Assam University
Silchar

Curriculum

for

Four-Year Under Graduate Programme

in

BOTANY

Under

National Education Policy – 2020 w.e.f.

Academic Session 2023-24

Note: This document is a DRAFT version of the syllabus approved by the BUGS in its meeting held on 30 July 2024. The same is to be placed in the Academic council meeting and any change/modification will be notified and uploaded in the University website. Till such time this may be used as a reference document.

Assam University, Silchar

NEP2020FYUGPCourse Curriculum (Botany)

Course Structure

Sem	DSC	DSM-1	DSM–2	IDC	SEC
I	**BOT:DSC-101(3)** Microbiology **BOT:DSC-102(3)** Phycology and Mycology	**BOT:DSM-101(3)** Biodiversity (Microbes, Cryptogams &gymnosperms)	-	**BOT:IDC-101(3)** Gardening and Nursery Management	**BOT:SEC-101(3)** Medicinal Plants & Herbal Technology
II	**BOT:DSC-151(3)** Cell Biology **BOT:DSC-152(3)** Practical–I	-	**BOT:DSM-151(3)** Angiosperm Morphology and Taxonomy	**BOT:IDC-151(3)** Biodiversity Conservation	**BOT:SEC-151(3)** Mushroom cultivation
III	**DSC-201(4)** Archegonite **BOT:DSC-202(4)** Genetics, Molecular Biology and Plant Breeding	**BOT:DSM-201(4)** Plant anatomy and embryology	-	**BOT:IDC-201(3)** Plants and Traditional Knowledge	**BOT:SSEC (T)-201(3)**Horticulture **BOT:SSEC (P)-201(3)** Horticulture

IV	**BOT:DSC-251(4)** Economic Botany **BOT:DSC-252(4)** Plant Systematics **BOT:DSC-253(4)** Plant Systematics and Economic Botany(Practical –II)	**BOT:DSM-252(3)** **Practical** Plant Anatomy, Embryology and Plant Physiology	**BOT:DSM-252(3)** Plant Physiology	-	-
V	**BOT:DSC-301(4)** Advance morphology and taxonomy **BOT:DSC-302(4)** Plant Physiology **BOT:DSC-303(4)** Practical-III	**BOT:DSM-301(3)** Biochemistry	**BOT:DSM-302(3)** Plant Ecology	-	-
VI	**BOT:DSC-351(4)** Ecology and Phytogeography **BOT:DSC-352(4)** Plant Biochemistry and Metabolism **BOT:DSC-353(4)** Plant Biotechnology **BOT:DSC-354(4)** Practical–IV	-	**BOT:DSM-351(4)** Practical		

VII	**BOT:DSC-401(4)** Reproductive biology of angiosperm	**BOT:DSM-401(4)** Cell & Molecular Biology			
	BOT:DSC-402(4) Plant Pathology				
	BOT:DSC-403(4) Ethnobotany, Biostatistics and Bioinformatics				
	BOT:DSC-404(4) Practical-V				
VIII	**BOT:DSC-451(4)** Practical with Research(Practical)	-	**BOT:DSM-451(4)** Applied Botany		
	BOT:DSC-452(4) Applied Botany				
	BOT:DSC-453(4) Biodiversity and climate change				
	BOT:DSC-454(4) Analytical techniques in plant science				

Note-Figures in the parenthesis represent credits assigned to the paper

Marks Distribution

<table>
<tr><td colspan="3">DSE, DSM and IDC Papers: All theory papers will have 70% External evaluation and 30% Internal evaluation. In practical papers, the marks distribution will be as follows:</td><td colspan="2">SEC papers</td></tr>
<tr><td rowspan="2">Description</td><td colspan="2">Marks</td><td colspan="2">Marks</td></tr>
<tr><td>External Assessment (A)</td><td>Internal Assessment (B)</td><td>Theory</td><td>50</td></tr>
<tr><td>Major experiment</td><td>28</td><td>15</td><td>Practical</td><td>30</td></tr>
<tr><td>Minor experiment</td><td>21</td><td>6</td><td>Internal</td><td>20</td></tr>
<tr><td>Viva-voce</td><td>14</td><td>6</td><td>Total</td><td>100</td></tr>
<tr><td>Record and submission</td><td>7</td><td>3</td><td colspan="2" rowspan="2">*Marks distribution is as given in the previous column marked(B)</td></tr>
<tr><td>Total</td><td>70</td><td>30</td></tr>
</table>

SEMESTER-I

BOT: DSC-101

Course Title: **Microbiology**

Credits:3 Contact hours:45 Marks:100

(All units are of equal credits)

Course Objective: *To study the diversity and complexity of microbial world and its applications.*

Unit-I: General Microbiology

History of microbiology, the discovery of viruses and different groups of microorganisms (from prokaryotes to eukaryotes); status of microorganisms in the living world, different groups of microorganisms, nutritional groups of microorganisms, microbial nutrition and growth (growth curve, factors affecting growth, control), sterilization methods, culture media types and preparations for bacteria, fungi and micro algae; Antibiotics and their mode of actions, Vaccines.

Unit-II: Virology and Bacteriology

Viruses: Virus stature, classification (Baltimore), general structure and replication; short accounts of viroids and prions; Structure of T-phages and TMV; methods of isolation of plant viruses, economic importance. Bacteria: General characteristics, types including mycoplasmas, spheroplasts and actinomycetes; cell and cell wall structures, classification, reproduction, and economic importance. Study of the genera: *Streptomyces*, *E. coli*, *Bacillus*, *Lactobacillus*, *Agrobacterium*, *Rhizobium* and *Pseudomonas*.

Unit-III: Agricultural Microbiology

Microorganisms in soil, role of microorganisms in Nitrogen cycle, Carbon cycle and Sulphur cycle in nature. Plant growth promoting bacteria, rhizosphere (microorganisms, positive and negative roles), and phyllosphere. Mycorrhiza- types and their role in agriculture and horticulture; Mechanism of biological Nitrogen fixation; Humus, microbial pesticides and herbicides.

Unit-IV: Food and Industrial Microbiology

Microbial spoilage of foods, preservation of foods, food poisoning, pasteurization of milk. Fermentation, Solid-state and liquid-state fermentations, batch and continuous fermentation, bioreactors, microbial production of enzymes, alcohol (Ethanol), antibiotics (Penicillin and Streptomycin) and organic acids (acetic acid, citric acid and lactic acid).

Unit-V: Water, Environmental and Medical Microbiology

Water micro-flora, role of microbes in sewage and domestic waste water treatment systems, determination of BOD and COD of water samples, microorganisms as indicator of water quality, tests for coliforms.

Bioremediation of contaminated soil, enumeration of microorganisms in air, control of air born microorganisms; biogas production; microbes in biodegradation of hydrocarbons. Microbial diseases (Aspergillosis. Tuberculosis, Tetanus, Gonorrhea, Syphilis, Leprosy), causes and preventive measures; probiotics.

Course Outcome: *The course will provide comprehensive overview on microbial world and its applications in diverse fields.*

Suggested Readings:

1. Bagyaraj,D.J.&Rangaswami,G.(2007):2nd edition,AgriculturalMicrobiology.PHILearningPvt. Ltd.
2. Banerjee,A.K.&Banerjee,N.(2008):FundamentalsofMicrobiologyandImmunology.NewCentralBookAgency(P) Ltd.Kolkata
3. Biswas,S.B.&Biswas,A.(1996):AnIntroductiontoViruses,4th edition,VikasPublishingHouse Pvt. Ltd.New Delhi.
4. Dubey,R.C.&Maheshwari,D.K.(2005):ATextbookofMicrobiology.S.Chand&CompanyLtd. NewDelhi.
5. Pelezar,M.J.(2001): Microbiology.5th edition,TataMcGraw-Hill Co.,NewDelhi.
6. Power, C. B. & Daginawala, H. F. (2010): General Microbiology, Vol.-I & II. HimalayaPublishingHouse, Mumbai.
7. Pyatkin, K. & Krivoshein, Y. (1982): Microbiology with Virology and Immunology. MIRPublishers,Moscow.
8. Reddy, S. M.; Girisham, S.; Babu, G. N. & Reddy, B. V. (2017): Applied Microbiology(Agricultural, Environmental, Food and Industrial Microbiology). Scientific Publishers,Jaipur.

BOT: DSC-102

Course Title: **Phycology and Mycology**

Credits: 3 Contact hours:45 Marks:100

(All units are of equal credits)

Course Objective: *To study the diversity, cellular organization and its application*

Unit-I: Algae

General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food, flagella; methods of reproduction; Classification: criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Significant contributions of important Phycologists (F.E. Fritsch, G.M.Smith, R.N.Singh, T.V. Desikachary, H.D.Kumar, M.O.P. Iyengar). Role of algae in environment, agriculture, biotechnology and industry.

Unit-II: Divisions of Algae

Characteristics; Ecology and distribution; range of thallus organization; Cell structure and reproduction of Cyanophyta and Xanthophyta. Morphology and life-cycle of *Nostoc* and *Vaucheria.* Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction of Chlorophyta. Morphology and life-cycles of *Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara.* Evolutionary significance of *Prochloron.* Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction of Phaeophyta & Rhodophyta. Morphology and life-cycles of *Ectocarpus* and *Polysiphonia.*

Unit-III: Fungi and its Associations

General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification (Ainsworth). Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza- their types, and significance.

Unit-IV: Major divisions of Fungi

Characteristic; Ecology and significance; Thallus organization; Reproduction; Life cycle with reference to *Synchytrium, Rhizopus*.

Life cycle and classification with reference to *Saccharomyces, Aspergillus*, *Penicillium, Alternaria & Fusarium,* General characteristics (asexual and sexual fruiting bodies); Heterokaryosis and parasexuality;

General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat *Puccinia*, *Ustilago* (symptoms), *Agaricus*;

General characteristics; Status of Slime molds, Types of fruiting bodies. General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora, Albugo.*

Unit-V: Applied Mycology

Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins; Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology. Mushroom cultivation.

Course Outcome: *The course will provide detailed understanding of algae and fungi*

Suggested Readings

1. Lee,R.E.(2008).Phycology,CambridgeUniversityPress,Cambridge.4th edition.
2. WileyJM,SherwoodLMandWoolvertonCJ.(2013)Prescott'sMicrobiology.9th Edition.McGraw HillInternational.
3. Kumar,H.D.(1999).IntroductoryPhycology.AffiliatedEast-WestPress,Delhi.
4. Sahoo,D.(2000).Farmingtheocean:seaweedscultivationandutilization.AravaliIntern ational,New Delhi.
5. Campbell,N.A.,ReeceJ.B.,UrryL.A.,CainM.L.,WassermanS.A.Minorsky P.V.,Jackson
6. R.B.(2008).Biology,PearsonBenjaminCummings,USA.8th edition.
7. Alexopoulos,C.J.,Mims,C.W.,Blackwell,M.(1996).IntroductoryMycology,JohnWiley &Sons (Asia)Singapore.4th edition.
8. Webster,J.andWeber,R.(2007).IntroductiontoFungi,CambridgeUniversityPress,
9. Sethi,I.K.andWalia,S.K.(2011).TextbookofFungiandTheirAllies,MacmillanPublishers India Ltd.

BOT: DSM-101

Course Title: **Biodiversity (Microbes, Cryptogams & gymnosperms)**

Credits: 3 Contacthours:45 Marks: 100

(All units are of equal credits)

Course Objective: *To study the biodiversity of microbes, algae, bryophytes, pteridophytes and gymnopsperms*

Unit-I: Microbes

Viruses - Characteristics and economic importance, T-phage virus and TMV, Lytic and Lysogenic cycle. Bacteria - Characteristics and economic importance, Cell structure, Reproduction of bacteria vegetative, asexual and recombination (Conjugation, Transformation and Transduction).

Unit-II: Algae

General characteristics; Classification, Ecology and occurrence, Economic importance, Range of thallus organization and Reproduction. Morphology and life cycle of *Nostoc, Volvox, Voucheria, Chara* and *Ectocarpus.*
Significant contributions of Phycologists -F.E. Fritsch, G. M. Smith and M.O.P. Iyenger.

