DEPARTMENTOF HIGHEREDUCATION
U.P.GOVERNMENT,LUCKNOW

NationalEducationPolicy-2020
CommonMinimumSyllabus
forallU.P.StateUniversitiesandColleges For
the first three years of
HigherEducation(UG)

PROPOSEDSTRUCTUREOFSYLLABUS

BOTANY

(FACULTYOFSCIENCE)

Dr. Neetu Singh
Convener

Dr. Neeta Singh
Convener

SUBJECT: BOTANY

Name	Designation	Affiliation
SyllabusSteering Committee		
Mrs.MonikaS.Garg, (I.A.S.) ChairpersonSteering Committee	AdditionalChiefSecretary	Dept.ofHigherEducationU.P.,Lucknow
Prof.PoonamTandan	Professor, Dept.of Physics	LucknowUniversity,U.P.
Prof.HareKrishna	Professor, Dept.of Statistics	CCSUniversityMeerut,U.P.
Dr.DineshC. Sharma	AssociateProfessor, Dept.of Zoology	K.M.Govt.GirlsP.G.CollegeBadalpur,G.B. Nagar,U.P.
SupervisoryCommittee-ScienceFaculty		
Dr.VijayKumarSingh	AssociateProfessor, Dept.of Zoology	AgraCollege,Agra
Dr.SantoshSingh	Dean, Dept.of Agriculture	MahatmaGandhiKashiVidhyapeeth,Varanasi
Dr.BabyTabussam	AssociateProfessor, Dept. of Zoology	Govt.RazaP.G.CollegeRampur, U.P.
Dr.Sanjay Jain	AssociateProfessor, Dept.of Statistics	St.John'sCollege,Agra

SyllabusDevelopedby:

S.No.	Name	Designation	Department	College/University
1.	DrSeemaBhadauria	Head& AssociateProfessor	Botany & Biotechnology	RBSCollege,Agra
2.	DrShwetaShekhar	AssistantProfessor	Botany	*DDU Gorakhpur University, Gorakhpur*
3.	DrHimshikhaYadav	AssistantProfessor	Botany	VRALGM Degree College, Bareilly

Semester-wiseTitlesofthePapersinB.Sc.(Botany)					
Year	**Sem.**	**Course Code**	**PaperTitle**	**Theory/ Practical**	**Credits**
CertificateCourseInMicrobialTechnology&AppliedBotany					
FIRST YEAR	I	B040101T	**Microbiology&PlantPathology**	Theory	4
		B040102P	**TechniquesinMicrobiology&PlantPathology**	Practical	2
	II	B040201T	**Archegoniates&Plant Architecture**	Theory	4
		B040202P	**LandPlantsArchitecture**	Practical	2
Diplomain PlantIdentification,Utilization&Ethnomedicine					
SECOND YEAR	III	B040301T	**FloweringPlantsIdentification&Aesthetic Characteristics**	Theory	4
		B040302P	**PlantIdentification technology**	Practical	2
	IV	B040401T	**EconomicBotany,Ethnomedicine&Phytochemistry**	Theory	4
		B040402P	**CommercialBotany&Phytochemical Analysis**	Practical	2
Bachelor ofScience					
THIRD YEAR	V	B040501T	**PlantPhysiology,Metabolism& Biochemistry**	Theory	4
		B040502T	**MolecularBiology&Bioinformatics**	Theory	4
		B040503P	**Experimentsinphysiology,Biochemistry&molecular biology**	Practical	2
		B040504R	***Project-I**	Practical	3
	VI	B040601T	**Cytogenetics, PlantBreeding& Nanotechnology**	Theory	4
		B040602T	**Ecology&Environment**	Theory	4
		B040603P	**Cytogenetics,Conservation&Environmentmanagement**	Practical	2
		B040604R	***Project-II**	Practical	3

Subjectprerequisites:

1. TostudyBotany, astudent musthavehadthesubject Biology/Biotechnologylearnt at10+2 level.
2. Keeninterestinplantsandplant-relatedresearch, Potentialinmathematics,biologyandchemistry
3. Skillsandaptitudefor scientificstudyand research
4. Creativityandgoodcomprehensionwhileworkingonscientificproceduresand research
5. Computeraptitude.

COURSEINTRODUCTION

ThenewcurriculumofB.Sc.inScience(Botany)offersessentialknowledgeandtechnicalskillstostudy 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 beexposed to cutting-edgetechnologiesthat arecurrentlyused in thestudyofplant 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. BotanyProgramme covers academic activities within the classroom sessions along with practical conceptsatlaboratorysessions.Infield,outstationactivitiesandprojectsarealsorequiredtobeorganized for

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real-life experience and learning.
Candidates who have curiosity in plants kingdom, ecosystem, love exploring exotic places and wish to workasresearchersorprofessionslikeBotanist,Conservationist,Ecologist,etc.canchooseB.Sc.Botany course.

Programmeoutcomes (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.

PO1	CBCSsyllabuswithacombinationofgeneralandspecializededucationshallintroducethe conceptsofbreadthand depthin learning
PO2	Shallproducecompetentplantbiologistswhocanemployandimplementtheirgained knowledgeinbasicandappliedaspectsthatwillprofoundlyinfluencetheprevailingparadigm ofagriculture,industry,healthcareandenvironmenttoprovidesustainabledevelopment.
PO3	Will increase the ability of critical thinking, development of scientific attitude, handling of problems and generating solutions, improve practical skills, enhance communication skill, socialinteraction,increaseawarenessinjudicioususeofplantresourcesbyrecognizingthe ethicalvalue system.
PO4	The training provided to the students will make them competent enough for doing jobs in Govt.andprivatesectorsofacademia,researchandindustryalongwithgraduatepreparation fornationalaswellasinternationalcompetitiveexaminations,especiallyUGC-CSIRNET, UPSCCivilServicesExamination, IFS,NSC,FCI,BSI,FRIetc.
PO5	Certificateanddiplomacoursesareframedtogenerateself-entrepreneurshipandself-employability,ifmultiexitoption isopted.
PO6	Lifelonglearning be achieved bydrawingattention tothevast world ofknowledgeofplants andtheirdomestication.

Programmespecificoutcomes(PSOs):

B.Sc.IYear/CertificatecourseinMicrobialTechnology&ClassicalBotany

ThisProgrammeimpartsknowledgeonvariousfieldsofplantbiologythroughteaching,interactionsand practicalclasses.Itshallmaintainabalancebetweenthetraditionalbotanyandmodernscienceforshifting it towards the frontier areas of plant sciences with applied approach. This syllabus has been drafted to enable the learners to preparethem for self-entrepreneurship and employment in various fields including academics as well as competitive exams. Students would gain wide knowledge in following aspects:

1. Diversityofplantsandmicrobes,theirhabitat,morphology,architecture andreproduction.

2. Plantdiseasecausingmicrobes,symptoms&control.

3. Economicvalue ofplants and their usein Human Welfare.

Programmespecificoutcomes(PSOs):

B.Sc.IIYear/(Diplomain PlantIdentification,Utilization&Ethnomedicine)

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This course provides a broad understanding of identifying, growing and using plants. This course is primarilyaimedtointroducepeopletotherichnessofplantdiversityfound insurroundingareas. Lecture sessionsaredesignedtocoverfundamentaltopicsconcerningclassificationofplantsandtheirutilization required forunderstandingthe floraand vegetation. Practical sessions are organized followingtheoryfor easy understanding of the various parts of the plants, structural organization of floral parts and diversity therein.Participantsaretakentodifferentlocationscoveringavarietyofhabitatsandforesttypesto acquaintthemwiththenativeflora.inthelongrun,willcontributetowardsbuildingmomentumfor people's participation in environmental conservation without compromising on academic rigor and our rich wealth of knowledge inherited over generations.

1. ThecoursewillcoverconventionaltopicsinField BotanylikeEvolutionaryHistory&Diversityof plants, Complete Morphology, Nomenclature of plants, Systems of Classification, Keys to important Families of Flowering Plants, Field Data Collection & Herbarium Techniques.

2. Thecourseisdesignedtobecomeacommercialcropgrower,florist,protectedcultivator,green belt plant advisor to industries, pharmacologist & taxonomist.

Programmespecificoutcomes(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. Thiscourseissuitabletoproduceexpertiseinconservationbiologylikeex-situconservation, 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. EntrepreneurshipSkillDevelopment,Understandtheissuesofenvironmentalcontextsandsustainable development, Inculcation of human values,

6. Strengthenmathematicalandcomputationalskills.Enablestudentstouse ICT& AIeffectively.

7. Develop good skills in the laboratory such as observation and evaluation by the use of modern tools and technology.

PSO1	Understanding the nature and basic concepts of all the plant groups, their metabolism, components at the molecular level, biochemistry, taxonomy and ecology. Thecoursewillmakethemawareofnaturalresourcesandtheenvironmentandtheimportance of conserving it. Hands-on training in various fields will develop practical skills, handling equipmentandlaboratoryusealongwithcollectionandinterpretationofbiologicalmaterials and data. Knowledge gained through theoretical and lab-based experiments will generate technicalpersonnelinvariouspriorityareassuchasgenetics,cellandmolecularbiology,plant systematics and biotechnology.

PSO2	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•FruitGrower•Morphologist•Cytologist•Ethnobotanist•Plantgeneticists etc.
PSO3	Inculcate strong fundamentals on modern and classical aspects of Botany, understand knowledgeofBotanyisanessentialpre-requisiteforthepursuitofmanyappliedsciences.It will facilitate students for taking up and shaping a successful career in Botany and allied sciences.
PSO4	Introductionofresearchprojectwillinculcateresearchaptitudeandpassionforhigher education and scientific research.

	ProposedYearwise Structure ofB.Sc.inBotany (CORE/ELECTIVECOURSES&PROJECTS)										
	Subject:**Botany**										**Total Credits /hrs/**
Course/Entry–Exit levels	**Year**	**Sem.**	**Paper1**	**Credit/ hrs**	**Paper2**	**Credit/ hrs**	**Paper3**	**Credits /hrs**	**Research Project**	**Credit/**	
Certificate Course In Microbial Technology & Applied Botany	**I**	**I**	**Microbiology& Plant Pathology**	4/60	**Techniquesin Microbiology & Plant Pathology**	2/60	--		Nil	Nil	6/120
		II	**Archegoniates & PlantArchitecture**	4/60	**Land Plants Architecture**	2/60	--		Nil	Nil	6/120
Diplomain Plant Identification, Utilization &Ethnomed icine	**II**	**III**	**FloweringPlants 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

Bachelorof Science		**V**	**PlantPhysiology, Metabolism &Biochemistry**	4/60	**Molecular Biology &Bioinformatics**	4/60	**Experiments in physiology, Biochemistry&**	2/60	***Project-I**	3/45	13/205

	III						molecularbiology				
		VI	Cytogenetics, PlantBreeding& nanotechnology	4/60	Ecology &Environment	4/60	Cytogenetics, Conservation& Environment management	2/60	*Project- II	3/45	13/205
Comments	**TotalCredits/Hrs./lectures:(CreditscanbeearnedfromOn-linePortalsofUGCto createAcademicBankand15% of thetopicsof eachpapercanbetaughtbyon-line/ Virtual/ ICT based as per choice of the Institution) *SuggestiveListofProjectsmentionedinDetailedPaperSyllabus**										**50/890**

BotanyCourseisOneoftheMajorSubjectsforBiologyStudentsandMinororElectiveforstudentsofother faculties
SecondMajorSubjectCanbeZoology/Biotechnology/Microbiology
ThirdMajorSubjectcanbefromScienceorAnyotherfacultyofUGC/AICTE–(Arts/Agriculture/Education/ law/ Commerce)
FourthSubjectisMinororElectivetobeselectedfromanyoneofotherFacultiesasperstudent'sowninterest One Vocational Course has to be opted from the list given in Syllabus as per NSDC guidelines
OneCo-curricularCourseiscompulsory

InternalAssessment&External Assessment

Internal Assessment	Marks	ExternalAssessment	Marks
ClassInteraction	**5**	VivaVoceonPracticals	10
Quiz	**5**	ReportofBotanicalExcursion/Lab Visits/Industrial training/Survey/Collection/Models	10
Seminar	**7**	Table work/Experiments	45
Assignments (Charts/ Flora/ Rural Service/ Technology Dissemination/BotanicalExcursion/LabVisits/Industrialtraining)	**8**	PracticalRecordFile	10
TOTAL ***BotanicalExcursion/LabVisits/Industrialtraining Is compulsory**	**25**		**75**

DETAILSYLLABUSFOR
CERTIFICATECOURSEINMICROBIALTECHNOLOGY&CLASSICAL BOTANY
OR
B.Sc.-I

CERTIFICATECOURSEINMICROBIALTECHNOLOGY&CLASSICALBOTANY/B.Sc.-I			
Programme:***CertificateCourseinMicrobialTechnology&Classical Botany***		Year:**I**	Semester: **I/Paper-I**
Subject:**Botany**			
CourseCode: B040101T	CourseTitle:**Microbiology&PlantPathology**		

Courseoutcomes: Afterthecompletionofthecoursethestudentswillbeable to:

1. Develop understandingabout the classificationand diversity ofdifferent microbes including viruses, Algae, Fungi &Lichens & their economic importance.
2. Developconceptualskillaboutidentifyingmicrobes,pathogens,biofertilizers&lichens.
3. Gainknowledgeaboutdevelopingcommercialenterpriseofmicrobialproducts.
4. Learnhost–pathogenrelationshipanddiseasemanagement.
5. LearnPresentationskills(oral&writing)inlifesciencesbyusageofcomputer&multimedia.
6. GainKnowledgeaboutusesofmicrobesinvariousfields.
7. Understandthestructureandreproductionofcertainselectedbacteriaalgae,fungiandlichens
8. GainKnowledgeabouttheeconomicvaluesofthislowergroupofplantcommunity.

Credits:**4**	**CoreCompulsory**
Max.Marks:**25+75**	Min.PassingMarks:

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TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**4-0-0**		
Unit	**Topic**	**No.of Lectures (60 hrs)**

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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. MicrobialTechniques&instrumentation** Microscopy– Light,phasecontrast,electron,scanningandtransmissionelectronmicroscopy,stainingtechniquesfor lightmicroscopy,samplepreparationforelectronmicroscopy.Common equipmentofmicrobiologylabandprinciple oftheir working – autoclave, oven, laminar air flow, centrifuge. Colorimetryand spectrophotometry, immobilization methods, fermentation and fermenters.	**8**
II	**Microbialworld** CellstructureofEukaryoticand prokaryoticcells,Grampositiveand Gram-negativebacteria,Structureofabacteria; 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,generalcharacteristics,viralculture, Structure of viruses,Bacteriophages,Structure ofT4 &,λ-phage; Lytic and Lysogenic cycles, viroid, Prions & mycoplasma & phytoplasma, Actinomycetes & plasmids and their economic uses.	**8**
III	**Phycology** RangeofthallusorganizationinAlgae,Pigments,Reservefood–Reproduction-Classificationandlifecycleof– *Nostoc,Chlorella,Volvox,Hydrodictyon,Oedogonium,Chara;Sargassum,Ectocarpus,Polysiphonia.* Economicimportanceofalgae-Roleofalgaeinsoilfertility-biofertilizer–Nitrogenfixation-Symbiosis;Commercial products of algae –biofuel, Agar.	**7**
IV	**Mycology** Generalcharacteristics, nutrition,lifecycle, Economicimportance ofFungi,Classification upto class.Distinguishing characters of Myxomycota: General characters of Mastigomycotina, Zygomycota: *Rhizopus,* **Ascomycota:** *Saccharomyces,Penicillium,Peziza.***Basidiomycotina:***Ustilago,Puccinia,Agaricus;***Deuteromycotina:***Fusarium, Alternaria*. Heterothallism, Physiological specialization, Heterokaryosis & Parasexuality.	**7**
V	**MushroomCultivation,Lichenology&Mycorrhiza** Mushroomcultivation. Generalaccountoflichens,reproductionandsignificance;*Mycorrhiza:ectomycorrhiza*and*endomycorrhiza*andtheir significance.	**7**
VI	**PlantPathology** Disease concept, Symptoms, Etiology & causal complex, Primary and secondary inoculum, Infection, Pathogenicity andpathogenesis,Koch'sPostulates.Mechanismofinfection(BriefideaaboutPre-penetration,PenetrationandPost-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	**DiseasesandControl** Symptoms,Causalorganism, Diseasecycle and Control measures of –Early&LateBlightofPotato,False Smutof Rice/ Brown spot of rice,Black Stem Rust of Wheat, *Alternaria* spot' and 'White rust of Crucifers, Red Rot of Sugarcane,WiltingofArhar,Mosaicdiseasesontobaccoandcucumber,yellowveinmosaicofbhindi;CitrusCanker, Littleleafofbrinjal;Dampingoffofseedlings,Diseasemanagement:Quarantine,Chemical,Biological,Integrated pest disease management	**8**

VIII	**AppliedMicrobiology** Food fermentations and food produced by microbes, amino acids, Production of antibiotics, enzymes, vitamins, alcoholic beverages, organic acid & genetic recombinant vaccines. Mass production of bacterial biofertilizers, blue green algae, *Azolla* and *mycorrhiza.* Plant growth promoting rhizobacteria & biopesticides— *Trichoderma sp.* and *Pseudomonas*, Single cell proteins, Organic farming inputs, Microbiology of water, Bioploymers, Bioindicators, biosensors, Bioremediation, Production of biofuels, biodegradation of pollutants and biodeterioration of materials & Cultural Property.	**8**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

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8. MicrobiologyFundamentalandApplications(hindi) (pb)

9. ISBN:9788188826230Edition:03Year:2016Author:Dr.PurohitSS,Dr.DeoPublisher: StudentEdition Language : Hindi

10. □□□□□ □□□ □□□□□□□□ □□□□□□□□-□□□:DefinitionalDictionaryofPlantPathology.PublisherCommission for Scientific and Technical Terminology.

