**SHAILABALA WOMEN'S AUTONOMOUS COLLEGE, CUTTACK**

# STATEMODELSYLLABUSFORUNDERGRADUATECOURSEINBOTANY

# (BachelorofScienceExamination)

**2023-24 Batch onwards**

## UNDER CHOICEBASEDCREDITSYSTEM

MAPPING OF
COURSES WITH EMPLOYABILITY/ENTREPRENEURSHIP/SKILL DEVELOPMENT

Mapping Colour Index:

- Employability
- Entrepreneurship
- Skill Development
- Employability, Skill Development
- Employability,Entrepreneurship, Skill Development

| CourseStructureofU.G.BotanyHonours | | | | |
|---|---|---|---|---|
| **Semester** | **Course** | **CourseName** | **Credit** | **Total marks** |
| Semester-I | AECC-I | | 4 | 100 |
| | C-1(Theory) | Microbiologyand Phycology | 4 | 75 |
| | C-1(Practical) | Microbiologyand Phycology | 2 | 25 |
| | C-2(Theory) | BiomoleculesandCellBiology | 4 | 75 |
| | C-2(Practical) | BiomoleculesandCellBiology | 2 | 25 |
| | GE-1A(Theory) | Biodiversity(Microbes, Algae,Fungi&Archegoniate) | 4 | 75 |
| | GE-1A(Practical) | Biodiversity(Microbes, Algae,Fungi& Archegoniate) | 2 | 25 |
| Semester-II | AECC-II | | 4 | 100 |
| | C-3(Theory) | Mycologyand Phytopathology | 4 | 75 |
| | C-3(Practical) | MycologyandPhytopathology | 2 | 25 |
| | C-4(Theory) | Archegoniate | 4 | 75 |
| | C-4(Practical) | Archegoniate | 2 | 25 |
| Semester-III | C-5(Theory) | AnatomyofAngiosperms | 4 | 75 |
| | C-5(Practical) | AnatomyofAngiosperms | 2 | 25 |
| | C-6(Theory) | EconomicBotany | 4 | 75 |
| | C-6(Practical) | EconomicBotany | 2 | 25 |
| | C-7(Theory) | Genetics | 4 | 75 |
| | C-7(Practical) | Genetics | 2 | 25 |
| | SEC-1 | | 4 | 100 |
| | GE-1B(Theory) | PlantEcology&Taxonomy | 4 | 75 |
| | GE-1B(Practical) | PlantEcology&Taxonomy | 2 | 25 |
| Semester-IV | C-8(Theory) | MolecularBiology | 4 | 75 |
| | C-8(Practical) | MolecularBiology | 2 | 25 |
| | C-9(Theory) | PlantEcology&Phytogeography | 4 | 75 |

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|---|---|---|---|---|
| | C-9(Practical) | PlantEcology&Phytogeography | 2 | 25 |
| | C-10(Theory) | PlantSystematics | 4 | 75 |
| | C-10(Practical) | PlantSystematics | 2 | 25 |
| | SECII | | 4 | 100 |
| Semester-V | C-11(Theory) | ReproductiveBiologyofAngiosperms | 4 | 75 |
| | C-11(Practical) | ReproductiveBiologyofAngiosperms | 2 | 25 |
| | C-12(Theory) | PlantPhysiology | 4 | 75 |
| | C-12(Practical) | PlantPhysiology | 2 | 25 |
| | DSE-1(Theory) | AnalyticalTechniquesinPlantsSciences | 4 | 75 |
| | DSE-1(Practical) | AnalyticalTechniquesinPlantsSciences | 2 | 25 |
| | DSE-2(Theory) | NaturalResource Management | 4 | 75 |
| | DSE-2(Practical) | NaturalResource Management | 2 | 25 |
| Semester-VI | C-13(Theory) | PlantMetabolism | 4 | 75 |
| | C-13(Practical) | PlantMetabolism | 2 | 25 |
| | C-14(Theory) | PlantBiotechnology | 4 | 75 |
| | C-14(Practical) | PlantBiotechnology | 2 | 25 |
| | DSE-3(Theory) | HorticulturePractices&PostHarvest Technology | 4 | 75 |
| | DSE-3(Practical) | HorticulturePractices&PostHarvestTechnology | 2 | 25 |
| | DSE- 4 Project work | Project Work/ Industrial Management | 6 | 100 |
| | | Total | **130** | **2000** |

## BOTANY

HONOURSPAPERS:

Corecourse–14papers
DisciplineSpecificElective–4papers
GenericElectiveforNonBotanystudents–
4papers.IncaseUniversityoffers2subjectsasGE,thenpapers1and2willbetheGEpaper.

Marksperpaper-Midterm:15marks,Endterm:60marks(Theory)+25marks(Practical),Total–
100marks
Creditperpaper–6
Teachinghoursperpaper–40hours(theory)+10hours(practical)

### CorePaperI

### MICROBIOLOGYANDPHYCOLOGY

**Unit-I**

Introductiontomicrobialworld,microbialnutrition,growthandmetabolism.**Viruses:-** Discovery,physiochemicalandbiologicalcharacteristics;classification(Baltimore),generalstructurewithspecialreferencetoviroidandprions;replication(generalaccount),DNAvirus(T-phage),lyticandlysogeniccycle;RNAvirus(TMV).Economicimportanceofviruseswithreferencetovaccineproduction,roleinresearch,medicineanddiagnostics,ascausalorganismsofplantdiseases.

**Unit–II**

**(i)Bacteria:-**Discovery,generalcharacteristics,types-archaebacteria,eubacteria,wall-lessforms(mycoplasmaandspheroplasts),cellstructure,nutritionaltypes,reproduction-vegetative, asexual and recombination (conjugation,transformationandtransduction).Economicimportanceofbacteriawithreferencetotheirroleinagricultureandindustry(fermentationandmedicine).

**(ii)Cyanobacteria:-**
Ecologyandoccurrence,cellstructure,heterocyst,reproduction,economicimportance;roleinbiotechnology.Morphologyandlife-cycleofNostoc.Generalcharacteristicsofprochlorophyceae,Evolutionarysignificanceof Prochloron.

**Unit–III**

**(i)Algae:-**
Generalcharacteristics;Ecologyanddistribution;rangeofthallusorganization;Cellstructureandcomponents;cellwall,pigmentsystem,reservefood(ofonlygroupsrepresentedinthesyllabus),flagella;andmethodsofreproduction,classification;criteria,systemofFritsch,Roleofalgaeintheenvironment,agriculture,biotechnologyandindustry.

**(ii)Chlorophyta:-**
Generalcharacteristics,occurrence,rangeofthallusorganization,cellstructureandreproduction.Morphologyandlife-cyclesofVolvox,Oedogonium and Coleochaete.

**Unit-IV**

**(i)Charophyta:-**Generalcharacteristics;occurrence,morphology,cellstructureandlife-cycleofChara;evolutionarysignificance.

**(ii)Xanthophyta:-**Generalcharacteristics;Occurrence,morphologyandlife-cycleofVaucheria.

**(iii)Phaeophyta:-**Characteristics, occurrence, cell structure and reproduction.Morphologyandlife-cyclesofEctocarpus.

**(iv)Rhodophyta:-**Generalcharacteristics, occurrence,cell structure and**(v)**reproduction.Morphologyandlife-cycleofPolysiphonia.

**PRACTICAL**

**Microbiology**

**(i)**Electronmicrographs/Modelsofviruses–T-PhageandTMV,Linedrawings/PhotographsofLyticandLysogenicCycle.

**(ii)**TypesofBacteriatobeobservedfromtemporary/permanentslides/photographs.**(iii)**Examinationofbacteriafromnaturalhabitat(curd)bysimplestaining

**(iv)** Electronmicrographsofbacteria,binaryfission,endospore,conjugation,rootNodule(live materialsandphotographs).

**(v)**Gramstaining.

**Phycology**

StudyofvegetativeandreproductivestructuresofNostoc,Volvox,Oedogonium,Coleochaete,Chara,Vaucheria,Ectocarpus,andPolysiphonia,Procholoron,Diatomsthroughelectronmicrographs,temporarypreparationsandpermanentslides(basedonavailabilityofmaterials).

**TextBooks:**

1.Singh,PandeyandJain(2017).MicrobiologyandPhycology,RastogiPublication,Meerut.

**ReferenceBooks:**

1.Lee,R.E.(2008).Phycology,CambridgeUniversityPress,Cambridge.4thedition.

2.Prescott,L.M.,HarleyJ.P.,KleinD.A.(2010).Microbiology,McGraw-Hill,India.8thedition.

3.Kumar,H.D.(1999).IntroductoryPhycology.AffiliatedEast-WestPress,Delhi.

4.Campbell,N.A.,ReeceJ.B.,UrryL.A.,CainM.L.,WassermanS.A.MinorskyP.V.,JacksonR.B.(2008).Biology,PearsonBenjaminCummings,USA.8thedition.

5.Pelczaretal.(2011)Microbiology,8thedition,TataMcGraw-HillCo,NewDelhi.

6.Willey,SherwoodandChristopher.LaboratoryexercisesinMicrobiology.McGraw-Hill,India.9thedition.

7.P.R.Vasista(2017)BotanyforDegreestudent,Algae,S.ChandPublication,NewDelhi.

8.B.K.Mishra(2018)MicrobiologyandPhycology,KalynaiPublishers,NewDelhi.

**CorePaperII**

**BIOMOLECULESANDCELLBIOLOGY**

**Unit-I**

(i)BiomoleculesandBioenergenetics:Typesandsignificanceofchemicalbonds;Structureandpropertiesofwater;pHandbuffers.Lawsofthermodynamics,conceptoffreeenergy,endergonicandexergonicreactions,coupledreactions,redoxreactions.

(ii)Enzymes:Structureofenzyme:holoenzyme,apoenzyme,cofactors,coenzymesandprosthe ticgroup;Classificationofenzymes;Featuresofactivesite,substratespecificity,mechanis mofaction(activationenergy,lockandkeyhypothesis,induced-fittheory),Michaelis–Mentenequation,enzymeinhibitionandfactorsaffectingenzymeactivity.

(iii)Carbohydrates:Nomenclature,classificationandfunctionofMonosaccharides;Disaccharides,OligosaccharidesandPolysaccharides

**Unit–II**

(i) Proteins:Structureofaminoacids;Peptidebonds;Levelsofproteinstructure-primary,secondary,tertiaryandquarternary;Isoelectricpoint;Proteindenaturationandbiologicalrolesofproteins.

(ii) Nucleicacids:Structureofnitrogenousbases;Structureandfunctionofnucleotides;TypesofnucleicacidsStructureofA,B,ZtypesofDNA;TypesofRNA;StructureoftRNA

(iii) Lipids:Definitionandmajorclassesofstorageandstructurallipids.Fattyacidsstructureandfunctions.Essentialfattyacids.Triacylglycerolsstructure,functionsandproperties.

**Unit–III**

(i)Thecell:Cellasaunitofstructureandfunction;Characteristicsofprokaryoticandeukaryoticcells;Originofeukaryoticcell(Endosymbiotictheory).

(ii)Celldivision:Eukaryoticcellcycle,stagesofmitosisandmeiosis.Regulationofcellcycle.

(iii)Cellwallandplasmamembrane:Chemistry,structureandfunctionofPlantCellWall.Overview ofmembranefunction;fluidmosaicmodel;Chemicalcompositionofmembranes;Membranetransport–Passive,activeandfacilitatedtransport,endocytosisandexocytosis.

**Unit-IV**

(i)Cell organelles: Nucleus;Structure-nuclear envelope,nuclearporecomplex,nuclearlamina,molecularorganizationofchromatin;nucleolus.

(ii)Cytoskeleton:Roleandstructureofmicrotubules,microfilamentsandintermediaryfilament.

(iii)Chloroplast,mitochondriaandperoxisomes:Structuralorganization;Function;Semiautonomousnatureofmitochondriaandchloroplast.Structure and function: EndoplasmicReticulum,GolgiApparatus,Lysosomes,

## PRACTICAL

(i)Qualitativetestsforcarbohydrates,reducingsugars,non-reducingsugars,lipidsandproteins.

(ii)Studyofplantcellstructurewiththehelpofepidermalpeelmountof Onion/*Rhoeo*(iii)DemonstrationofthephenomenonofprotoplasmicstreaminginHydrillaleaf.

(iv)Countingthecellsperunitvolumewiththehelpofhaemocytometer.(Yeast/pollengrains).

(v)Studythephenomenonofplasmolysisanddeplasmolysis.

(vi)Studydifferentstagesofmitosisandmeiosisusingacetocarmineandacetoorcinemethod.