Unit-III: Fungi & Lichens

General characteristics; Classification, Economic importance of Fungi; Reproduction; Morphology and life cycle of and *Rhizopus, Penicillium* and *Puccinia,*
Symbiotic association–Lichens and its economic importance; General account and significance of Mycorrhiza.

Unit-IV: Bryophytes

Unique characters of archegoniates and alternation of generation.

Bryophytes - General characteristics; Adaptation to land habit, Classification (upto orders) Ecology and Economic importance; Evolution of sporophyte; Morphology and lifecycle of *Marchantia, Anthoceros* and *Polytrichum*.

Unit-V: Pteridophytes and Gymnosperms

Pteridophytes - General characteristics; Classification (upto orders) and economic importance; Reproduction; Heterospory and seed habit; Stelar organization; Early land plants - *Rhynia;* Morphology and reproduction of *Lycopodium* and *Selaginella*.

Gymnosperm - General characteristics; classification and economic importance; Morphology, anatomy and reproduction of *Cycas, Pinus*, *Gingko* and *Gentum.*

Course Outcome: *The course will highlight the diversity of microbial world along with cryptogams and gymnosperms.*

Suggested Readings:

1. Lee,R.E.(2008).Phycology.CambridgeUniversityPress,Cambridge
2. Acharya,B.C.andMishraB.K.(2019).PlantBiodiversity–asperCBCSSyllabus,Kalyani Publishers.
3. Bhattacharya,HaitandGhosh(2017).ATextBookofBotany:Vol.1&Vol2.NewCentral BookAgency(P) Ltd.
4. Mishra,B.K.andDashN(2019).ATextBookofMicrobiologyandPhycology– asperCBCSSyllabus,KalyaniPublishers.
5. Mishra,B.K.andDashN(2019).AnIntroductiontoMycologyandPhytopathology–asper CBCS Syllabus,KalyaniPublishers
6. Singh,PandeyandJain(2018).ATextBookofBotany– ARCHEGONIATE(Bryophyta,Pteridophytaand Gymnosperms),RastogiPublications.
7. Vashishta,B.R.(2017).BotanyforDegreeStudents–Algae.S.ChandPublishing.
8. Vashishta,B.R.(2017).BotanyforDegreeStudents–Fungi.S.ChandPublishing.
9. Vashishta,B.R.(2017).BotanyforDegreeStudents–Bryophyta.S.ChandPublishing.
10. Vashishta,B.R.(2017).BotanyforDegreeStudents–Pteridophyta.S.ChandPublishing.
11. Vashishta,B.R.(2017).BotanyforDegreeStudents–GymnospermsS.ChandPublishing

BOT:IDC-101

Course Title: **Gardening and Nursery Management**

Credits:3 Contacthours:45 Marks:100

(All units are of equal credits)

Course Objective: *To study the multi-faced aspects of gardening and nursery*

Unit-1: Gardening Introduction

History and Scope of gardening in India, Routine garden operations, Garden types, general features and styles. Garden adornments.

Unit-2: Nursery and Garden Management

Types of gardening: Landscape, home gardening, Kitchen Garden. Orchards, Terrace gardening, etc. Concept of Public Parks and Botanical Gardens; Selection of Plant Materials and designing of gardens, Gardening operations and management practices : soil layering, manuring, watering, sowing of samplings, Management and control of weeds and pests and harvesting operations, storage and marketing strategies.

Unit-3: Structures of Nursery and Gardens

Green house- Technology, management, and advantages, Polyhouse, glass house, shed house, net house.

Unit-4: Plant Propagation

Methods of plant propagation- Cutting, layering, Budding and grafting. Seed structure and Seed Dormancy. Concepts of plant growth regulators: Rooting media (Peat moss, Vermiculite, Perlite, Sand and Bark). Cultivation and harvesting of Potato and Tomato.

Unit-5: Indoor Gardening

Indoor Gardening: Definition, areas suitable for placing indoor plants, factors affecting growth of indoor plants, pot plants, foliage plants, Hanging Baskets, Terrariums, Vertical gardens, Bonsai. Plants suitable for Indoor Gardening.

Course Outcome: *The course will help to empower students to take up gardening and nursery management as career option.*

Suggested readings

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., NewDelhi.
2. Sandhu,M.K.,1989,PlantPropagation,WileEasternLtd.,Bangalore,Madras.
3. Kumar,N.,1997,IntroductiontoHorticulture,RajalakshmiPublications,Nagercoil.
4. EdmondMusser&Andres,FundamentalsofHorticulture,McGrawHillBookCo.,NewDelhi.
5. Agrawal,P.K.1993,HandBookofSeedTechnology,Dept.ofAgricultureandCooperation,NationalSeedCorporation Ltd.,New Delhi.
6. JanickJules.1979.HorticulturalScience.(3rdEd.),W.H.FreemanandCo.,SanFrancisco,USA.

BOT: SEC-101

Course Title: **Medicinal Plants & Herbal Technology**

Credits: 3 Contact hours: 60 Marks:100

THEORY

Credits:2 Contact hours: 30 Marks:50

(All units are of equal credits)

Course objective:

To study the use of medicinal plants in improving human life.

Unit-1: Traditional Systems of Medicine

Brief history of use of medicinal herbs; Indigenous system of medicines-Ayurveda (History, origin, panchamahabhutas, saptadhatu, tridosha and rasayana), plants used in ayurvedic treatments, Methods of preparation of asava, arishta, gutikas, churna, lehamand bhasmas; Unani (History, concept, Umoor-e-tabiya) and Siddha (Origine, basis, plants used in Siddha medicine), medical terms.

Unit-2: Medicinal Plants and their Conservation; Application of Natural Products

Local Medicinal plants, Concept of endangered taxa, Endangered and endemic medicinal plants of India, Red list criteria; *In*situ and *Ex*situ conservation of medicinal plants, brief account of CIMAP; Application of natural products to certain diseases - Jaundice, cardiac, infertility, diabetics, blood pressure, memory loss, rheumatism and skin diseases.

Unit-3: Pharmacognosy

Systematic position, distinguishing features and uses of following herbs in curing various ailments -Tulsi, Ginger, Fenugreek, Indian Gooseberry, Ashoka, Arjun; Future of pharmacognosy. Herbs as health food (Alfaalfa, Chicory, Garlic, Ginseng, Ashwagandha and Spirulina).

Unit-4: Phytochemistry and Analytical Pharmacognosy

Active principles and methods of their testing of medicinal herbs, Drug adulteration (types), methods of drug evaluation, WHO guidelines for the assessment of herbal medicines, phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids and phenolic compounds).

Unit-5: Patenting and Regulatory Authorities of Natural Products

Definition of common terms-Patent, IPR, Traditional Knowledge, Farmer's right, Breeder's right, Bioprospecting, and Biopiracy. Turmeric patent and Neem patent; Drugs Technical Advisory Board (DTAB), Plant based medicinal and aromatic industries and institutions in India; Good manufacturing practice (GMP) of Indian system of medicine

Course outcome: *The course will provide a comprehensive understanding on the importance of medicinal plants and herbal technology in health care.*

SuggestedReadings

1. Anonymous(1948-66): WealthofIndia,RawMaterials,7Vols,CSIR,NewDelhi.
2. Anonymous(1992):TheuseofTraditionalMedicineinPrimaryHealthCare.WHO,AITBSPublishersand Distributors, NewDelhi.
3. Anonymous(1994):TheUsefulPlantsofIndia.Publications&InformationDirectorate,CSIR,New Delhi.
4. Arora,P&Arora,V.(2019):ATextBookofHerbalDrugTechnology.S.Vikas&Company(MedicalPublishers) India,Jalandhar.
5. Chopra,R.N.;Nayar,S.L.andChopra,I.C.(1956):GlossaryofIndianmedicinalPlants,CSIR, New Delhi.
6. Jain,S.K.(1994): Medicinal Plants.5thedition.NBT,NewDelhi.
7. Laxman,P.(2015):PatentinginIndia:Policy,ProcedureandPublicFunding.IKInternational PublishingHouse. New Delhi.
8. Mukerji,B.(1953):The Indian Pharmaceutical Codex, NewDelhi.

SEC-101: PRACTICAL

Credit: 1 Contact Hours: 30 Marks: 30

Course Objective: To study about the local medicinal plants and their properties.

1. Survey and collection of medicinal plants used by local communities.
2. Categorization of medicinal plants as per the disease criteria.
3. Preparation of plant material for extraction process.
4. Preparation of crude plant extracts by maceration techniques.
5. Preparation of crude plant extracts by Soxhlet apparatus.
6. Method of recovery of crude plant extracts.
7. Qualitative estimation of crude plant extracts.
8. Quantitative estimation of plant extracts.
9. TLC profiling of plant extracts.
10. Study of antimicrobial activity of plant extracts.

Course Outcome: *The course will provide comprehensive field survey skills and laboratory-based skills on medicinal plants, their extract preparation and further analysis of it.*

SEMESTER-II

BOT: DSC-151

Course Title: **Cell Biology**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course objective:

To study the cellular organization of prokaryotic and eukaryotic organisms.

Unit-1: Historical background of Cell Biology

Broad Classification of Cell Types (in Prokaryote sand Eukaryotes); Cell as basic unit of life; Cell Theory; Pre-cellular evolution and artificial creation of cell; Characteristic features of cell types: Mycoplasma (PPLO); Viroids; Prions; Archaea bacteria and Eubacteria; Eukaryotic microbes; Ecological amplitude of cell in high altitude, arctic, hot spring, arid, brackish and freshwater.

Unit-2: Structure and function of cell organelles

Cell wall and cell membrane; Models of cell membrane; role of various membrane proteins, lipids and carbohydrates; role of channels and pumps in cellular transport and signaling; Cytoskeleton and Cytosol; Golgi-bodies; Endoplasmic reticulum; Ribosomes; Lysosomes; Peroxysomes; Endosymbiotic Theory: Mitochondria and Chloroplast.

Unit-3: Ultrastructure and function of Nucleus:

Composition of nucleus; Nucleic acids: DNA and RNA-composition, structure of DNA; A, B and Z forms of DNA; Replication of DNA, Denaturation of DNA, DNA polymerases; Different types of RNA and their role.

Unit-4: Cell Division and its regulation

Cell cycle; cell-cell interaction; cell locomotion (amoeboid, flagellar and cilliar), Muscle and nerve cell; Cell Senescence and Programmed Cell Death; Apoptosis; Cell differentiation; Biology of cancer; Cell Division: Mechanisms of Mitosis and Meiosis; Role of Centromere, Kinetochore and Spindle apparatus.

Unit-5: Techniques in cell biology

Microscopy: Principles of Light and Electron microscopy TEM and SEM; Phase contrast and fluorescence microscopy; Principles of Chromatographic techniques - Paper chromatography, TLC, Column chromatography; HPLC; Autoradiography and its applications; Centrifugation.

Course Outcome: The course will provide a detailed understanding of cellular organization of prokaryotic and eukaryotic organism.

Suggested Readings

1. Campbell, MK (2012) Biochemistry, 7th ed.,Published by Cengage Learning

2. Campbell, PN and Smith AD (2011)Biochemistry Illustrated, 4thed.,Published by Churchill Livingstone

3. Tymocz koJL, Berg JM and Stryer L(2012) Biochemistry: A short course, 2nd ed., W.H. Freeman

4. Berg JM, Tymocz koJL and StryerL(2011) Biochemistry, W.H. Freeman and Company

5. Nelson DL and Cox MM(2008) Lehninger Principles of Biochemistry, 5thEdition.,W.H.Freemanand Company.

6. Karp, G.(2010).Cell Biology ,John Wiley & Sons,U.S.A.6th edition.

7. Hardin ,J., Becker, G., Sklien smith, L.J.(2012).Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.

8. Cooper, G.M. and Hausman , R.E.(2009) The Cell: AMolecularApproach.5th edition. ASM Press & Sunderl and, Washington, D.C.; Sinauer Associates, MA.

9. Becker, W.M., Kleinsmith ,L.J. ,Hardin .J. and Bertoni, G.P. (2009)The WorldoftheCell.7thedition. Pearson Benjamin Cummings Publishing, San Francisco

BOT:DSC-152

Course Title: **Practical–I (Lower Cryptogams and Cell Biology)**

Credits: 3	Contact hours: 60	Marks: 100
	(All units are of equal credits)	

Course objective:

To study the cellular organization of lower cryptogams and other eukaryotes.