11. ModernMicrobiology(hindi)(hb)ISBN:9788177543599Edition:1Year:2018Author:Dr. PurohitSS,Dr. Singh T Publisher : Agrobios (India)

12. Suggestedbooks“PlantpathologybyR.S.Mehrotra,TataMcGraw-HillEducation”areincludedinreading resources list

Unit-IA:

i. *https://indianculture.gov.in/rarebooks/economic-botany-indiahttps://www.infinityfoundation.com/mandala/t_es/t_es_tiwar_botany_frameset.htm*

ii. *https://www.researchgate.net/publication/335715457_Ancient_Indian_rishi's_Sages_knowledge_of_botany_and_medicinal_plants_since_Vedic_period_was_much_older_than_the_period_of_Theophrastus_A_case_study-_who_was_the_actual_father_of_botany*

iii. *https://www.scribd.com/presentation/81269920/Botany-of-Ancient-India*

iv. *https://insa.nic.in/writereaddata/UpLoadedFiles/IJHS/Vol17_2_17_PKBhattacharyya.pdf*

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

vi Ancient Botany (Sciences of Antiquity) Paperback – 1 October 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-IB.

1. Kumar,H.D.(1999).IntroductoryPhycology.AffiliatedEast-West.PressPvt.Ltd.Delhi.2ndedition.
2. Tortora,G.J.,Funke,B.R.,Case,C.L.(2010).Microbiology:AnIntroduction,PearsonBenjaminCummings,U.S.A.10thedition.
3. Sethi,I.K.andWalia,S.K.(2011).TextbookofFungi&TheirAllies,MacMillanPublishersPvt.Ltd.,Delhi.
4. Aggarwal,S.K.2009.FoundationCourseinBiology,AonebooksPvt.Ltd.,NewDelhi.
5. Aneja,K.R.1993.ExperimentsinMicrobiology,PathologyandTissueCulture,VishwaPrakashan,NewDelhi.
6. AnnieRagland,2012.AlgaeandBryophytes,SarasPublication,Kanyakumari,India.
7. Basu,A.N.1993.EssentialsofPlantViruses,VectorsandPlantdiseases,NewAgeInternational,NewDelhi.
8. Chopra.G.L.1984.AtextbookofAlgae,Rastogipublications,Meerut,India.
9. Desikachari,T.V.1959.Cyanophyta,ICAR,NewDelhi.
10. Dubey,R.C.andMaheshwari.D.K.2012.PracticalMicrobiology,S.Chand&Company,Pvt.Ltd.,NewDelhi.
11. Fritsch,R.E.1977.StructureandReproductionofAlgae,CambridgeUniversity Press,London.
12. Kodo,C.I.andAgarwal,H.O.1972.PrinciplesandtechniquesinPlantVirology,VanNostrand,ReinholdCompany,NewYork.
13. Agrios,G.N.(1997).PlantPathology,4thedition.Cambridge,U.K.:AcademicPress.
14. Alexopoulos,C.J.,Mims,C.W.,Blackwell,M.(1996).IntroductoryMycology,4thedition.Singapore,Singapore:JohnWiley&Sons.
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16. Reven,F.H.,Evert,R.F.,Eichhorn,S.E.(1992).BiologyofPlants.NewYork,NY:W.H.FreemanandCompany.
17. Sharma,P.D.(2011).PlantPathology.Meerut,U.P.:RastogiPublication.
18. Webster,J.,Weber,R.(2007).IntroductiontoFungi,3rdedition.Cambridge,U.K.:CambridgeUniversityPress..
19. PandeyB.P.2001.CollegeBotanyVolume1,SChand&CompanyPvt.Ltd,NewDelhi.
20. Pandey.B.P.2014ModernPracticalBotany,(Vol-I)S.ChandandCompanyPvt.Ltd.,NewDelhi.
21. Pelzar,1963.Microbiology,TataMcGrawHill,NewDelhi
22. Rangaswamy,G.2009,DiseaseofCropPlantsinIndia,PrienticeHallofIndia,NewDelhi.
23. Sambamurty.A.V.S.S.2006,ATextbookofAlgae,I.K.InternationalPublishingHouse,Pvt.Ltd.,NewDelhi.
24. Sharma,P.D.2012,MicrobiologyandPlantPathology,RastogiPublicationPvtLtd.,Meerut,India.
25. Singh,R.P.2007.MicrobialTaxonomyandCultureTechniques,KalyaniPublication,NewDelhi.
26. Smith.G.M.1996.CryptogamicBotanyVolumeI,TataMcGrawHill,NewDelhi.
27. SundarRajan.S.2010.CollegeBotanyVolumeI,HimalayaPublications,Mumbai.
28. Vashishta,B.R.Sinha,A.K.andSingh,V.P.1991.Algae,S.ChandandCompany,Pvt.Ltd.,NewDelhi

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

SuggestedContinuousEvaluationMethods:

ContinuousInternalEvaluationshallbebasedonallottedAssignmentandClassTests.Themarksshall

InternalAssessment	Marks
ClassInteraction	**5**
Quiz	**5**
Seminar	**7**
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	**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:SmartandInteractiveClass

OtherRequisites:Videocollection,Books,CDs,AccesstoOn-lineresources,DisplayCharts

Suggested equivalent online courses:

https://indianculture.gov.in/rarebooks/economic-botany-indiahttps://community.plantae.org/tags/mooc futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-sciencehttps://www.coursera.org/courses?query=plantshttp://egyankosh.ac.in/handle/123456789/53530https://www.classcentral.com/tag/microbiologyhttps://www.edx.org/learn/microbiology https://www.mooc-list.com/tags/microbiologyhttps://www.udemy.com/topic/microbiology/https://ucmp.berkeley.edu/bacteria/bacteria.htmlhttps://www.livescience.com/53272-what-is-a-virus.htmlhttps://gclambathach.in/lms/Economic%20importance%20of%20Algae.pdfhttps://www.slideshare.net/sardar1109/algae-notes-1https://www.onlinebiologynotes.com/algae-general-characteristics-classification/https://www.sciencedirect.com/topics/immunology-and-microbiology/fungushttps://ucmp.berkeley.edu/fungi/fungi.html https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdfhttp://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293http://www.hillagric.ac.in/edu/coa/ppath/lect/plpath111/Lect.%201%20%20Introduction-Pl%20Path%20111.pdfhttp://www.jnkvv.org/PDF/11042020102651plant_pathology.pdfhttps://www.apsnet.org/edcenter/disimpactmngmnt/topc/EpidemiologyTemporal/Pages/ManagementStrategies.aspxhttps://learn.saylor.org/course/view.php?id=23&sectionid=6821 https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopyhttp://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdfhttps://lipidnanostructuresgroup.weebly.com/https://zoology4civilservices.wordpress.com/2016/06/18/65/https://microbenotes.com/laminar-flow-hood/

CERTIFICATECOURSEINMICROBIALTECHNOLOGY&CLASSICALBOTANY/B.Sc.-I

Programme:***Certificate CourseInMicrobialTechnology&ClassicalBotany***	Year:**I**	Semester:**I/Paper-II**
Subject:**Botany**		
CourseCode:B040102P	CourseTitle:**TechniquesinMicrobiology&PlantPathology**	

Courseoutcomes: Afterthecompletionofthecoursethestudentswillbeable:

1. Understandtheinstruments,techniques,labetiquettesandgoodlabpracticesforworkinginamicrobiology laboratory.
2. DevelopskillsforidentifyingmicrobesandusingthemforIndustrial,AgricultureandEnvironmentpurposes.
3. PracticalskillsinthefieldandlaboratoryexperimentsinMicrobiology&Pathology.
4. learntoidentifyAlgae,LichensandplantpathogensalongwiththeirSymbioticandParasiticassociations.
5. CaninitiatehisownPlant&SeedDiagnosticClinic
6. Canstartownenterpriseonmicrobialproducts

Credits:**2**	**CoreCompulsory**
Max.Marks:**25+75**	Min.PassingMarks:
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**0-0-2**	

Unit	**Topic*(MinimumAnythreefromeachunitdependingonfacilities)**	**No.ofLectures (60 hrs)**
1.	**INSTRUMENTS&TECHNIQUES** 1. Laboratorysafetyandgoodlaboratorypractices 2. Principles andapplicationofLaboratoryinstruments-microscope,incubator, autoclave, centrifuge, LAF, filtration unit, shaker, pH meter. 3. Bufferpreparation&titration 3. CleaningandSterilizationofglasswares 4. Preparationofmedia-NutrientAgarandBroth 5. InoculationandculturingofbacteriainNutrientagarandnutrientbroth 6. Preparationofagarslant,stab,agarplate 7. PhenolCoefficientmethodtotesttheefficacyofdisinfectants	**7**
II	**BACTERIALIDENTIFICATION** 1. Isolationofbacteria. 2. Identificationofbacteria. 3. Stainingtechniques:Gram's,Negative,Endospore,CapsuleandCellWall. 4. CulturalcharacteristicsofbacteriaonNA. 5. Pureculturetechniques(Typesofstreaking). 6. Biochemicalcharacterization: IMViC,Carbohydratefermentationtest,Mannitolmotilitytest,Gelatinliquefactiontest,Ureasetest, Nitrate reduction test, Catalase test, Oxidase test, Starch hydrolysis, Casein hydrolysis.	**8**
III	**MYCOLOGICALSTUDY:** 1. Isolationofdifferentfungi:Saprophytic,Coprophilous,Keratinophilic. 2. Identificationoffungibylactophenolcottonbluemethod. *Rhizopus,Saccharomyces, Penicillium, Peziza, Ustilago, Puccinia; Fusarium, Curvularia, Alternaria.* 3. *Agaricus*:Specimensofbuttonstageandfulgrownmushroom;SectioningofgillsofAgaricus. 4. Lichens:crustose,folioseandfruticosespecimens.	**8**
IV	**PHYCOLOGY:** 1.TypestudyofalgaeandCyanobacteria–*Spirullina,Nostoc.* Chlorophyceae-*Chlorella,Volvox,Oedogonium,Cladophora,*and*Chara;*Xanthophyceae–*Vaucheria;*Bacillariophyceae–*Pinnularia*Phaeophyceae–*SargassumR*hodophyceae-*Polysiphonia*	**7**
V	**EXPERIMENTALPLANTPATHOLOGY** 1. Preparationoffungalmedia(PDA)&Sterilizationprocess. 2. Isolationofpathogenfromdiseasedleaf. Identification:PathologicalspecimensofBrownspotofrice,Bacterialblightofrice,Loosesmutof wheat,Stemrotofmustard,Lateblightofpotato;Slidesofuredial,telial,pycnial&aecialstagesof *Puccinia,* Few viral and bacterial plant diseases.	**8**

VI	**PRACTICALSINAPPLIEDMICROBIOLOGY-1** 1. Isolationofnitrogenfixingbacteriafromrootnodulesoflegumes. 2. Enumerationofrhizospheretononrhizospherepopulationofbacteria. 3. IsolationofantagonisticPseudomonasfromsoil. 4. MicroscopicobservationsofrootcolonizationbyVAMfungi. 5. IsolationofAzospirillumsp.fromtherootsofgrasses. 6. Isolationofphyllospheremicroflora. 7. IsolationofPsolubilizingmicroorganisms.	**8**
VII	**PRACTICALSINAPPLIEDMICROBIOLOGY-2** 1. Wineproduction. 2. Isolationoflacticacidbacteriafromcurd. 3. Isolationoflipolyticorganismsfrombutterorcheese. 4. Immobilizedbacterialcellsforproductionofhydrolyticenzymes. 5. Enzymeproductionandassay–cellulase,proteaseandamylase. 6. Immobilizationofyeast. 7. Isolationofcellulolyticandanaerobicsulphatereducingbacteria. 8. Isolationandcharacterizationofacidophilic,alkalophilicandhalophilicbacteria.	**8**
VIII	1. CultivationofSpirulina,&Chlorellainlabforbiofuel 2. Visit to NBAIM, Mau, Varanasi (Kashi)/ IMTECH (Institute of Microbial Technology), Chandigarh for viewing Culture Repository 3. VisittobiofertilizersandbiopesticidesunittounderstandabouttheUnitoperationprocedures 4. MushroomcultivationforProtein	**6**
	5. Alcoholproduction.fromSugarcaneJuice.	

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

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2. □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□-IDhankar-Sharma–TrivediISBNCode:978-81-8142-697-065,RBDPublishing House Shivaji Nagar Civil Lines,Jaipur - 302006 (Rajasthan)
3. □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□.एस-□□-1एस□□□□□□□□□□□□□□□□□□□□□:□□□□□□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□□□□□□□□□□:2018
4. PracticalBotany (PartI) ISBN#:81-301-0008-8Sunil DPurohit, GotamK Kukda &Anamika SinghviEdition:2013 Apex Publishing House Durga Nursery Road, Udaipur, Rajasthan (bilingual)
5. Modern Mushroom Cultivation And Recipes (hindi) (hb)ISBN : 9788177545180Edition : 01Year : 2017Author : Singh Riti , Singh UCPublisher : Agrobios (India)
6. BiofertilizerProductionManual(hindi)(hb)ISBN:9788177541274Edition:01Year:2014Author:GehlotDPublisher :Agrobios(India)Language:Hindi

1. Aneja,K.R.1993.ExperimentsinMicrobiology,PathologyandTissueCulture,VishwaPrakashan,NewDelhi.
2. Dubey,R.C.andMaheshwari.D.K.2012.PracticalMicrobiology,S.Chand&Company,Pvt.Ltd.,NewDelhi.
3. Kodo,C.I.andAgarwal,H.O.1972.PrinciplesandtechniquesinPlantVirology,VanNostrand,ReinholdCompany, New York.
4. MadhaveeLatha,P.2012,ATextbookofImmunology,S.Chand&CompanyPvt.Ltd.,New Delhi.
5. Pandey.B.P.2014ModernPracticalBotany,(Vol-I)S.ChandandCompanyPvt.Ltd.,NewDelhi.
6. Sambamurty.A.V.S.S.2006,ATextbookofAlgae,I.K.InternationalPublishingHouse,Pvt.Ltd.,
7. Singh,R.P.2007.MicrobialTaxonomyandCultureTechniques,KalyaniPublication,New Delhi.
8. https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf
9. http://nhb.gov.in/pdf/Cultivation.pdf
10. https://www.k-state.edu/fungi/Greeting/Publications_files/2006%20Handbook.pdf
11. Sen,Surjit,Acharya,Krishnendu,Rai,Manjula2019IBSN-978-93-88347-23-5-BiofertilizersandBiopesticides .Technoworld,Kolkata
12. http://www.kvkkendrapara.org/pdf/Bio%20Fertilizer%20Production%20and%20marketing.pdf
13. http://www.gbv.de/dms/tib-ub-hannover/751302945.pdf
14. Hochman,Gal,Zilberman,David2014IBSN-1461493285-AlgaeFarmingandItsBio-ProductsSpringer
18. Gokare A. Ravishankar , Ranga Rao Ambati 2019Handbookof AlgalTechnologies and Phytochemicals Volume II: Phycoremediation, Biofuels and Global Biomass Production Print ISBN: 9780367178192
19. Amos Richmond Ph.D., Prof. Emeritus, Qiang Hu Ph.D 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, Second EditionPrint ISBN:9780470673898

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:Opentoallbutspecial for
B.Sc.Biotech,B.Sc.Microbiology,B.Sc.Agriculture,B.A.(Curators),B.A.Archaeology,B.A.Geology,BAMS.

SuggestedContinuousEvaluationMethods:
ContinuousInternalEvaluationshallbebasedonallottedAssignmentandClassTests.Themarksshallbeasfollows:

Internal Assessment	Marks
ClassInteraction	**5**
Quiz	**5**
Seminar	**7**
Minorfieldwork/excursion/labvisit/technologydisseminationetc.	**8**

Courseprerequisites:
Qualification: Tostudythiscourse,astudentmusthavequalified10+2withBiology/NSQFlevel3fromSectorSkillCouncils/ Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Microbiology/biomedical Science.
Facilities:SmartandInteractiveClass
OtherRequisites:Videocollection,Books,CDs,AccesstoOn-lineresources,DisplayCharts
LabRequisites:Microscopes,Stains,Dissectionbox,Haemocytometer,Specimens,Permanentslides,Autoclave,incubator, Oven,laminarflowcabinet,balances,Fermenter,AnaerobicjarandSpectrophotometer.

Suggestedequivalentonlinecourses:
https://community.plantae.org/tags/mooc
futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.htmlhttps://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
http://allaboutalgae.com/benefits/https://repository.cimmyt.org/xmlui/bitstream/handle/10883/3219/64331.pdfhttps://www.mooc-list.com/tags/microbiology
http://www.agrifs.ir/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%7D%20%5B8171339239%5D%20%281984%29.pdf
https://www.coursera.org/courses?query=plantshttp://egyankosh.ac.in/handle/123456789/53530https://www.classcentral.com/tag/microbiologyhttps://www.edx.org/learn/microbiologyhttps://www.mooc-list.com/tags/microbiology
https://www.udemy.com/topic/microbiology/

Programme/Class:B.Sc.-I/***CertificateCourseIn MicrobialTechnology&ClassicalBotany***	Year:**I**	Semester:**II** **Paper-I**
Subject:**Botany**		
CourseCode:B040201T	CourseTitle:**ArchegoniatesandPlantArchitecture**	

Courseoutcomes:

Afterthecompletionofthecoursethestudentswillbeableto:

1. Developcriticalunderstandingonmorphology,anatomyandreproductionofBryophytes,Pteridophytesand Gymnosperms
2. Understandingofplantevolutionandtheirtransitiontoland habitat.
3. Understandmorphology,anatomy,reproductionanddevelopmentalchangesthereinthroughtypologicalstudyand create a knowledge base in understanding the basis of plant diversity, economic values & taxonomy of plants
4. Understandthedetailsofexternalandinternalstructuresoffloweringplants.