**TextBooks:**


1. V.B.Rastogi(2016).IntroductoryCytology,KedarNath&RamNath,Meerut
2. P.K.Gupta(2017).BiomoleculesandCellBiology,RastogiPublication,Meerut.


**ReferenceBooks:**


1. K.Sahoo(2017)BiomoleculesandCellBiology,KalynaiPublishers,NewDelhi.
2. TymoczkoJL,BergJMandStryerL(2012)Biochemistry:Ashortcourse,2nded.,W.H.Freeman
3. NelsonDLandCoxMM(2008)LehningerPrinciplesofBiochemistry,5thEdition.,W.H.FreemanandCompany.
4. Cooper,G.M.andHausman,R.E.2009TheCell:AMolecularApproach.5thedition.ASMPress&Sunderland,Washington,D.C.;SinauerAssociates,MA.
5. Becker,W.M.,Kleinsmith,L.J.,Hardin.J.andBertoni,G.P.2009TheWorldoftheCell.7th edition.PearsonBenjaminCummingsPublishing,SanFrancisco


## CorePaperIII

### MYCOLOGYANDPHYTOPATHOLOGYU

**Unit-I**

(i)Introductiontotruefungi:Definition,Generalcharacteristics;Affinitieswithplantsandanimals;Thallusorganization;Cellwallcomposition;Nutrition;Classification.

(ii)Zygomycota:Generalcharacteristics;Ecology;Thallusorganisation;Lifecyclewithreferencetо*Rhizopus*.

(iii)Ascomycota:Generalcharacteristics(asexualandsexualfruitingbodies);Ecology;Heterokaryosisandparasexuality;lifecycleandclassificationwithreferenceto*Saccharomyces,Penicillium.*

(iv)Basidiomycota:Generalcharacteristics;EcologyandClassification;Lifecycleof*Puccinia* and *Agaricus.*

**Unit-II**

(i)AlliedFungi:Generalcharacteristics;StatusofSlimemolds,Classification;Occurrence;Typesofplasmodia;Typesoffruitingbodies.

*(ii)*Oomycota:Generalcharacteristic;Ecology;Lifecycleandclassificationwithreferenceto*Phytophthora.*

(iii)Symbioticassociations:Lichen–Occurrence;Generalcharacteristics;Growthformsandrangeofthallusorganization;Natureofassociationsofalgalandfungalpartners;Reproduction.Mycorrhiza-Ectomycorrhiza,Endomycorrhizaandtheirsignificance.

**Unit-III**

AppliedMycology:Roleoffungiinbiotechnology,Applicationoffungiinfoodindustry(Flavour&texture,Fermentation,Baking,Organicacids,Enzymes,Mycoproteins);Secondarymetabolites(Pharmaceuticalpreparations) Agriculture (Biofertilizers; Mycotoxins;Biologicalcontrol(Mycofungicides,Mycoherbicides,Mycoinsecticides,Myconematicides);Medicalmycology.Mushroomcultivation,

**Unit-IV**

Phytopathology:Termsandconcepts;Generalsymptoms;etiology;symptomology;Host-Pathogenrelationships;diseasecycleandenvironmentalrelation;preventionandcontrolofplantdiseases,androleofquarantine.Bacterialdiseases–Citruscankerandangularleafspotdiseaseof Cotton.Viraldiseases–TobaccoMosaicviruses,veinclearing.Fungaldiseases–Earlyblightofpotato,Looseandcoveredsmut.

**PRACTICAL**

(i)Introductiontotheworldoffungi(Unicellular,coenocytic/septatemycelium,asocarps&basidiocarps).

(ii)*Rhizopus*:studyofasexualstagefromtemporarymountsandsexualstructuresthroughpermanentslides.

(iii)*Penicillium*:studyofasexualstagefromtemporarymounts.StudyofSexualstagefrompermanentslides/photographs.

(iv)*Agaricus*:Specimensofbuttonstageandfullgrownmushroom;sectioningofgillsof*Agaricus*,andfairyringsaretobeshown.

(v) *Albugo:* Study of symptoms of plants infected with *Albugo*; asexual phase study through section/temporary mounts and sexual structures through permanent slides.

(vi) Phytopathology:Herbariumspecimensofbacterialdiseases;CitrusCanker;Viraldiseases: Mosaicdiseaseofladies'finger,papaya,cucurbits,moong,blackgram,Fungaldiseases:Blastofrice,Tikkadiseaseofgroundnut,powderymildewoflocallyavailableplantsandWhiterustofcrucifers.

**TextBooks:**

1.B.K.Mishra(2017),MycologyandPhytopathology,KalynaiPublishers,NewDelhi.

**ReferenceBooks:**


1.Sharma,P.D.(2017).MycologyandPhytopathologyRastogiPublication,Meerut.2.Agrios, G.N.1997PlantPathology,4thedition,AcademicPress,U.K.

3.Alexopoulos,C.J.,Mims,C.W.,Blackwell,M.(1996).IntroductoryMycology,JohnWiley&Sons(Asia)Singapore.4thedition.

4.Webster,J.andWeber,R.(2007).IntroductiontoFungi,CambridgeUniversityPress,Cambridge.3rdedition.

5.Sethi,I.K.andWalia,S.K.(2011).TextbookofFungiandTheirAllies,MacmillanPublishersIndiaLtd.

6.Mehrotra,R.S.(2011).PlantPathology.TataMcGraw-HillPublishingCompanyLimited,New Delhi


**CorePaperIV**

**ARCHEGONIATE**

**Unit-I**

(i)Introduction:Unifyingfeaturesofarchegoniates;Transitiontolandhabit;Alternationofgenerations.Generalcharacteristics;OriginoflandplantsandAdaptationstolandhabit;

(ii)Bryophytes:OriginandClassification;Rangeofthallusorganization.Classification(uptofamily).Reproductionand evolutionarytrends in *Riccia*,*Marchantia*,*Funaria* (developmentalstagesnotincluded).Ecologicalandeconomicimportanceofbryophytes.

**Unit-II**

Pteridophytes:Generalcharacteristics,classification.Classification(uptofamily),morphology,anatomyandreproductionof*Selaginella*,*Equisetum* and *Marselia*Apogamy,andapospory,heterosporyandseedhabit,telometheory,stellarevolutionandeconomicimportance.

**Unit-III**

Gymnosperms:Generalcharacteristics,classification(uptofamily),morphology,anatomyandreproductionof*Cycas*,*Pinus*and*Gnetum*.(Developmentaldetailsnottobeincluded).Ecologicalandeconomicimportance.

**Unit-IV**

Palaeobotany:Geologicaltimescale,fossilsandfossilizationprocess.Morphology,anatomyandaffinitiesofRhynia, Lepidodendron,CycadeoideaandWilliamsonnia.

**PRACTICAL**

(i) Morphologyofthallusandanatomyof*Riccia*,*Marchantia*,*Funaria*

(ii) *Selaginella*-Morphology,wholemountofleafwithligule,transversesection of stem,wholemountofstrobilus,wholemountofmicrosporophyllandmegasporophyll

(temporaryslides),longitudinalsectionofstrobilus(permanentslide).

(iii) *Equisetum*-
Morphology,transversesectionofinternode,longitudinalsectionofstrobilus,transverse sectionofstrobilus,wholemountofsporangiophore,wholemountofspores(wetanddry)(t emporaryslide),transversesectionofrhizome(permanentslide).

(iv) Study of temporary preparations and permanent slides of*Marselia*

(v)Studyfrompermanentslidesof *Marselia*(L.S.ofsporocarp)and*Lycopodium*(L.S.ofstrobilus).

(vi)*Cycas*-
Morphology(coralloidroots,bulbil,leaf),wholemountofmicrosporophyllandmeghaspore,T.Sr oot,leaflet

*(vii)Pinus*-
Morphology(longanddwarfshoots,wholemountofdwarfshoot,maleandfemalecones),T.S.Nee dle,stem,L.S.malecone,wholemountofmicrosporophyll,wholemountofMicrospores(tempora ryslides),L.S.offemalecone

(viii)*Gnetum*-
Morphology(stem,male&femalecones),transversesectionofstem,verticalsectionofovule(per manentslide)

(ix)Studyofsomefossilslides/photographsaspertheory.(x)Bota nicalexcursion/studytour.

**TextBooks:**


**1.**P.R.Vasista(2017)BotanyforDegreestudent,Bryophyta,S.ChandPublication,NewDelhi.
2.Singh,PandeyandJain(2017).Archegoniate,RastogiPublication,Meerut.


**ReferenceBooks:**


1.B.S.Acharya(2017),Archegoniate,KalynaiPublishers,NewDelhi.
2.Vashistha,P.C.,Sinha,A.K.,Kumar,A.(2010).Pteridophyta.S.Chand.NewDelhi,India.
3.Bhatnagar,S.P.&Moitra,A.(1996).Gymnosperms.NewAgeInternational(P)LtdPublishers,Ne wDelhi,India.
4.Raven,P.H.,Johnson,G.B.,Losos,J.B.,Singer,S.R.(2005).Biology.TataMcGrawHill,Delhi.


**CorePaperV**

**ANATOMYOFANGIOSPERMSU**

**Unit-I**

(i)IntroductionandscopeofPlantAnatomy:Applicationsinsystematics,forensicsandpharmaco gnosy.

(ii)Tissues:Classification;Simpleandcomplextissues(nophylogeny);cyto-differentiationoftrachearyelementsandsieveelements;Pitsandplasmodesmata;Cellwallin growthsandtransfercells,encrustationandincrustation,Ergasticsubstances.

**Unit-II**

(i)Stem:Organizationofshootapex(Apicalcelltheory,Histogentheory,TunicaCorpustheory,continuingmeristematicresidue,cyto-histologicalzonation);Typesofvascularbundles; Anatomyofdicotandmonocotstem.VascularCambium:Structure,functionandseasonalactivityofcambium;secondarygrowthinstem(normalandanomalous).

(ii)Leaf:Anatomyofdicotandmonocotleaf,Kranzanatomy.

**Unit-III**

(i)Root:Organizationofrootapex(Apicalcelltheory,Histogentheory,Korper-Kappetheory);Quiescentcentre;Rootcap;Anatomyofdicotandmonocotroot;Endodermis, exodermisandoriginoflateralroot.Secondarygrowthinroots.

(ii)Wood:Axiallyandradiallyorientedelements;Typesofraysandaxialparenchyma;Cyclicaspectsandreactionwood;Sapwoodandheartwood;Ringanddiffuseporouswood;Earlyand latewood,tyloses;Dendrochronology.

(iii)Periderm:Developmentandcompositionofperiderm,rhytidomeandlenticels.

**Unit–IV**

(i)AdaptiveandProtectiveSystemsEpidermaltissuesystem,cuticle,epicuticularwaxes,trichomes(uni-andmulticellular,glandularandnonglandular:twoexamplesofeach),stomata(classification);Anatomicaladaptationsofxerophytesandhydrophytes.

(ii)SecretorySystem:Hydathodes,cavities,lithocystsandlaticifers.

**PRACTICAL**

1.Studyofdistributionandtypesofparenchyma,collenchymaandsclerenchyma,Xylem:Trachearyelements-tracheids,vesselelements;thickenings;perforationplates;xylemfibres,Phloem:Sievetubes-sieveplates;companioncells;phloemfibres.
2.Wood:ringporous;diffuseporous;tyloses;heart-andsapwood.
3.Epidermalsystem:celltypes,stomatatypes;trichomes:non-glandularand glandular.4.Root:monocot,dicot,secondarygrowth.
5.Stem:monocot,dicot-primaryandsecondarygrowth;periderm;lenticels.6.Leaf:isobilateral,dorsiventral,$C_4$leaves(Kranzanatomy).

**TextBooks:**

1.Singh,PandeyandJain(2017).AnatomyofAngiosperms,RastogiPublication,Meerut.

**ReferenceBooks:**

1.EamesandMcDaniels().Anintroductiontoplantanatomy,TataMcGrowHills,NewDelhi
2.Esau,K.(1977).AnatomyofSeedPlants.JohnWiley&Sons,Inc.,Delhi.3.M.S.Tayal(2012)RajpalandSons,NewDelhi
4.B.K.Mishra(2017).AnatomyofAngiosperms,KalynaiPublishers,NewDelhi.5.B.P.Pandey(2017)PlantAnatomy,S.ChandPublication,NewDelhi.

**CorePaperVI**

**ECONOMICBOTANY**

**Unit-I**

(i)OriginofCultivatedPlants:ConceptofCentresofOrigin,theirimportancewithreferencetoVavilov'swork.Plantintroductions;Cropdomesticationandlossofgeneticdiversity;evolutionofnewcrops/varieties,importanceofgermplasmdiversity.