Unit-1: Microbes

Models of virus–T Phage, Lytic & Lysogenic cycle from photograph, Study of bacterial reproduction- binary fission, Conjugation and endospores from temporary/ permanent slides/ photographs. Gram staining techniques in bacteria through Curd/ Root nodules. Preparation of media-nutrient agar and broth

Unit-2: Algae

Identification and study of vegetative/reproductive structures of the following genera through temporary preparation of slides/ permanent slides–
Cyanobacteria: *Nostoc/Anabaena*
Chlorophyceae: *Chlamydomonas, Chlorella, Volvox and Chara*;
Xanthophyceae: *Voucheria;*
Bacillariophyceae: *Pinnularia;*
Phaeophyceae: *Ectocarpus Sargassum*;
Rhodophyceae: *Polysiphonia/ Batrachospermum*.

Unit-3: Fungi & Lichen

Identification and study of vegetative / reproductive structures of the following genera through temporary preparation of slides (by Lactophenol Cotton Blue methods) – *Rhizopus, Penicillium, Ustilago* and *Puccinia.*
Study of Crustose, Foliose and Fruticose Lichen.

Unit-4: Cell Biology

Study of plant cell with the help of epidermal peel mount of Onion / Rhoeo / Crinum
Cytochemical staining of DNA-feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
Measurement of cell size by the technique of micrometry.
Countingthecellsperunitvolumewiththehelpofhaemocytometer.Studyof phenomenon of plasmolysis and de-plasmolysis
Study of effect of organic solvent and temperature on membrane permeability.
Study different stages of Mitosis and Meiosis.

Unit-5: Viva/ Practical Record Books/Field study.

Botanical Excursion: visit to institute of microbial technology/visit to local vegetation to understand about lower cryptogams and submission of excursion report. Viva-voce covering entire syllabus by External Examiners. Submission of Record Books.

Course outcome: *The course will provide a detailed picture of cellular organization of flower cryptogam and eukaryotes.*

BOT: DSM-151

Course Title: **Angiosperm Morphology and Taxonomy**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course objective:

To study the morphological features and classification of angiosperms.

Unit-1: Morphology

Study of modified roots, stems and leaves, phyllotaxy, inflorescence types (including special types); evolution of inflorescence, aestivation and placentation, flower as a modified shoot, types of fruits; floral formula, floral diagram, structure of fruits and seeds. Role of Morphology in taxonomy.

Unit-2: Introduction to Plant Taxonomy

Definition and components of plant taxonomy (Identification, Classification and nomenclature); taxonomic literature; Herbarium and its preparation, role of herbarium, major herbarium of the world, Central National Herbarium; botanical gardens and their role, major herbarium of the world and India, A J C Bose Indian Botanic Garden; Flora and its contents, Flora of Assam and Flora of British India; Taxonomic keys; taxonomic evidences from morphology, palynology, cytology, phytochemistry and molecular data; taxonomic hierarchy. Writing of plant description.

Unit-3: Botanical Nomenclature

Binomial nomenclature; ICN, its principles and rules, ranks and names, typification, author citation, effective and valid publication, rejection of names, principles of priority, naming of new taxon, naming of hybrids.

Unit-4: Classification

History, types of classification- artificial, natural and phylogenetic; Bentham and Hooker system, Engler and Prantl system and Tathkajan system of classifications, numerical taxonomy and cladistics; characters, character weighting and coding; cluster analysis; phenograms, cladograms.

Unit-5: Angiosperm Families

Distinguishing characters, range of vegetative and floral characters and economically important plants of Magnoliaceae, Asteraceae, Solanaceae, Lamiaceae, Euphorbiaceae, Moraceae, Orchidaceae, Liliaceae, Musaceae and Poaceae, flower morphology of Orchids.

Course outcome: *The course will give a comprehensive understanding of morphological features of angiosperms and direct the taxonomic datasets of angiosperms.*

Suggested Readings

1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi.3 rdedition.
2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Maheshwari, J.K. (1963).Flora of Delhi. CSIR, NewDelhi.
5. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, NewYork.
6. Jain, S.K. & Rao, R.R. (1977): A hand book of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers. NewDelhi.
7. Singh, G. (2012): Plant Systematics, Theory and Practice. 3rd edition. Chaman Enterprises, New Delhi.
8. Stace, C.A. (1989): Plant Systematics and Biosystematics. 2nd edition. Cambridge University Press.Cambridge. UK.
9. Vasishta, P.C. (1974): Taxonomy of Angiosperms. 2ndedition. R.Chand & Co. NewDelhi.

BOT: IDC-151

Course Title: **Biodiversity Conservation**

Credits: 3 Contact hours:45 Marks: 100

(All units are of equal credits)

Course objective: *To study the conservation and management of biodiversity.*

Unit-1:

General account: Definition of biodiversity, levels of biodiversity, soil types of India, Climate change; global warming; ozone layer depletion; acid rain and their impact on human communities, agriculture and food security; climate of India, climatic regions of India, diverse flora of India, diverse fauna of India, measuring biodiversity: alpha, beta and gamma diversity.

Unit-2

Global biodiversity: genetic diversity, species diversity, ecosystem diversity; key stone species, biodiversity in tropics, conservation of biodiversity; ecology and economy, bioethics and conservation, IUCN Red Data Book, Red List categories; Causes of extinction; Endemism.

Unit-3

Biodiversity of India: Value of Indian biodiversity, Indian biodiversity under serious threat, causes of threats; Hotspots of Indian biodiversity; Germplasm and diversity, In situ conservation; Ex situ conservation; Sustainability, Bioethics and tribal population; Sustainable development rights; India as a mega-biodiversity Nation.

Unit-4

Protected areas: Status of biodiversity conservation, National Parks, Sanctuaries, Biosphere reserves, Biodiversity act, Biopiracy, International efforts for conservation of biodiversity; Mangrove conservation; Wildlife protection act; Forest protection act; Convention on Biological Diversity (CBD); The Biodiversity Act (2002); National Environmental Policy (2004).

Unit-5

Biogeographical regions: Endemism; Floristic regions of India; Vegetation of India (Forest vegetation and grassland vegetation); Indian desert; Western Ghats; The Islands, North-East India; Aims and objectives of Environmental Education; Environmental Impact Assessment (EIA); Role of important NGOs in Environmental protection in India; India's initiative for mitigating climate change.

Course outcome: *The course will provide a comprehensive overview on the conservation and management aspects of biodiversity and the importance of biodiversity conservation in the era of climate change.*

Suggested Readings:

1. Sharma,P.D.(2014):EcologyandEnvironment.13thEdition,RastogiPublications,Meerut,India.
2. Sodhi,N.S.;Raven,P.H.;Gibson,L.(2013):ConservationBiology:VoicesfromtheTropics.JohnWiley
3. Gleeson,B.andLow,N.(eds.)(1999):GlobalEthicsandEnvironment,London,Routledge.
4. Asthana,D.K.andAsthanaM.(2010):AtextbookofEnvironmentalstudies(Forundergraduatestudents),S.Chand and Company Ltd., Ram Nagar, NewDelhi.
5. Singh,J.S;SinghS.P.andGuptaS.R.(2008):EcologyandEnvironmentalScience.S.Chand and Company Ltd. ,Ram Nagar, New Delhi

BOT:SEC-151

Course Title: **Mushroom Cultivation**

Credits: 3 Contact hours: 60 Marks: 100

THEORY

(All units are of equal credits)

Course objective: *To study the diverse aspects of mushroom cultivation and its economic and medicinal values.*

Unit-1: History of Mushroom Cultivation

Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - *Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus*.

Unit-2: Cultivation Techniques

Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure-culture: Medium, sterilization, preparation of spawn, multiplication.

Unit-3: Mushroom bed Preparation

Mushroom bed preparation-paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation- Low-cost technology, composting technology in mushroom production.

Unit-4: Storage and Nutrition

Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition -Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

Unit-5: Food Preparation

Food Preparation: Types of food prepared from mushroom. Research Centres-National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Course outcome: *The course will provide the basis to understand the diverse aspects of mushroom cultivation and its importance.*

Suggested Readings

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991)

OysterMushrooms,DepartmentofPlantPathology,TamilNaduAgriculturalUniversity,Coimbatore.
2. Swaminathan,M.(1990)FoodandNutrition.Bappco,TheBangalorePrintingandPublishingCo. Ltd., No. 88, Mysore Road,Bangalore-560018.
3. Tewari,PankajKapoor,S.C.,(1988).Mushroomcultivation,MittalPublications,Delhi.

SEC-151: PRACTICAL

Credit: 1 Contact Hours: 30 Marks: 30

Course Objective: To study about the mushroom cultivation and their applications.

1. Survey of edible mushroom available in this region.
2. Collection of required materials for mushroom cultivation.
3. Pureculture: Medium, sterilization, preparation of spawn
4. Mushroom bed preparation with paddy straw
5. Mushroom bed preparation with sugarcane trash.
6. Mushroom bed preparation with maize straw
7. Preparation compost for mushroom cultivation.
8. Storage techniques for mushroom.
9. Nutritional analysis of mushroom.
10. Preparation of food item with mushroom.

Course Outcome: *To have a comprehensive understanding and practical skill-based knowledge to cultivate mushrooms as a source of livelihood.*

SEMESTER – III

BOT: DSC-201T

Course Title: **Archegoniate**

Credits: 3 | Contact hours: 45 | Marks: 100

(All units are of equal credits)

Course Objective: To study the diversity, ecology and economic importances of archegoniate plants.

Unit 1: Introduction

Affinities among archegoniate; Transition to land habit; Alternation of generations. Ecological importance of archegoniates.

Unit 2: Adaptation of Land Plants

Salient Features; Adaptations to land habit, Amphibian nature of Bryophyte, Evolution of Land Plants.

Unit 3: Bryophytes

Distinguishing features, Classification, reproduction, structure of sporophytes, evolutionary trends in Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Polytrichum. Economic importance of bryophytes with special reference to Sphagnum.

Unit 4: Pteridophytes

General characteristics; Classification and origin of Pteridophytes. Early land plants (Cooksonia and Rhynia). Distinguishing features, structure and reproduction of Psilotum, Lycopodium Selaginella, Equisetum, Marsilea and Pteris. Apogamy, and apospory, heterospory and seed habit, telome theory, stelar structure and evolution; Economic importance.

Unit 5: Gymnosperms

Distinguishing features, Classification, structure and reproduction (excluding developmental features) of Cycas, Pinus, Ginkgo and Gnetum. Economic importance. Various forms of fossils, theories of fossilization, Geological Time Scale, fossil flora of India.

Course Outcome: *To have a comprehensive understanding about various archegoniate plants, their morphology, ecology and economic importances.*

Suggested Readings

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
2. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms.New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot.Allahabad.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology.Tata McGraw Hill, Delhi.
5. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.

BOT: DSC-202T

Course Title: **Genetics, Molecular Biology and Plant Breeding**

Credits: 3 Contact hours: 45 Marks: 10

(All units are of equal credits)

Course Objective: To study the fundamental and classical genetics, basics of molecular biology, and introduction to plant breeding .

Unit 1: Mendelian Genetics and Extra Chromosomal Inheritance

Mendelism: History; Principles of inheritance; Probability and pedigree analysis; Incomplete dominance and Co dominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Penetrance and Expressivity, Numericals; Polygenic inheritance. Classical vs. molecular concepts of gene; Structure of Phage T4, rII Locus. Chloroplast mutation: mitochondrial mutations in yeast; heredity- Kappa particles in *Paramecium.* Plastid inheritance.

Unit 2: Linkage, change in chromosome structure and number, Gene Mutations, Population and Genetics

Linkage and crossing over- Recombination frequency, Interference and coincidence; Numericals based on gene mapping; Sex Linkage. Deletion, Duplication, Inversion, Translocation, Reversion, Position effect, Euploidy and Aneuploidy. Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Transposons, Allele frequencies, Genotype frequencies, Hardy-Weinberg Law.

Unit 3: Nucleic Acid, the Structures of DNA and RNA

Discovery of DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment). DNA Structure: Salient features of double helix, cot curves; Organization of DNA-Prokaryotes, Viruses, Eukaryotes. Mitochondria and chloroplast DNA. The Nucleosome; Chromatin structure- Euchromatin, Heterochromatin.