Credits:**4**	**CoreCompulsory**
Max.Marks:**25+75**	Min.PassingMarks:

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**4-0-0**

Unit	Topic	Lectures (60hrs)
I	**IntroductiontoArchegoniates&Bryophytes** Unique features of archegoniates, Bryophytes: General characteristics, adaptations to land habit, Range of thallus organization. Classification (up to family), morphology, anatomy and reproductionof*Riccia,Marchantia,AnthocerosandSphagnum*.(Developmentaldetailsnotto be included). economic importance of bryophytes .	**7**
II	**Pteridophytes** Generalcharacteristics,Earlylandplants(*Rhynia*).Classification(uptofamily)with examples,Heterosporyandseedhabit,stelarevolution,economicimportanceofPteridophytes.	**8**
III	**Gymnosperms** Classificationanddistributionofgymnosperms;SalientfeaturesofCycadales,Ginkgoales, Coniferales and Gnetales, their examples, structure and reproduction; economic importance	**8**
IV	**Palaeobotany** General account of Cycadofilicales, Bennettitales and Cordaitales; Geological time scale; Briefaccountofprocessoffossilization&typesof fossilsandstudytechniques;Contribution of Birbal Sahni	**8**
V	**AngiospermMorphology(Stem,Roots,Leaves&Flowers,Inflorescence)** Morphologyandmodificationsofroots;Stem,leafandbud.Typesofinflorescences; flowers, flower parts, fruits and types of placentation; Definition and types of seeds.	**7**
VI	**PlantAnatomy:**Meristematicandpermanenttissues,Organs(root,stemandleaf).Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica - Corpus theory. Secondarygrowth -Root and stem- cambium(structure and function) annular rings,Anomaloussecondarygrowth-*Bignonia,Boerhaavia,Dracaena,Nyctanthes*	**7**
VII	**ReproductiveBotany** Plant Embryology, Structure of microsporangium, microsporogenesis, , Structure of megasporangiumanditstypes,megasporogenesis,Structureandtypesoffemalegametophyte, types of pollination, Methods of pollination, Germination of pollen grain, structure of male gametophyte,Fertilization,structureofdicotandmonocotembryo,Endosperm,Double fertilization, Apomixis and polyembryony.	**8**
VIII	**Palynology:** Pollen structure, pollen morphology, pollen allergy , Applied Palynology: Basicconcepts,Palaeopalynology,Aeropalynology,Forensicpalynology,Roleintaxonomic evidences.	**7**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

1. [illegible]([illegible])[illegible],कवक,[illegible],[illegible],[illegible],[illegible],[illegible],[illegible]-[illegible]:[illegible]-[illegible],[illegible]व [illegible]:[illegible],[illegible]

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3. [illegible]एस[illegible]2017[illegible] [illegible]

4. ए.[illegible].[illegible]&[illegible]2018.[illegible]एसआर [illegible]

1. GanguleeH.S.andK.Kar1992.CollegeBotanyVol.IandII.(NewCentralBookAgency)
2. Bhatnagar,S.P.andMoitra,A.(1996).Gymnosperms.NewAgeInternational(P)LtdPublishers,NewDelhi,India.
3. Parihar,N.S.(1991).AnintroductiontoEmbryophyta.Vol.I.Bryophyta.CentralBookDepot,Allahabad.
4. RashidA(1999)AnIntroductiontoPteridophyta,VikasPublishingHousePvt.Ltd.NewDelhi.
5. SharmaOP(1990)TextbookofPteridophyta.MacMillanIndiaLtd.Delhi.
6. VashishthaBR,SinhaAKandKumarA(2010)BotanyforDegreeStudents–Pteridophyta,S.ChandandCompany,
7. VashishthaBR,SinhaAKandKumarA(2010)BotanyforDegreeStudents–Gymnosperms,S.Chandand
8. PariharNS(1976)BiologyandMorphologyofPteridophytes.CentralBookDepot.
9. BhatnagarSP(1996)Gymnosperms,NewAgeInternationalPublisher.
10. PandeyBP(2010)CollegeBotanyVolIIS.ChandandCompany,NewDelhi
11. Maheswari,P.1971.AnIntroductiontoEmbryologyofAngiosperms.McGrawHillBookCo.,London
12. Bhattacharyaet.al.2007.AtextbookofPalynology,Central,NewDelhi.
13. Bhojwani,S.S.andS.P.Bhatnagar.2000.TheEmbryologyofAngiosperms(4thEd.),VikasPublishingHouse,.
14. P.K.K.Nair-AtextbookofPalynology.
15. Johri,B.M.1984.EmbryologyofAngiosperms.Springer-Verleg,Berlin.
16. DuttaA.C.2016.BotanyforDegreeStudents.OxfordUniversity Press.
17. E.J.Eames.MorphologyofVascularPlants,StandardUniversityPress.
18. Dickinson,W.C.(2000).IntegrativePlantAnatomy.HarcourtAcademicPress,USA.
19. Fahn,A.(1974).PlantAnatomy.PergmonPress,USA.
20. Evert,R.F.(2006)Esau'sPlantAnatomy:Meristems,Cells,andTissuesofthePlantBody:TheirStructure,Function and Development. John Wiley and Sons, Inc.

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:**Opentoallbutspecialfor**B.Sc.Biotech, B.Sc.Forestry,B.Sc.Agriculture,B.Pharma,B.A.(Curators),B.A.Archaeology,B.A.Geology,BAMS

SuggestedContinuousEvaluationMethods:
ContinuousInternalEvaluationshallbebasedonallottedAssignmentandClassTests.Themarksshallbeasfollows:

Courseprerequisites:

Qualification: Tostudythiscourse,astudentmusthavequalified10+2 withBiology/NSQFlevel4fromSectorSkill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

Facilities:SmartandInteractiveClass,wififacility

OtherRequisites::Videos,Books,CDs,Flora,Herbarium,AccesstoOn-lineresources,DisplayCharts

Suggestedequivalentonlinecourses:

https://www.anbg.gov.au/bryophyte/what-is-bryophyte.htmlhttps://pteridoportal.org/portal/index.phphttps://www.conifers.org/zz/gymnosperms.phphttp://www.mobot.org/MOBOT/research/APweb/https://milneorchid.weebly.com/plant-id-for-beginners.htmlhttps://www.botany.org/PlantImages/PlantAnatomy.phphttp://webap p1.dlib.indiana.edu/inauthors/view?docId=VAC0868&doc.view=printhttps://palynology.org/http://www2.estrellamountain.edu/faculty/farabee/biobk/Biobookflowers.htmlhttps://www.sciencelearn.org.nz/resources/100-plant-reproductionhttps://palaeobotany.org/

Internal Assessment	Marks
Class Test	5
Quiz	5
Seminar	7
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	8
	25

Programme/Class:***CertificateCourseInMicrobial Technology&ClassicalBotany***	Year:**I**	Semester:**II** **Paper-II(Practical)**
Subject:**Botany**		
CourseCode:B040202P	CourseTitle:**LandPlantsArchitecture**	

Courseoutcomes:

1. Thestudents willbe madeawareofthegroupof plantsthat have givenrisetolandhabitandthe floweringplants. Throughfieldstudytheywillbeabletoseetheseplantsgrowinnatureandbecomefamiliarwiththebiodiversity.
2. Studentswould learnto create their small digital reports where theycancapture the zoomed inand zoomed out picturesaswellasvideosincasetheyareabletofindsomerarestructureorphenomenonrelatedtotheseplants.
3. Developanunderstandingbyobservationandtablestudyofrepresentativemembersofphylogeneticallyimportant groups to learn the process of evolution in a broad sense.
4. Understandmorphology,anatomy,reproductionanddevelopmentalchangesthereinthroughtypologicalstudyand create a knowledge base in understanding plant diversity, economic values & taxonomy of lower group of plants
5. Understandthecomposition,modifications,internalstructure&architectureoffloweringplantsforbecominga Botanist.

Credits:**2**	**CoreCompulsory**
Max.Marks:**25+75**	Min.PassingMarks:

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**0-0-2**

Unit	Topic	No.ofLectures
I	**Bryophytes:** Marchantia-morphologyofthallus,W.M.rhizoidsandscales,V.S.thallusthrough Gemma cup, W.M. gemmae (all temporary slides), V.S. antheridiophore, archegoniophore, L.S. sporophyte (all permanentslides). *Sphagnum*- morphology, W.M.leaf,rhizoids,operculum,peristome,annulus,spores(temporaryslides); permanent slides showing antheridial and archegonial heads, L.S. capsule and protonema.	**8**
II	**Pteridophytes:** *Lycopodium*:Habit,stemT.S.stobilusV.S.,*Selaginella*:Habit,rhizophoreT.S, stem T . S, axis with strobilus, V.S. of strobilus, Megasporophyll and microsporophyll. *Equisetum*-Habit,rhizomeandstemT.S.andV.S.ofstrobilus. *Azolla*–Habitat&itsstructure	**7**
III	**Gymnosperms** 1. *Cycas* – 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 andV.S.ofovule.*Pinus*-Branchofindefinitegrowth,spurshoot,T.Sofoldstem and needle R.L.S and T. L. S. of stem, male and female cone, V.S. of male and female cone. 2. *Ephedra*&*Thuja*:Habit,stemT.S(youngand mature),leafT.S,maleand female strobilus, V. S. of male and female cone, ovule V. S. and seed.	**8**
IV	**Palaeobotany&Palynology** 1. Morphologyof*Rhynia*andfossilsgymnosperms&othergroups. 2. VisitBirbalSahniInstituteofPalaeosciencesorvirtualconferencewiththeirscientis to learn fossilization. 3. MarkandknowaboutIndiangeographicalsitesrichinplantfossils.	**6**

V	**AngiospermMorphology** 1. Tostudydiversityinleafshape,sizeandotherfoliarfeatures. 2. Tostudymonopodialandsympodialbranching. 3. MorphologyofFruits 4. Inflorescencetypes-studyfromfresh/preservedspecimens 5. Flowers-studyofdifferenttypesfromfresh/preservedspecimens 6. Fruits-studyfromdifferenttypesfromfresh/preservedspecimens 7. Studyofovules(permanentslides/specimens/photographs)-types(anatropous, orthotropous, amphitropous and campylotropous) 8. ModificationsinRoots,stems,leavesandinflorescences	**8**
VI	**PlantAnatomy:** Normal&Anomaloussecondarythickening -*Bignonia,Dracaena,Boerhaaviadiffusa, Nyctanthes* Studyofprimaryandsecondarygrowth intherootandstemofmonocotsanddicotsby section cutting and permanent slides. Studyofinternalstructureofdicotandmonocotleaves. Study of structure of stomata.	**8**
VII	**ReproductiveBotany** 1. Structureofanther,microsporogenesisandpollengrains 2. Structureofovuleandembryosacdevelopment(throughslides). 3. Studyofembryodevelopmentinmonocotsanddicots. 4. Vegetativepropagationbymeansofcutting,buddingandgraftingexercises. 5. Studyofseedgermination. 6. Studyofpollenmorphologyofthefollowingplants –*Hibiscus,Vinca,Balsam,Ixora, Crotalaria, Bougainvillea* by microscopic observation. **7.** Calculationofpollenviabilitypercentageusinginvitropollengerminationtechniques.	**8**
VIII	**CommercialUsesandProductiontechnology** 1. *Azolla*production 2. ProductiontechnologyofResins 3. ProductionandpropagationofOrnamental*Pteris*,Cycadales,Coniferalesfor landscaping. 4. Labmethodforqualitativetesting/extractionofEphedrine,Taxoland*Thuja*oil.	**7**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

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[illegible]

Pandey,BPandTrivedi,P.S.1997.BotanyVol.I(10thedition).VikasPublishingHouse. Pandey, BP; Misra; Trivedi, P.S. 1997. Botany Vol. II. Vikas Publishing House.

Pandey,BPandChadha.1997.BotanyVol.III.VikasPublishingHouse.

Santra,SCandChatterjee.2005.CollegeBotanyPracticalVol.I.NewCentralBookAgency(P)Ltd. Kumar, S and Kashyap. 2003. Manual of Practical Algae. Campus BooksInternational, New Delhi Bendre and Kumar A text book of Practical Botany. Vol I,II., Rastogi Pub. Meerut.

SureshKumar,AmarSinghKashyapManualofPracticalAlgae..CampusBooksInternet,New Delhi.

Santra,SC.2005.CollegeBotanyPracticalVol.II.NewCentralBookAgency(P) Ltd.

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:

OpentoallbutspecialforB.Sc.Biotech,B.Sc.Forestry,B.Sc.Agriculture,B.Pharma, B.A.

SuggestedContinuousEvaluationMethods: ContinuousInternalEvaluationshallbebasedonallotted Assignment and Class Tests. The marks shall be as follows:

InternalAssessment	**Marks**
ClassInteraction	**6**
Fieldwork/Virtual/E-learning/Participationingroupdiscussions	**7**
IndustrialorCentrallaboratorytrainingoftwoweeksinsummer/winter (Compulsory)	**12**
	25

Courseprerequisites:

Qualification: Tostudythiscourse,astudentmusthavequalified10+2 withBiology/NSQFlevel3fromSectorSkill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

Facilities:SmartandInteractiveClass

OtherRequisites:Microscopes,Stains,Dissectionbox,Haemocytometer,Specimens,Permanentslides,Autoclave, incubator, Oven, laminar flow cabinet, balance

Suggested equivalent online courses:

https://www.easybiologyclass.com/topic-botanyhttp://www3.botany.ubc.ca/bryophyte/index.html

http://ecflora.cavehill.uwi.edu/bio_courses/bl14apl/practical_3.1.htmh

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

http://www.fao.org/3/a-v9236e.pdfhttps://iinrg.icar.gov.in/library/nrg/nrg.pdf

https://agritech.tnau.ac.in/banking/nabard_pdf/Azolla%20Cultivation/Model_projct_on_Azolla_cultivation.pdfhttp://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

DetailSyllabusof
B.Sc.-II Year
or
Diplomain
PlantIdentification, Utilization&Ethnomedicine

DiplomainPlantIdentification,Utilization&Ethnomedicine

<table>
<tr><td colspan="4">DiplomainPlantIdentification,Utilization&Ethnomedicine</td></tr>
<tr><td colspan="2">Programme/Class:DiplomainPlantIdentification,Utilization&Ethnomedicine</td><td>Year:II</td><td>Semester:III
Paper-I</td></tr>
<tr><td colspan="4">Subject:Botany</td></tr>
<tr><td colspan="2">CourseCode:B040301T</td><td colspan="2">CourseTitle:FloweringPlantsIdentification&AestheticCharacteristics</td></tr>
<tr><td colspan="4">Courseoutcomes:
Afterthecompletionofthecoursethestudentswillbeableto:
1. Togainanunderstandingofthehistoryandconcepts underlyingvariousapproachestoplanttaxonomyand classification.
2. Tolearnthemajorpatternsofdiversityamongplants,andthecharactersandtypesofdatausedtoclassifyplants.
3. Tocomparethedifferentapproachestoclassificationwithregardtotheanalysisofdata.
4. Tobecomefamiliarwithmajortaxaandtheiridentifyingcharacteristics,andtodevelopindepthknowledgeofthe current taxonomy of a major plant family.
5. Todiscoverandusediversetaxonomicresources,referencematerials,herbariumcollections,publications.
6. Fortheentrepreneurcareerinplants,onecanestablishanursery,Startalandscapingbusiness,SetupafarmOr Run a plantation consultancy firm</td></tr>
<tr><td colspan="2">Credits:4</td><td colspan="2">CoreCompulsory</td></tr>
<tr><td colspan="2">Max.Marks:25+75</td><td colspan="2">Min.PassingMarks:</td></tr>
<tr><td colspan="4">TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):4-0-0</td></tr>
<tr><td>Unit</td><td colspan="2">Topic</td><td>No.ofLectures (60hrs)</td></tr>
<tr><td>I</td><td colspan="2">TaxonomicResources&Nomenclature
Componentsoftaxonomy(identification,nomenclature,classification);Taxonomic resources: Herbarium- functions & important herbaria, Botanical gardens, Flora, Keys- single access and multi-access.
PrinciplesandrulesofBotanicalNomenclatureaccordingtoICN(ranksandnames; principle of priority, binomial system; type method, author citation, valid-publication).</td><td>7</td></tr>
<tr><td>II</td><td colspan="2">Typesofclassification&Evidences
Artificial,naturalandphylogenetic.BenthamandHooker(uptoseries), EnglerandPrantl(uptoseries)angiospermphylogenygroup(APGIV)classification. Introduction to taxonomic evidences from palynology, cytology, phytochemistry & Molecular biology data (Protein and Nucleic acid homology).</td><td>8</td></tr>
<tr><td>III</td><td colspan="2">IdentificationofAngiospermicfamilies-I:(FamiliescanbechosenUniversity wise as per local available flora)
Astudyofthefollowingfamilieswithemphasisonthemorphologicalpeculiarities and economic importance of its members (based on Bentham & Hooker’s system) Ranunculaceae, Malvaceae, Rutaceae, Fabaceae,Myrtaceae , Cucurbitaceae, Rubiaceae,Asteraceae, Apocynaceae, Acanthaceae,Asclepiadaceae,Solanaceae.</td><td>8</td></tr>
</table>