(ii)Cereals: General account and CultivationofWheat,Rice,Millets

(iii)Legumes:Generalaccount,importancetomanandecosystem.

(iv) Sugars&Starches:Morphologyandprocessingofsugarcane,productsandby-productsofsugarcaneindustry.Potato–morphology,propagation&uses.

**Unit-II**

(i)Spices:Listingofimportantspices,theirfamilyandpartused,economicimportancewithspecialreferencetofennel,saffron,cloveandblackpepperBeverages:Tea,Coffee(morphology,processing&uses)

(ii)Drug-yieldingplants:Therapeuticandhabit-formingdrugswithspecialreferencetoCinchona,Digitalis,PapaverandCannabis.

(iii)Tobacco:Tobacco(Morphology,processing,usesandhealthhazards)

**Unit-III**

(i)Oils&Fats:Generaldescription,classification,extraction,theirusesandhealthimplications groundnut,coconut,linseedand*Brassica*(Botanicalname,family&uses)

(ii)EssentialOils:Generalaccount,extractionmethods,comparisonwithfattyoils&theiruses.

**Unit-IV**

(i)NaturalRubber:Para-rubber:tapping,processinganduses.

(v) Timberplants:Generalaccountwithspecialreferencetoteakandpine.Fibers:Classificationbasedontheoriginoffibers,CottonandJute(morphology,extractionanduses).

**PRACTICAL**

(i)Cereals:Rice(habitsketch,studyofpaddyandgrain,starchgrains).

(ii)Legumes:Soyabean/moongbean/blackgram,Groundnut,(habit,fruit,seedstructure,micro-chemicaltests).

(iii)Sugars&Starches:Sugarcane(habitsketch;canejuice-micro-chemicaltests),Potato(habitsketch,tubermorphology,T.S.tubertoshowlocalizationofstarchgrains,starchgrains,micro-chemicaltests).

(iv)SpiceandBeverages:clove,blackpepper,Tea(plantspecimen,tealeaves),Coffee(plantspecimen,beans).

(v)Oils&Fats:Groundnut,Mustard–plantspecimen,seeds;testsforfatsincrushedseeds.

*(vi)*Drug-yieldingplants:Specimensof*Digitalis*,*Papaver*and*Cannabis*.(vii)Woods:*Tectona*,*Pinus*/Sal:Specimen,Sectionofyoungstem

(viii)Fiber-yieldingplants:Cotton(specimen,wholemountofseedtoshowlintandfuzz;wholemountoffiberandtestforcellulose),Jute(specimen,transversesectionofstem,testforligninontransversesectionofstemandfiber).

**TextBooks:**

1.B.P.Pandey(2017)EconomicBotany.S.ChandPublication,NewDelhi.

**ReferenceBooks:**

1.Kochhar,S.L.(2012).EconomicBotanyinTropics,MacMillan&Co.NewDelhi,India.
2.SambaMurtyandSubrahmanyam(2011).TextBookofModernEconomicBotany,CBSPublishersandDistributors,NewDelhi.
3.Hill,AlbertF.EconomicBotany,TataMcGrowHillPublishingCompany,Ltd.NewDelhi.
4.Wickens,G.E.(2001).EconomicBotany:Principles&Practices.KluwerAcademicPublishers,TheNetherlands.
5.Singh,PandeyandJain(2017).EconomicBotany,RastogiPublication,Meerut.6.B.Baruah(2017).EconomicBotany,KalyaniPublishers,NewDelhi.

## CorePaperVII

## GENETICS

**Unit-I**

(i)Mendeliangenetics:
Mendelism:History;Principlesofinheritance;Chromosometheoryofinheritance;Autosomesandsexchromosomes;Incompletedominanceandcodominance;Multiplealleles,Lethalalleles,Epistasis,Pleiotropy,RecessiveandDominanttraits,Polygenicinheritance.

(ii)ExtrachromosomalInheritance:Chloroplastmutation:VariegationinFouro'clockplant;Mitochondrialmutationsinyeast;Maternaleffects-shellcoilinginsnail;Infectiveheredity-KappaparticlesinParamecium.

**Unit-II**

Linkage,crossingoverandchromosomemapping;
Cytologicalbasisofcrossingover;Recombinationfrequency,twofactorandthreefactorcrosses;Interferenceandcoincidence;Numericalsbasedongenemapping;SexLinkage.

**Unit-III**

(i)Variationinchromosomenumberandstructure:Deletion,Duplication,Inversion,Translocation,Positioneffect,EuploidyandAneuploidy

(ii)Genemutations:Typesofmutations;MolecularbasisofMutations;Mutagens–physicalandchemical(Baseanalogs,deaminating,alkylatingandintercalatingagents);Detectionofmutations:CIBmethod.RoleofTransposonsinmutation.DNArepairmechanisms.

**Unit-IV**

(i)Finestructureofgene:Classicalvs.molecularconceptsofgene;Cis-Transcomplementationtestforfunctionalallelism;StructureofPhageT4,rIILocus.

(ii)PopulationandEvolutionaryGenetics:Genepool,Allelefrequencies,Genotypefrequencies,Hardy-WeinbergLaw,roleofnaturalselection,mutation,geneticdrift.GeneticvariationandSpeciation.

**PRACTICAL**

1.Meiosisthroughtemporarysquashpreparation.
2.Mendel'slawsthroughseedratios.Laboratoryexercisesinprobabilityandchi-squareanalysis.
3.Chromosomemappingusingtestcrossdata.
4.Pedigreeanalysisfordominantandrecessiveautosomalandsexlinkedtraits.
5.Incompletedominanceandgeneinteractionthroughseedratios(9:7,9:6:1,13:3,15:1,12:3:1,9:3:4).
6.BloodTyping:ABOgroups&Rhfactor.
7.Chromosomeanomaly:TranslocationRing,LaggardsandInversionBridge,breaketc.

**TextBooks:**

**1.**B.D.Singh(2017).FundamentalofGenetics,KalyaniPublishers,NewDelhi.**2.**P.K.Gupta(2017).Genetics,RastogiPublication,Meerut.

**ReferenceBooks:**

1.Gardner,E.J.,Simmons,M.J.,Snustad,D.P.(1991).PrinciplesofGenetics,JohnWiley&Sons,India.8thedition.
2.Sinnot,DunnandDobzhansky(1985)PrinciplesofGenetics,TataMcGrowHill,NewDelhi
3.Klug,W.S.,Cummings,M.R.,Spencer,C.A.(2012).ConceptsofGenetics.BenjaminCummings,U.S.A.10thedition.
4.Griffiths,A.J.F.,Wessler,S.R.,Carroll,S.B.,Doebley,J.(2010).IntroductiontoGeneticAnalysis.W.H.FreemanandCo.,U.S.A.10thedition.
5.Strickberger,Monroe,W.Genetics,PearsonPublishers,3rdEdition6.V.B.Rastogi(2017).Genetics,KedarNath&RamNath,Meerut

**CorePaperVIII**

**MOLECULARBIOLOGY**

**Unit-I**

Nucleicacids:Carriersofgeneticinformation:Historicalperspective;DNAasthecarrierofgeneticinformation(Griffith's,Hershey&Chase,Avery,McLeod&McCarty),Typesofgeneticmaterial,denaturationandrenaturation.OrganizationofDNA- Nucleosomeconceptand Fraenkel-Conrat'sexperiment.OrganelleDNA-mitochondriaandchloroplastDNA.Chromatinstructure-Euchromatin,Heterochromatin-ConstitutiveandFacultativeheterochromatin.

**Unit-II**

(i)ThereplicationofDNA:ChemistryofDNAsynthesis(Kornberg'sdiscovery);Generalprinciples–bidirectional,semi-conservativeandsemidiscontinuousreplication,RNApriming;VariousmodelsofDNAreplication,replicationoflineards-DNA,replicationofthe5′endoflinearchromosome;EnzymesinvolvedinDNAreplication.

(ii)Centraldogmaandgeneticcode:Keyexperimentsestablishing-TheCentralDogma (Wobble Hypothesis),Geneticcode(deciphering&salientfeatures)

(iii)ProcessingandmodificationofRNA:Splitgenes-conceptofintronsandexons,splicingpathways of groupI&groupIIintron, Spliceosome mediated and alternative splicing;Ribozymes,exonshuffling;RNAeditingandmRNAtransport.

**Unit-III**

MechanismofTranscription:Transcriptioninprokaryotesandeukaryotes; Regulationoftranscriptioninprokaryotesandeukaryotes:Prokaryotes:Operonconcept-Regulationoflactosemetabolismandtryptophansynthesisin*E.coli*.Eukaryotes:transcriptionfactors,heatshockproteins,steroidsandpeptidehormones;Genesilencing

**Unit-IV**

Translation(Prokaryotesandeukaryotes):Ribosomestructureandassembly;ChargingoftRNA,aminoacyltRNAsynthetases;Variousstepsinproteinsynthesis,proteinsinvolvedininitiation,elongationandterminationofpolypeptides;Fidelityoftranslation;Inhibitorsofprotein synthesis;Post-translationalmodificationsofproteins.

**PRACTICAL**

1.PreparationofLBmediumandraisingE.coli.
2.IsolationofgenomicDNAfromE.coli./onionroots3.RNAestimationbyorcinolmethod.
4.DNAestimationbydiphenylaminereagent/UV Spectrophotometry.
5. Photographsestablishingnucleicacidasgeneticmaterial(MesselsonandStahl's,Averyetal,Griffith's,Hershey&Chase'sandFraenkel&Conrat's experiments)
6.StudyofBarrbodyfrombuccalsmearpreparation.

**TextBooks:**

1.P.K.Gupta(2017).MolecularBiology,RastogiPublication,Meerut.

**ReferenceBooks:**

1. WatsonJ.D.,Baker,T.A.,Bell,S.P.,Gann,A.,Levine,M.,Losick,R.(2007). MolecularBiologyoftheGene,PearsonBenjaminCummings,CSHLPress,NewYork, U.S.A.6thedition.
2. Snustad,D.P.andSimmons,M.J.(2010).PrinciplesofGenetics.JohnWileyandSonsInc.,U.S.A.5thedition.
3. Klug,W.S.,Cummings,M.R.,Spencer,C.A.(2009).ConceptsofGenetics.BenjaminCummings.U.S.A.9thedition.

4. SheelarandBianchi(2009)MolecularBiologyoftheCell,WilleyPublisher,NewDelhi
5. Griffiths,A.J.F.,Wessler,S.R.,Carroll,S.B.,Doebley,J.(2010).IntroductiontoGeneticAnalysis.W.H.FreemanandCo.,U.S.A.10thedition.
6. BruceAlbertsetal.2014.MolecularBiologyofthecellGarlandScience.6thEdition
7. C.B.Power(2017)CellBiology,HimalayaPublishingHouse,NewDelhi
8. AC.Sahu(2017).EssentialsofMolecularBiology,KalynaiPublishers,NewDelhi.

**CorePaperIX**

**PLANTECOLOGY&PHYTOGEOGRAPHY**

**Unit-I**

(i)IntroductionConceptofecology,Autoecology,Synecology,systemecology,Levelsoforganization.Inter-relationshipsbetweenthelivingworldandtheenvironment,thecomponentsofenvironment,conceptofhydrosphereandlithosphereanddynamism,homeostasis.

(ii)Light,temperature,windandfire:Variations;adaptationsofplantstotheirvariation.

**Unit-II**

(i)Soil:Formation;Composition;Physical;ChemicalandBiologicalcomponents;Soilprofile;Roleofclimateinsoildevelopment.

(ii)Water:Importance:Statesofwaterintheenvironment;Precipitationtypes;HydrologicalCycle;Waterinsoil;Watertable.

**Unit-III**

BioticinteractionsandPopulationecology:CharacteristicsandDynamics.

Plantcommunities:Conceptofecologicalamplitude;Habitatandniche;Characters:analyticalandsynthetic;Ecotoneandedgeeffect;Dynamics:succession–processes,types;climaxconcepts.

**Unit-IV**

(i)Ecosystems:Structure;Processes;Trophicorganisation;FoodchainsandFoodwebs;Ecologicalpyramids.

(ii)Functionalaspectsofecosystem:Principlesandmodelsofenergyflow;Productionandproductivity;Ecologicalefficiencies;Biogeochemicalcycles;CyclingofCarbon,Nitrogenand Phosphorus.

(iii)Phytogeography:Principles;Continentaldrift;Theoryoftolerance;Endemism;PhytogeographicaldivisionofIndia;LocalVegetation.