Unit 4: Central Dogma, Genetic Code, DNA replication and Translation

The Central Dogma, Genetic code, Mechanism of DNA replication, Transcription in prokaryotes and eukaryotes; Principles of transcriptional regulation, Lac operon and Trp operon, Split genes-concept of introns and exons, splicing and processing of mRNA, Protein synthesis; Post-translational modifications of proteins.

Unit 5: Plant Breeding

Introduction and objectives; breeding systems: modes of reproduction in crop plants. Important achievements, Centers of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self-pollinated, cross pollinated and Vegetatively propagated plants; Hybridization, advantages and limitations; Concept of quantitative inheritance, mechanism,; Inbreeding depression, genetic basis of inbreeding depression, heterosis and its applications.

Course Outcome: *To have a comprehensive understanding about the fundamentals of genetics, its components and various nuclear functions and processes. To understand plant breeding and its applications.*

Suggested Readings

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India.8th edition.

2. Snustad, D.P. and Simmons, M.J.(2010).Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.

3. Klug, W.S. Cummings, M.R., Spencer, C.A.(2009).Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition.

4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010).Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

5. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007).Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A.6th edition.

6. Russell, P.J.(2010). I-Genetics-A Molecular Approach. Benjamin Cummings, U.S.A.3rd edition.

7. Singh, B.D.(2005).Plant Breeding: Principles and Methods. Kalyani Publishers. 7thedition.

8. Chaudhari, H.K. (1984).Elementary Principles of Plant Breeding. Oxford–IBH. 2ndedition.

9. Acquaah, G. (2007). Principles of Plant Genetics & Breeding.Blackwell Publishing.

BOT: DSM-201T

Course Title: **Plant Anatomy and Embryology**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective: To study the general plant anatomical structures, their characteristics and importances, embryology and its development.

Unit 1: Meristematic and permanent tissues
Characteristics and Classification of Meristematic Tissues Root and shoot apical meristems; Simple and complex tissues, Organs: Structure and function of dicot and monocot root stem and leaf.

Unit 2: Tissue System and adaptation
Tissue systems: Epidermal, Ground, Vascular, Vascular cambium–structure and function, seasonal activity. Secondary grow thin root and stem, heart wood and sapwood, Anatomical adaptations in xerophytes and hydrophytes.

Unit 3: Structural organization of flower
Structure and Functions of flower, Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and Ultrastructure of mature embryo sac.

Unit 4: Pollination and Fertilization
Pollination: Types, Mechanisms and adaptations, Pollen- Pistil Interaction, Contrivances for cross pollination, Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 5: Embryo and endosperm
Embryo: Structure development & Types, Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship, Apomixis and polyembryony**:** Causes and application.

Course outcome: *To have a comprehensive understanding of plant anatomy, its morphological characters, embryo and its development.*

Suggested Readings

1. Bhojwani,S.S.&Bhatnagar,S.P.(2011).EmbryologyofAngiosperms.VikasPublicationHousePvt.Ltd .NewDelhi.5th edition.
2. Mauseth, J.D.(1988).Plant Anatomy. The Benjamin/ Cummings Publisher, USA.

BOT: IDC--201T

Course Title: **Plants and Traditional Knowledge**

Credits: 3 | Contact hours: 45 (All units are of equal credits) | Marks: 100

Course Objective: To study about the indigenous and traditional uses of plants, their ethnobotanical features, and applications.

Unit 1: Basics of Plant Traditional Knowledge.
Brief history, scope and importance of Traditional Knowledge Systems, Concept and importance of Traditional Systems of treatment: Ayurveda, Siddha and Unani. Role and importance of AYUSH in promoting scientific exploration of Traditional Knowledge.

Unit 2: Study of plants used in Traditional Systems.
Concept of Ethnobotany: Brief history, importance, materials and methods of Ethnobotanical Investigation, study of plants used by dominant ethnic tribes in N.E. India. Sarpogondha, Basak, Tulsi, Turmeric, Ginger, Ashoka, Arjun spp.

Unit 3: Terminologies and Principles of Traditional Knowledge.
Brief Knowledge on Prior Informed Consent (PIC), Benefits Sharing, Intellectual Property Rights (IPR), Ethnic foods, Food Botanicals and community Knowledge, Bio- cultural Knowledge and skills, Food preservation and Traditional Knowledge (TK).

Unit 4: Traditional Knowledge and Conservation.
Role of T.K. in Conservation and management of Agro-diversity, cultural diversity, Forestry, Climate change. Community Knowledge in sustainable management of natural resources.

Unit 5: Traditional Knowledge and Future.
India as a vast reservoir of Traditional Knowledge: documentation and scientific validation. Need for Conservation of Traditional Knowledge, Policy implications. Application of modern tools and techniques in Conservation of TK.

Course outcome: *To have a comprehensive understanding of traditional knowledge systems, its significance and conservation.*

Suggested Readings:

1.The Treatise of Indian Medicinal Plants (Vol.1&2): A. Chatterjee&S.C.Prakshi. 1995.CSIR publications.
2.Medicinal Plants: An Ethnobotanical Approach. P.C.Trivedi. 2006.Agrobios.
3. Glossary of Indian Plants: R.N.Chopra,S.L.Nayan& I.C. Chopra 1956 CSIR publications.
4. Tribal Medicine: Traditional Practices and changes. J.J.Roy Barman.2003.Mittal publications.
5. Indigenous Drugs of India.Kannada, Lall, Dey & Raj Bahadur. 1984.International Book Distributors.
6.Decision and Support System on medicinal Plants.AnupamMishra, S.V.Ngachan, R K.Singh. 2011.ICAR NEH Region Umiam.Meghalaya.
7. Enormity of Traditional Knowledge Systems for Livelihood, Food security of North Eastern Region. Anupam Mishra, S.V.Ngachan, Ramesh Singh.2011. ICAR NEH Region.Umiam.Meghalaya.

BOT: SEC-201

Course Title: Horticulture

Credit: 2 Contact hours: 30 Marks: 50

(All units are of equal credits)

Course Objective: To study the concept of horticulture, its various practices, and their applications.

Unit 1: Introduction to Horticulture
Definition, Importance and scope of horticultural and floricultural crops. Divisions of horticulture with suitable examples and their importance. Export scenario and scope for Horticulture in India. Landscaping in Horticulture.

Unit 2: Classification & Vegetative propagation of Horticulture Crops
Introduction to annuals, biennials, perennials, herbs, shrubs, trees, climbers, succulents, cacti, palms, orchids, bulbous ornamentals, medicinal and aromatic plants.
Cuttings: propagation by root, leaf and stem cuttings; layering: techniques of simple, serpentine, mound, trench and air layering; Grafting and Budding.

Unit 3: Introduction to flowers and fruit crops
Concept of floriculture and pomology. Distribution and cultivation of Orchids, Asters, Roses, Mango, Banana, Citrus and Pine apples. Orchard Management.

Unit 4: Introduction to vegetable and plantation crops
Origin, history, distribution, cultivation and uses of Arecanut and Coconut .Importance, varieties, climate and soil, seeds and sowing, manuring, diseases and their control, Cultivation of Brinjal, Tomato, Coriander.

Unit 5: Entrepreneurships, Sustainable Production and extension programmes
Entrepreneurships in Horticulture, Sustainable Production Practices for Local Fruit Production; Grading, packing, storage and marketing of fruits. Agro Horticultural Societies, Krishi Vignan Kendras (KVK).

Course outcome: *To have a comprehensive understanding of horticulture and its importance.*

Suggested Readings

1.Prasad and Kumar, 2014.: Principles of Horticulture 2nd Edition Agribios India
2. Kumar, N., 1990 Introduction to Horticulture. Rajyalakshmi Publications, Nagarkoil, Tamilnadu
3.Jithendra Singh, 2002. Basic Horticulture. Kalyani Publishers, Hyderabad
4. Kausalkumar Misra and Rajesh Kumar, 2014 Fundamentals of Horticulture Biotech books
5. Brady Nyle C and Ray R Well 2014 Nature and Properties of Soil Pearson Educational Inc , New Delhi

BOT: SEC-201 (Practical)

Credit 1 Contact Hours: 30 Marks: 30

Course Objective: To study the various tools and techniques of horticulture.

1. Study the tool/ equipment used in horticulture
2. Identification and prepare a list of annuals, biennials, perennials.
3. Study and identification of horticultural crops with special reference to palms, ornamentals, medicinal and aromatic plants.
4. Identification of common disease on vegetable crops.
5. Demonstration experiments on cutting, layering, grafting and budding.
6. Viva-voce and submission of Practical Record book.

Course Outcome: *To develop basic horticulture skills, identify horticultural crops, their diseases and propagation techniques.*

SEMESTER – IV

BOT: DSC-251 T

Course Title: **Economic Botany**

Credits: 3 Contact hours: 45 Marks:100

(All units are of equal credits)

Course Objective: To study the various economically important plants and their uses.

Unit 1: Origin of Cultivated Plants

Centre of origin and their importance with special reference to Vavilop's works; Introduction and domestication of plants; loss of crop genetic diversity, evolution of new crops varieties; importance and conservation of germplasm; classification of plant resources on the basis of their uses.

Unit 2: Plants used as Food, beverages and spices

Cereals: Rice and wheat (Origin, morphology and processing of post-harvest management and uses) and Millets: Brief account of millets and their nutritional values);
Legumes: Origin, Morphology, Cultivation and uses of Chick pea and pigeon pea; Nutritious value of legume.
Tea & Coffee: Morphology, Cultivation, processing and their uses.
Spices: Listing of important spices, their families and parts used with special reference to Barak valley and Assam. Study of fennel, saffron, clove and black pepper.

Unit 3: Plants and plant Products of Industrial Value

Oil/fats: Morphology, extraction, uses and health implication of ground nut, coconut, soybean and mustard. Non-edible oil yielding plants Karanja seed oil, Mahua oil, Castor oil with their families and uses.
Sugar and Starches: morphology, processing of sugarcane, products and by products of sugarcane industry, Potato: morphology, propagation, post-harvest management, uses of potato. **Fibres**: classification based on the origin of fibres. Cotton, Coir and Jute (Morphology, extraction and uses).
Rubbers: Natural rubber/ para rubber: tapping, processing and uses.

Unit 4: Drug-yielding Plants

Therapeutic and habit-forming drugs with special reference to *Rauwolfia, Cinchona, Withania*, *Digitalis*, *Aloe vera, Taxus,* Opium poppyand *Cannabis* and Tobacco (Morphology, processing uses and health hazards)

Unit 5: Forest Products

Forest and Forest products; Listing of important spices, their families and parts used.
Timber and Non-timber Forest Products (NTFP) with special reference to bamboo and wild fruits.

Course outcome: *To understand the economical importance of plants and their products.*

Suggested Readings:

1. Singh. Pandey and Jain (2019).Economic Botany. Rastogi Publication, Meerut-250002
2. Wickens, G.E. (2001). Economic Botany: Principles and Practices. Kluwer Academic Publishers, Netherland.
3. Vardhana, R. (2009). Economic Botany, Sarup Book Publishers PVT. Ltd., New Delhi.
4. Hill, A. F. (2012). Economic Botany: A Textbook of Useful Plants and Plant Products, Surjeet Publications, Ashok Vihar 2, New Delhi.

BOT: DSC—252 T

Course Title: **Plant Systematics**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective: To study the plant taxonomy and its tools to measure the hierarchy.

Unit 1: Introduction to Plant systematics

Introduction to systematics; Plant identification, Classification, Nomenclature. Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary). Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora;

Unit 2: Taxonomic hierarchy & botanical nomenclature

Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids. Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access.

Unit 3: Systems of classification

Major contributions of Theophrastus, Linnaeus, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (up to series); Brief reference of Angiosperm Phylogeny Group (APGIII) classification. Characters; Variations; Estimating Resemblances: OTUs, Character weighting and coding; Cluster analysis; Clustering methods Phenograms, cladograms, Merits & Demerits of Numerical Taxonomy .