IV	**IdentificationofAngiospermicfamilies-II:(FamiliescanbechosenUniversity wise as per local available flora)** Astudyofthefollowingfamilieswithemphasisonthemorphologicalpeculiarities andeconomicimportanceofitsmembers(basedonBentham &Hooker'ssystem)-Amaranthaceae, Euphorbiaceae, Papaveraceae, Apiaceae, Lamiaceae,Orchidaceae, Liliaceae, Musaceae, Poaceae.	**7**
V	**ModerntrendsinPlanttaxonomy**: BriefideaonPhenetics,Biometrics,Cladistics(Monophyletic,polyphyleticand paraphyletic groups; Plesiomorphy and apomorphy).	**8**
VI	**TOOLS&SOFTWARESINPLANTIDENTIFICATION-** GIS(Mappingof(i)Patterns(ii)Features(iii)Quantities 0P02.010H11YLIP - Free Phylogenetic Software, DigitalTaxonomy(e-flora),DescriptionLanguageforTaxonomy–DELTA Internet directory for botany.	**7**
VII	**Computerusage&Android Applications** MSOffice:PPT,MicrosoftExcel,dataentry,graphs,aggregatefunctions,formulasand functions, number systems, conversion devices, secondary storage media. GPStagging,PlantIdentificationApps.	**7**
VIII	**AestheticCharacteristicsofPlants:** Aestheticcharacteristicsofplants,English,Italian,French,Persian,MughalandJapanese gardens;Featuresofagarden(Gardenwall,Fencing,Steps,Hedge,Edging,Lawn,Trees, shrubsandshrubberies,climbersandcreepers,rockery,Flowerbeds,Shrubbery,Borders, Water garden). Some Famous gardens of India. Conservatory, green houses, Indoor garden, Roof garden, Topiary, Bonsai.	**8**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

1. □□□□□□□□□□□□□□□□□□□□□□□□□□□□(□□□□□l□□□□,□□□□□□□□,□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□)□□□□-□□□□,□□□□□□□□□□□□□□□□□□:□□□□□□□□□□□□□□,□□□□
2. □□□□□□□□□□□,□□□□□□□□□□□□भवन□□□.क.स.□□□□□□□□□□□□□□□□□□□□□□□□
3. PropagationAndNurseryManagement(hindi)(hb)ISBN:9788177546200Edition:01Year:2016Author:Pandey S.K.,SoniN.Publisher:Agrobios(India)
4. Dr.AmarSingh.पादपवर्गिकी-PlantTaxonomy(AnOldandRareBook)fromthecategoryAyurvedainourBooks collection. Uttar Pradesh Hindi Sansthan, Lucknow

1. PlantSystematics.ArunK.Pandey&ShrutiKansana.2020.JayaPublishingHouse.
2. Bole,P.V.andVaghani,Y.(1986)FieldguidetothecommontreesofIndia.OxfordUniversityPress;Bombay.
3. Brandis,D.(1906)IndianTrees(London,5thedition.1971).InternationalBookDistributors;DehraDun.
4. Dallwitz,M.J.,Paine,T.A.andZurcher,E.J.(2003).Principlesofinteractivekeys.http://delta-intkey.com
5. https://www.naace.co.uk/school-improvement/ict-mark/
6. https://www.socitm.gov.uk,(2002)Learninginthe21stcenturyExecutivebriefingASocitmInsightpublication,July 2002 Socitm.
7. K.B.Anjaria,(2015)"ElectronicHerbariumandDigitalDatabasePreparationofCommonTreesofAnandDistrict, Gujarat" MRP submitted to UGC, WRO, Pune 2015 (unpublished)
8. LizeronEremias and R. Subash.(2013) "E-Content Development: A Milestone In The Dynamic Progress Of E-Learning"InternationalJournalofTeacherEducationalResearch(IJTER)Vol.2No.1January,2013ISSN:2319-4642
9. Pandey,B.P.2007.BotanyforDegreeStudents:DiversityofSeedPlantsandtheirSystematics,Structure,Development and Reproduction in Flowering Plants. S. Chand & Company Ltd,New Delhi.
10. Stace,C.A.1989.PlantTaxonomyandBiostatistics(2ndEd.).EdwardArnold,London.
11. Singh,G.1999.PlantSystematics:TheoryandPractice.OxfordandIBH,NewDelhi.
12. DuttaA.C.2016.BotanyforDegreeStudents.OxfordUniversityPress.
13. Davis,P.H.andV.H.Heywood.1963.PrinciplesofAngiospermTaxonomy.OliverandBoyd,London.
14. Heywood,V.H.andD.M.Moore(Eds).1984.CurrentConceptsinPlantTaxonomy.AcademicPress,London.
15. Austin,R.2002.Elementsofplantingdesign.NewYork:JohnWiley&Sons.
16. Bertauski,T.2005.Designingthelandscape:Anintroductoryguideforthelandscapedesigner.UpperSaddleRiver, NJ: Pearson Prentice Hall.
17. Thomas,H.,andS.Wooster.2008.Thecompleteplantingdesigncourse:Plansandstylesforeverygarden.London: Octopus Publishing Group.
18. Scarfone,S.2007.Professionalplantingdesign:Anarchitecturalandhorticulturalapproachforcreatingmixedbed plantings. New York: John Wiley & Sons.
19. Randhawa,G.S.andMukhopadhyay,A.1986.FloricultureinIndia.AlliedPublishers.

Thiscoursecanbeoptedasanelectivebythestudents ofthefollowing subjects:**Opentoallbutspecialfor** B.Sc.Biotech B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

SuggestedContinuousEvaluationMethods:

ContinuousInternalEvaluationshallbebasedonallottedAssignmentandClassTests.Themarksshallbeas follows:

InternalAssessment	Marks
ClassInteraction	5
Quiz	5
Seminar	7
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	8

Dr. Neetu Singh
Convenor

		25
	Courseprerequisites: **Qualification:**Tostudythiscourse,astudentmusthavequalified10+2 withBiology/NSQFlevel3fromSector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry). **Facilities:SmartandInteractiveClass** **OtherRequisites::Videocollection,Books,CDs,Flora,Herbarium,AccesstoOn-lineresources,Display Charts**	
	Suggested equivalent online courses: https://www.easybiologyclass.com/topic-botany/http://egyankosh.ac.in/handle/123456789/53530 https://www.delta-intkey.com/www/desc.htmhttps://milneorchid.weebly.com/plant-id-for-beginners.htmlhttps://plants.usda.gov/classification.htmlhttps://www.senecahs.org/pages/uploaded_files/Plant%20Classification.pdf https://www.ladykeanecollege.edu.in/files/userfiles/file/Dr_%20S_%20Nongbri%20III%20Sem%20ppt.pdfhttps://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=2267037https://www.delta-intkey.com/	

	Programme/Class::***DiplomainPlant Identification,Utilization&Ethnomedicine***	Year:**II**	Semester:**III** **Paper-II(Practical)**
	Subject:**Botany**		
	CourseCode:B040302P	CourseTitle:**PlantIdentificationtechnology**	

Courseoutcomes:

Afterthecompletionofthecoursethestudentswillbe able:

1. Tolearnhowplantspecimensarecollected,documented,andcuratedforapermanentrecord.
2. Toobserve,record,andemployplantmorphological variationandtheaccompanyingdescriptive terminology.
3. Togainexperiencewiththevarioustoolsandmeansavailabletoidentifyplants.
4. Todevelopobservationalskillsandfieldexperience.
5. Toidentifyataxonomicallydiversearrayofnative plants.
6. Torecognizecommonandmajorplantfamilies.
7. ToUnderstandaestheticcharactersoffloweringplantsbymaking-landscapes,gardens,bonsai,miniatures
8. Comprehendtheconceptsofplanttaxonomyandclassificationof Angiosperms.

	Credits:**2**	**CoreCompulsory**
	Max.Marks:**25+75**	Min.PassingMarks:
	TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**0-0-2**	

	Unit	Topic* *(PerformAnythreeexperimentsfromeachunitasper facility)	No.ofLecture (60Hrs)
	I	**Herbarium:Plantcollecting,PreservationandDocumentation:** StepwisePracticingHerbariumtechniques:a.FIELDEQUIPMENTS,GlobalPositioning System(GPS)instrument&Collectionofanywild25plantspecimensb. Learntohandle 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 themusingStandardmethodg.OrganizethemandgiveIndexRegisterNumber	**7**
	II	**TaxonomicIdentificationusingplantstructure** a. Classify 25 plants on the basis of Taxonomic description (Plant Morphology, Anatomy, Reproductiveparts,Habit,adaptationanomalies)accordingtoBenthamandHookernatura system of classification in the following families: Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Scrophulariaceae, Acanthaceae, Labiatae (Lamiaceae), Rubiaceae.	**8**
	III	**Identificationduringexcursions** a.Conducting Spot identification (Binomial, Family) of common wild plants from families includedinthetheoreticalsyllabus(listtobeprovided)andmakingFIELDNOTEBOOK 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,floraldiagramsandFloralFormulae.Identifyandassignthemtotheirrespective families giving reasons.	**8**
	IV	**COLLECTION,PRESERVATIONANDSTORAGEOFALGAE,FUNGI BRYOPHYTES, PTERIDOPHYTES (Two each)**	**7**
	V	**BotanicalNomenclature&reportingMethod:** **a.** GivenomenclaturetocollectedplantsasperICNrulesandpreparelabelsasper BSI **b. AuthorCitation,EffectivePublicationandPrincipleof Priority:** To showa specime paperonBasicstructureofataxonomicResearchpublished onanewspeciesintaxonomic journal	**7**

	VI	**COMPUTERS** 1.Learning to use EXCEL Microsoft PowerPoint and Word., WORKING WITHFOLDERANDWINDOWSUTILITY.,CREATEANDMANAGE FILESANDFOLDERTREE,	**7**
		2. Practice browsing different sites using search engines. practice and understanddifferentE-Mailservices–Outlook,Yahoomail,rediffmailetc. Practice CreatingE-Mail accounts, Sending, Receiving& Storingof mails. **3.** CreateandParticipateinvirtualconferencinginaninteractiveZoom Meeting	
	VII	**ComputerApplicationintaxonomy** 1.UseTaxonomicSoftwares(DichotomousKey) 2 . Practicals on Phylogenetic analysis 3.MakelinedrawingofPlantsfordescription 4.Usingofplantidentificationappsonandroidphones	**8**
	VIII	1. CreateaBonsaiofanyplant 2. Developaminiaturegarden 3. DrawLayoutsofvarioustypesofgardens 4. PlantPropagationmethodspractice	**8**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

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[illegible]3[illegible]:[illegible]
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[illegible].एस-[illegible]-1,II,IIIएस[illegible]
[illegible]:[illegible]
[illegible]IIAuthorName:-Dhankar-Sharma-TrivediRBDPublicationHouse

1. Day,S.C.(2003)AArtofMiniaturePlantCulture.-Agrobios.Jodhpur,India.
2. PracticalTaxonomyofAngiospermsBy:RKSinhaISBN:9789386768520I.KInternationalPublishing HousePvt. Ltd.

1. Day,S.C.(2003)CompleteHomeGardening.(2003)Agrobios,Jodhpur,India.
2. Dhopte,A.M.(2003)PrinciplesandTechniquesforPlantScientists.-Agrobios,Jodhpur,India.
3. Khan,M.R.(1995)HorticultureandGardening.-NiraliPrakashan,Pune.India.
4. PramilaMehraGardeningforeveryone-.Hindpocketbookprivatelimited,NewDehli.
5. KumarsenV.Horticulture,SarasPublication
6. RameshBangiaLearningComputerFundamentals.,.,KhannaBookPublishers
7. BoseT.K.&Mukherjee,D.,1972,GardeninginIndia,Oxford&IBHPublishingCo.,New Delhi.
8. Sandhu,M.K.,1989,PlantPropagation,WileEasternLtd.,Bangalore,Madras.
9. Randhawa,G.S.andMukhopadhyay,A.1986.FloricultureinIndia.AlliedPublishers.
10. Bole,P.V.andVaghani,Y.(1986)FieldguidetothecommontreesofIndia.OxfordUniversityPress; Bombay.
11. Womersley,J.S.1981.Plantcollectingandherbariumdevelopment:Amanual.
12. Brandis,D.(1906)IndianTrees(London,5thedition.1971).InternationalBookDistributors;DehraDu
13. Dallwitz,M.J.,Paine,T.A.andZurcher,E.J.(2003).Principlesofinteractivekeys.http://delta-intkey.com
https://www.naace.co.uk/school-improvement/ict-mark/
14. Manilal,K.S.andM.S.MukteshKumar(ed.)(1998)AHandbookofTaxonomyTraining,DST,N. Delhi
15. Naik,V.N.(1984)TaxonomyofAngiospermsTataMcGrow-HillPublicationCom.Ltd.,NewDelhi
16. Primak,R.B.(2004)APrimerofConservationBiology.SinauerAssociates,Inc.Publishers
17. Quicke,Donald,L.J.(1993)PrinciplesandTechniquesofCommemoratoryTaxonomy.Blakie, Academic andProfessional,London
18. Singh,G(2004)PlantSystematics:TheoryandpracticeOxfordandYBHPublishingCo.Pvt.Ltd.,New

Dr. Neetu Singh
Convenor

Delhi.
19. Bridson,D.&L.Forman.eds.1998.TheHerbariumHandbook.3rded.RoyalBotanicGardens,Kew (Reprinted 1999).
20. DeVogel,E.F.1987.ManualofHerbariumTaxonomy:TheoryandPractice.UNESCO,Jakarta.
21. Fosberg,F.R.&M.-H.Sachet.1965.Manualfortropicalherbaria.Int.Bur.Pl.Tax.&Nom.,Regnum Vegetabile Vol. 39. Utrecht.
22. Jain,S.K.&R.R.Rao.1977.Ahandbookoffieldandherbariummethods.Today&Tomorrow'sPrinter and Publishers, New Delhi.
23. Victor,J.E.,M.Koekemoer,L.Fish,S.J.Smithies,M.Mossmer.2004.Herbariumessentials:theSouthe African Herbarium user manual. Southern African Botanical Diversity Network Report No. 25. SABONET, Pretoria.

Thiscoursecanbeoptedas anelectivebythestudents ofthefollowing subjects:**Opentoallbutspecialfor** B.S Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

SuggestedContinuousEvaluationMethods:
ContinuousInternalEvaluationshallbebasedonallottedAssignmentandClassTests.Themarksshallbeas follows:

InternalAssessment	Marks
ClassInteraction	**5**
BotanicalExcursion-compulsory	**12**
Assignment	**8**
	25

Courseprerequisites:
Qualification: Tostudythiscourse,astudentmusthavequalified10+2withBiology/NSQFlevel3from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).
Facilities:SmartandInteractiveClass
OtherRequisites::Videocollection,Books,CDs,Flora,Herbarium,AccesstoOn-lineresources,Display Charts
LabRequisites:Microscopes(Compound,Stereo)Dissectionbox,stain,Herbarium,Herbariumpress, Dryers, Grinder, Reference Flora

Suggestedequivalentonlinecourses:

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

AnyOther:

***Botanical Excursions*:**One teacher along with a batch not more than 7 students be taken for botanical excursiontoplacesofBotanicalinterest,oneineachterm.Iftherearefemalestudentsina batchof7students, one additional lady teacher is permissible for excursion.

EachexcursionwillnotbemorethanSEVENdaysduringcollegeworkingdays.T.A.andD.A.forteachers and non-teaching staff participating in excursions should be paid as per rules. Tour report duly certified by tourinchargeteacherandHeadoftheDepartmentshouldbesubmittedatthetimeofpracticalexamination. 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 externalassessment both.In external assessment student will have to present his excursion report along with industrial training/central labs visits and BSI or Museumvisits.Ininternalassessmentheshallhavetolabelthecampusplantswithbotanicaldetails/develop herbal/floristic garden/conserve plants in botanical garden/contribute specimens via collection .

Aprojectsupportedalongwithphotographstakenduringfieldstudytobesubmittedgivingcomprehensive idea

aboutdifferenttypesofinflorescence,flowersandfruits/

Atleastthreefieldexcursionsathills/Oceans/DesertsincludingoneCompulsoryexcursiontoBotanical Garden, FRI/BSI and Central National Herbarium (CNH). Central ResearchInstitutes/Hot Spots

Programme /Class*: **Diploma in Plant Identification,Utilization&Ethnomedicine***	Year:**II**	Semester:**IV** **Paper-I**
Subject:**Botany**		
CourseCode:B040401T	CourseTitle**:EconomicBotany,EthnomedicineandPhytochemistry**	

Course outcomes:

Afterthecompletionofthecoursethestudentswillbeable to:

1. Understandabouttheusesofplants–willknowoneplant-one employment
2. Understandphytochemicalanalysisrelatedtomedicinallyimportantplantsandeconomic products produced by the plants
3. knowabouttheimportanceofMedicinalplantsand itsusefulparts,economically important plants inourdaily lifeand also about thetraditional medicines and herbs,and its relevance in moderntimes.