## PRACTICAL

1.DeterminationofpHofvarioussoilandwatersamples(pHmeter,universalindicator/Lovibond comparatorandpHpaper)
2.Analysisforcarbonates,chlorides,nitrates,sulphates,organicmatterandbasedeficiencyfromt wosoilsamplesbyrapidfield tests.
3.Determinationofdissolvedoxygenofwatersamplesfrompollutedandunpollutedsources.
4.Studyofmorphologicaladaptationsofhydrophytes,xerophytes,halophyles(twoeach).
5.Determinationofminimalquadratsizeforthestudyofherbaceousvegetationinthecollegecam pus,byspeciesareacurvemethod(speciestobelisted).
6.Quantitativeanalysisofherbaceousvegetationfordensityandabundanceinthecollegecampus.
7.Fieldvisittofamiliarizestudentswithecologyofdifferentsites.

**TextBooks:**

1.Sharma,P.D.(2017).FundamentalsofEcology.RastogiPublications,Meerut,India.

**ReferenceBooks:**

1.Odum,E.P.(2005).Fundamentalsofecology.CengageLearningIndiaPvt.Ltd.,NewDelhi.5th edition.

2.Singh,J.S.,Singh,S.P.,Gupta,S.(2006).EcologyEnvironmentandResource Conservation.AnamayaPublications,NewDelhi,India.

3.Wilkinson,D.M.(2007).FundamentalProcessesinEcology:AnEarthSystems Approach.OxfordUniversityPress.U.S.A.

4.Kormondy,E.J.(1996).Conceptsofecology.PHILearningPvt.Ltd.,Delhi,India.4thedition .

5.Santra,S.C.(2015)EnvironmentalScience.NewCentralBookAgency(P)Ltd.Kolkata.
6.M.C.DasandS.P.Das(2009).FundamentalofEcology.TataMGrowHill,NewDelhi.
7.ShuklaandChandel(2016).AtextbookofPlantEcology.SChandPublication,NewDelhi

## CorePaperX

## PLANTSYSTEMATICS

**Unit-I**

Plantidentification,Classification,Nomenclature;Biosystematics.Identification:Fieldinventory; FunctionsofHerbarium;Importantherbariaandbotanicalgardensoftheworldandindia;Virtualherb arium;E-flora;Documentation:Flora,Monographs,Journals;Keys:SingleaccessandMulti-access

**Unit-II**

Taxonomichierarchy:Conceptoftaxa(family,genus,species);Categoriesandtaxonomichierarchy; Speciesconcept(taxonomic,biological,evolutionary).

Botanicalnomenclature:Principlesandrules(ICN);Ranksandnames;Typification,authorcitation,validpublication,rejectionofnames,principleofpriorityanditslimitations;Namesofhybrids.

**Unit-III**

(i)Systematics-aninterdisciplinaryscience:Evidencefrompalynology,cytology,phytochemistryandmolecular data.

(ii)Systemsofclassification:MajorcontributionsofTheophrastus,Linnaeus,deCandolle, Hutchinson,TakhtajanandCronquist;ClassificationsystemsofBenthamandHooker(uptoseries)andHutchinson(uptoseries) with reference to merits and demerits;BriefreferenceofAngiospermPhylogenyGroup(APGIII)classification.

**Unit-IV**

PhylogenyofAngiosperms:Termsandconcepts(primitiveandadvanced,homologyandanalogy,parallelismandconvergence,monophyly,Paraphyly,polyphylyandclades).Origin&evolutionofangiosperms;methodsofillustratingevolutionaryrelationship(phylogenetictree,cladogram).

FamiliesofAngiosperms:DescriptivestudiesofMagnoliaceae, Rubiacae,Poaceae,Lamiaceae, Asclepiadaceae, Acanthaceae,Orchidaceae and Apocynaceae.

**PRACTICAL**

(i)Studyofvegetativeandfloralcharactersofavailablematerialsofthefollowingfamilies(Description,V.S.flower,sectionofovary,floraldiagram/s,floralformula/eandsystematicpositionaccordingtoBentham&Hooker'ssystemofclassification):Magnoliaceae,Rosaceae,Rubiacae,Liliaceae,Poaceae,andOrchidaceaespertheorysyllabus (Identification upto species level).

(ii)Fieldvisit,plantcollectionandherbariumpreparationandsubmission.Mountingofaproperlydriedandpressedspecimenofanywildplantwithherbariumlabel(tobesubmittedintherecordbook)

**TextBooks:**

1.O.P.Sharma(2009)PlantTaxonomy,TataMcGrowHill,NewDelhi

**ReferenceBooks:**

1.Singh,G.(2012).*PlantSystematics:*TheoryandPractice.Oxford&IBHPvt.Ltd., NewDelhi.3rdedition.

2.Jeffrey,C.(1982).AnIntroductionto*PlantTaxonomy.*CambridgeUniversityPress,Cambridge.

3.Judd,W.S.,Campbell,C.S.,Kellogg,E.A.,Stevens,P.F.(2002).PlantSystematics-APhylogeneticApproach.SinauerAssociatesInc.,U.S.A.2ndedition.4.Saxena,H.O.andBrahman,M..TheFloraofOrissa,CSIRPublication.

5.T.K.Bose(2009).TreesoftheWorld,RegionalPlantResourceCentre,Bhubaneswar,Odisha,India

6.Radford,A.E.(1986).Fundamentalsof*PlantSystematics*.HarperandRow,NewYork.

7.Hanes,H.H.(2009).BotanyofBiharandOrissa,

8.C.R.Mohanty(2017).TextBookofPlantSystematics,KalynaiPublisher,NewDelhi.

9.M.S.Subrahmainayam(2011)ModernPlantTaxonomy,VikashPublishingHouse,New Del hi

10.B.P.Pandey(2017).TaxonomyofAngiosperm.S.ChandPublication.

**CorePaperXI**

**REPRODUCTIVEBIOLOGYOFANGIOSPERMS**

**Unit-I**

(i)Introduction:Historyandscope.

(ii)Anther:Antherwall:Structureandfunctions,micro-sporogenesis,callosedepositionanditssignificance.

(iii)Pollenbiology:Micro-gametogenesis;Pollenwallstructure,MGU(malegermunit)structure,NPCsystem;Palynology andscope(abriefaccount);Pollenwallproteins;Pollenviability,storageandgermination;Abnormalfeatures:Pseudomonads,polyads,massulae,pollinia.

**Unit-II**

Ovule:Structure;Types;Specialstructures–endothelium,obturator,aril,caruncleandhypostase;Femalegametophyte–mega-sporogenesisandmega-gametogenesis;Typesandultrastructureofmatureembryosac(DetailsofPolygonumtype).

**Unit-III**

(i)Pollinationandfertilization:Pollinationtypesandsignificance;adaptations;structureofstigmaandstyle;pathofpollentubeinpistil;doublefertilization.

(ii)Selfincompatibility:Basicconcepts;Methodstoovercomeself-incompatibility:mixedpollination,budpollination,stubpollination.

**Unit-IV**

(i)Endosperm:development,structureandfunctions

(ii)Embryo:Typesofembryogeny;Generalpatternofdevelopmentofdicotandmonocotembryo;Suspensor:structureandfunctions;Embryo-endospermrelationship;Nutritionofembryo.

(iii)Seed:Structure,importanceanddispersalmechanisms

(iv)Polyembryonyandapomixes:Introduction;Classification;Causesandapplications.

**PRACTICAL**

(i)Anther:Wallanditsontogeny;Tapetum(amoeboidandglandular);MMC,sporetetrads,uninucleate,bicelledanddehiscedantherstagesthroughslides/micrographs,malegermunit(MGU)throughphotographsandschematicrepresentation.

(ii)Pollengrains:Freshandacetolyzedshowingornamentationandaperture,psuedomonads, polyads, pollinia (slides/photographs,fresh material),ultrastructureofpollenwall(micrograph);Pollenviability:Tetrazoliumtest,Germination:Calculationofpercentagegerminationindifferent mediausinghangingdropmethod.

(iii)Ovule:Types-anatropous, orthotropous, amphitropous/campylotropous,circinotropous,unitegmic,bitegmic;Tenuinucellateandcrassinucellate;Specialstructures:Endothelium,obturator,hypostase,caruncleandaril(permanentslides/specimens/photographs).Femalegametophytethroughpermanentslides/photographs:Types,ultrastructureofmatureeggapparatus.

(iv)Embryogenesis:Studyofdevelopmentofdicotembryothroughpermanentslides;dissectionofdevelopingseedsforembryosatvariousdevelopmentalstages;Studyofsuspensorthroughelectronmicrographs.

**TextBooks:**

1.Singh,PandyandJain(2017).ReproductiveBiologyofAngiosperms,RastogiPublications,Meerut

**ReferenceBooks:**

1.PMaheswari(2009).EmbryologyofAngiosperms.

2.Shivanna,K.R.(2003).PollenBiologyandBiotechnology.OxfordandIBHPublishingCo.Pvt.Ltd.Delhi.

3.Raghavan,V.(2000).DevelopmentalBiologyofFloweringplants,Springer,Netherlands.

4.Johri,B.M.l(1984).EmbryologyofAngiosperms,Springer-Verlag,Netherlands.

5.Bhojwani,S.S.andBhatnagar,S.P.(2011).TheEmbryologyofAngiosperms,VikasPublishingHouse.Delhi.5thedition.

6.B.K.Mishra(2017).ReproductiveBiologyofAngiospermsKalynaiPublishers,NewDelhi.

**CorePaperXII**

**PLANTPHYSIOLOGY**

**Unit-I**

(i)Plantwaterrelationship:WaterPotentialanditscomponents,waterabsorptionbyroots,aquaporins,pathwayofwatermovement,symplast,apoplast,transmembranepathways,rootpressure,guttation.Ascentofsap–cohesion-tensiontheory.Transpirationandfactorsaffectingtranspiration,anti-transpirants,mechanismofstomatalmovement.

(ii)Translocationinthephloem:Experimentalevidenceinsupportofphloemasthesiteofsugartranslocation.Pressure–FlowModel;Phloemloadingandunloading;Source–sinkrelationship.

**Unit-II**

(i)Mineralnutrition:Essentialandbeneficialelements,macroandmicronutrients,criteria for essentiality,mineraldeficiencysymptoms,rolesofessentialelements,chelatingagents.

(ii)NutrientUptake:Soilasanutrientreservoir,transportofionsacrosscellmembrane,passiveabsorption,electrochemicalgradient,facilitateddiffusion,activeabsorption,roleofATP,carriersystems,protonATPasepumpandionflux,uniport,co-transport,symport,andantiport.

**Unit-III**

Plantgrowthregulators:Discovery,chemicalphysiological roles of Auxin, nature(basicstructure),bioassayandCytokinin,Abscisicacid,Ethylene. Gibberellins,BrassinosteroidsandJasmonicacid.

**Unit-IV**

(i)Physiologyofflowering:Photoperiodism,florigenconcept,vernalization,seeddormancy.

(ii)Phytochrome:Discovery,chemicalnature,roleofphytochromeinphoto-morphogenesis,lowenergyresponses(LER)andhighirradianceresponses(HIR),modeofaction.

**PRACTICAL**

1.Determinationofosmoticpotentialofplantcellsapbyplasmolyticmethod.

2.Determinationofwaterpotentialofgiventissue(potatotuber)byweightmethod.

3.Studyoftheeffectofwindvelocityandlightontherateoftranspirationinexcisedtwig/leaf.

4.Calculationofstomatalindexandstomatalfrequencyfromthetwosurfacesofleavesofamesophyteandxerophyte.

5.Tocalculatetheareaofanopenstomaandpercentageofleafareaopenthroughstomatainamesophyteandxerophyte(bothsurfaces).

6.Tostudythephenomenonofseedgermination(effectoflight).

7.Tostudytheinductionofamylaseactivityingerminatingbarleygrains8.Todemonstratesuctiondueto transpiration.

**TextBooks:**

1.R.K.Sinha,(2015).ModernPlantPhysiology,NarosaPublishingHouse,NewDelhi.

**ReferenceBooks:**

1.Hopkins,W.G.andHuner,A.(2008).IntroductiontoPlantPhysiology.JohnWiley andSons.U.S.A.4thedition.

2.Taiz,L.,Zeiger,E.,MØller,I.M.andMurphy,A(2015).PlantPhysiologyand Development.SinauerAssociatesInc.USA.6thedition.

3.BajracharyaD.(1999).ExperimentsinPlantPhysiology-ALaboratoryManual. NarosaPublishingHouse,NewDelhi.

4.Salisbury,F.B.andRoss,C.W.PlantPhysiologyWadsworthPublishingCompany,California

5.A.C.Sahoo(2018).OutlinesofPlantPhysiologyKalynaiPublishers,NewDelhi.6.N.K..Srivatava(2017).PlantPhysiology,RastogiPublications,Meerut.