Dicotyledonae: Ranunculaceae, Magnoliaceae, Brassicaceae, Malvaceae, Febaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Solanaceae, Acanthaceae, Verbenaceae, Lamiaceae, Monocotyledonae: Hydrocharitaceae,Orchidaceae, Musaceae, Arecaceae, Araceae, Cyperaceae, Poaceae.

Unit 4: Study of Angiospermic families

Taxonomic Characters: Variations, resemblances, weighting and coding. OTUS, Cluster analysis, Clades. Numerical Taxonomy (Taxometrics). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals.

Unit 5: Biometrics and Phylogeny of Angiosperms

Terms and Concepts (primitive and advanced, homology and analogy, parallelism, and convergence, monophyly, paraphyly, polyphyly, and clades).Origin and evolution of angiosperm, co-evolution of angiosperm and animals, Methods of illustrating evolutionary relationship (Phylogenetic tree, cladograms)

Course outcome: *To have a comprehensive understanding of plant taxonomy, its components and various tools to study the plant systematics.*

BOT: DSC—253 (Practical)

Course Title: **Plant Systematics and Economic Botany**

Credits: 4 Marks: 100

***Course Objectives**: This course will provide detailed practical knowledge on taxonomy of angiosperm families and their economic importance.*

1. Taxonomic Studies (dissection, drawing, Taxonomic Description) of the Dicolyledonous species: Brassica sp; Sida sp; Cassia sp; Ageratum sp; Vernonia sp; Eclipta sp; Solanum sp; Rungia sp; Leucas sp; Ocimum sp; Amaranthus sp. Monocolyledonous species: Monocharia sp; Musa sp; Commelina sp; Cyprus sp; Cynodon sp.

2. Study of plants with economic importance (brief Description with diagram, economically important part/parts) Cereals: Rice, Wheat, Maize. Legumes: Pea, Lentil, any beans. Fats and Oil: Brassica Coconut. Fibre plants: Chorcorus, Boherhmia. Medicinal and Alkaloids: Adatodha, Aegel, Datura, Raulvofia, Nicotianum.

3. Field visit to any phyto-geographical regions or BSI or Institutes of botanical importance (Outside the State)

4. Herbarium Techniques: Collection, pressing, drying, poisoning, Mounting, labeling and identification of at least five locally available wild plants).

5. Practical Note Book.

6. Field Visit Report.

7. Viva voice and attendance.

***Course Outcome**: This course will provide detailed practical knowledge on morphology, taxonomy and economic importance. This paper will also emprise on preparation herbarium preparation and visit to different BSI.*

Suggested Readings

1.Singh,(2012).*PlantSystematics:*TheoryandPracticeOxford&IBHPvt.Ltd.,NewDelhi.3rded
ition

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

3.Judd,W.S.,Campbell,C.S.,Kellogg,E.A.,Stevens,P.F.(2002).PlantSystematics-
APhylogeneticApproach.SinauerAssociatesInc.,U.S.A.2ndedition.

4.Maheshwari,J.K.(1963).*Flora*ofDelhi.CSIR,NewDelhi.

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

BOT: DSC—252 (Practical)

Course Title: **Plant Anatomy, Embryology and Plant Physiology**

Credits: 3 Contact hours: 45 Marks: 100

***Course Objectives**: This course will provide Understanding on various morphological and anatomical features of plants, adaptive anatomy of xerophytes and hydrophytes, double staining mechanism, and various physiological features of plant metabolism.*

1. Study of apical meristem of root, shoot and vascular cambium through permanent slides and photographs.
2. Study of parenchyma, collenchyma and sclerenchyma through permanent slides and photographs.
3. Study of xylem and phloem elements through permanent slides and photographs.
4. Study of Root anatomy: Dicot & Monocot through permanent slides and photographs.
5. Stem: Dicot and monocot though temporary preparation (double stain method) and permanent slides.
6. Leaf: isobilateral, dorsiventral and Kranz anatomy through temporary preparation and permanent slides.
7. Adaptive anatomy: Xerophyte and hydrophytes
8. Study of types of ovules though permanent slides or photographs.
9. Female gametophyte: Polygonum monosporic types of embryo sac development though permanent slides and photographs.
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Determination of osmotic potential of plant cell sap by the method of plasmolysis
12. Determination of water potential of given tissue (potato tuber) by weight method,
13. Study of the effect of sunlight on the rate of transpiration in excised leaf/ twig
14. Effect of carbon dioxide concentration on the rate of photosynthesis.
15. Practical Record Book submission and Viva covering entire theory and Practical syllabus.

***Course Outcome**: This course will provide detailed practical knowledge on adaptive anatomy of xerophytes and hydrophytes, double staining mechanism, anatomy of plants.*

Suggested Readings

`

BOT: DSM – 252 T

Course Title: **Plant Physiology**

Credits: 3 Contact hours: 45 Marks: 100
(All units are of equal credits)

Learning Objective:

To study the physiological processes and their mechanism in plants

Unit 1: Plant-water relations

Importance of water, water potential and its components; Pathway of water movement, symplast, apoplast, transmembrane pathways; Transpiration and its significance;Factors affecting transpiration; Importance of stomata, Root pressure and guttation.

Unit 2: Mineral nutrition

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 3: Photosynthesis & Respiration

Photosynthetic Pigments (Chl a, b, xanthophylls, carotenes); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration. Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Unit 4: Plant growth regulators

Discovery, chemical nature and physiological roles of Auxins, Gibberellins, Cytokinin, Abscisic acid, Ethylene and their applications.

Unit 5: Plant response to light and temperature

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far-red light responses on photomorphogenesis; Vernalization.

Course Outcome: The course will highlight the mechanism and action of various physiological processes which maintain a plants life.

Suggested Readings

1.Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2.Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3.Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

SEMESTER V

BOT: DSC—301T

Course Title: Advance Morphology and Anatomy

Credits: 3 Contact hours: 45 Marks: 100
(All units are of equal credits)

Course Objective: *To study the concept of anatomical features of angiosperm, morphology of seed, and reproduction.*

Unit 1: Morphology of seed plants

Characteristic features of seed bearing plants, modification of root stem and leaves, Flower-structure and functions of floral parts, "Flower is modified Shoot", Origin and evolution of inflorescences, special types of inflorescences

Unit 2: Reproductive morphology

Pollination and its types, structure and functions of anther and pistil, Pollen-Pistil interaction, self-incompatibility, Double Fertilization and Triple Fusion, Evolution of Carpel, Formation and types of seed, Endosperm and Embryo, Formation and types of fruits, Development of Embryo-Sec, Dispersal mechanisms of seeds, Placentation and its evolution.

Unit 3: Application of plant anatomy

Applications of anatomy in biosystematics, Forensic science and Pharmagognosy, Internal organizations and development of plant body, Polarity, Cytodifferentiations and organogenesis, Tissue and tissue systems, Organization of shoot apex, Apical Cell Theory, Histogen Theory, Tunicacorpus Theory, Organization of root apex (Apical Cell Theory, Histogen Theory, Quiescent Centre, Root stem transition.

Unit 4: Vascular cambium and wood

Cyto differentiation of treachery elements, Seive elements, Pits and Plasmodesmata, Structure, function and seasonal activity of cambium, Secondary growth in roots and stem, Anomalous secondary growth in stem, Sap wood and Heart wood,earlywood and late wood, Tyloses, Growth Ring and Dendrochronology.

Unit 5: Adaptive and protective anatomy

Epidermal tissue system: Cuticule, waxes, trichomes, Stomata, Hydathodes, Cavities, Lithocysts, laticifers, periderm, rhytidome, lenticels and ergastic substances, Anatomic features of Hydrophytes and xerophytes.

***Course Outcome**: This course will provide understanding on anatomical features of plants, vascular characteristics and plant adaptations.*

Selected Readings:

1. The Embryology of Angiosperms: Bhojwani, S.S and Bhatnagar, S.P.(2000): Vikash Publishing House, New Delhi
2. Embryology of Angiosperms: Johri, B.M. (1984):Springverlag, Berlin
3. The Morphology of Angiosperms: Sporne, K.R. (1977) B.T. Publications, Bombay
4. Pant Anatomy: Fahn. A (1974), Porgamon Press, Oxford
5. Anatomy of Seed Plants (1977): Ezau, K, John Willy & Sons, New York
6. Patterns in Plant Development (1989): Steeves, T.A and Sussex, I.M. Cambridge University Press, Cambridge
7. Advance Morphology: Eames

BOT: DSM—301T

Course Title: Plant **Biochemistry**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective: *To study the fundamental principles and concepts in plant biochemistry and to enable the students to comprehend the intricate biochemical processes.*

Unit 1: Carbohydrates

Structure, properties and biological significance of monosaccharide's, disaccharides and polysaccharides; homo and hetero polysaccharides; mucopolysaccharides; glycoproteins and their biological functions.

Unit 2: Amino acids and proteins

Structure and properties of amino acids; physical and chemical properties of proteins; different level of structural organization of proteins; forces stabilizing protein structure and shape; fibrous and globular proteins. Protein purification techniques: protein extraction and fractionation techniques.

Unit 3: Lipids and Nucleic acids

Classification and properties of fatty acids; saturated and unsaturated fatty acids; essential fatty acids; phospholipids; glycolipids; steroids. Nucleic acids: nucleosides and nucleotides; purines and pyrimidine's; physical and chemical properties of nucleic acids; double helical model of DNA; types of DNA.

Unit 4: Carbohydrate metabolism

Glycolysis; fate of pyruvate under aerobic and anaerobic conditions; pentose phosphate pathway; gluconeogenesis; glycogenolysis TCA cycle; electron transport chain; cyanide resistant respiration; factors affecting respiration.

Unit 5: Enzymes

Nomenclature and classification of enzymes; active site; lock-and-key model and induced-fit model; factors affecting enzyme activity; activation energy; allosteric regulation; enzyme inhibition- competitive, non-competitive and uncompetitive; cofactors; prosthetic groups; enzyme kinetics; ribozymes.

Course Outcome: *The course will provide students with a comprehensive understanding of the molecular foundations of life. By the end of the course, students will be able to describe the structure and properties of biomolecules. Furthermore, students will have a comprehensive understanding of the major pathways of metabolism.*

Suggested readings

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger: Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

BOT: DSC—302T

Course Title: **Plant Physiology**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective: *To study the basic concept of plant metabolism and their importance along with various aspects of photosynthesis, respiration, plant hormone and stress.*

Unit 1: Water relations and phloem transport

Basic Concepts on diffusion, osmosis and water potential, Osmotic system and components of water potential; Diffusion Pressure Deficit; Water absorption by roots; pathways of water movement, apoplastic, symplastic and trans-membrane transport of water; Transpiration and factors affecting transpiration; anti-transpirants; Stomatal anatomy and stomatal movement; Aquaporins and its function; Phloem translocation; Phloem loading and unloading; Pressure Flow model, Source-Sink relationship; cohesion-tension theory, Pressure flow theory

Unit 2: Photosynthesis and respiration

Photosynthesis: Light and Dark Reactions; Photosystem (PS) I and II; Cyclic and non-cyclic electron transport; Mechanisms of photosynthesis in C3, C4 and CAM plants; Kranz Anatomy; Factor affecting photosynthesis, Photophosphorylation; Respiration: Aerobic and anaerobic respiration; Respiratory quotient (RQ); Glycolysis, Krebs (TCA) cycle, electron transport system, oxidative phosphorylation; Photorespiration; Source-Sink relationship.

Unit 3: Mineral nutrition

Mineral nutrition in plants: Essential and non-essential elements; Factors affecting nutrient availability; Nutrient acquisition; Mechanisms of mineral uptake and translocation; Ion transporters; xylem-phloem mobility; Ion traffic in roots, passive and active transport, functions of essential elements in plants, symptoms and effects of nutrient deficiency in plants

Unit 4: Plant growth regulation

Seed dormancy and germination; Concept of Vernalization, Photoperiodism, Gravitropism and its regulation; Concept of florigen; Floral Development, Discovery, Biosynthesis and Physiological role of auxin, gibberellins, Cytokinins, Abscisic Acid (ABA) and ethylene; Biological nitrogen fixation and assimilation in plants; Phytochrome and photomorphogenesis; Circadian rhythms, Photoperiodism.