Credits:**4**	**CoreCompulsory**
Max.Marks:**25+75**	Min.PassingMarks:
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**4-0-0**	

Unit	Topic	No. of Lectures (60hrs)
I	**Originanddomesticationofcultivatedplants** Centersofdiversityofplants,originofcropplants.Domesticationandintroductionofcropplants. Concepts of sustainable development; cultivation, production and uses of Cereals, legumes, Spices & beverages.	7
II	**Botanyofoils,Fibers,timberyieldingplants& dyes** Studyof the plants with Botanical names, Family, part used, and economic uses yielding Edible &essentialoils;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&TraditionalKnowledge** IPR and WTO (TRIPS, WIPO), Patent Act 1970 and its amendments, TIFAC, NRDC, Rights, Procedure of obtaining patents, Working of patents, Infringement, Copyrights, Trademarks, GeographicalIndications,TraditionalKnowledgeDigitalLibrary,ProtectionofTraditional Knowledge&ProtectionofPlantVarietiesandBiotechinventions.	8
V	**Ethnobotany** Methodologiesofethnobotanicalresearch:Fieldwork,Literature,HerbariaandMuseaandother aspects of ethnobotany. Importance of ethnobotany in Indian systems of medicine (Siddha, Ayurveda and Unani), Role of AYUSH, NMPB, CI-MAP and CARI. Tribalknowledgetowardsdiseasediagnosis,treatment,medicinalplants,plantconservationand cultivation.	8
VI	**Medicinalaspects** Study of common plants used by tribes (*Aegle marmelos, Ficus religiosa, Cynodon dactylon, Eclipta alba, Oxalis, Ocimum sanctum* and *Trichopus zeylanicus)* Ethnobotanical aspect of conservationandmanagementofplantresources,Preservationofprimevalforestsintheform ofsacredgrovesofindividualspeciesandBotanicalusesdepictedinourepics.	8
	Plants inprimaryhealthcare*:*commonmedicinalplants*:Tinospora,Acorus,Ocimum,Turmeric* and*Aloe*.IndianPharmacopeia,QualityEvaluationofcrudedrugs&adulteration	
VII	**Pharmacognosy** Preparationofdrugs for commercial market -Organoleptic evaluationofdrugs -Microscopic evaluation of drugs - Physical evaluation of drugs - Active and inert constituents of drugs - Classification of drug plants - individual drugs - drug adulteration.Sources of crude drugs – roots, rhizome, bulb, corm, leaves, stems, flowers, fruits and seeds ; organoleptic study of *Adhatoda vasica, Andrographis paniculata, Azadirachta indica, Coriandrum sativum, Datura metel, Eclipta alba, Emblica officinalis, Ocimum sanctum, Phyllanthus amarus, Ricinus communis, Vinca rosea* and *Zingiber officinale.*	8
VIII	**HerbalPreparations&Phytochemistry:** Collectionof wild herbs - Capsules-compresses -Elixirs - Glycerites -Hydrotherapyor Herbal bath-Herbaloils-LiquidextractsorTincture-Poultices-Salves-Slipperyelmslurryandgruel -Suppositories -Teas.Plantnatural products, generaldetection,extractionand characterization procedures. Glycosides and Flavonoids and therapeutic applications. Anthocyanins and Coumarinsandtherapeuticapplications,Lignans,Terpenes,VolatileoilsandSaponins, CarotenoidsandAlkaloidsCarotenoidsandpharmacologicalactivities.	7

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

1. □□□□□□□□□□□□□□□□□□□□□□□□□□□□(□□□□□l□□□□,□□□□□□□□,□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□)□□□□-□□□□,□□□□□□□□□□□□□□□□□□□:□□□□□□□□□□□□□□□,□□□□
2. □□□□□□□□□□□□,□□□□□□□□□□□□□भवन□□□.क.स.□□□□□□□□□□□□□□□□□□□□
3. □□□-Dhankar-Sharma–Trivedi
4. AushdhiyePoudhe(Hindi)byR.P.Sharma|1January2013YKINGBOOKS

1. Kochhar,S.L.(2011).EconomicBotanyintheTropics,MacMillanPublishersIndiaLtd.,NewDelhi.4thedition.
2. Sambamurthy,AVSS&Subrahmanyam,NS(2000).EconomicBotanyofCropPlants.AsiatechPublishers.NewDelhi.
3. Singh,D.KandK.V.Peter.2014.Protectedcultivationofhorticulturalcrops.NewIndiaPublishingAgency,India.
4. ReddyP.Parvatha.2016.Sustainablecropprotectionunderprotectedcultivation.Springer,Singapore.
5. AmitDeogirikar.2019.ATextBookonProtectedCultivationandSecondaryAgriculture.RajlaxmiPrakashan, Aurangabad, India.
6. Singh,B.,B.Singh,N.SabirandMHasan.2014.Advancesinprotectedcultivation.NewIndiaPublishing Agency,India.
7. Sharma,OP.1996.Hill'sEconomicBotany(LateDr.AFHill,adoptedbyOPSharma).TataMcGrawHillCo.Ltd.,New Delhi.
8. JoeJ.Hanan.1997.Greenhouses:AdvancedTechnologyforprotectedhorticulture.CRCPress.
9. Krishnamurthy,K.V.(2004).AnAdvancedTextrbookofBiodiversity-PrinciplesandPractices.OxfordandIBH Publications Co. Pvt. Ltd. New Delhi
10. N.K.Acharya:Textbookonintellectualpropertyrights,AsiaLawHouse(2001).
11. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications(2003).
12. P.Ganguli,IntellectualPropertyRights:UnleashingtheKnowledgeEconomy,TataMcGraw-Hill(2001).
13. Arthur Raphael Miller, Micheal H.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
14. JayashreeWatal,IntellectualpropertyrightsintheWTOanddevelopingcountries,OxfordUniversityPress,Oxford.
15. Jain,S.K.andV.Mudgal.1999.AHandbookofEthnobotany.BishenSinghMahendraPalSingh,Dehradun.
16. Jeffrey,C.1982.AnIntroductiontoPlantTaxonomy.CambridgeUniversityPress,Cambridge.London.
17. Joshi,S.G.2000.MedicinalPlants.OxfordandIBH,NewDelhi.
18. Kokate,C.andGokeale-Pharmocognacy-NiraliPrakashan,NewDelhi.
19. Lad,V.1984.Ayurveda–TheScienceofSelf-healing.MotilalBanarasidass,NewDelhi.
20. Lewis,W.H.andM.P.F.ElwinLewis.1976.MedicalBotany.PlantsAffectingMan'sHealth.A
a.WileyInterscience Publication.JohnWileyandSons,NewYork.
21. Farooqui,A.A.andSreeraman,B.S.2001.Cultvationofmedicinalandaromaticcrops.UniversitiesPress.
22. Harborne, J. B. 1998. Phytochemical methods – a guide to modern techniques of plant analysis 3 rd edition, Chapman and Hall.
23. Yesodha, D., Geetha, S and Radhakrishnan, V. 1997. Allied Biochemistry. Morgan publications, Chennai.1. GurdeepChatwal, 1980. Organic chemistry of natural productis. Vol. I. Himalaya Publishing house.
24. Kalsi,P.S.andJagtap,S.,2012.Pharmaceuticalmedicinalandnaturalproductchemistry.N.K.MehraforNarosa Publishing House Pvt. Ltd. New Delhi.
25. Wallis,T.E.1946.TextbookofPharmacognosy,J&AChurchillLtd.

26. Roseline,A.2011.Pharmacognosy.MJPPublishers,Chennai.
27. JainS.K.1989.MethodsandapproachesinEthnobotany,SocietyofEthnobotanists, Lucknow.
28. Sharol Tilgner, N. D. 1999. Herbal medicine -Fromthe heart of the earth.Edn. 1, Printed in the USA by Malloy Lithographing Inc.
29. Pal,D.C.&Jain,S.K.,1998.TribalMedicine.NayaPrakashPublishers,Calcutta.
30. Datta&Mukerji,1952.PharmacognosyofIndianrootsofRhizomsdrugs.BulletinNo.1Ministryof Health, Govt. of India.
31. YoungKen,H.W.,1948.TextBookofPharmacognosy.BlakistonC.,Philadelphia.
32. Shukla,R.S.,2000.Forestryfortribaldevelopment.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.BiologicalInstrumentationandmethodology.S.Chand&Co.Ltd.
35. K.WilsonandJ.WalkerEds.2005.BiochemistryandMolecularBiology.CambridgeUniversityPress.
36. k.WilsonandKHGoulding.1986.PrinciplesandtechniquesofPracticalBiochemistry.(3ednEdward Arnold, London.

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:**Opentoallbutspecialfor**B.Sc.Biotech, B.Sc.Forestry,B.Sc.Agriculture,B.Pharma,B.A.(Curators),B.A.Archaeology,B.A.Geology,BAMS

SuggestedContinuousEvaluationMethods:

ContinuousInternalEvaluationshallbebasedonallottedAssignmentandClassTests.Themarksshallbeasfollows:

InternalAssessment	Marks
ClassInteraction	**5**
Quiz	**5**
Seminar	**7**
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	**8**
	25

Courseprerequisites:

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:SmartandInteractiveClass

OtherRequisites::Videocollection,Books,CDs,Flora,Herbarium,AccesstoOn-lineresources,DisplayCharts

Suggested equivalent online resourses:

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

Programme:***DiplomainPlantIdentification,Utilization&Ethnomedicine***	Year:**II**	Semester:**IVPaper-II**
Subject:**Botany**		
CourseCode: B040402P	CourseTitle:**CommercialBotany&PhytochemicalAnalysis**	

Courseoutcomes: Afterthecompletion ofthecoursethe studentswill be able to:

1. Knowaboutthecommercialproductsproducedfromplants.
2. Gaintheknowledgeaboutcultivationpracticesofsomeeconomiccrops.
3. Understandabouttheethnobotanicaldetailsofplants.
4. Learnaboutthechemistryofplants&herbalpreparations
5. Canbecomeaprotectedcultivator,aromaticoilproducer,Pharmacologistorqualityanalystindrugcompany.

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

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**0-0-2**

Unit	Topic **(Performminimumanythreeexperimentsfromeachunit)**	No.of Lectures (60hrs)
I	**EconomicBotany&Microtechnique:** Cereals:Wheat(habitsketch,L.S./T.S.ofgrain,starchgrains,micro-chemicaltests);rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests) Legume:Peaorgroundnut(habit,fruit,seedstructure,micro-chemical tests) Source of sugars and starches: Sugarcane (habit sketch; cane juice- micro-chemical tests); potato (habitsketch, tuber morphology, T.S. of tuber to show localization of starch grains, W.M. of starch) grains, micro-chemical tests. Tea-tealeaves,testsfor tannin Mustard-plantspecimen,seeds,testsforfatincrushedseeds 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. StudyofspecimensofeconomicimportancementionedinUnitI-&II	**8**
II	**CommercialCultivation** Field visit to Green houses for understanding Floriculture & vegetables production Developmentofhydroponicsnutrientsolutions&runningmodelsforcultivationof vegetables Developmentof hydroponicsnutrientsolutions&runningmodelsforcultivationoffodder	**8**
III	**CultivatingMedicinalandaromaticplants&Essentialoil extraction** a.Lemongrass/Neem/Zinger/Rose/Mint	**7**
IV	**Documentationfrom**TraditionalKnowledgeDigitalLibrary, Mark the Geographic Indications on Map, Understand–NakshtraVatika,Navgrahvatikaanddevelopinyourcollege ToextractthenamesoftheplantsandBotanicalusesdepictedinourepics. Visit NISCAIR, New Delhi	**7**

V	**Ethnobotany** Studyofcommonplantsusedbytribes.*Aeglemarmelos,Ficusreligiosa,Cynodon dactylon.* Visitatribalareaandcollectinformationontheirtraditionalmethodoftreatmentusing crude drugs. Familiarizewithatleast5folkmedicinesandstudythecultivation,extractionandits medicinal application. Observetheplantsofethnobotanicalimportanceinyourarea. VisittoanAyurvedacollegeorAyurvedicResearchInstitute/ Hospital	**7**
VI	**InstrumentationandherbalPreparations** Develop Capsules of herbs/ Develop Herbal oils/ Develop Poultice/cream Analysesomeactiveingredientsusingchromatography/Spectrophotometry	**8**
VII	**Pharmacognosy** Organolepticstudiesofplantsmentionedinthetheory: 1. Morphologicalstudiesofvegetativeandfloralparts. 2. Microscopicpreparationsofroot,stemandleaf. 3. Stomatalnumberandstomatalindex. 4. Veinisletnumber. 5. Palisaderatio. 6. Fibresandvessels(maceration). 7. Starchtest 8. Proteinsandlipidtest	**8**
VIII	**Phytochemistry:** Determinationofthepercentageofforeignleafinadrugcomposedofamixtureofleaves. Dimensions of Calcium oxalate crystals in powdered crude drug. Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins & resins. Any5 herbal preparations.	**7**

SuggestedReadings:***CourseBookspublishedinHindimaybeprescribedbythe Universities***.

1. PlantEcologyAndEconomicBotanybyDhankar-Sharma-Trivedi,RBDPublication
2. □□□□□□□□□□□□□□ShivaKant,PankajKumarBrahmiya:ThakurPublication
3. PHARMACOGNOSY...HindiEdition(Paperback,Hindi,Dr.AkanchaRashi,KHUSHALJASWANI), RM Publication
4. □□□□□□□□□□□□□□□□□□□□□□□□□□□□2□□□□□□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

1. Wallis,T.E.1946.TextbookofPharmacognosy,J &AChurchillLtd.
2. Roseline,A.2011.Pharmacognosy.MJPPublishers,Chennai.
3. JainS.K.1989.MethodsandapproachesinEthnobotany,SocietyofEthnobotanists, Lucknow.
4. Pal,D.C.&Jain,S.K.,1998.TribalMedicine.NayaPrakashPublishers, Calcutta.
5. Datta& Mukerji, 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health, Govt. of India.
6. YoungKen,H.W.,1948.TextBookofPharmacognosy.BlakistonC.,Philadelphia.
7. Shukla,R.S.,2000.Forestryfortribaldevelopment.A.H.Wheeler&Co.Ltd.,India.
8. Raychudhuri,S.P.,1991.(Ed.)RecentadvancesinMedicinalaromaticandspicecrops.Vol.1,Today& Tomorrow's printers and publishers, New Delhi.
9. KhasimS.MBotanicalMicrotechniques:Principlesand Practice-
10. Sambamurthy,AVSS&Subrahmanyam,NS(2000).EconomicBotanyofCropPlants.AsiatechPublishers. ew Delhi.
11. Singh,D.KandK.V.Peter.2014.Protectedcultivationofhorticulturalcrops.NewIndiaPublishingAgency

Thiscoursecanbeoptedasanelectivebythestudentsofthefollowingsubjects:**Opentoallbutspecialfor**B.Sc. Biotech,B.Sc.Forestry,B.Sc.Agriculture,B.Pharma,B.A.(Curators),B.A.Arch,.BAMS

SuggestedContinuousEvaluationMethods:

ContinuousInternalEvaluationshallbebasedonallottedAssignmentandClassTests.Themarksshallbe as follows:

InternalAssessment	Marks
ClassInteraction	5
Quiz	5
Seminar	7
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	8
	25

Courseprerequisites:

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:SmartandInteractiveClass

OtherRequisites: Videocollection,Books,CDs,Flora,Herbarium,AccesstoOn-lineresources,DisplayCharts

Labrequisites: Repositoryofeconomicproducts,Microscopes/Botanical/HerbalGarden,TLC,Spectrophotometer.

Suggested equivalent online courses:

https://www.entrepreneurindia.co/Document/Download/pdfanddoc-144615-.pdfhttp://nopr.niscair.res.in/handle/123456789/45825https://www.wipo.int/export/sites/www/tk/en/resources/pdf/medical_tk.pdfhttps://www.bentoli.com/commercial-farming-agriculture/

DETAILSYLLABUS
OF
B.Sc.-IIIYEAR
or
BACHELOROFSCIENCE
(BOTANY)

BACHELOROFSCIENCE(BOTANY)

Programme/Class:***BachelorofScience***	Year:**III**	Semester:**V** **Paper-I**
Subject:BOTANY		
CourseCode:B040501T	CourseTitle:**PlantPhysiology,Metabolism&Biochemistry**	

Course outcomes:

Afterthe completion ofthe coursethestudentswill beable to:

1. Understandthe roleof Physiologicalandmetabolicprocesses forplantgrowthanddevelopment.
2. Learnthesymptoms ofMineral Deficiencyin cropsandtheirmanagement.
3. AssimilateKnowledge aboutBiochemical constitutionofplant diversity.
4. Knowtheroleofplantsindevelopmentofnaturalproducts,nutraceuticals,dietarysupplements,antioxidants

Credits:**4**	**CoreCompulsory**
Max.Marks:**25+75**	Min.PassingMarks:

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek)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. Criteriaofessentialityofelements;Roleofessentialelements;Symptomsofmineraldeficiency in major crops, Transport of ions across cell membrane, active and passive transport, Composition of phloem sap, girdling experiment; Pressure flow model.	**7**
II	**CarbonOxidation** Krebscycle, Glycolysis, fate ofpyruvate-aerobic and anaerobicrespirationand 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	**NitrogenMetabolism** 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	**LipidMetabolism&Photosynthesis** LipidMetabolism:Synthesisandbreakdown 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	**PlantDevelopment,Movements,Dormancy&Responses** Developmental roles of Phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene.) autonomic & paratonic movements, Control and Coordination in plants, Photoperiodism (SDP,LDP,Dayneutralplants);Phytochrome(discoveryandstructure),redandfarred-light responses on photomorphogenesis, Seed physiology & Dormancy, Vernalization & Senescence	**8**

VI	**Biomolecules** *Carbohydrates:*Nomenclatureandclassification;Roleofmonosaccharides(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 **Nucleicacids:**Structureofnitrogenousbases;Structureandfunctionofnucleicacids,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,dietarysupplementsandantioxidants.	**8**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

1. [illegible]:[illegible]एचएस[illegible] [illegible]:[illegible],[illegible]
2. [illegible],[illegible] [illegible]:[illegible],[illegible]
3. [illegible]जनन[illegible].MadanKumar.2020.
4. PlantPhysiologyandBiochemistryISBN#:81-301-0035-5SunilDPurohit,K.Ahmed& GotamKKukdaEdition: 2013Pages: 368+VIII TextBook(Hindi)
5. [illegible]Dhankar-Sharma–TrivediRBDPublishing