7.PandeyandSinha(2011).PlantPhysiology,VikashPublishingHouse,NewDelhi

**CorePaperXIII**

**PLANTMETABOLISM**

**Unit-I**

(i)Conceptofmetabolism:Introduction,anabolicandcatabolicpathways,regulationofmetabolism,roleofregulatoryenzymes(allosteric,covalentmodulationandIsozymes).

(ii)Mechanismsofsignaltransduction:Calcium,phospholipids,cGMP,NO.

**Unit-II**

Carbonassimilation:Historicalbackground,photosyntheticpigments and itsrole, antennamoleculesandreactioncentres,photochemicalreactions,photosyntheticelectrontransport, PSI,PSII,Qcycle,$C_3$,$C_4$pathways;Crassulaceanacidmetabolism;Factorsaffecting$CO_2$reduction.Photorespiration

**Unit-III**

(i)CarbonOxidation:Glycolysis,fateofpyruvate,regulationofglycolysis,oxidativepentosephosphatepathway,oxidativedecarboxylationofpyruvate,regulationofPDH,NADHshuttle; TCAcycle,regulationofthecycle,mitochondrialelectrontransport,oxidativephosphorylation,cyanide-resistantrespiration,factorsaffectingrespiration.

(ii)ATP-Synthesis:MechanismofATPsynthesis,substratelevelphosphorylation,chemiosmoticmechanism(oxidativeandphoto-phosphorylation),ATPsynthase,Boyersconformationalmodel,Racker'sexperiment,Jagendorf'sexperiment;roleofuncouplers.

**Unit-IV**

(i)Lipidmetabolism:Synthesisandbreakdownoftriglycerides,β-oxidation,glyoxylatecycle,gluco-neogenesisanditsroleinmobilisationoflipidsduringseedgermination,αoxidation.

(ii)Nitrogenmetabolism:Nitrateassimilation,biologicalnitrogenfixation(examplesoflegumes andnon-legumes);Physiologyandbiochemistryofnitrogenfixation;Ammoniaassimilationandtrans-amination.

**PRACTICAL**

1.Isolationandquantitizationofphotosyntheticpigments.

2.ExperimentaldemonstrationofHill'sreaction.

3.Tostudytheeffectoflightintensityontherateof photosynthesis.4.Effect ofcarbondioxideontherateofphotosynthesis.

5. Tocompareratesofrespirationindifferentpartsofaplant.6. Demonstration ofabsorptionspectrumofphotosyntheticpigments.

**TextBooks:**

1.S,K.Gupta(2017).PlantMetabolism,RastogiPublication,Meerut.22

**ReferenceBooks:**


1.Hopkins,W.G.andHuner,A.(2008).IntroductiontoPlantPhysiology.JohnWiley andSons.U.S.A.4thedition.

2.Taiz,L.,Zeiger,E.,MØller,I.M.andMurphy,A(2015).PlantPhysiologyand Development.SinauerAssociatesInc.USA.6thedition.

3.Harborne,J.B.(1973).PhytochemicalMethods.JohnWiley&Sons.NewYork.

4.A.C.Sahoo(2018).OutlinesofPlantMetabolism,KalynaiPublishers,NewDelhi.


## CorePaperXIV

## PLANTBIOTECHNOLOGY

**Unit-I**

PlantTissueCulture:Historicalperspective;Asepticticssueculturetechniques,Compositionofmedia;Totipotency;Organogenesis;Embryogenesis(somaticandzygotic);Protoplastisolation,culturean dfusion;Tissuecultureapplications(micropropagation,androgenesis,viruselimination,secondary metaboliteproduction,haploids,triploidsandhybrids;Cryopreservation;GermplasmConservation ).

**Unit-II**

RecombinantDNAtechnology-I:RestrictionEndonucleases(History,TypesI-IV,biologicalroleandapplication);RestrictionMapping(LinearandCircular);CloningVectors:Pro karyotic(pBR322,R i plasmid,BAC);Lambdaphage,Cosmid,Shuttlevector;EukaryoticVectors( YACandbrieflyPAC,MAC,HAC).GeneCloning(RecombinantDNA,BacterialTransformationan dselectionofrecombinantclones,PCR-mediated).

**Unit-III**

RecombinantDNAtechnology-II:GeneConstruct;constructionofgenomicandcDNAlibraries,screeningDNAlibrariestoobtainge neofinterestbygeneticselection;complementation,colonyhybridization;Probes-oligonucleotide,Methodsofgene transfer

*Agrobacterium*-mediated,Directgenetransfer byElectroporation,Microinjection,Microprojectilebombardment;Selectionoftransgenics –selectablemarkerandreportergenes(Luciferase,GUS,GFP).

**Unit-IV**

ApplicationsofBiotechnology:Pestresistant(Bt-cotton);herbicideresistantplants(RoundUpReadysoybean);Transgeniccropswithimprovedqualit ytraits(FlavrSavrtomato,Goldenrice);Improvedhorticulturalvarieties(Moondustcarnations);Rol eoftransgenicsinbioremediation(Superbug);ediblevaccines;Industrialenzymes(Aspergillase,Pro tease,Lipase);GentiallyEngineeredProducts–HumanGrowthHormone;Humulin;Biosafetyconcerns.

## PRACTICAL

1.a)Preparationoftissueculture(MS)medium.
(b)Demonstrationof*invitro*sterilizationandinoculationmethodsusingleafandnodalex plantsoftobacco,*Datura*,*Brassica*etc.
2.Studyofantherculture.
3.
Preparationofartificialseeds.4.T estingandstudyofBtcotton.5.Isolatio nofplasmidDNA.
6.Gelelectrophoresis(demonstration).

**TextBooks:**

1.H.S.Chawla(2010).IntroductiontoPlantBiotechnology.Oxford&IBHPublish ingCo.Pvt.Ltd.,NewDelhi.

**ReferenceBooks:**

1.Bhojwani,S.S.andRazdan,M.K.,(1996).PlantTissueCulture:TheoryandPractice .ElsevierScienceAmsterdam.TheNetherlands.
2.Glick,B.R.,Pasternak,J.J.(2003).MolecularBiotechnology-PrinciplesandApplicationsofrecombinantDNA.ASMPress,Washington.
3.Stewart,C.N.Jr.(2008).PlantBiotechnology&Genetics:Principles,TechniquesandAp plications.JohnWiley&SonsInc.U.S.A.
4.Y.P.S.BajajSeries,SpringerVerlag
5.B.D.Singh(2018).PlantBiotechnologyKalynaiPublishers,NewDelhi.6.P.K.G upta(2017).PlantBiotechnology,RastogiPublication,Meerut.
7.R.C.Dubey(2017).AdvancedBiotechnology,S,ChandPublication,NewDelhi

## DisciplineSpecificElectivePaper-1

## ANALYTICALTECNIQUESINPLANTSCIENCES

**Unit-I**
Imagingandrelatedtechniques:Principlesofmicroscopy;Lightmicroscopy;Fluorescencemicrosc opy;Flowcytometry(FACS);TransmissionandScanningelectronmicroscopy–samplepreparationforelectronmicroscopy,cryofixation,negativestaining,shadowcasting,freeze fracture,freezeetching.

**Unit-II**
Cellfractionation:Centrifugation:Differentialanddensitygradientcentrifugation,sucrose density gradient,$CsCl_2$gradient,analyticalcentrifugation,ultracentrifugation.Radioisoto pes:Useinbiologicalresearch,auto-radiography,pulsechaseexperiment.Spectrophotometry:Principleanditsapplicationinbi ologicalresearch.

**Unit-III**
Chromatography: Principle; Paperchromatography; Columnchromatography,TLC,GLC,Ion-exchangechromatography;Molecularsievechromatography.Characterizationofproteinsandnucl eicacids:X-raydiffraction;X-raycrystallography;Electrophoresis:AGE,PAGE,SDS-PAGE

**Unit-IV**

Biostatistics:Statistics,data,population,samples,parameters;RepresentationofData:Tabular,Graphical;Measuresofcentraltendency:Arithmeticmean,mode,median;Measuresofdispersion:Range,meandeviation,variation,standarddeviation;Chi-squaretestforgoodnessoffit.T-Testandcorrelation.

**PRACTICAL**

1.Studyofdifferentmicroscopictechniquesforchromosomestudy2.StudyofPCRDemonstration.
3.Toseparatechlorophyllbypaperchromatography.
4.Toseparatephytochemicalsbythinlayerchromatography.5.Toestimateproteinconcentrationthrough Lowry'smethods.6.Toseparate proteinsusingPAGE.
7.ToseparateDNA(marker)usingAGE.8.Estimationofplantpigments.

**TextBooks:**

1. C.S.Patil(2017).AdvancedAnalyticalTechniques,ABEBooks,NewDelhi.

**ReferenceBooks:**

1.Plummer,D.T.(1996).AnIntroductiontoPracticalBiochemistry.TataMcGraw-HillPublishingCo.Ltd.NewDelhi.3rdedition.

2.Ruzin,S.E.(1999).PlantMicrotechniqueandMicroscopy,OxfordUniversityPress,NewYork.U.S.A.

3.Ausubel,F.,Brent,R.,Kingston,R.E.,Moore,D.D.,Seidman,J.G.,Smith,J.A.,Struhl,K.(1995).ShortProtocolsinMolecularBiology.JohnWiley&Sons.3rd edition.

4.Zar,J.H.(2012).BiostatisticalAnalysis.PearsonPublication.U.S.A.4thedition.5.K.R. Aneja(2014).Laboratorymanualofmicrobiologyandbiotechnology, Medtech,NewDelhi

**DisciplineSpecificElectivePaper-1I**

**NATURALRESOURCEMANAGEMENT**

**Unit-I**

(i)Naturalresources:Definitionandtypes.
(ii)Sustainableutilization: Concept,approaches(economic,ecologicalandsocio-cultural).
(iii)Land:Utilization(agricultural,horticultural,silvicultural);Soildegradationandmanagement.
(iv) Water:Freshwater(rivers,lakes,groundwater,waterharvestingtechnology,rainwaterstorageandutilization.

**Unit-II**

BiologicalResources:Biodiversity-definitionandtypes;Significance;Threats;Managementstrategies;Bioprospecting;IPR;CBD;NationalBiodiversityActionPlan).

Forests:Definition,Coveranditssignificance(withspecialreferencetoIndia);Majorandminorforest products;Depletion;Management.

**Unit-III**

(i)Energy:Renewableandnon-renewablesourcesofenergy-solar,wind,tidal,geothermalandbioenergyresources.

(ii)Contemporarypractices in resource management:EIA, GIS,ParticipatoryResourceAppraisal,EcologicalFootprintwithemphasisoncarbonfootprint.

**Unit-IV**

ResourceAccounting;Wastemanagement.Nationalandinternationaleffortsinresourcemanagementandconservation

**PRACTICAL**

(i)Estimationofsolidwastegeneratedbyadomesticsystem(biodegradableandnon-biodegradable)anditsimpactonlanddegradation.

(ii)Collectionsofdataonforestcoverofspecificarea.

(iii)MeasurementofdominanceofwoodyspeciesbyDBH(diameteratbreastheight)method.

(iv) Calculationandanalysisofecologicalfootprint.(v) Ecologicalmodeling.

**TextBooks:**

1.B.W.Pandey.2005.NaturalResourceManagement.MittalPublication,NewDelhi

**ReferenceBooks:**

1.Vasudevan,N.(2006).EssentialsofEnvironmentalScience.NarosaPublishingHouse, NewDelhi.

2.Singh,J.S.,Singh,S.P.andGupta,S.(2006).Ecology,Environmentand ResourceConservation.AnamayaPublications,NewDelhi.

3.Rogers,P.P.,Jalal,K.F.andBoyd,J.A.(2008).AnIntroductiontoSustainable Development.PrenticeHallofIndiaPrivateLimited,NewDelhi.

**DisciplineSpecificElectivePaper-1II**

**HORTICULTURALPRACTICESANDPOST-HARVESTTECHNOLOGY**

**Unit-I**

(i)Introduction:Scopeandimportance,Branchesofhorticulture;Roleinruraleconomyandemploymentgeneration;Importanceinfoodandnutritionalsecurity;Urbanhorticultureandecotourism.

(ii)Ornamentalplants:Types,classification(annuals,perennials,climbersandtrees);Identificationandsalientfeaturesofsomeornamentalplants[rose,marigold,gladiolus,orchids,poppies,gerberas,tuberoseandsucculents(*Opuntia* and*Agave*).

**Unit-II**

(i)Fruitandvegetablecrops:Production,originanddistribution;Descriptionofplantsandtheireconomicproducts;Managementandmarketingofvegetableandfruitcrops.