Unit 5: Ecophysiology and stress physiology

Ecophysiology and its importance; Physiological adaptations in plants; Concept of stress physiology; Physiological responses in plants to abiotic stresses; ABA signaling in plants; Reactive oxygen species (ROS), Oxidative stress; ROS scavenging system; Molecular physiology of stress tolerance in plants.

Course Outcome*: This course will provide a detailed understanding on Mineral nutrition, transport of minerals from soil by plants, photosynthesis, mode of action of plant hormone and various impacts of biotic and abiotic stress on plants.*

Suggested Reading

1. Plant Physiology (2017). Frank B. Salisbury and Cleon W. Ross. Thomson Wordsworth, Australia
2. Fundamentals of Plant Physiology, V. K. Jain, S. Chand & Company, India
3. Fundaments of Plant Physiology, L. Taiz, E.Zeiger, Oxford University Press
4. Plant Physioloy, P. Stewert, S. Globig, CRC Press, Boca Raton, FL

BOT: DSM-303

Course Title: **Practical**

Contact hours: 45

(All units are of equal credits)

Credits: 3 Marks = 100

Course Objectives: *To understand practical knowledge about taxonomic characterization of plants of different families and various metabolic phenomenon takes palace in plants.*

1. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification):

Ranunculaceae -	*Ranunculus, Delphinium*
Brassicaceae -	*Brassica, Alyssum / Iberis*
Myrtaceae -	*Eucalyptus, Callistemon*
Umbelliferae -	*Coriandrum /Anethum / Foeniculum*
Asteraceae -	*Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax*
Solanaceae -	*Solanum nigrum/Withania*
Lamiaceae -	*Salvia/Ocimum*
Euphorbiaceae -	*Euphorbia hirta/E.milii, Jatropha*
Liliaceae -	*Asphodelus/Lilium/Allium*
Poaceae -	*Triticum/Hordeum/Avena*

*** Any other available plant (one from each family)

2. Field visit to different photo-geographical regions or BSI or Institutes of botanical importance (Outside the State)

3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

4.Determination of osmotic potential of plant cell sap by plasmolytic method.

5.Determination of water potential of given tissue (potato tuber) by weight method.

6. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.

7. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).

9. To study the phenomenon of seed germination (effect of light).

10. To study the induction of amylase activity in germinating seeds.

Course Outcome: *To have a comprehensive practical knowledge about vegetative and floral characters of the families of plants along with physiology of plant metabolism.*

Suggested Readings:

1. Singh, (2012). *Plant Systematics:* Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.
2. Jeffrey, C. (1982). An Introduction to *Plant Taxonomy.* Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Maheshwari, J.K. (1963). *Flora* of Delhi. CSIR, New Delhi.
5. Radford, A.E. (1986). Fundamentals of *Plant Systematics*. Harper and Row, New York
6.Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
7. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.

BOT: DSM—302

Course Title: **Plant Ecology**

Credits: 3 | Contact hours: 45 (All units are of equal credits) | Marks: 100

Course Objective: *To study the basic concept of ecosystem and their components, population and community structure. The paper also deals with the adaptation of flora and fauna.*

Unit 1: Introduction to ecology

Basic concepts, levels of organization, inter-relationship between the living world and the environment, the component of environment, dynamism, homeostasis, types of species interactions.

Unit 2: Soil and water

SOIL: Origin, Formation and Composition Physical, Chemical and Biological components, Soil Profile, Role of climate in soil development, Importance of soil.
WATER: States of water, Importance of water, Precipitation and its types, Hydrological cycle, water in soil and atmosphere, Water Table.

Unit 3: Population and community ecology

Characteristics of population, Population regulation, Dynamics, Ecological Speciation, Concept of Ecological amplitude, habitat and niche, Ecotone and edge effect, Nature of plant community, Community structure and attributes, Keystone species and control of Community structure, Plant succession and types.

Unit 4: Ecosystem: structure, function and processes

Concept, structure and functions, Ecosystem and stability, Energy flow model and Ecological efficiencies, Concept of productivity: Primary and Secondary, Productivity, Biomass and standing crops, Trophic organization, Food Chains and Food Web, Ecological Pyramids, Biogeochemical cycles: Carbon and Nitrogen cycles.

Unit 5: Adaptive ecology and biogeography

Variations, Adaptation of plants to their variation, Theory of Tolerance, Continental drift, Endemism, Biomass and major bio geographical zones in India, Phyto geographical divisions of India with emphasis of local vegetation.

Course Outcome*: This course will provide a detailed understanding on ecology and ecosystems, interactions, ecosystem processes, adaptations and biogeogrqaphical aspects*

Selected Readings

1. Ambasht, R.S &Ambasht, N.K. (2003): Modern trends in Terrestrial Elocogy. Plenum Publishers, New York.
2. Ambasht, R.S &Ambasht, N.K. (2008): A Textbook of Plant Ecology (15thedt), CBJ Publishers and Distributors, New Delhi
3. Kormondy, E.J. (1996): Concepts of Ecology, Prentice Hall-New-Learning Pvt.Ltd.Delhi.
4. Odum, E.P (1983): Basic Ecology, W.B. Saunders College Publishers, New York.
5. Puri, G.S., Gupta, R.K. & Puri, S. (1983): Forest Ecology, Phytogeography and Forest Conservation, Oxford and I.B.H.C, New Delhi
6. Singh, J.S, Singh, S.P. & Gupta, S (2006): Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi
7. Sharma, P.D. (2010): Ecology and Environment, Rastogi Publications, Meerut, India
8. Sahu, A.C. (2020): Fundamentals of Plant Ecology & Phytogeography, Kalyani Publishers
9. Baruah, A. (2022): Text Book of Plant Ecology & Taxonomy, Kalyani Publishers
10. Asthana, D.K. & Asthana(2003):Environment Management: Issues and Solutions, John Wiley & Sons

SEMESTER-VI

BOT: DSC—351

Course Title: **Ecology and Phytogeography**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective: *To study the various aspects of ecology, ecosystem and phytogeography*

Unit-1: Introduction to Ecology and Ecosystem

Ecology: Basic concepts, Levels of organization, Inter-relationships between the living world and the environment. Ecosystem: Structure, functions, and types, trophic organization, food chains and food webs, ecological pyramids, homeostasis.

Unit 2: Abiotic and Biotic Factors

Importance, Formation of soil, Composition of soil (Physical, Chemical and Biological), Soil profile, Role of climate in soil development, Plant adaptation to environmental factors (light, temperature, wind, and fire); autotrophy, heterotrophy; symbiosis, commensalism, ammensalism, parasitism.

Unit 3: Population Ecology and Community Ecology

Population Characteristics, Growth curve, Concept of Ecological Speciation, Plant Community: Basic concept, types and characters (analytical and synthetic), Dynamics: succession – processes, types, climax concepts, Habitat and Niche: concept & types, Ecological Amplitude, Ecotone and Edge Effect

Unit 4: Functional Ecology

Principles and models of energy flow; Production and productivity; Ecological efficiencies; Ecological energetics; Biogeochemical cycles (C, N and S), Water cycle, microbial ecology.

Unit 5: Phytogeography

Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Vegetation types of NE India with special reference to Assam.

Course Outcome*: This course will provide a detailed understanding on ecology and ecosystems, biotic and abiotic interactions, ecosystem processes, population and community interactions and plant distribution.*

Suggested Readings:

1. Ambasht and Ambasht (2002) A text book of Plant Ecology. CBS publisher and Distributors.
2. Bowmen WD, Hacker SD, Cain ML (2018) Ecology, Oxford University Press.
3. Deka U, Dutta T (2022) Plant Ecology and Phytogeography. Asian Humanitities Press, Guwahati, Assam.

4. KapurP, GovilSR (2000, 2007). Experimental Plant Ecology.CBS Publishers and Distributors, New Delhi (India).
5. Kormondy EJ (1996) Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.
6. Misra R (1968, Reprinted in 2019). Ecology Workbook. Scientific Publishers (India), Jodhpur
7. Odum EP (2005) Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
8. Raj M, Deka H (2022) Plant Ecology and Phytogeography. Ashok Book Stall, Guwahati, Assam.
9. Sharma PD (2010) Ecology and Environment. Rastogi Publications, Meerut, India.8th edition.
10. Smith TM, Smith RL (2015) Elements of ecology. Pearson publishers., London. 9th Edition

BOT: DSC—352

Course Title: **Plant Biochemistry and Metabolism**

Credits: 3Contact hours: 45 Marks: 100

(All units are of equal credits)

Course objective:

To study the biomolecules and their importance in living system and the various metabolic pathways leading to formation of significant molecules and their catabolism

Unit 1: Bimolecular Structure and Function

Types and significance of chemical bonds; Structure and properties of water; pH and buffers. Structu**re** and classification of Carbohydrate, protein and lipid. Importance of biomolecules in living system. Laws of thermodynamics, the concept of free energy, endergonic and exergonic reactions, coupled reactions, and redox reactions.

Unit 2: Enzyme Kinetics

Enzyme nomenclature and classification, holoenzyme, apoenzyme, cofactors, coenzymes, and prosthetic group; Features of the active site, mechanism of enzyme action, Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

Unit 3: Carbon Assimilation

Photosynthetic pigments, and reaction centres, photosynthetic electron transport, CO_2 reduction (C3 cycle), photorespiration, C4 pathways; Crassulacean acid metabolism and their regulation, Red Drop, Emerson Enhancement effect, Blackmans Laws of Limiting factor.

Unit 4: Carbohydrate Metabolism & Carbon Oxidation

Synthesis and catabolism of starch, Glycolysis, regulation of glycolysis, pentose phosphate pathway, TCA cycle, anaplerotic reactions, regulation of the Krebs cycle, mitochondrial electron transport, oxidative phosphorylation, Anerobic respiration in plants, Mechanism of ATP synthesis.

Unit 5: Plant Hormones & Nitrogen metabolism

Biosynthesis of Auxin, Gibberellin, Cytokinin, and Abscisic acid.Transport and mode of action of plant hormones, physiological and biochemical effects of hormones in plants.
Biological nitrogen fixation (leguminous and non-leguminous); Nitrate assimilation, biochemistry of nitrogen fixation; Ammonia assimilation.

Course Outcome*: the course enable students to learn diverse types of biomolecules, their mode of action and role in maintaining metabolic balance.*

Suggested Readings-

1. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
2. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
3. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
4. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology.John Wiley and Sons. U.S.A. 4th edition.
5. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
6. Sinha RK (2004). Modern Plant Physiology.Narosa Publishing House.

BOT: DSC—353

Course Title: **Plant Biotechnology**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective:

The objective of this course is to introduce the students to plant tissue culture, rDNA technology, gene transfer and applications of biotechnology.

Unit 1: Plant Tissue Culture

Historical perspective; Composition of media; Role of vitamins and hormones in plant tissue culture; Totipotency; Organogenesis; Embryogenesis; Protoplast isolation, culture and fusion; Micro-propagation; Androgenesis; Haploid production; Virus elimination; Secondary metabolite production; Triploids; Cryopreservation; Germplasm Conservation.

Unit 2: Recombinant DNA technology

Restriction Endonucleases (Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid,; Eukaryotic Vectors (YAC).

Unit 3: Gene Cloning

Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR mediated gene cloning; Construction of genomic and cDNA libraries, Screening DNA libraries to obtain gene of interest by genetic selection; Colony hybridization; PCR.

Unit 4: Methods of gene transfer

Agrobacterium-mediated gene transfer, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Unit 5: Applications of Biotechnology

Pest resistant plants (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); edible vaccines; Gentically Engineered Products–Human Growth Hormone, Humulin; Biosafety concerns.

Course Outcome: *Upon successful completion of this course, the students will be able to explain the fundamentals of plant tissue culture, gene cloning and various applications of plant biotechnology. This knowledge will equip them to work in various areas of plant biotechnology.*

Suggested readings

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science. Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications.John Wiley & Sons Inc. U.S.A.