1. Hopkins,W.G.&Hiiner,N.P.IntroductiontoPlantPhysiology(3rded.)2004,JohnWiley&Sons.
2. A Handbook On Mineral Nutrition And Diagnostic Techniques For Nutritional Disorders Of Crops (pb)ISBN : 9788177543377Edition : 01Year : 2011Author : Pathmanabhan G , Vanangamudi M , Chandrasekaran CN , Sathyamoorthi K , Babu CR , Babu RC , Boopathi PNPublisher : Agrobios (India)
3. Jain,V.K.FundamentalofPlantPhysiology(7thed.)2004.S.ChandandCompany.
4. Salisbury,F.B.&Ross,C.W.PlantPhysiology(4thed.),19992,WadsoworthPublishingCompany.
5. Panday,S.N.&Sinha,B.K.PlantPhysiology(4thed.),2006,VikasPublishingHousePvt. Ltd.
6. Mukherjee,S.&Ghosh,A.PlantPhysiology(2nded.),2005,NewCentralBookAgency.
7. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New Central Book. Agencies.
8. Voet,D.andVoet,J.G.,Bio-Chemistry(3rded.),2005,JohnWiley&Sons.
9. Mathews,C.K.,VanHolder,K.E.&Ahren,K.G.Bio-Chemistry(3rded.),2000,PearsonEducation.
10. LehningerPrinciplesofBiochemistry.SixthEdition.2013.DavidL.Nelson,MichaelM.Cox.Freeman,Macmillan.
11. Srivastava,HN.2006.Pradeep'sBotanyVol.V.PradeepPublications,Jalandhar.
12. Verma,SK.PlantPhysiologyandBiochemistry.S.Chand&Sons,NewDelhi.
13. Buchanon,GruissenandJones.PlantPhysiology&Biochemistry:BiochemistryandMolecularBiologyofplants,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.PhytochemicalMethods.JohnWiley&Sons,NewYork.
16. Watson,J.D.,BakerT.A.,Bell,S.P.,Gann,A.,Levine,M.,andLosick,R.,2008MolecularBiologyoftheGene6th edition. Cold

Spring Harbour Lab. Press, Pearson Pub.
17. P.K.Gupta.BIOTECHNOLOGYANDGENOMICS.RastogiPublications,7thReprint(1stEdition):2016-2017

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:Opentoallbut special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech,

SuggestedContinuousEvaluationMethods: ContinuousInternalEvaluationshallbebasedonallottedAssignmentand Class Tests

InternalAssessment	Marks
ClassInteraction	**5**
Quiz	**5**
Seminar	**7**
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	**8**
	25

Courseprerequisites:
Qualification: Tostudythiscourse,astudentmusthavequalified10+2withBiology/NSQFlevel3fromSectorSkill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ /Gardening)
Facilities:SmartandInteractiveClass
OtherRequisites:Videocollection,Books,CDs,AccesstoOn-lineresources,DisplayCharts

Suggested equivalent online courses:
https://www.classcentral.com/course/swayam-plant-physiology-and-metabolism-17732https://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:***BachelorofScience***	Year:**III**	Semester:**V** **Paper-II**
Subject:BOTANY		
CourseCode:B040502T	CourseTitle:**MolecularBiology&Bioinformatics**	

Course outcomes:
Afterthe completion ofthe coursethestudentswill beable to:
1. Understand nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.
2. KnowaboutProcessingandmodificationofRNAandtranslationprocess,functionandregulationofexpression.
3. Gainworkingknowledgeofthepracticalandtheoreticalconceptsofbioinformatics

Credits:**4**	**CC/Elective**
Max.Marks:**25+75**	Min.PassingMarks:
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek)4-**0-0**	

Unit	**Topic**	**No. of Lectures(60hrs)**

I	**Geneticmaterial** 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.DNAreplication(Prokaryotesandeukaryotes):bidirectionalreplication,semi–conservative,semidiscontinuousRNApriming,Ø(theta)modeofreplication,replicationof linear, dsDNA, replicating the 5´end of linear chromosome including replication enzymes.	**7**
II	**Transcription&Regulationofgeneexpression** 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&TechniquesofgeneticengineeringBlottingtechniques:Northern,SouthernandWesternBlotting,DNAFingerprinting;** MolecularDNAmarkersi.e.RAPD,RFLP,SNPs;DNAsequencing,PCRand ReverseTranscriptase-PCR.Hybridomaandmonoclonalantibodies,ELISAand Immunodetection. Antibody Engineering.	**8**
IV	**ApplicationsofGeneticengineering** 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&itsapplications** Computerfundamentals-programminglanguagesinbioinformatics,roleofsupercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure basedandligandbasedapproaches),SystemsBiologyandFunctionalBiology.Applications andLimitationsofbioinformatics.	**8**
VI	**Biologicaldatabases:** Introductiontobiologicaldatabases -primary,secondaryandcomposite databases,NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot,TrEMBL,PDB),metabolicpathwaydatabase(KEGG,EcoCyc,andMetaCyc),small molecule databases (PubChem,)	**8**
VII	**DataGenerationandDataRetrieval** Generationofdata(Genesequencing,Proteinsequencing,Massspectrometry,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	**Phylogeneticanalysis** Similarity,identityandhomology,Alignment–localandglobalalignment,pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogeneticanalysis:Constructionofphylogenetictree,dendrograms,methodsof construction of phylogenetic trees.	**8**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

1.DrPoojaRai.□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□,Bhopal

2. **Sharma-TrivediMolecularBiologyAndBiotechnology(□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□)byRBDPublisher**
3. Plant Physiology and Biochemistry ISBN #: 81-301-0035-5Author:SunilDPurohit,K.Ahmed& Gotam K KukdaEdition: 2013Pages: 368 + VIIIType: Text Book (Hindi)
4. MolecularBiologyBiotechnologyISBN#: 81-301-0033-9Author:SunilDPurohit&GotamK KukdaEdition:2013Pages: 366+ XType: Text Book (Hindi) Apex Publishing House, Udaipur,Rajasthan
5. BioinformaticsPaperback–1January2015byDrArchanaPandeya(Author),Santosh Choubey (Editor), & 2 More Hindi AISECT Ltd.
6. BIOTECHNOLOGYANDGENETICENGINEERING(Hindi,Hardcover,Dr.ArchnaNigam)

1. Primrose,SB.1995.PrinciplesofGenomeAnalysis.BlackwellScienceLtd.Oxford,UK..
2. E.J.GardnerandD.P.Snustad.PRINCIPALOFGENETICS(1984),JohnWiley&Sons,NeyYork.
3. Watson,J.D.,BakerT.A.,Bell,S.P.,Gann,A.,Levine,M.,andLosick,R.,2008MolecularBiologyoftheGene6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
4. Freifelder-MolecularBiology.
5. P.K.Gupta.BIOTECHNOLOGYANDGENOMICS.RastogiPublications,7thReprint(1stEdition):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 andProteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
8. Roy,D.(2009).Bioinformatics,1stedition.NewDelhi,Delhi:NarosaPublishingHouse.
9. Andreas,D., Baxevanis, B.F., Francis, Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons.
10. PevsnerJ.(2009).BioinformaticsandFunctionalGenomics,2ndedition.NewJersey,U.S.:WileyBlackwell.
11. XiongJ.(2006).EssentialBioinformatics,1stedition.Cambridge,U.K.:CambridgeUniversityPress
12. ATextbookOfBasicAndMolecularGenetics(pb)ISBN:9788188826193Edition:01Year:2018Author:Dr.Parihar P

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:
Opentoallbutspecialforfollowing:B.Sc.Math,B.Sc.Statistics,B.Sc.Nutrition,B.Sc.Biophysics,B.Sc.Biotech, B.Sc. Forestry, B.Sc. Agriculture.

SuggestedContinuousEvaluationMethods: ContinuousInternalEvaluationshallbebasedonallottedAssignmentand Class Tests. The marks shall be as follows:

InternalAssessment	Marks
ClassInteraction	**5**
Quiz	**5**
Seminar	**7**
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	**8**
	25

Courseprerequisites:
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:SmartandInteractiveClass
OtherRequisites:Videocollection,Books,CDs,AccesstoOn-lineresources,DisplayCharts

Suggestedequivalentonlinecourses:
https://www.edx.org/learn/molecular-biology
https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineeringhttps://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090https://www.coursera.org/courses?query=geneticshttps://www.coursera.org/courses?query=molecular%20biologyhttps://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-2907https://nptel.ac.in/courses/102/103/102103013/

Programme/Class:***BachelorofScience***	Year:**III**	Semester:**V** **Paper-III**
Subject:**Botany**		
CourseCode:B040503P	CourseTitle:***Experimentsinphysiology,Biochemistry& molecularbiology***	

Course outcomes:

Afterthe completion ofthe coursethestudentswill beable to:

1. Know and authentic the physiological processes undergoing in plants along withtheir metabolism
2. IdentifyMineraldeficienciesbasedonvisualsymptoms
3. Understandanddevelopskillforconductingmolecularexperimentsforgenetic engineering

Credits:2	**CoreCompulsory**
Max.Marks:**25+75**	Min.PassingMarks:

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek)0-**0-2**

Unit	**Topic*** ***(Performanythreefromeachunitbasedonfacility)***	**No. of Lectures(60 hrs)**
I	**Plantwaterrelation,MineralNutritionandtranslocationinphloem** 1. Determinationof osmoticpotential of plantcell sapbyplasmolyticmethodusing leaves of Rhoeo / Tradescantia. 2. Osmosis–bypotatoosmoscope experiment 3. Effectoftemperatureonabsorptionofwaterbystoragetissueanddeterminationof Q10. 4. Experimenttodemonstratethetranspirationphenomenonwiththebelljarmethod 5. ExperimentfordemonstrationofTranspirationbyFour-Leaf Experiment: 6. Structureofstomata(dicot& monocot) 7. Determinationofrateoftranspirationusingcobaltchloridemethod. 8. ExperimenttomeasuretherateoftranspirationbyusingFarmer'sPotometer 9. ExperimenttomeasuretherateoftranspirationbyusingGanong'spotometer 10. EffectofTemperatureonmembranepermeabilitybycolorimetricmethod. 11. Studyofmineraldeficiencysymptomsusingplant material/photographs.	**8**
II	**NitrogenMetabolism,PhotoSynthesis& Respiration** 1. A basic idea of chromatography: Principle, paper chromatography and column chromatography; demonstration of column chromatography. 2. Separationofplastidialpigmentsbysolvent andpaperchromatography. 3. Estimationoftotalchlorophyllcontentfromdifferentchronologicallyagedleaves(young, mature and senescence) by Arnon method. 4. Effect of HCO_3concentration on oxygen evolution during photosynthesis in an aquatic plantandtofindouttheoptimumandtoxicconcentration(eitherbyvolumemeasurementor bubble counting). 5. Measurementofoxygenuptakebyrespiringtissue(perg/hr.) 6.Determination of the RQ of germinating seeds. 7.Effectoflightintensityonoxygenevolutioninphotosynthesisusing Wilmott'bubble	**8**

III	**PlantDevelopment,Movements,Dormancy&Responses** 1. Geotropismandphototropism—Klinostàt 2. Hydrotropism a. Measurementofgrowth—ArcandLiverAuxonometer 3. Tostudythephenomenonofseedgermination(effectof light). 4. Tostudytheinductionofamylaseactivityingerminatinggrains.	**8**
	5. TestofseedviabilitybyTTCmethod. 6. TostudytheeffectofdifferentconcentrationsofIAAon*Avena* coleoptileelongation(IAAbioassay)	
IV	**Techniquesforbiochemicalanalysis** 1. WeighingandPreparationofsolutions-percentage,molar&normal solutions, dilution from stock solution etc. 2. Separationofaminoacidsbypaper chromatography. 3. Detection of organic acids: citric, tartaric, oxalic and malic from laboratory samples., 4. QualitativeAnalysisofcarbohydrates, 5. Estimationofreducingsugarbyanthronemethod, 6. QualitativeAnalysisofLipids 7. QualitativeanalysisofAminoacidsandProteins 8. QuantitativeAnalysisofNucleicAcids, 9. Analysisofdietarysupplements,nutraceuticals&antioxidants 10. Testingofadulterantsinfood items.	**8**
V	**Geneticmaterial** 1. Instrumentsandequipmentsusedinmolecularbiology. 2. PreparationofLBmediumandcultivatingE.colionit. 3. IsolationofGenomicDNA 4. IsolationofDNAfromplants 5. ExaminationofthepurityofDNAbyagarosegelelectrophoresis. 6. QuantificationofDNAbyUV-spectrophotometer 7. EstimationofDNAbydiphenylaminemethod.	**7**

VI	**Preparationofmodels/ 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 (MesselsonandStahl'sexperiment);Telomeraseassistedend-replicationoflinear 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. UnderstandingthemechanismofRNAibyphotographs	**7**
VII	**GeneticEngineering** 1. Isolationof protoplasts. 2. ConstructionofrestrictionmapofcircularandlinearDNAfromthedata provided. 3. Isolationofplasmid DNA. 4. RestrictiondigestionandgelelectrophoresisofplasmidDNA(demonstration/ photograph). 5. Calculatethepercentagesimilaritybetweendifferentcultivarsofaspecies usingRAPDprofile.Constructadendrogramandinterpretresults.	**7**
	6. AgarosegelanalysisofplasmidDNA 7. RestrictiondigestionofplasmidDNA-DemonstrationofPCR	
VIII	**ApplicationsofGeneticengineering** 1. ELISATest, 2. Viabilitytestsofcells 3. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 4. Studyofsteps ofgeneticengineeringfor production ofBtcotton,Golden rice, FlavrSavrtomatothroughphotographs.	**7**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

1. [illegible] 3 [illegible]

1. Karp,G.2010.CellandMolecularBiology:ConceptsandExperiments.6thEdition.JohnWiley& Sons. Inc.

2. ALaboratoryManualOfPlant,Physiology,BiochemistryAnd EcologyISBN: 9788177544589Edition :01Year:2012Author:AkhtarInamPublisher:Agrobios(India)
3. Advanced Methods In Physiology And Biochemistry (pb)ISBN : 9789381191132Edition : 01Year : 2016Author:PadmanabanG,ChandrasekaranCN,ThangaveluAU,Dr.SivakumarR,KalimuthuN ,Dr.BoominathanP,Dr.AnbarasanP,Agrobios.
4. MethodsinPlantBiochemistryandMolecularBiology.1997.Dashek,WV(ed.).CRCPress.
5. WilsonandWalker.PracticalBiochemistry:PrinciplesandTechniques.CambridgeUniversity Press.U.K.
6. Thimmaiah,SR.2004.StandardMethodsofBiochemicalAnalysis.Kalyani Publishers.
7. Henry,RJ.1997.PracticalApplicationofPlantMolecularBiology.Chapman&Hall,London

Thiscoursecanbeoptedasan electivebythe studentsoffollowingsubjects:

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.

SuggestedContinuousEvaluationMethods:

ContinuousInternalEvaluationshallbebasedonallottedAssignmentandClassTests.Themarksshallbeasfollows:

InternalAssessment	Marks
ClassInteraction	**5**
Quiz	**5**
Seminar	**7**
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	**8**
	25

Courseprerequisites:

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:SmartandInteractiveClass

OtherRequisites:Videocollection,Books,CDs,AccesstoOn-lineresources,DisplayCharts

Labrequisites:Electrophoresisunits,Gelrocker,UV-transilluminator,VortexMixer,Shaker,CVT,

HiMediaBiotechnology&MolecularbiologyKits/Chemicals,Micropipettes,Elisareader/MicrotitreReader
Suggestedequivalentonlinecourses: https://www.edx.org/learn/molecular-biologyhttps://krishikosh.egranth.ac.in/handle/1/5810039999https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090https://www.coursera.org/courses?query=geneticshttps://www.coursera.org/courses?query=molecular%20biologyhttps://www.edx.org/learn/genetic-engineering https://www.mooc-list.com/tags/genetic-engineering https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907

Programme/Class:**BachelorofScience**	Year:**III**	**Semester:V** **Paper-IV**
Subject:**BOTANY**		
CourseCode:-B040504R	CourseTitle:**ProjectinBotanyforPre-graduation**	

Courseoutcomes:

- Projectworkwillsupplementfieldexperimentallearninganddeviationsfromclassroomandlaboratory transactions.
- project work will enhance the capabilityto applygained knowledge and understanding for selecting, solvingand decision-making processes.
- Itwillpromotecreativityandthespiritofenquiryinlearners.
- 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.
- Itwillenhancetheirabilities,enthusiasm,andinterest.

Credits:**03**	Core:**Compulsory**
Max.Marks:**25+75**	Min.PassingMarks:**……**

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**0-0-3**.

SuggestiveListOfPROJECTS

1. RuralAreas:Floraofacity/village,BiodiversityofVillage,Soil&seedtestingserviceprovisiontofarmers,
2. Industrialwastemanagement
3. waterpollutionstatusofruralwater&promotionofWASHinvillages
4. PlantDiseaseidentificationinfarms,nurseriesandorchards.
5. Digitalportalforplants:Campus,cityorparticular area
6. Rareandendangeredplants&theirconservation&domestication
7. Airpollutiontoleranceindex(APTI):Screeningofsensitive/tolerantplantspeciesatvariouslocationsin particular area
8. Science Communication by Creating science documentaries of innovators , Internet Science (Social media,Websites, Blogs, Youtube, Podcast etc.)
9. ScienceOutreachTalksandPublicSensitizationforplantbiodiversityconservationsensitizationofpublic.
10. Phytochemistryofmedicinalplants&theirantimicrobial,nutraceuticalandantioxidantproperties
11. Studyofpollengrainsindifferentflowers
12. Studyofstomataindifferentplants
13. Studyofvarioustypesofsecretoryandspecialtissuesin plants.