(ii)Horticulturaltechniques:Applicationofmanure,fertilizers,nutrientsandPGRs;Weedcontrol;Biofertilizers,biopesticides;Irrigationmethods(dripirrigation,surfaceirrigation,furrowandborderirrigation);Hydroponics;PropagationMethods:asexual(grafting,cutting,layering,budding),sexual(seedpropagation),Scopeandlimitations.

(iii)Landscapingandgardendesign:
Planningandlayout(parksandavenues);gardeningtraditions-AncientIndian,European,MughalandJapaneseGardens;Urbanforestry;policiesandpractices.

**Unit-III**

(i)Post-harvesttechnology:Importanceofpostharvesttechnologyinhorticulturalcrops;Evaluationofqualitytraits;Harvestingandhandlingoffruits,vegetablesandcutflowers;Principles,methodsofpreservationandprocessing;Methodsofminimizinglosesduringstorageandtransportation;

(ii)Diseasecontrolandmanagement:Fieldandpost-harvestdiseases;Identificationofdeficiencysymptoms;remedialmeasuresandnutritionalmanagementpractices;Cropsanitation;IPMstrategies(genetic,biologicalandchemicalmethodsforpestcontrol);Quarantinepractices;

**Unit-III**

(i)Post-harvesttechnology:Importanceofpostharvesttechnologyinhorticulturalcrops;Evaluationofqualitytraits;Harvestingandhandlingoffruits,vegetablesandcutflowers;Principles,methodsofpreservationandprocessing;Methodsofminimizinglosesduringstorageandtransportation;

(ii)Diseasecontrolandmanagement:Fieldandpost-harvestdiseases;Identificationofdeficiencysymptoms;remedialmeasuresandnutritionalmanagementpractices;Cropsanitation;IPMstrategies(genetic,biologicalandchemicalmethodsforpestcontrol);Quarantinepractices;

**Unit-IV**

Horticulturalcrops-conservationandmanagement:Documentationandconservationofgermplasm;Roleofmicropropagationandtissueculturetechniques;Varietiesandcultivarsofvarioushorticulturalcrops;IPRissues;National,internationalandprofessionalsocietiesandsourcesofinformationonhorticulture.

**PRACTICAL**

Practicalrelatedtotheory

**TextBooks:**

**1.**K.V.Peter.(2009).BasicsofHorticulture,KalyaniPublishers,NewDelhi.

**ReferenceBooks:**

1.Singh,D.&Manivannan,S.(2009).GeneticResourcesofHorticulturalCrops.RidhiInternational,Delhi,India.

2.Swaminathan,M.S.andKochhar,S.L.(2007).GrovesofBeautyandPlenty:AnAtlasofMajorFloweringTreesinIndia.MacmillanPublishers,India.

3.NIIRBoard(2005).CultivationofFruits,VegetablesandFloriculture.NationalInstituteofIndustrialResearchBoard,Delhi.

4.Kader,A.A.(2002).Post-HarvestTechnologyofHorticulturalCrops.UCANRPublications,USA.

5.Capon,B.(2010).BotanyforGardeners.3rdEdition.TimberPress,Portland,Oregon.

6.P.H.Pandey(2007).PrinciplesandPracticesofPostHarvestTechnology,KalyaniPublishers,NewDelhi.

**DisciplineSpecificElectivePaper-1V**

**INDUSTRIALANDENVIRONMENTALMICROBIOLOG**

**Unit-I**

(i)Scopeofmicrobesinindustryandenvironment:Bioreactors/Fermentersandfermentationprocesses:Batchandcontinuousfermentations.Componentsofatypicalbioreactor,Typesofbioreactors-laboratory.

(ii)Microbialproductionofindustrialproducts:Microorganismsinvolved,media,fermentationconditions,downstreamprocessing:Filtration,centrifugation,celldisruption,solventextraction,precipitationandultrafiltration.

**Unit-II**

Microbialenzymesofindustrialinterestandenzymeimmobilization:Microorganismsforindustrialapplicationsandhandsonscreeningmicroorganismsforcaseinhydrolysis;starchhydrolysis;cellulosehydrolysis.Methodsofimmobilization,advantagesandapplicationsofimmobilization.

**Unit-III**

Microbesandqualityofenvironment:Distributionofmicrobesinair;Isolationofmicroorganismsfromsoil,airandwater.

Microbialfloraofwater:Waterpollution,roleofmicrobesinsewageanddomesticwastewatertreatmentsystems.DeterminationofBOD,COD,TDSandTOCofwatersamples;Microorganismsasindicatorsofwaterquality.

**Unit-IV**

Microbesinagricultureandremediationofcontaminatedsoils:Biologicalfixation;Mycorrhizae;Bioremediationofcontaminatedsoils.Isolationofrootnodulatingbacteria,arbuscularmycorrhizalcolonizationinplantroots.

**PRACTICAL**

1.Principlesandfunctioningofinstrumentsinmicrobiologylaboratory2.Handsonsterilizationtechniquesandpreparationofculturemedia
3.Screeningmicroorganismsforindustrialuse.
4.Mycorrhiza,arbuscularmycorrhizalcolonizationinplantroots5.DeterminationofBOD,COD,TDSandTOCofwatersamples;6.Microorganismsasindicatorsofwaterquality

**TextBooks:**

1.P.D.Sharma.(2017)EnvironmentalMicrobiology.RastogiPublications,Meerut.

**SuggestedReadings**

1.Pelzar,M.J.Jr.,ChenE.C.S.,Krieg,N.R.(2010).Microbiology:Anapplication basedapproach.TataMcGrawHillEducationPvt.Ltd.,Delhi.
2.Tortora,G.J.,Funke,B.R.,Case.C.L.(2007).Microbiology.PearsonBenjaminCummings, SanFrancisco,U.S.A.9thedition.
3.PradiptaK.Mohapatra(2008).TextBookofEnvironmentalMicrobiology,I.K.InternationalPublishingHouse,NewDelhi
4.A.K.Rath(2018).IndustrialandEnvironmentalMicrobiology,KalyaniPublishers,NewDelhi.

**OR**

**DISSERTATION/PROJECTWORK****

| Identification ofproblem | Reviewof Literature | Methodology | Findings | Analysis | Viva-Voce | Total |
|---|---|---|---|---|---|---|
| 10 | 10 | 10 | 25 | 25 | 20 | 100 |

**=Studentswhoscoremorethan≥60%inaggregateareeligibleforprojectwo

**GenericElectivePaperI**

**BIODIVERSITY(MICROBES,ALGAE,FUNGIANDARCHEGONIATE)**

**Unit-I**

Microbes:Viruses–Discovery,generalstructure,replication(generalaccount),DNAvirus(T-phage);Lyticandlysogeniccycle,RNAvirus(TMV);Economicimportance;Bacteria–Discovery,Generalcharacteristicsandcellstructure;Reproduction–vegetative,asexualandrecombination(conjugation,transformationandtransduction);Economicimportance.

**Unit-II**

(i)Algae:Generalcharacteristics;Ecologyanddistribution;Rangeofthallusorganizationandreproduction;Morphologyandlife-cyclesofthefollowing:*Chlamydomonas*,*Oedogonium*, *Nostoc*, *Vaucheria*Economicimportanceofalgae.

(ii)Fungi:Introduction-Generalcharacteristics,ecologyandsignificance,rangeofthallusorganization,cellwallcomposition,nutrition,reproductionandclassification;TrueFungi-Generalcharacteristics,ecologyandsignificance,lifecycleof*Rhizopus*(Zygomycota) *Penicillium* (Ascomycota), *Puccinia* (Basidiomycota); SymbioticAssociations-Lichens:

**Unit-III**

(i)**Bryophytes:**Generalcharacteristics,adaptationstolandhabit,Classification,Rangeofthallusorganization,Classification(uptofamily),morphology,anatomyandreproductionof*Marchantia*and*Funaria*(Developmentaldetailsnottobeincluded).Ecologyandeconomicimportanceofbryophytes.

(ii)**Pteridophytes:**Generalcharacteristics,classification,Earlylandplants*Rhynia*Classification(uptofamily),morphology,anatomyandreproductionof*Selaginella*, Equisetum(Developmentaldetailsnottobeincluded).Heterosporyandseedhabit,stellarevolution.Ecologicalandeconomicalimportanceof Pteridophytes.

**Unit-IV**

Gymnosperms: General characteristics, classification.Classification (up to family),morphology,anatomyandreproductionof*Cycas*,*Pinus*and*Gnetum*.(Developmentaldetailsnottobeincluded).Ecologicalandeconomicalimportance.

**PRACTICAL**

1. Gramstaining
2. Studyofvegetativeandreproductivestructuresof*Nostoc*, *Chlamydomonas* (electronmicrographs),*Oedogonium*,*Vaucheria*,*andPolysiphonia*throughtemporarypreparationsandpermanentslides.
3. *RhizopusandPenicillium*:Asexualstagefromtemporary mounts andsexualstructuresthroughpermanentslides.
4. *Agaricus*:Specimensofbuttonstageandfullgrownmushroom;Sectioningofgillsof*Agaricus*.
5. *Marchantia*-morphologyofthallus,w.m.rhizoidsandscales,v.s.thallusthroughgemma cup, w.m. gemmae (all3temporary slides), v.s. antheridiophore,archegoniophore,l.s.sporophyte(allpermanentslides).

6. *Selaginella*- morphology,w.m.microsporophyll and w.m.leafwithmegasporophyll (permanentslide). ligule,t.s.(temporary stem,w.m.slides),l.s. strobilus, strobilus

7.*Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m.sporangiophore,w.m.spores(wetanddry)(temporaryslides);t.srhizome(permanentslide).

8.*Cycas*- morphology(coralloidroots,bulbil,leaf),t.s.coralloidroot,t.s.rachis,v.s.leaflet,v.s.microsporophyll,w.m.spores(temporaryslides),l.s.ovule,t.s.root(permanentslide).

9.*Pinus*- morphology(longanddwarfshoots,w.m.dwarfshoot,maleandfemale),w.m.dwarfshoot,t.s.needle,t.s.stem,,l.s./t.s.malecone,w.m.microsporophyll,w.m.microspores(temporaryslides),l.s.femalecone,t.l.s.&r.l.s.stem(permanentslide).

**TextBooks:**

1.Mitra,MitraandChoudhury.StudiesinBotanyVolume1.MoulikPublisher,Kolkata.NinthRevisedEdition

**ReferenceBooks:**

1.Kumar,H.D.(1999).IntroductoryPhycology.AffiliatedEast-West.PressPvt.Ltd.Delhi.2nd edition.
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,MacMillanPublishers Pvt.Ltd.,Delhi.
4.Alexopoulos,C.J.,Mims,C.W.,Blackwell,M.(1996).IntroductoryMycology,JohnWileyandSons(Asia),Singapore.4thedition.
5.Raven,P.H.,Johnson,G.B.,Losos,J.B.,Singer,S.R.,(2005).Biology.TataMcGrawHill,Delhi,India.
6.Vashishta,P.C.,Sinha,A.K.,Kumar,A.,(2010).Pteridophyta,S.Chand.Delhi,India.7.Bhatnagar,S.P.andMoitra,A.(1996).Gymnosperms.NewAgeInternational(P) LtdPublishers,NewDelhi,India.
8.Parihar,N.S.(1991).AnintroductiontoEmbryophyta.Vol.I.Bryophyta.CentralBookDepot,Allahabad.
9.B.P.Pandey(2017),Botanyfordegreestudies(asperCBCS).S.Chand
10.B.S.AcharyaandB.K.Mishra(2018).PlantBiodiversity,KalyaniPublishers,NewDelhi.

**GenericElectivePaperII**

**PLANTECOLOGYANDTAXONOMY**

**Unit-I**

(i)Ecologicalfactors:Soil:Origin,formation,composition,soilprofile.Water:Statesofwaterintheenvironment,precipitationtypes.Lightandtemperature:VariationOptimalandlimitingfactors;Shelfordlawoftolerance.Adaptationofhydrophytesandxerophytes

(ii)Plantcommunities:Characters;Ecotoneandedgeeffect;Succession;Processesandtypes

**Unit-II**

(i)Ecosystem:Structure;Bioticandabioticcomponents,energyflowtrophicorganisation;Foodchainsandfoodwebs,Ecologicalpyramidsproductionandproductivity;Biogeochemicalcycling;Cyclingofcarbon,nitrogenandPhosphorous

(ii)Phytogeography:Principlebiogeographicalzones;Endemism

**Unit-III**

(i) Introductionto plant taxonomy: Identification, Classification,Nomenclature.

