion, Methods of citation, Bibliography and Abbreviations Communication Skills, review of published research, seminar, presentation etc.

Unit IV

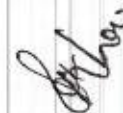
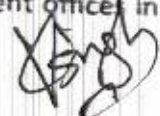
Computer application for research, Word Processing, Data Processing, Graphical Processing, Use of Web-2 tools for research, use of Graphical Software, Use of Multimedia Tools, Ethics in Research

Unit V

Concept of bioethics, benefits and harm, consent, privacy and confidentiality, sharing of benefits; Intellectual Property Right: Definition of IPR, World Intellectual Property Organization (WIPO) and its role; Patent: kinds of patent classification, patent criteria, Procedure of obtaining patent, copy right and trade mark, Organization of patent offices in India



Manish

Course Code: B041004T	Year: Second	Semester : Fourth
Course Title: Biodiversity, Remote Sensing and Environment Management		

Unit I

Biodiversity: Definition, Measurement (Alpha, Beta & Gamma), Global biodiversity

Unit-II

Levels of biodiversity: Genetic, species, community and ecosystem; Magnitude and distribution: Diversity gradients

Unit III

Threats to biodiversity: Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Red data book

Unit IV

Strategies for biodiversity conservation: Principles of biodiversity conservation, *in-situ* and *ex-situ* conservation strategies

Unit V

Remote sensing, Environmental management and Environmental forecasting

Course Code: B041005P	Year: Second	Semester : Fourth
Course Title: Major Research Project/ Dissertation		

The topic would be decided by the candidate in consultation with the respective supervisor. Major Research Project/ Dissertation will be based on existing branches of botany and the title will be decided keeping the view on the modern aspect in the related discipline. It will be the part of semester IV; however, the title of Major Research Project/Dissertation will be assigned by concerned faculty member/board in the beginning of semester III to provide sufficient time to complete Major Research Project /Dissertation.