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

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects: **Opentoall**

SuggestedContinuousEvaluationMethods:

ContinuousInternalEvaluationshallbebasedon allottedAssignmentandClassTests.Themarksshallbeas follows:

InternalAssessment	Marks
ClassInteraction	**5**
Seminar	**10**

Thesis/dissertation	**10**
	25
Courseprerequisites:	

Qualification: Tostudythiscourse,astudentmusthavequalified10+2 withBiology/NSQFlevel3fromSectorSkill Councils/Diplomaholder fromITIin(Biology/ Agriculture/Biotech/Forestry/Microbiology/Gardening/biomedical Science. **Facilities:** SmartandInteractiveClass **OtherRequisites:** Alllistedunderallpapersofthecourse.
Suggestedequivalentonlinecourses: https://ndl.iitkgp.ac.in/ https://asiafoundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiwA-hX5J-QhBITSyPnvj3r8yeio-L9f5uTy1a6oEoALCLa9Ebu0pyz858yQZxoC5wkQAvD_BwEhttp://www.dli.ernet.in/ http://www.ulib.org/http://www.tkdl.res.in /http://www.vigyanprasar.gov.in/digilib DirectoryofOpenAccessRepositories(DOAR)http://www.opendoar.org Registry of Open Access Repositories (ROAR)http://roar.eprints.org/ http://www.iscnagpur.ac.in/knowledge_learning_files/5.7_General_Open_Access_e-Resources.pdf

Programme/Class:***BachelorofScience***	Year:**III**	Semester:**VI** **Paper-I**
Subject:**Botany**		
CourseCode:B040601T	CourseTitle:**Cytogenetics,PlantBreeding&Nanotechnology**	

Courseoutcomes: Afterthecompletionofthecoursethestudentswillbeable:

1. Acquireknowledgeoncellultrastructure.
2. Understandthestructureandchemicalcompositionofchromatinandconceptofcelldivision.
3. InterprettheMendel'sprinciples,acquireknowledgeoncytoplasmicinheritanceandsex-linkedinheritance.
4. Understandtheconceptof'onegeneoneenzymehypothesis'alongwiththemolecularmechanismofmutation.

Credits:**4**	**CoreCompulsory**
Max.Marks:**25+75**	Min.PassingMarks:

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**4-0-0**

Unit	Topic	No. of Lectures (60hrs)
I	**Cellbiology** 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.Cellcycle:G0,G1,SandG2phases–mitosis:openandclosedmitosis–amitosis- meiosis. Variation in Chromosome number (Numerical aberrations)- anueploidy and Euploidy- haploidy, polyploidy- significance (Structural aberrations) - deletion, duplication, inversion and translocation.	**8**
II	**Genetics** Chromosometheoryofinheritance,crossingoverandlinkage;Incompletedominance 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	**Plantbreeding** Plant introduction. Agencies of plant introduction in India, Procedure of introduction - Acclimatization – Achievements, Selection - mass selection, pure line selection and clonal selection.Geneticbasisofselectionmethods,Hybridization:Procedureofhybridization,inter generic, inter specific, inter varietal hybridization with examples. Composite and synthetic varieties,Malesterility,Heterosisanditsexploitationinplantbreeding,Mutation,Molecular Breeding (useofDNAmarkersinplantbreeding),achievements in India,Breedingforpest, pathogenicdiseasesandstressresistance.	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;Measurementofdispersion–Coefficientofvariation,StandardDeviation,Standard errorofMean;Testofsignificance:chi-squaretestforgoodnessoffit.Computerapplication in biostatistics - MS Excel and SPSS	7
V	**Planttissueculture**	8
	Principles,componentsandtechniquesof*invitro*plantcultures,Calluscultures,Cellculture, cellsuspensioncultures,Embryogenesisandorganogenesis,Protoplastisolationandculturing ofprotoplast-principleandapplication,regenerationofprotoplasts,protoplastfusionand 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.Introductiontobiologicalnanomaterials.Biomineralization,Magnetosomes, nano-pesticides,nano-fertilizers,nano-sensors.	**7**
VII	**ArtificialIntelligenceinPlantSciences** Big Data Analytics, Blockchain Technology, 3-D Printing, Machine learning, Algorithms of Machine Learning,ExpertsystemsandFuzzylogic, ArtificialNeuralNetworksandGenetic algorithms,PredictiveAnalytics,AgentsandRobotics,IoTSensors,ObjectImagecapture& analysis ; Applications of Artificial Neural Networks in Plant Science.	**8**
VIII	**IntroductiontouseofDigitaltechnologies –AI,IoT&ICTinBotany** Educational software- INFLIBNET, NICNET, BRNET, internet as a knowledge repository-google scholar, science direct. resource management, weather forecasting. IoT Database management,IoTplatforms,IoTGraphicaluserinterface•IoTapplicationdevelopmentfor AndroidMobilephones,ICTApplicationsfordifferentcropsandhorticulture	**7**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

1. [illegible],[illegible]:[illegible]:[illegible]
2. [illegible], [illegible], [illegible] **Sharma and Trivedi by RBD Publisher**
3. **CellBiologyAndGenetics(Hindi)2/e PB........ GuptaPK(Hindi)rastogiPublications**
4. **PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN:ISBN:9781698665283Authors:H.R.DaglaJaiNarainVyasUniversity**
5. **Biotechnology:FundamentalsAndApplication(hindi)(hb)ISBN:9788177544732Edition: 03Year : 2018Author : Dr. Purohit SS , Mathur S**
6. **Biotechnology(Hindi)(Hindi,Paperback,B.D.Singh)HindiPublisher:KalyaniPubishers ISBN: 9789327246070, 9327246071**
7. **Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-0066-1Sunil D Purohit & Gotam K Kukda, Apex Publishing House**
8. **GeneticsandBiotechnologySunilDPurohit,K.Ahmed&GotamKKukdaApex Publishing House**
9. **PadapPrajanan(Hindi)Hardcover–1January2016byChandraPrakashShukl(Author) Pointer Publishers, Jaipur**
10. **PLANTBREEDING:PRINCIPLEANDMETHODSBDSINGH-INHINDI**
11. [illegible]-[illegible] **CommissionforScientificand Technical Terminology (CSTT)**
12. [illegible] **Commission for Scientific and Technical Terminology (CSTT)**

1. G.M.Cooper.(2015).Thecell:AMolecularApproach.7thEdition.SinauerAssociates.
2. Alberts,B.,Johnson,A.D.,Lewis,J.,Morgan,D.,Raff,M.,Roberts,K.,Walter,P. (2014).MolecularBiologyof Cell. 6th Edition. WW. Norton & Co.
3. Campbell,M.K.(2012)Biochemistry,7thed.,PublishedbyCengageLearning.
4. Campbell,P.N.andSmith,A.D.(2011).BiochemistryIllustrated,4thed.,PublishedbyChurchillLivingstone
5. Tymoczko,J.L.,Berg,J.M.andStryer,L.(2012).Biochemistry:Ashortcourse,2nded.,W.H.Freeman.
6. Berg,J.M.,Tymoczko,J.L.andStryer,L.(2011)Biochemistry,W.H.FreemanandCompany

7. Nelson,D.L.andCox,M.M.(2008).LehningerPrinciplesofBiochemistry,5thEd.,W.H.FreemanandCompany.
8. Karp,G.(2010).CellBiology,JohnWiley&Sons,U.S.A.6thedition.
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).PrinciplesofGenetics,JohnWiley&sons,India.8the
11. Snustad,D.P.andSimmons,M.J.(2010).PrinciplesofGenetics,JohnWiley&SonsInc.,India.5thedition.
12. Klug,W.S.,Cummings,M.R.,Spencer,C.A.(2009).ConceptsofGenetics.BenjaminCummings,U.S.A..
13. Griffiths,A.J.F.,Wessler,S.R.,Carroll,S.B.,Doebley,J.(2010).IntroductiontoGeneticAnalysis.W.H.Freeman and Co., U.S.A. 10th edition.
14. MKRaxdanAnIntroductiontoPlantTissueCulture–;Oxfird&IBHPublishingCo.Pvt.Ltd.,NewDelhi
15. AggarwalSK(2009)FoundationCourseinBiology,2ndEdition,AneBooksPvt.Ltd
16. AllardRW(1960)PrinciplesofPlantBreeding.JohnwilleyandSons.Inc.NewYork
17. BDSingh(2003)PlantBreeding.KalyaniPublishers
18. Cohn,N.S.(1964)ElementsofCytology.BraceandWorldInc,NewDelhi
19. Darnel,J.Lodish,HandBaltimore,D.(1991)Cellandmolecularbiology.LeaandFibiger,Washington.
20. DeRobertis,E.D.PandRobertis,E.M.P(1991)CellandmolecularbiologyScientificAmericanbooks.
21. Dobzhansky,B(1961)Geneticandoriginofspecies,ColumbiauniversityPressNewYork
22. Durbin(2007)BiologicalSequenceAnalysis.CambridgeUniversityPressIndiaPvt.Ltd
23. GeraldKarp(1985)Cellbiology,McGrawHillcompany..
24. Lewin,B,(1994)Genes,OxfordUniversityPress,NewYork.
25. Lewis,W.H(1980)Polyploidy.PlenumPress,NewYork.
26. NichollT(2007)AnIntroductiontoGeneticEngineering,CambridgeUniversityPressIndiaPvt.Ltd
27. RoyS.C.andKalayankumarDe(1997)Cellbiology.NewcentralBoosCalcutta
28. SandhyaMitra,(1998)Elementsofmolecularbiology.Macmillan,IndiaLtd.
29. SharmaJR(1994)PrinciplesandPracticesofPlantBreeding.TataMcGraw-HillPub.Co.NewDelhi
30. Sharma,A.KandSharmaA(1980)ChromosometechniqueTheoryandpractice,AdityaBooks,NewYork
31. Swanson,C.P(1957)CytologyandGenetics.Englewoodcliffs,NewYork.
32. Taylor(2008)BiologicalSciences.CambridgeUniversityPressIndiaPvt.Ltd
33. Twymann,R.M.(1998)AdvancedmolecularbiologyVivabooksNewDelhi.
34. VeerBalaRastogi(2008),FundamentalsofMolecularBiologyAneBooksPvt. Ltd
35. A.J.Nair.BasicsofBiotechnology-LaxmiPublications,NewDelhi.
36. SSPurohitandSKMathur;Biotechnology-FundamentalsandApplication-Agrobotanica,India.
37. A.J.NairIntroductiontoGeneticEngineering&Biotechnology.Jones&BartlettPublishers,Boston,USA.
38. HSChawlaIntroductiontoPlantBiotechnology-;Oxford&IBHpublishingCo.Pvt.Ltd.,NewDelhi.
39. HDKumarModernconceptofBiotechnology,VikasPublishing House,Pvt.Ltd.,NewDelhi.
40. PCTrivedi,Plantbiotechnology,RecentAdvancesPanimaPublishingCorporation,NewDelhi.
41. Du,C.,andS.A.Jackson.2019.Machinelearningandcomplexbiologicaldata.GenomeBiology20:76. https://doi.org/10.1186/s13059-019-1689-0
42. AlexisandMathewLeon.,FundamentalsofInformationTechnologyLeonVikas
43. PlantR.E.,StoneN.D.(1991).Knowledge-based systemsinagriculture. McGraw-Hill,Inc. 1221Avenueofthe 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. 22841Quicksilver Drive Dulles, VA 20166.
46. V.RajaramanIntroductiontoInformationTechnology,.,PrenticeHll.
47. RameshBangiaLearningComputerFundamentals.,KhannaBookPublishers
48. Bass, Joel,E and et. al.,Allyn& Bacon, 2009 .Methods for Teaching Science asInquiry,The truth of science,Newton R.G.,

49. R.Rangaswami(2009)ATextbookofAgricultureStatistics.NewAgeInternational(P)Limited,Hyderabad.
50. NageshwarRaoG.(2007)StatisticsforAgricultureSciencesBSPublications.NewDelhi
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53. SnedecorGW.&CochranWG.(1989)StatisticalMethods.IowaStateUniversityPress.
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59. SulabhaK.Kulkarni.2014Nanotechnology:PrinciplesandPractices.CPpublishing,NewDelhi.
60. BSMurty,PShankar,BaldevRaj,BBRath,JamesMurday.2012.TextbookofNanoscienceandNanotechnology. Springer
61. K.K.ChattopadhyayandA.N.Banarjee.2009.IntroductiontoNanoscienceandNanotechnology.PHIPublication.
62. SharmaA.K.2005.TextBookOfBiostatisticsI,DiscoveryPublishingHouse.
63. Annadurai,B.2007.TextBookofBiostatistics.NewAgeInternational.
64. Gurumani,N.2010.AnIntroductiontoBiostatistics(2ndEdn).MJPPublishers.
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67. Pattnaik,P.K.,Kumar,R.,Pal,S.,Panda,S.N.(Eds.)IoTandAnalyticsforAgriculture,2020
68. https://www.springer.com/gp/book/9789811391767
69. https://www.springer.com/gp/book/9789811550720
70. PetersenRogerG.(1994)AgriculturalFieldExperimentsDesignandAnalysisbyMarcelDekker,NewYork.

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:
OpentoallbutspecialforB.Sc.Biotech,B.Sc.Forestry,B.Sc.Agriculture,B.Pharma,B.Sc.FoodScience, B.A.(Curators),B.A.Geology.

SuggestedContinuousEvaluationMethods: ContinuousInternalEvaluationshallbebasedonallottedAssignment and Class Tests. The marks shall be as follows:

InternalAssessment	Marks
ClassInteraction	**5**
Quiz	**5**
Seminar	**7**
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	**8**
	25

Coursepre-requisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level3fromSectorSkillCouncils/DiplomaholderfromITIin(Biology/Agriculture/Forestry/ Biotech/ Math/Statistics/Chemistry/ Computer Science)

Facilities:SmartandInteractiveClass

OtherRequisites:Videocollection,Books,CDs,AccesstoOn-lineresources,DisplayCharts

Suggestedequivalentonlinecourses:
https://www.cytology-iac.org/educational-resources/virtual-slide-libraryhttps://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspxhttps://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/

FurtherSuggestions:
AccesstoStatistics,Chemistry,Mathand Biotechnologyresourceswillbe required

Programme/Class:***BachelorofScience***	Year:**III**	Semester:**VI** **Paper-II**
Subject:**Botany**		
CourseCode:B040602T	CourseTitle:**Ecology&Environment**	

Course outcomes:

1. acquaintthestudentswithcomplexinterrelationshipbetweenorganismsandenvironment;
2. make them understand methods for studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography.
3. This knowledge iscritical in evolving strategies for sustainable natural resource management and biodiversity conservation.

Credits:**4**	**CoreCompulsory/Elective**
Max.Marks:**25+75**	Min.PassingMarks:

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**4-0-0**

Unit	Topic	No.ofLectures (60 hrs)
I	**Natural resources & Sustainable utilization**: Land Utilization, Soil degradation and management strategies; Restoration of degraded lands. Water , Wetlands; Threats and management strategies, Ramsar sites ,Forests: Major and minor forest products; Depletion, Biological Invasion, Energy: Renewable and non-renewable sources of energy , Contemporary practices in resource management : EIA, GIS, Participatory Resource Appraisal,EcologicalFootprint withemphasisoncarbonfootprint, Resource Accounting.	**7**
II	**Ecology&Ecosystem** DefinitionofEcology,EcologicalFactors,Positiveandnegativeinteractions.Ecosystem – Concept of an ecosystem-structureand function of an ecosystem. Abioticandbioticcom-Energyflowinanecosystem Ecological Succession-Definition & types. Processes and types (autogenic,allogenic, autotrophic, heterotrophic, primary & secondary), Hydrosere and Xerosere. Foodchainsandfoodwebs,Ecologicalpyramids,productionandproductivity; And components. Types of ecosystems: Forest Ecosystem, Grassland, Crop land, aquatic Ecosystems Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites.	**8**
III	**SoilFormation,Properties&Conservation** Soil: Origin, Formation, composition, Soil types, Soil Profile, Soil Microorganisms, soil processes, SoilErosion, Biogeochemical cycles, SoilConservation:Biological– Contour farming, Mulching, Strip cropping, Terracing and Crop rotation. Mechanical–Basin Listing, Construction of dams, Watershed Management, Soil reclamation	**7**

IV	**Biodiversityanditsconservation:** Definition-genetic,species,andecosystemdiversity.Valueofbiodiversity:social, ethical,aestheticandoptionvalues;hotspotsofBiodiversitythreatstobiodiversity,Biotic communitiesandpopulations,theircharacteristicsanddynamics.Endemicand endangered species of plants in India. Ecological niche, ecotypes, ecological indicators. *Conservation of Biodiversity:* Ex-situandin-situconservation,Reddatabook,botanicalgardens,Nationalpark, Sanctuaries, hot & hottest spots and Bioreserves. Role of Seed Bank and Gene Bank Valuingplantresources,ecotourism,RoleofNBPGR,FAO,BSI.	**7**
V	**Phytogeography:** BiogeographicregionsofIndia&world,Agroecological&FloristiczonesofIndia. NaturalvegetationofIndia,staticanddynamicplantgeography,basicprinciples governinggeographicaldistributionofplants,PhytogeographicalregionsofIndia, Vegetational types in Uttar Pradesh.	**7**
VI	**Environmentalaudit&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,approachesandinitiativestowardsSustainability;Sustainable developmentinpractice.	**8**
VII	**Pollution,Wastemanagement&CircularEconomy** 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,biotricklingfilters;regulatoryframeworkforpollutionmonitoring 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,collectionandsegregation,Incineration,Pyrolysisand gasification, Sanitarylandfilling ; composting, Biogas production ,Circular Economy &sustainability.	**8**
VIII	**Environmentalethics,CarbonCredits&Roleof GIS** Carbon credit: concept, exchange of carbon credits. Carbonsequestration,importance,meaningandways. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wastelandreclamation.Consumerismandwasteproducts. Clean development mechanism. Geographical Information Systems: definitions and components; spatial and non-spatial data; GIS software packages; GPS survey, data import, processing, and mapping. ApplicationsandcasestudiesofremotesensingandGISinlanduseplanning,forest resources&agriculturestudies.	**8**

SuggestedReadings:

CourseBooks publishedin Hindimaybeprescribed bytheUniversities.