(ii)Identification:FunctionsofHerbarium,importantherbariaandbotanicalgardensoftheworldandIndia;Documentation:Flora,Keys:singleaccessandmulti-access

**Unit-IV**

(i)Taxonomichierarchy:Ranks,categoriesandtaxonomicgroups

(ii)Botanicalnomenclature:Principlesandrules(ICN);ranksandnames;binominalsystem,typification,authorcitation,validpublication,principleofpriorityanditslimitations.

(iii)Classification:Typesofclassification-artificial,naturalandphylogenetic.BenthamandHooker(uptoseries),Hutchinson(uptoseries).

(iv)Taxonomicdescriptionofthefamilies: Fabaceae,Magnoliaceae, LamiaceaeandPoaceae.

**PRACTICAL**

**1.**Studyofinstrumentsusedtomeasuremicroclimaticvariables:Soilthermometer,maximumandminimumthermometer,anemometer,psychrometer/hygrometer,raingaugeandluxmeter.
**2.**DeterminationofpH,andanalysisoftwosoilsamplesforcarbonates,chlorides,nitrates,sulphates,organicmatterandbasedeficiencybyrapidfieldtest.
**3.**Comparisonofbulkdensity,porosityandrateofinfiltrationofwaterinsoilofthreehabitats.
**4.**(a)Studyofmorphologicaladaptationsofhydrophytesandxerophytes(foureach).(b)Studyofbioticinteractionsofthefollowing:Stemparasite(*Cuscuta)*,Rootparasite
**5.**(*Orobanche*),Epiphytes,Predation(Insectivorousplants)
**6.**Determinationofminimalquadratsizeforthestudyofherbaceousvegetationinthecollegecampusbyspeciesareacurvemethod.(speciestobelisted)

**7.**Quantitativeanalysisofherbaceousvegetationinthecollegecampusforfrequencyandcomparisonwith Raunkiaer'sfrequencydistributionlaw.

**8.**Studyofvegetativeandfloralcharactersofthefollowingfamilies(Description,V.S.flower,sectionofovary,floraldiagram/s,floralformula/eandsystematicpositionaccordingtoBentham&Hooker'ssystemofclassification):Malvaceae,Caesalpiniaceae,Fabaceae,Apocynaceae,AsteraceaeandPoaceaeasintheorysyllabus.

**9.**Mountingofaproperlydriedandpressedspecimenofanywildplantwithherbariumlabel(tobesubmittedintherecordbook).

**TextBooks:**

1. Sharma,P.D.(2017).FundamentalsofEcology.RastogiPublications,Meerut,India.

**ReferenceBooks:**

1.Kormondy,E.J.(1996).ConceptsofEcology.PrenticeHall,U.S.A.4thedition.

2.Sharma,P.D.(2010)EcologyandEnvironment.RastogiPublications,Meerut,India.8th edition.

3.Simpson,M.G.(2006).*PlantSystematics.*ElsevierAcademicPress,SanDiego,CA,U.S.A.

4.Singh,G.(2012).*PlantSystematics:*TheoryandPractice.Oxford&IBHPvt.Ltd.,New Delhi.3rdedition.

5.A.C.Sahu(2017).PlantEcologyandPhytogeography,KalyaniPublishers,NewDelhi.

6.M.C.DasandS.P.Das(2009).FundamentalofEcology.TataMGrowHill,NewDelhi.

7.ShuklaandChandel(2016).AtextbookofPlantEcology.SChandPublication,New Delhi

8.C.R.Mohanty(2017).TextBookofPlantSystematics,KalynaiPublisher,NewDelhi.

## GenericElectivePaperIII

## PLANT PHYSIOLOGY AND METABOLISM

**Unit-I**

(i)Plant-waterrelations:Importanceofwater,waterpotentialanditscomponents;Transpirationanditssignificance;Factorsaffectingtranspiration;Rootpressureandguttation.

(ii)Mineralnutrition:Essentialelements,macroandmicronutrients;Criteriaofessentialityofelements;Roleofessentialelements;Transportofionsacrosscellmembrane,activeandpassivetransport,carriers,channelsandpumps.

(iii)Translocationinphloem.:Compositionofphloemsap,girdlingexperiment;Pressureflowmodel;Phloemloadingandunloading

**Unit-II**

(i)Photosynthesis:PhotosyntheticPigments(*Chl*a,b,xanthophylls,carotene);PhotosystemIandII,reactioncenter,antennamolecules;ElectrontransportandmechanismofATPsynthesis;$C_3$,$C_4$andCAMpathwaysofcarbonfixation.

(ii)Respiration: Glycolysis, anaerobic respiration, TCA cycle; OxidativePhosphorylation.

**Unit-III**

(i)Enzymes:Structureandproperties;Mechanismofenzymecatalysisandenzymeinhibition.

(ii)Nitrogenmetabolism:Biologicalnitrogenfixation;Nitrateandammoniaassimilation.

**Unit-IV**

(i)Plantgrowthregulators:Discoveryandphysiologicalrolesofauxins,gibberellins,cytokinins,ABA,ethylene.

(ii)Plantresponsetolightandtemperature:Photoperiodism(SDP,LDP,Dayneutralplants);Phytochrome(discoveryandstructure),redandfarredlightresponsesonhotomorphogenesis;Vernalization.

**PRACTICAL**

1.Determinationofosmoticpotentialofplantcellsapbyplasmolyticmethod.
2.Tostudytheeffectoftwoenvironmentalfactors(lightandwind)ontranspirationbyexcisedtwig.
3.Calculationofstomatalindexandstomatalfrequencyofamesophyteanda xerophyte.4.Demonstrationof Hillreaction.
5.Demonstratetheactivityofcatalaseandstudytheeffectof pHandenzymeconcentration.6.Tostudytheeffectoflightintensityandbicarbonateconcentrationon $O_2$ evolutionin photosynthesis.
7.Comparisonoftherateofrespirationinanytwopartsofaplant.

**TextBooks:**

1.A.C.Sahu(2018).PlantPhysiologyandMetabolism.KalyaniPublishers,NewDelhi.

**ReferenceBooks:**

1.Taiz,L.,Zeiger,E.,MØller,I.M.andMurphy,A(2015).PlantPhysiologyand Development.SinauerAssociatesInc.USA.6thedition.

2.Hopkins,W.G.,Huner,N.P.,(2009).IntroductiontoPlantPhysiology.JohnWiley&Sons,U.S.A.4thEdition.

3.Bajracharya,D.,(1999).ExperimentsinPlantPhysiology-ALaboratoryManual.NarosaPublishingHouse,NewDelhi.

4.H.S.Srivatava.PlantPhysiology,RastogiPublications,NewDelhi

**GenericElectivePaperIV**

**PLANTANATOMYANDEMBRYOLOGY**

**Unit-I**

(i)Meristematicandpermanenttissues:Rootandshootapicalmeristems;Simpleandcomplextissues

(ii)Organs:Anatomyofdicotandmonocotrootstemandleaf.

**Unit-II**

(i)SecondaryGrowth:Vascularcambium–structureandfunction,seasonalactivity.Secondarygrowthinandstem,Wood(heartwoodandsapwood)

(ii)Adaptiveandprotectivesystems:Epidermis,cuticle,stomata;Generalaccountofadaptationsinxerophytesandhydrophytes.

**Unit-III**

(i)Structuralorganizationofflower:Structureofantherandpollen;Structureandtypesofovules;Typesofembryosacs,organizationandultrastructureofmatureembryosac.

(ii)Pollinationandfertilization:Pollinationmechanismsandadaptations;Doublefertilization;

**Unit-IV**

(i)Endosperm:Endospermtypes,structureandfunctions.

(ii)Embryo:Dicotandmonocotembryo;Structureanddevelopment,Embryoendospermrelationship.

(iii)Seed-structureanddevelopment,appendagesanddispersalmechanisms.

**PRACTICAL**

1.Studyofmeristemsthroughpermanentslidesandphotographs.

2.Tissues(parenchyma,collenchymaandsclerenchyma);Maceratedxylaryelements,Phloem(Permanentslides,photographs)

3.Stem:Monocot:*Zeamays;*Dicot:*Helianthus*;Secondary:*Helianthus*(onlyPermanentslides).

4.Root:Monocot:*Zeamays*;Dicot:*Helianthus*;Secondary:*Helianthus*(onlyPermanentslides).

5.Leaf:DicotandMonocotleaf(onlyPermanentslides).

6.Adaptiveanatomy:Xerophyte(*Nerium*leaf);Hydrophyte(*Hydrilla*stem).

7.Structureofanther(youngandmature),tapetum(amoeboidandsecretory)(Permanentslides).

8.Typesofovules:anatropous,orthotropous,circinotropous,amphitropous/ campylotropous**.**

**TextBooks:**

1.Singh,PandeyandJain(2017).AnatomyofAngiosperms,RastogiPublication,Meerut.

**ReferenceBooks:**

1.Bhojwani,S.S.&Bhatnagar,S.P.(2011).EmbryologyofAngiosperms.VikasPublicationHousePvt.Ltd.NewDelhi.5thedition.

2.Mauseth,J.D.(1988).PlantAnatomy.TheBenjamin/CummingsPublisher,USA.3.C.R. Mohanty(2018).PlantAnatomyandEmbryology.KalyaniPublishers,New Delhi.

**BOTANYPapersforPASSstudents**

DisciplineSpecificCore–
4papersDisciplineSpecificElective–
2papers

Marksperpaper-Midterm:15marks,Endterm:60marks,Practical:25marks,Total–
100marks

Creditperpaper–6
Teachinghoursperpaper–40hours(theory)+20hours(practical)

| Semester | CourseOpted | CourseName | Credit | Marks |
|---|---|---|---|---|
| **Semester-I** | DSC-1(Theory), | Paper-I,Biodiversity(Microbes, Algae,FungiandArchego | 4 | 75 |
| | DSC-1(Practical) | Paper–I,Biodiversity(Microbes, Algae,FungiandArchego | 2 | 25 |
| **Semester-II** | DSC-2(Theory), | Paper-II,PlantEcologyandTax | 4 | 75 |
| | DSC-2(Practical), | Paper-II,PlantEcologyandTaxono | 2 | 25 |
| **Semester-III** | DSC-3(Theory), | Paper-III,PlantAnatomyandEmb | 4 | 75 |
| | DSC-3(Practical), | Paper-III,PlantAnatomyandEmb | 2 | 25 |
| **Semester-IV** | DSC-4(Theory), | Paper-IV,PlantPhysiol ogyandMetabol | 4 | 75 |
| | DSC-4(Practical) | Paper-IV,PlantPhysiol ogyandMetabol | 2 | 25 |
| **Semester-V** | DSE-1(Theory), | BotanyPaper-I–EconomicBotanyandB iotechnology | 4 | 75 |
| | DSE-1(Practical), | Botanypaper-I–EconomicBotanyandB iotechnology | 2 | 25 |
| **Semester-VI** | DSE-2(Theory), | Botanypaper-II–CellandMolecularB iology | 4 | 75 |
| | DSE-2(Practical), | Botanypaper-II–CellandMolecularB iology | 2 | 25 |
| | | Total: | 36 | 600 |

**DisciplineSpecificCorePaperI**

## Biodiversity(Microbes,Algae,FungiandArchegoniate)

### THEORY

**Unit1:Microbes:**

Viruses–Discovery,generalstructure,replication(generalaccount),DNAvirus(T-phage);Lyticandlysogeniccycle,RNAvirus(TMV);Economicimportance;Bacteria–Discovery,Generalcharacteristicsandcellstructure;Reproduction–vegetative,asexualandrecombination,Economicimportance.**Algae:**Generalcharacteristics;Ecologyanddistribution;Rangeofthallusorganizationandreproduction;Classificationofalgae;Morphologyandlife-cyclesofthefollowing:*Nostoc*,*Chlamydomonas*,*Oedogonium*,*Fucus*.Economicimportanceofalgae.

**Unit2:Fungi**

Generalcharacteristicsoffungi,ecologyandsignificance,rangeofthallusorganization,cellwallcomposition,nutrition,reproductionandclassification;TrueFungi-Generalcharacteristics,ecologyandsignificance,lifecycleof*Rhizopus*(Zygomycota)*Penicillium*, *Alternaria*(Ascomycota),*Puccinia*,*Agaricus*(Basidiomycota);SymbioticAssociations-Lichens:Generalaccount,reproductionandsignificance;Mycorrhiza:ectomycorrhizaandendomycorrhizaandtheirsignificance.

**Unit3:ArchegoniateandBryophyte**

Unifyingfeaturesofarchegoniates,Transitiontolandhabit,Alternationofgenerations.Generalcharacteristics,adaptationstolandhabit,Classification,Rangeofthallusorganization.Classification(uptofamily),morphology,anatomyandreproductionof*Marchantia*and*Funaria*.(Developmentaldetailsnottobeincluded).Ecologyandeconomicimportanceofbryophyteswithspecialmentionof*Sphagnum*.