BOT: DSC—354 (Practical)

Course Title: **Ecology and Phytogeography; Plant metabolism and Biochemistry; Plant Biotechnology**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course objective: *To provide students with hands-on experience in areas such as ecology, plant metabolism and biochemistry and plant biotechnology.*

1. Determination of pH of various soil and water samples.
2. Study of morphological adaptations of hydrophytes and xerophytes (two each).
3. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method (species to be listed).
4. Quantitative analysis of herbaceous vegetation in the college campus for frequency andcomparison with Raunkiaer's frequency distribution law.
5. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
6. Study of Soil textures by sieve analysis.
7. Local field visit to familiarise students with ecology of different sites.
8. Determination of osmotic potential of plant cell sap by plasmolytic method.
9. Effect of carbon dioxide on the rate of photosynthesis.
10. Preparation of solutions and buffers.
11. Separation of amino acids by paper chromatography.
12. Chlorophyll separation by paper chromatography.
13. Preparation of complex nutrient medium (Murashige & Skoog's medium).
14. Selection, sterilization and preparation of an explant for culture.
15. Techniques of inoculation under aseptic conditions.
16. Demonstration of various steps of Micropropagation.
17. Isolation of plasmid DNA (Demonstration).
18. Isolation of Protoplasts (Demonstration).
19. Viva-voce covering entire syllabus by External and Internal Examiners.
20. Submission of Practical Record Books.

Course outcome: *By the end of this course, the students will acquire practical skills in laboratory techniques. These practical competencies will equip students for careers in connection with ecology, plant metabolism and biochemistry and plant biotechnology.*

Suggested readings:

1. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation.Anamaya Publications, New Delhi, India.
2. Sharma, P.D. (2010). Ecology and Environment.Rastogi Publications, Meerut, India.8th edition.

3. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach.
4. Bajracharya D. (1999).Experiments in Plant Physiology-A Laboratory Manual. Narosa
1. Publishing House, New Delhi.
5. Harborne, J.B. (1973). Phytochemical Methods.John Wiley & Sons. New York.
6. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry.VI Edition. W.H Freeman and Co.
7. Gupta, R& Makhija, S and Toteja R. (2018). Cell Biology : Practical Manual. Prestige Publishers.
8. Buzarbarua, A.(2000). A Textbook of Practical Plant Chemistry. S. Chand and Co. Ltd.
9. Trigiano, R. N., & Gray, D. J. (2015). Plant Tissue Culture Concepts and Laboratory Exercises. CRC Press.
10. Bhojwani, S. S., & Razdan, M. K. (1996). Practical Plant Tissue Culture. Oxford & IBH Publishing.
11. Dutta Gupta, S., & Prakash, Y. S. S. (2013). Plant Tissue Culture and Biotechnology: Emerging Trends. Springer.

BOT: DSM—351 (Practical)

Credits: 3 Contact hours: 45 Marks: 100

Course Objective: *To study the basic Practical aspects of DO, frequency distribution, testing of water sample, soil parameters, hydrophyphytes, xerophytes etc.*

1. Study of instruments used to measure microclimatic variables: Soil Thermometer, maximum and minimum thermometer, anemometer, Psychometer / Hygrometer, Rain gauge and Lux Meter.
2. Determination of P H of various soil and water samples (P H Paper, P H Meter).
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Comparison of bulk density, porosity and rate of infiltration. Water in soil of three habitats.
5. Determination of organic matter of different soil samples by Walk Ley and Black Rapid Tiltration method.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
7. (a) Study of morphological and anatomical adaptations of hydrophytes and Xerophytes (4 each).
(b) Study of biotic interactions of the following: Stem Parasite (Cusuta); Root Parasite (Orobanche); Epiphytes, Predation (Insectivorous plants).
8. Study of soil textures by seive analysis.
9. Determination of density and frequency of herbaceous vegetation in the College campus by Quadrat method.
10. Excursion or field visit to familiarize students with floristically rich areas / educational research institutes of ecological significance.

Course Outcome: *To study the basic Practical aspects of frequency distribution, testing of soil parameters, morphology of hydrophyphytes, xerophytes and interaction of biotic and abiotic environment factors etc.*

Suggested Readings:

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

SEMESTER-VI

BOT: DSC—401

Course Title: **Reproductive Biology of Angiosperms**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective: *To study the basic concept of reproduction mechanism of Angiosperm, formation of embryo.*

Unit 1: Introduction to Reproductive Biology of Angiosperms

History and scopes; Contributions of G. B. Amici, W. Hofmeister, E. Strasburger, S. G. Nawaschin, P. Maheswari, B. M. Johri, W. A. Jensen, P. Heslop-Harrison, M.S. Swaminathan. Flower: structure and development, Flower as a modified determinate shoot; Flower development: genetic and molecular aspects

Unit 2: Anther and Pollen Biology

Structure of anther- anther wall and function, microsporogenesis and development of male gametophyte; Pollen wall structure, MGU (Male Germs Unit) pollen morphology and NPC system. Pollen wall proteins, pollen viability, storage and germination. Abnormal features: pseudomonad, polyads, massulae, pollinia.

Unit 3: Ovule

Structure and types of ovules, megasporogenesis and development of female gametophyte: megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (Details of *Polygonum* type); types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 4: Pollination and fertilization

Pollination-types and significance; mechanisms and adaptations, double fertilization. Basic concept of self-incompatibility, stub pollination, intra-ovarian and in vitro pollination, parasexual hybridization, cybrids, in vitro-fertilisation.

Unit 5: Embryo, Endosperm and Seed

Endosperm-types, structure and functions, development of dicot and monocot embryo. Embryo-endosperm relationship, nutrition of embryo, embryo development in *Paeonia*, Apomixis and Polyembryony and its practical application. Seed structure and dispersal mechanisms.

Course Outcome: *This course will provide a detailed understanding reproduction of angiosperm.*

Suggested readings:

1.Bhojwani, S. S. and Bhatnagar, S. P. (2011). The Embryology of Angiosperms. Vikash publishing Hous, Delhi
2.Raghavan, V. (2000). Developmental Biology of Flowering Plants, Sringer, Netherlands.
3.Maheshwari P. (2020). An Introduction to the Embryology of Angiosperms, Alpha Edition.
4.Singh V., Pande, P. C., Jain, D. K. (2018). Embryology of Angiosperms (Including: Morphology & Morphogenesis), Rastogi Publications, Meerut, Uttar Pradesh.

BOT: DSC—402

Course Title: **Plant Pathology**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective: *To study the basic concept of Plant disease, disease resistance and molecular mechanism of disease and pathogenesis.*

Unit 1: Introduction to Plant Diseases

Historical developments, Classification of Plant diseases; General account of diseases caused by plant pathogens; Pathogen attack and defense mechanisms: physical, physiological, biochemical and molecular aspects.

Unit 2: Plant Disease Epidemiology and Management

Mechanism of transmission and spread of plant pathogens; Disease cycle; Epidemics; Plant disease forecasting; Plant disease management: chemical, biological, IPM systems, breeding for disease resistance; Innovative methods of plant disease control; Bio pesticides; Simulation epidemics.

Unit 3: Genetics of Resistance and Susceptibility

Genes for virulence and avirulance, their application in resistance and susceptibility; Genetics of plant pathogen interaction; Effect of environmental factors and nutrition on disease development; Brief concept and types of plant immunity; Induced resistance (immunization).

Unit 4: Viral and Bacterial Pathology

Isolation and purification of plant viruses; Serological and molecular methods for detection and identification of virus and bacteria; Modern methods of plant virus control (cross protection, transgenic approaches, RNAi, CRISPR- CAS system); Viral and bacterial diseases: Causal organisms, symptoms, disease cycle and control measures of Mosaic disease of Tobacco and Cucumber, Yellow vein mosaic of Bhindi, Leaf curl of Papaya, Citrus canker, Scab of potato, Angular leaf spot of Cotton.

Unit 5: Fungal Pathology

Fungal diseases: Causal organisms, symptoms, disease cycle and control measures of Blast and brown spot of Rice, Rust and smuts of Wheat, Downy mildew of Bajra, White rust of Crucifers, Late Blight of Potato, Wilt of Pigeon Pea, Damping off seedlings, Tikka disease of Ground nut, Red rot of Sugarcane, Grey Blight of Tea; Application of information technology in plant pathology.

Course Outcome: *This course will provide a detailed understanding on plant disease, microbes involved, and control of diseases.*

Suggested readings

1. Agrios, G.N, 197: Plant pathology, Academic Press, London

2. Aneja, K.R. 1993: Experiments in Microbiology, Plant Pathology and Tissue Culture, Vishwa Prakahan New Delhi.

3. Bridge, P. et al 1998: Molecular variability of fungal pathogens, CAB international, UK

4. Bridge, P. et al 1999: Application of PCR IN mycology, CAB international, UK

5. Mehrotra, R.S. 2003: Plant Pathology, McGraw Hill Education (India) Private Ltd, New Delhi

6. Porsloy, G.J. 1996: Biotechnologies and Integrated Pest Management, CAB international, UK

7. Rangaswamy, G.2009: Diseases of Crop Plants in India, Prantice Hall publications, New Delhi.

8. Sharma, P.D. 2011: Plant Pathology, Rastogi publications , New Delhi,

9. Trigiano Robert, N. 2007: Plant Pathology Concepts and Laboratory Exercises, 2nd Edition , CRC

BOT: DSC—403

Course Title: **Ethnobiology, Biostatistics and Bioinformatics**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective: *To study the basic concept of Ethnobiology, applications of Biostatistics and various aspects of Bioinformatics.*

Unit 1: Basic aspects of Ethnobiology

Introduction, concept, scope and objectives of ethnobiology; Ethnobotany as an interdisciplinary science; Ethnic groups or Tribals of India, and their lifestyles; Plants used by the tribals: a) Food plants b) Intoxicants and beverages c) Resins and oils; Biopiracy, Intellectual Property Rights.

Unit 2: Role of ethnobotany in modern Medicine

Medico-ethnobotanical sources in India; Role of ethnobotany in modern medicine with special reference to *Rauwolfia sepentina, Azadirachta indica, Ocimum sanctum* and *Vitexnegundo*; Role of ethnic groups in conservation of plant genetic resources.

Unit 3: Data

Types of data, Collection of data; Tabular and graphical representation of statistical data. Measures of central tendency: mean; median; mode. Measures of Dispersion: absolute measures and relative measures; range; variance; mean deviation; standard deviation and standard error.

Unit 4: Biostatistics

Definition of probability; Binomial, poison and normal distributions; Hypothesis Testing: null hypothesis; alternative hypothesis; confidence level; significance level; t-test, chi-square test; definition of Correlation and regression.

Unit 5: Basics of Bioinformatics

Bioinformatics tools and uses, Biological database GENBANK, NCBI; PDB; BLAST Sequence homology; Detecting open reading frames; Global and local alignment; Multiple sequence analysis; Phylogenetic analysis.

Course Outcome: *Students will acquire the skills on ethnobiological research, statistical analysis of biological data and utilisation of bioinformatics tools. They will also proficiently utilize biological databases for research and applications.*

Suggested readings

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian Ethnobotny, Oxford and I B H, New Delhi – 1981
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists
4. Biostatistic, Danniel, W.W., 1987.New York, John Wiley Sons.
5. Statistics for Biologists, Campbell, R.C., 1998.Cambridge University Press.
6. Banerjee, P. K. (2007). Introduction to Biostatistics (A Textbook of Biometry). India: S.Chand Limited.
7. Antonisamy, B., Premkumar, P. S., Christopher, S. (2017). Principles and Practice of Biostatistics. India: Elsevier India.
8. Rosner, B. (2016). Fundamentals of Biostatistics. United States: Cengage Learning.
9. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
10. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition.Wiley-Blackwell.
11. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

BOT: DSC-404

Course Title: Practical – V

(Reproductive Biology of Angiosperms; Plant Pathology; Ethnobiology, Biostatistics and Bioinformatics)

Credits: 4 Contact hours: 60 Marks: 100

(All units are of equal credits)

Course objective: *To provide students with hands-on experience in areas such as Reproductive Biology of Angiosperms, Plant pathology, Ethnobiology, Biostatistics and Bioinformatics*.