1. EnvironmentalStudies(Hindi)ISBN81-301-0004-5B.L.Chaudhary&JitendraPandeyEdition:2013Pages: 340 + XII Apex Publishing House
2. SoilandWaterConservationISBN#: 978-81-301-0071-5S.C.Mahnot&P.K.SinghApexPublishing
3. House
4. EcologyAndEnvironmentalBiology(□□□□□□□□□□□□□□□□ □□□□□□□□□ □□□□□□□)byRBD Publisher Author: Bhatia - Jain - Kohli - Shrivastava - Singh – Verma
5. □□□:□□□□□□□□□□□□□□□□□□□□□□□□: □□□□□□□□□□□□□□□□□□□□□□
6. ParyavaranEvamParisthitiki5e(Hindi)Paperback–20February2020MajidHusain
7. Environmental Biology and Phytogeography ISBN #:978-81-301-0064-7B.L.Chaudhary,Gotam KKukda & Jitendra Kumar Joshi
8. Ugc Unified: Environmental Sciences (hindi) (pb) ISBN: 9788177545814 Edition : 01Year : 2015Author : Dr. Purohit SS , Dr. Deo PP , Dr. Agrawal Ashok KPublisher : Agrobios (India)

1. ChapmanandRiss.Ecology:PrinciplesandApplications,LatestEd.,CambridgeUniversityPress
2. Shukla,R.S.&Chandel,P.S.PlantEcology,LatestEd.,S.ChandelandCo.
3. Kumar,H.D.ModernConceptofEcology,LatestEd.VikasPublishingHouse
4. Begon,M.,Herper,J.L.andTownsend,C.R.Ecology-Individuals,PopulationsandCommunities(3rd ed.),OxfordBlackwellScience
5. Verma,P.S.&Agarwal,U.K.ConceptofEcology,LatestEd.,S.Chand&Company

6. Odum,F.P.FundamentalsofEcology,LatestEd.,Saunders
7. Sharma,P.D.ElementsofEcology,LatestEd.,RastogiPublications
8. Ambasht,R.S.&Ambasht,N.K.ATextBookofPlantEcology,LatestEd.,CBSPublication&Distributors
9. Mani,M.S.Bio-GeographyofIndia,LatestEd.,Springer-Verlag.
10. Mackenzieetal.Ecology,LatestEd.,VivaBooks.
11. Gurevitch,J.(etal.).,TheEcologyofplants,2002,SinauerAssociates.
12. Kimar,U.&Asija,M.J.Bio-diversity:Principles&Conservation,2005,StudentEdition,Agrobios(India)
13. Krishnamurthy,K.V.AnAdvancedTextBookonBiodiversity,2003,Oxford&IBHPublishingCo.Ltd.
14. Mitra,D.,Guha,J.K.,Chowdhury,S.K.StudiesinBotany,Vol.II(7thed.)MoulikLibrary.
15. Primack,R.B.EssentialsofConservationBiology,1993,SinauerAssociates.
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.2014.3rdEd.SinauerAssociates
18. Vasudevan,N.(2006).EssentialsofEnvironmentalScience.NarosaPublishingHouse,NewDelhi.
19. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. AnamayaPublications, New Delhi.
20. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
21. Abbasi,S.A.(1998).EnvironmentalPollutionanditsControl.CogentInternational,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. andTchobanoglaus, G. (1985). Environmental Engineering, Mc Graw Hill BookCompany, Singapore.
24. Rand,M.C.,Greenberg, A.E.andTaras,M.J.(Ed.)(1995).Standardmethodsfortheexaminationofwaterand wastewater: 19th edition, American Public Health association (APHA), Washington, D.C.
25. Scragg,A.(1999).EnvironmentalBiotechnology,AddisonWesleyLongman,Singapore.
26. Tchobanoglaus,G.(1988). WastewaterEngineering: Treatment,Disposal,Reuse.Tata McGraw Hill, New Delhi.
27. Aarve,V.P.,William,A.W.andDebra,R.R.(2002).Solidwasteengineering.Cengagereading,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.andFrank,K.(2002).Handbookofsolidwastemanagement:(Secondedition).McGrawHills.
30. Kanthi,L.S.(2000).BasicsofSolidsandhazardouswastemanagementTechnologies.PrenticeHall.
31. Anonymous.1997.NationalGeneBank:IndianHeritageonPlantGeneticResources(Booklet).NationalBureau of Plant Genetic Resources, New York.
32. Gillespie,A.2006.ClimateChange,OzoneDepletionandAirPollution:LegalCommentaries
33. withPolicyandScienceConsiderations.MartinusNijhoffPublishers.
34. Hardy,J.T.2003.ClimateChange:Causes,EffectsandSolutions.JohnWiley&Sons.
35. Harvey,D.2000.ClimateandGlobalClimateChange.PrenticeHall.
36. Manahan,S.E.2010.EnvironmentalChemistry.CRCPress,TaylorandFrancisGroup.
37. Maslin,M.2014.ClimateChange:AVeryShortIntroduction.OxfordPublications.
38. Mathez,E.A.2009.ClimateChange:TheScienceofGlobalWarmingandourEnergyFuture.ColumbiaUniversity Press.
39. Mitra,A.P.,Sharma,S.,Bhattacharya,S.,Garg,A.,Devotta,S.&Sen,K.2004.ClimateChangeandIndia. Universities Press, India.
40. Philander,S.G.2012.EncyclopediaofGlobalWarmingandClimateChange(2ndedition).SagePublications.
41. .Demers,M.N.2005.FundamentalsofGeographicInformationSystem.Wiley&Sons.
42. Richards,J.A.&Jia,X.1999.RemoteSensingandDigitalImageProcessing.Springer.
43. Sabins,F.F.1996.RemoteSensing:PrinciplesanInterpretation.W.H.Freeman.
44. Gaston,KJ.&Spicer,J.I.1998.Biodiversity:AnIntroduction.BlackwellScience,London,
45. Singh,J.S.&Singh,S.P.1987.ForestvegetationoftheHimalaya.TheBotanicalReview53:80-192.
46. Sodhi,N.S.&Ehrlich,P.R.(Eds).2010.ConservationBiologyforAll.OxfordUniversityPress.
47. Sodhi, N.S., Gibson, L. & Raven, P.H. 2013. Conservation Biology: Voices from the Tropics. Wiley-Blackwell, Oxford, UK.

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:Opentoallbutspecial for B.Sc.Biotech,B.Sc.Microbiology,B.Sc.Agriculture,B.A.(Curators),B.A.Archaeology,B.A.Geology

SuggestedContinuousEvaluationMethods:
ContinuousInternalEvaluationshallbebasedonallottedAssignmentandClassTests.Themarksshallbeasfollows:

InternalAssessment	Marks
ClassInteraction	**5**
Quiz	**5**
Seminar	**7**
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	**8**
	25

Courseprerequisites:
Qualification: Tostudythiscourse,astudentmusthavequalified10+2withBiology/NSQFlevel3fromSectorSkill Councils/DiplomaholderfromITIin(Biology/Agriculture/Biotech/Forestry/Microbiology/Gardening/biomedical Science.
Facilities:SmartandInteractiveClass
OtherRequisites:Videocollection,Books,CDs,AccesstoOn-lineresources,DisplayCharts

Suggestedequivalentonlinecourses:
https://community.plantae.org/tags/mooc
uturelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
https://www.coursera.org/courses?query=plantshttp://egyankosh.ac.in/handle/123456789/5353
0

Programme/Class:*BachelorofScience*	Year:**III**	Semester:**VI** **Paper-III**
Subject:**Botany**		
CourseCode:B040603P	CourseTitle:**LabonCytogenetics,Conservation& Environmentmanagement**	

Courseoutcomes: Afterthecompletionofthecoursethestudentswillbeable:

1. Toperformallexperimentsrelatedtothesemester-i.e.Planttissueculturedplants,conductingbreedingon field, conserving and depolluting the environment.
2. Canbeemployedinenvironmentimpactassessmentcompanies&starthisownventure

Credits:**2**	**CoreCompulsory**
Max.Marks:**25+75**	Min.PassingMarks:
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):0-**0**-**2**	

Unit	Topic	No. of Lectures(60hrs)
I	**Cellbiology** 1. Studyofplantcellstructurewiththehelpofepidermalpealmountof Onion/Rhoeo/Crinum 2. Measurementofcellsizebythetechniqueof micrometry. 3. Countingcellsperunitvolumewiththehelpofhaemocytometer (Yeast/pollen grains) 4. Determinationofmitoticindexandfrequencyofdifferentmitoticstages in pre-fixed root tips of Allium cepa.	**7**
II	**Genetics** 1. Monohybridcross(Dominanceandincompletedominance) 2. Dihybridcross(Dominanceandincompletedominance) 3. Geneinteractions(Alltypesofgeneinteractionsmentionedinthe syllabus) a. Recessiveepistasis9:3:1. b. Dominantepistasis12:3:I c. Complementarygenes9:7 d. Duplicategeneswithcumulativeeffect9:6:1 e. Inhibitorygenes13:3 4. Observethegeneticvariationsamonginterandintraspecificplants. 5.DemonstrationofBreedingtechniques-Hybridization,casestudiesof 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.Calculationofcorrelationcoefficientvaluesandfindingouttheprobability. 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. Computerapplicationinbiostatistics -MSExcelandSPSS	**7**
IV	**Planttissueculture** 1.Familiarizationofinstrumentsandspecialequipmentsusedintheplant tissue culture experiments 2.Preparationofplanttissueculturemedium,andsterilization,Preparationof stock solutions of nutrients for MS Media. 3.Surfacesterilizationofplantmaterialsforinoculation(implantationinthe medium) 4.Micropropagationofpotato/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. Studyofbioticinteractionsof:Stemparasite(Cuscuta),Rootparasite (Orobanche) Epiphytes, Predation (Insectivorous plants). 4. Observationandstudyofdifferentecosystemsmentionedinthe syllabus. 5. Fieldvisittofamiliarizestudentswithecologyofdifferentsites	**8**

VI	**SoilFormation,Properties& Conservation** 1. Determination of pH of various soil and watersamples (pH meter, universal indicator/Lovibond comparator and pH paper) 2. Analysisforcarbonates,chlorides,nitrates,sulphates,organicmatter and base deficiency from two soil samples by rapid field tests. 3. DeterminationoforganicmatterofdifferentsoilsamplesbyWalkley & Black rapid titration method. 4. SoilProfilestudy 5. SoiltypesofIndia-Map	**8**
VII	**BiodiversityandPhytogeography:** 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. MarkingofvegetationtypesofIndia,World&UttarPradeshonmaps	**7**
	3.PhytogeographicalareasofIndia	
VIII	Pollution&Wastemanagement 1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter 2. Estimationofchlorideanddissolvedoxygencontentinwater sample 3. Comparative anatomical studies of leaves form polluted and less polluted areas. 4. MeasurementofdissolvedO2byazidemodificationofWinkler'smethod. 5. Determinationofdissolvedoxygenofwatersamplesfrompollutedand unpolluted sources. 6. MicrobiologicalassessmentofdrinkingwaterusingMPNtechnique-water from well, river, water supply department and packaged drinking water 7. Makingkitchenwastefromcompost/vermicompostbyEnzymes/Bio decomposer/ Whey with dung. **ClimateChange,CarbonCredits&RoleofGIS** 1. ConductingWasteAuditofyourInstitution -Demo 2. GreenauditingoftheCollege/University-Demo	**7**

SuggestedReadings:asinpapersabove:

CourseBooks publishedin Hindimaybe prescribed bytheUniversities.

1. PracticalBotany(PartIII)Author:SunilDPurohit,AnamikaSinghvi&KiranTak2013Apex Publishing House,Raj.
2. PracticalBotany(PartII)Author: N.C.Aery, SunilDPurohit &GotamKKukda2013Apex Publishing House,Raj.
3. □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□3□□□□□□□□□□□□□□□□ □□
4. AHandbookOfSoil,FertilizerAndManure(2ndEd.)(pb)ISBN:9788177544152Edition: 02Year : 2017Author : Gupta PKPublisher : Agrobios (India)
5. GreenTechnology:AnApproachForSustainableEnvironmentISBN:9788177543438Edition: 01Year : 2021Author : Dr. Purohit SSPublisher : Agrobios (India)
6. LaboratoryManualOfChemicalAndBacterialAnalysisOfWaterAndSewageISBN: 9788177540802Edition:01Year:2011Author:TherouxFR,EldridgeEF,Mallmann WLPublisher : Agrobios (India)
7. Methods In Environmental Analysis: Water Soil And Air (2nd Ed.) ISBN : 9788177543087Edition:02Year:2021Author:GuptaPKPublisher:Agrobios(India)
8. WaterTreatmentAndPurificationTechnologyISBN:9788177540024Edition:01Year: 2009Author : Ryan WJPublisher : Agrobios (India

http://vidyamitra.inflibnet.ac.in/index.php/home/subjects?domain=Life+Science&subdomain=Botanyhttp://heecontent.upsdc.gov.in/Home.aspx
(http://epathshala.nic.in/,http://epathshala.gov.in/)

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:
Open to all but special forB.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.Sc.FoodScience, B.A.(Curators), B.A. Geology.

SuggestedContinuousEvaluationMethods: ContinuousInternalEvaluationshallbebasedonallottedAssignment and Class Tests. The marks shall be as follows:

InternalAssessment	Marks
ClassInteraction	**5**
Quiz	**5**
Seminar	**7**
Assignment(Charts/Flora/RuralService/TechnologyDissemination)	**8**
	25

Coursepre-requisites:

Qualification: Tostudythiscourse,astudentmusthavequalified10+2with Biology/NSQFlevel3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ Math/Statistics/Chemistry/ Computer Science)
Facilities:SmartandInteractiveClass
OtherRequisites:Videocollection,Books,CDs,AccesstoOn-lineresources,DisplayCharts Lab requisites: Biotech instruments, environmental lab instruments.

Suggestedequivalentonlinecourses:
https://www.cytology-iac.org/educational-resources/virtual-slide-libraryhttps://www.asct.com/ASCTWeb/Content/Cytopreparation_Online_Course.aspxhttps://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/

FurtherSuggestions:AccesstoStatistics,Chemistry,MathandBiotechnologyresourceswillbe required

Programme/Class:**BachelorofScience**	Year:**III**	Semester:**VI/Project- II/ Paper-IV**
Subject:**BOTANY**		
CourseCode:-B040604R	CourseTitle:**ProjectinBotanyforGraduation**	

Courseoutcomes:
Aftercompletingthiscourseastudentwill have:

- Projectworkwillsupplementfieldexperimentallearninganddeviationsfromclassroomandlaboratory transactions.
- projectwork willenhancethecapabilitytoapplygainedknowledgeandunderstandingfor selecting,solvingand decision-making processes
- Itwillpromotecreativityandthespiritofenquiryinlearners.
- TheywilllearntoconsultScientists,libraries,laboratoriesandherbariumsandlearnimportanceofdiscussions, Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation in form of dissertation writing
- Itwillenhancetheirabilities,enthusiasm,andinterest.

Credits:**03**	Core:**Compulsory**
Max.Marks:**25+75**	Min.PassingMarks:**……**

TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):**0-0-3**.

SUGGESTIVELISTOFPROJECTS

Preparebedsforgrowingnurseryforherbs,shrubsandtrees.
Develop Green house facility in college and grow plants
Develop hydroponics facility in college and grow plants.
Developbotanicalgardeninthecollegewithlabelling Vertical gardens, roof gardens.
Culture&artofmakingbonsai.
ComputerAidedDesigning(CAD)foroutdoorandindoorscapingExposuretoCAD(Computer Aided Designing)
PhytochemicalAnalysisofMedicinalplants Bio composting and Vermicomposting.
PerformingAromatherapybyessentialOils

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

Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:
Thiscoursecanbeoptedasanelectivebythestudentsoffollowingsubjects:Opentoall

SuggestedContinuousEvaluationMethods:

InternalAssessment	Marks
ClassInteraction	**5**
Seminar	**10**
Thesis/dissertation	**10**
	25

Courseprerequisites:
Qualification: Tostudythiscourse,astudentmusthavequalified10+2withBiology/NSQFlevel3from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.
Facilities: SmartandInteractiveClass
OtherRequisites: Alllistedunderallpapersofthecourse.

Suggestedequivalentonlinecourses:
https://ndl.iitkgp.ac.in/***http://heecontent.upsdc.gov.in/Home.aspx(http://epathshala.nic.in/,http://epathshala.gov.in/)****nptel.iitm.ac.in*
https://asiafoundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiwA-hX5J-QhBITSyPnvj3r8yeio-L9f5uTy1a6oEoALCLa9Ebu0pyz858yQZxoC5wkQAvD_BwEhttp://www.dli.ernet.in/,http://www.ulib.org/
http://www.tkdl.res.in/,http://www.vigyanprasar.gov.in/digilib
DirectoryofOpenAccessRepositories(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