**Unit5:Pteridophytes&Gymnosperms**

Generalcharacteristics,classification,Earlylandplants(*Cooksonia*and*Rhynia*).Classification(uptofamily),morphology,anatomyandreproductionof*Selaginella*,*Equisetum*and*Pteris*.(Developmentaldetailsnottobeincluded).Heterosporyandseedhabit,stelarevolution.Ecologicalandeconomicalimportanceof Pteridophytes.

Generalcharacteristics,classification.Classification(uptofamily),morphology,anatomyandreproductionof*Cycas*and*Pinus*.(Developmentaldetailsnottobeincluded).Ecologicalandeconomicalimportance.

### PRACTICAL

1.EMs/Modelsofviruses–T-PhageandTMV,Linedrawing/PhotographofLyticandLysogenicCycle.

2.TypesofBacteriafromtemporary/permanentslides/photographs;EMbacterium,Gramstaining

3.Studyofvegetativeandreproductivestructuresof*Nostoc*,*Chlamydomonas*(electronmicrographs),*Oedogonium*,*Fucus**(**Fucus*-Specimenandpermanentslides)

4.***Penicillium***:Asexualstagefromtemporarymountsandsexualstructuresthroughpermanentslides.

5.***Puccinia***:HerbariumspecimensofBlackStemRustofWheatandinfectedBarberryleaves;section/teasemountsofsporesonWheatandpermanentslidesofboththehosts.

6.***Agaricus***:Specimensofbuttonstageandfullgrownmushroom;SectioningofgillsofA*garicus.*

7.**Mycorrhiza**:ectomycorrhizaandendomycorrhiza(Photographs)

8.***Marchantia***&***Funaria***-
morphologyofthallus,w.m.rhizoidsandscales,v.s.thallusthroughgemmacup,w.m.gemmae(alltemporaryslides),v.s.ofreproductiveorganl.s.sporophyte.

9.***Selaginella&Equisetum***-
morphology,w.m.leafwithligule,t.s.stem,ts/l.sofreproductiveorgan

10.***Cycas&Pinus***-
morphology(roots,bulbil,leaf),t.s.root,v.s.leaflet,wholemountorv.s.ofreproductiveorgans

**TextBooks**

1.Singh,PandeyandJain(2017).MicrobiologyandPhycology,RastogiPublication, Meerut.

2.B.K.Mishra(2017),MycologyandPhytopathology,KalynaiPublishers,NewDelhi.3.Singh, PandeyandJain(2017).Archegoniate,RastogiPublication,Meerut.

**SuggestedReadings**

1.Kumar,H.D.(1999).IntroductoryPhycology.AffiliatedEast-West.PressPvt.Ltd.Delhi.2nd edition.

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.Alexopoulos,C.J.,Mims,C.W.,Blackwell,M.(1996).IntroductoryMycology,JohnWileyand Sons(Asia),Singapore.4thedition.

5.Raven,P.H.,Johnson,G.B.,Losos,J.B.,Singer,S.R.,(2005).Biology.TataMcGrawHill,Delhi, India.

6.Vashishta,P.C.,Sinha,A.K.,Kumar,A.,(2010).Pteridophyta,S.Chand.Delhi,India.7.Bhatnagar,S.P.andMoitra,A.(1996).Gymnosperms.NewAgeInternational(P)LtdPublishers,NewDelhi,India.

8.Parihar,N.S.(1991).AnintroductiontoEmbryophyta.Vol.I.Bryophyta.CentralBookDepot, Allahabad.

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**DisciplineSpecificCorePaperII**

**PlantEcologyandTaxonomy**

**THEORY**

**Unit1:Ecologicalfactors**

Introductiontoplantecologyandtaxonomy.Soil:Origin,formation,composition,soilprofile.Water:Statesofwaterintheenvironment,precipitationtypes.Lightandtemperature:VariationOptimalandlimitingfactors;Shelfordlawoftolerance.Adaptationofhydrophytesandxerophytes.

**Unit2:PlantcommunitiesandEcosystems**

Characters;Ecotoneandedgeeffect;Succession;Processesandtypes.Structure;energyflowtrophic organisation;Foodchainsandfoodwebs,Ecologicalpyramidsproductionandproductivity;Biogeochemicalcycling;Cyclingofcarbon,nitrogenandPhosphorous

**Unit3:PhytogeographyandPlantTaxonomy**

Principlebiogeographicalzones;Endemism.Identification,Classification,Nomenclature.FunctionsofHerbarium,importantherbariaandbotanicalgardensoftheworldandIndia;Documentation:Flora,Keys:singleaccessandmulti-access,Taxonomicevidencesfrompalynology,cytology,phytochemistryandmoleculardata.Taxonomichierarchy:Ranks,categoriesandtaxonomicgroups

**Unit4:Classification&Botanicalnomenclature**

Principlesandrules(ICN);ranksandnames;binominalsystem,typification,authorcitation,validpublication,rejectionofnames,principleofpriorityanditslimitations.

Classification:Typesofclassification-artificial,naturalandphylogenetic.BenthamandHooker(uptoseries),EnglerandPrantl(uptoseries).Biometrics,numericaltaxonomyandcladistics:clusteranalysis;phenograms,cladograms(definitionsanddifferences).

**PRACTICAL**

1. Studyofinstrumentsusedtomeasuremicroclimaticvariables:Soilthermometer,maximumandminimumthermometer,anemometer,psychrometer/hygrometer,raingaugeandluxmeter.
2. DeterminationofpH,andanalysisoftwosoilsamplesforcarbonates,chlorides,nitrates,sulphates,organicmatterandbasedeficiencybyrapidfieldtest.
3. (a)Studyofmorphologicaladaptationsofhydrophytesandxerophytes(foureach).(b)Studyofbioticinteractionsofthefollowing:Stemparasite(*Cuscuta)*,Rootparasite(Orobanche),Epiphytes,Predation(Insectivorousplants)
4. Determinationofminimalquadratsizeforthestudyofherbaceousvegetationinthecollegecampusbyspeciesareacurvemethod.(speciestobelisted)
5. Quantitativeanalysisofherbaceousvegetationinthecollegecampusforfrequencyandcomparisonwith Raunkiaer'sfrequencydistributionlaw
6. Studyofvegetativeandfloralcharactersofthefollowingfamilies(Description,V.S.flower,sectionofovary,floraldiagram/s,floralformula/eandsystematicpositionaccordingtoBentham&Hooker'ssystemofclassification):Brassicaceae,Asteraceae,Solanaceae,Lamiaceae,Liliaceae
7. Mountingofaproperlydriedandpressedspecimenofanywildplantwithherbariumlabel(tobesubmittedintherecordbook).

**TextBooks**

1. Sharma,P.D.(2017).FundamentalsofEcology.RastogiPublications,Meerut,India.2.O.P.Sharma(2009)PlantTaxonomy,TataMGrowHill,NewDelhi

**SuggestedReadings**

1.Kormondy,E.J.(1996).ConceptsofEcology.PrenticeHall,U.S.A.4thedition.
2.Sharma,P.D.(2010)EcologyandEnvironment.RastogiPublications,Meerut,India.8th edition.
3.Simpson,M.G.(2006).*PlantSystematics.*ElsevierAcademicPress,SanDiego,CA,U.S.A.
4.Singh,G.(2012).*PlantSystematics:*TheoryandPractice.Oxford&IBHPvt.Ltd.,NewDelhi.3rd edition.

**DisciplineSpecificCorePaperIII**

**PlantAnatomyandEmbryology**

**THEORY**

**Unit1:Tissues,Organsandspecialtissues**

Rootandshootapicalmeristems;Simpleandcomplextissues.Structureofdicotandmonocotrootstemandleaf.Vascularcambium–structureandfunction,seasonalactivity.Secondarygrowthinrootandstem,Wood(heartwoodandsapwood).Epidermis,cuticle,stomata;Generalaccountofadaptationsinxerophytesandhydrophytes.

**Unit2:Structuralorganizationofflower**

Structureofantherandpollen;Structureandtypesofovules;Typesofembryosacs,organizationandultrastructureofmatureembryosac.

**Unit3:Pollinationandfertilization**

Pollinationmechanismsandadaptations;Doublefertilization;Seed-structureappendagesanddispersalmechanisms.Apomixisandpolyembryony**:**Definition,typesandpracticalapplications.

**Unit4:Embryoandendosperm**

Endospermtypes,structureandfunctions;Dicotandmonocotembryo;Embryoendospermrelationship.

**PRACTICAL**

1.Studyondifferenttypesoftissues:parenchyma,collenchymas,sclerenchyma,Xylaryelements,Phloem
3.Stem,rootandleafanatomy:Monocot,Dicot,Secondarygrowth.
4.Adaptiveanatomy:Xerophyte(*Nerium*leaf);Hydrophyte(*Hydrilla*stem).5.Structureofanther(youngandmature),tapetum(amoeboidandsecretory).
6.Typesofovules:anatropous,orthotropous,circinotropous,amphitropous/campylotropous.7.Femalegametophyte:*Polygonum*(monosporic)typeofEmbryosacDevelopment.
8.Calculationofpercentageofgerminatedpolleninagivenmedium.

**TextBooks**

1.Singh,PandeyandJain(2017).AnatomyofAngiosperms,RastogiPublication,Meerut.2.Singh, PandyandJain(2017).ReproductiveBiologyofAngiosperms,Rastogi Publications,Meerut

**SuggestedReadings**

1.Bhojwani,S.S.&Bhatnagar,S.P.(2011).EmbryologyofAngiosperms.VikasPublicationHousePvt.Ltd.NewDelhi.5thedition.

2.Mauseth,J.D.(1988).PlantAnatomy.TheBenjamin/CummingsPublisher,USA.

**DisciplineSpecificCorePaperIV**

**PlantPhysiologyandMetabolism**

**THEORY**

**Unit1:Plant-waterrelationsandnitrogenmetabolism**

Importanceofwater,waterpotentialanditscomponents;Transpirationanditssignificance;Factorsaffectingtranspiration;Rootpressureandguttation.Biologicalnitrogenfixation;Nitrateandammonia assimilation.

**Unit2:MineralnutritionandPhloemtranslocation**

Essentialelements,macroandmicronutrients;Criteriaofessentialityofelements;Roleofessentialelements;Transportofionsacrosscellmembrane,activeandpassivetransport,carriers,channelsandpumps.Translocationinphloem:Compositionofphloemsap,girdlingexperiment;Pressureflowmodel;Phloemloadingandunloading.

**Unit3:Photosynthesisandrespiration**

PhotosyntheticPigments(Chla,b,xanthophylls,carotene);PhotosystemIandII,reactioncenter,antennamolecules;ElectrontransportandmechanismofATPsynthesis;C3andC4.Glycolysis,anaerobic respiration,TCAcycle;Oxidativephosphorylation.

**Unit4:Enzyme,PlantgrowthregulatorsandPlantresponse**

Enzymes:Structureandproperties;Mechanismofenzymecatalysisandenzymeinhibition.Discoveryandphysiologicalrolesofauxins,gibberellins,cytokinins,ABA,ethylene.Plantresponsetolightandtemperature:Photoperiodism(SDP,LDP,Dayneutralplants);Phytochrome (discovery and structure), red and far red light responses onphotomorphogenesis;Vernalization.

**PRACTICAL**

1.Determinationofosmoticpotentialofplantcellsapbyplasmolyticmethod.

2.Tostudytheeffectoftwoenvironmentalfactors(lightandwind)ontranspirationbyexcisedtwig.

3.Calculationofstomatalindexandstomatalfrequencyofamesophyteandaxerophyte.4.DemonstrationofHillreaction.

5.Tostudytheeffectoflightintensityandbicarbonateconcentrationon$O_2$evolutioninphotosynthesis.

7.Comparisonoftherateofrespirationinanytwopartsofaplant.8.Suctionduetotranspiration.

**TextBooks**

1.R.K.Sinha,(2015).ModernPlantPhysiology,NarosaPublishingHouse,NewDelhi.2.S,K.G upta(2017).PlantMetabolism,RastogiPublication,Meerut.

**SuggestedReadings**

1.Taiz,L.,Zeiger,E.,(2010).PlantPhysiology.SinauerAssociatesInc.,U.S.A.5th Edition.
2.Hopkins,W.G.,Huner,N.P.,(2009).IntroductiontoPlantPhysiology.JohnWiley&Sons,U.S.A.4th Edition.
3.Bajracharya,D.,(1999).ExperimentsinPlantPhysiology-ALaboratoryManual.NarosaPublishingHouse,NewDelhi.