1. Study of Pollen grains by acetolysis method.
2. Study of psuedomonads, polyads and pollinia (by photographs/fresh material).
3. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous (by specimens/photographs).
4. Female gametophyte through permanent slides/ photographs.
5. Intra-ovarian pollination (Demonstration).
6. Study of dicot and monocot embryo through permanent slides.
7. Study of suspensor through electron micrograph.
8.Herbarium specimens/ photographs of bacterial diseases: Citrus Canker and Angular leaf spot of cotton,
9.Herbarium specimens/ photographs of viral diseases: TMV and Vein clearing.
10. Study of fungal diseases: Early blight of potato, Late blight of potato, Black stem rust (Puccinia), White rust of crucifers.
11. Preparation of fungicide (Bordeaux mixture).
12. Identification and description of plants of ethnobotanical value.
13. Identification and description of plants used by tribals for their household.
14. Collection and study of different wild edible fruits.
15. Study of t-test from given data.
16. Study of Chi-square test from given data.
17. Correlation analysis and interpretation.
18.Exploring Biological database
19. Viva-voce covering entire syllabus by External and Internal Examiners.
20. Submission of Practical Record Books.

Course outcome: Upon completing this course the students will develop practical skill on reproductive Biology of Angiosperms, management of plant diseases, Ethno biological aspects, statistical data analysis and Bioinformatics tools.

Suggested readings:

1. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
2. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
3. Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.
4. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.

5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.
6. Cunningham, A.B. (2001). Applied Ethnobotany. Earthscan Publishers Ltd., London & Sterling, VA, USA.
7. Jain, S.K. (1981). Glimpses of Indian Ethnobotany.Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.
8. Jain, S.K. (1989). Methods and approaches in Ethnobotany. Society of Ethnobotanists, Lucknow.
9. Antonisamy, B., Premkumar, P. S., Christopher, S. (2017). Principles and Practice of Biostatistics. India: Elsevier India.
10. Rosner, B. (2016). Fundamentals of Biostatistics. United States: Cengage Learning.
11. Attwood, T. K., & Parry-Smith, D. J. (1999). Introduction to Bioinformatics. Pearson Education.
12. Felsenstein, J. (2004). Inferring Phylogenies.Sinauer Associates.

BOT: DSM-401

Course Title: **Cell and Molecular Biology**

Credits: 4 Contact hours: 60 Marks: 100
(All units are of equal credits)

Unit 1: The Cell, Cell Organelles and Cell Division

Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory); Overview of membrane function; fluid mosaic model; Membrane transport, endocytosis and exocytosis. Structure & function of Cell organelles , Definition, types of cell division, cell cycle, mitosis, meiosis & their significance; cell cycle- checkpoints, role of protein kinases.

Unit 2: Nucleic acid

Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel- Conrat's experiment. DNA Structure: structure of DNA, cot curves; Organization of DNA-Prokaryotes, Viruses, Eukaryotes. RNA Structure mitochondria and chloroplast DNA. The Nucleosome; Chromatin, Heterochromatin.

Unit 3: The replication of DNA, Central Dogma and Genetic Code

General principles – bidirectional, semi- conservative and semi discontinuous replication of DNA, RNA priming; Various models of DNA replication, Enzymes involved in DNA replication. Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code.

Unit 4: Transcription, Modification and Processing of tRNA

Transcription in prokaryotes and eukaryotes; Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in *E. coli.* Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Split genes-concept of introns and exons, spliceosome machinery.

Unit 5: Translation

Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, Post-translational modifications of proteins.

Course Outcome: *This course will provide a detailed understanding on structure of cell, types, organelles and molecular mechanism of metabolism.*

Suggested Readings

1. Karp, G.(2010).Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
2. Hardin, J., Becker, G., Kliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
3. Cooper, G.M. and Hausman, R.E. (2009), The Cell: A Molecular Approach. 5th edition.ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009), The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco
5. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007).Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A.6th edition.
6. Russell, P.J. (2010), i-Genetics-A Molecular Approach. Benjamin Cummings, U.S.A.3rd edition.

BOT: DSC—451

Course Title: **Research Methodology**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

Course Objective: *To study the basic concept of research, research ethics, copyrights, data presentation and omics.*

Unit 1: Basic concepts of research

Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical).Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

Unit 2: General laboratory practices

Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

Unit 3: Data collection and documentation of observations

Maintaining a laboratory record; Methods of collection of data, Sampling methods, Tabulation and generation of graphs, Analysis of data, Imaging of tissues specimens and application of scale bars.

Unit 4: The art of scientific writing and its presentation

Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct, plagiarism. Ethical issues in scientific writings.

Unit 5: Overview of Biological Problems

History; Key biology research areas, Model organisms in biology (A brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics.

Course Outcome: The paper will enable to gather knowledge about basic research methodologies, research ethics and data presentation.

Suggested Readings

1. Research Methodology – C.R.Kothari

BOT: DSC—452

Course Title: **Applied Botany**

Credits: 3 Contact hours: 45 Marks:100

(All units are of equal credits)

Course Objective: *To study the basic concepts of Applied Botany and to apply fundamental knowledge of various agricultural practices.*

Unit 1: Basic aspects

Introduction, objectives and importance of applied Botany; relation of plants to man; role of Botany in rural development; importance of plants in various services; various disciplines of Botany and their applications in human welfare; cultivation of edible fungi; enthnobotany-introduction and importance; genetic engineering; transgenic plants; phytoremediation and its role in pollution control.

Unit 2: Agricultural practices

Ancient agricultural practices; modern agricultural practices: polyhouse, drip irrigation, hydroponics, terrace farming; computer based agriculture; Organic farming: introduction, objective, brief technique, significance and limitations; Silviculture: definition and management practices; social forestry and its importance; Forestry: definition, branches and role in human welfare.

Unit 3: *In vitro* culture

Micropropagation and its importance; culture media; role of hormones in tissue culture; callus culture; bud culture; androgenesis; anther culture; embryo culture; endosperm culture; meristem culture; somaclonal variation- its advantages and limitations; somatic cell hybridization; cybrids; suspension culture; production of secondary metabolites; cryopreservation.

Unit 4: Biofertilizers

Introduction, types and significance of biofertilizers; symbiotic biofertilizers; non-symbiotic biofertilizers; algal biofertilizers; Mycorrhiza: definition, types and significance; isolation and mass multiplication of *Rhizobium*; isolation and mass multiplication of *Azospirillum*; blue-green algae and *Azolla* in rice cultivation; green manuring, vermicomposting and its significance.

Unit 5: Propagation of plants

Introduction to gardening; cutting, layering and grafting; pruning, manuring and watering; role of plant growth regulators in horticulture; Bonsai; bottle gardens; indoor plants; green

house; orchards; ornamental climbers; ornamental trees; bulbous plants; rooting media: peat moss and vermiculite; kitchen gardens; vertical gardens; landscaping of educational institutions.

Course Outcome: *Students will acquire the skills on applied Botany. They will able to explore about employment opportunities in the field of Botany.*

Suggested readings

1. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
2. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
3. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., NewDelhi.
4. DUbey, R.C., 2005 A Text book of Biotechnology S.Chand& Co, New Delhi.
5. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
6. Maiti R., Rodrigues H.G. and Thakur A.S. “Applied Botany” American AcademicPress.2017
7. Gupta P. K. “Molecular Biology and Genetic Engineering “ Rastogi Publications.2005
8. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.

BOT_DSC_453

Course Title: **Biodiversity and Climate Change**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

***Course Objective*:** To study the various aspects of biodiversity, its conservation, management and science of climate change, sustainable development strategies.

Unit 1: Introduction

Introduction- Definition, Genetic diversity, Species diversity, Ecosystem diversity: Structural and functional aspects. Bio-geographic classification of India, Basic concepts of conservation biology, history of conservation biology, the value of biodiversity and conservation, current practice in conservation, conservation of genetic diversity, species diversity, ecosystem diversity.

Unit 2: Biodiversity of India

Value of biodiversity, hotspots of biodiversity, germplasm and diversity, sustainability, bioethics and tribal population, sustainable development, India as a mega biodiversity Nation.

Unit 3: Threats to biodiversity

Natural and anthropogenic disturbances; habitat loss, habitat degradation, and habitat fragmentation; climate change; pollution; hunting; over-exploitation; deforestation; hydropower development; invasive species; land use changes; overgrazing; man wildlife conflicts; consequences of biodiversity loss; Intermediate disturbance hypothesis.

Unit 4: Conservation of biodiversity

In situ conservation (Biosphere Reserves, National Parks, Wildlife Sanctuaries); *Ex-situ* conservation (botanical gardens, zoological gardens, gene banks, seed and seedling banks, pollen culture, tissue culture and DNA banks), role of local communities and traditional knowledge in conservation, IUCN Red List categorization – guidelines, practice and application; Red Data book; ecological restoration; afforestation; social forestry; agro forestry; joint forest management.

Unit 5: Climate Change

Climate change: Basic concepts; global warming, causes and consequences (Rise in Sea levels, Glacier melting, Biodiversity Loss), Adaptation, Mitigation, Global and National Efforts, Sustainable Development Goals (SDGs), Role of NGO in climate change mitigation.

Course Outcome: *This course will provide a detailed understanding on various concepts and*

issues concerning biodiversity and conservation at local, regional and global levels, understanding of climate change concepts.

Suggested Readings:

1. Wilkinson DM (2007) Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press, U.S.A.
2. Carina Hoorn, Allison Perrigo, Alexandre Antonelli (2018). Mountains, Climate and Biodiversity John Wiley and Sons Ltd, Oxford, UK.
3. Gabriel M. (2000) Biodiversity and conservation Oxford and IBH publishing company Pvt Ltd. New Delhi.
4. Krishnamoorthy, K.V (2004) An Advanced text book on Biodiversity- principles and Practice: Oxford and IBH publishing company Pvt. Ltd. New Delhi.
5. Heywood, V.H. & Watson, R.T. (1995) Global Biodiversity Assessment.
6. Singh, J. S., Singh, S.P. & Gupta, S. 2006. Ecology, Envionment and Resource Conservation.Anamaya Publications, New Delhi.

SEMESTER-VIII

BOT: DSC—454

Course Title: **Analytical Techniques in Plant Science**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

***Course Objective*:** To study the various aspects of analytical techniques in plant science.

Unit 1: Imaging related techniques

Principles of microscopy, light microscopy, fluorescence microscopy, confocal microscopy; Use of fluorochromes, Chromosome banding, FISH, chromosome painting, Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit 2: Cell Fractionation and Radioisotopes

Centrifugation – differential and density gradient centrifugation, sucrose density gradient, $CsCl_2$ gradient, analytical centrifugation, ultra centrifugation, marker enzyme. Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment;

Unit 3: Spectrophotometry and Chromatography

Spectrophotometry: Principle and its application in biological research; Chromatography: principle, paper chromatography, column chromatography, TLC, GLC, HPLC, ion-exchange chromatography, molecular sieve chromatography.

Unit 4: Characterization of proteins and nucleic acids

Mass spectrometry, X-ray diffraction, X-ray crystallography, characterization of proteins and nucleic acids, Electrophoresis: AGE, PAGE, SDS-PAGE.

Unit 5: Biostatistics:

Biostatistics, Data, samples, representation of data: tabular and graphical; measures of central tendency: arithmetic mean, median and mode; measures of dispersion: mean deviation, standard deviation and standard error; chi square test.

Course Outcome: *This course will provide a detailed understanding on various concepts of techniques used in plant science.*

Suggested Readings:

1. Ruzin, S. E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York, USA.
2. Plumber, D. T. (1996). An Introduction to Practical Biochemistry, Tata McGraw-Hill Publication Co. Ltd. New Delhi.
3. Dutta, S. (2022). Analytical Techniques in Plant Sciences, Biostatistics and Dissertations (Theory and Practice). Kalyani Publishers, Ludhiana.

BOT: DSM—451

Course Title: **Applied Botany**

Credits: 3 Contact hours: 45 Marks: 100

(All units are of equal credits)

***Course Objective*:** To study the structure, types and uses of Algae, fungi, bryophyte, Pteridophytes.

Unit 1: Applied Phycology

Resource potential and economic uses commercial utility of algae, Distribution of economically important algae in India: Algal immobilization and applications; Methods of preparation and application of liquid sea weed fertilizers; Biodiesel producing algae, Phycoremediation.

Unit 2: Applied Mycology

Application of fungi in food industries; Production of enzymes; Production of pharmaceuticals; Fungi in production of pigments; Fungi in production of inorganic acids; Mycotoxins; Fungi as bio-control agents: mycoherbicides, mycofungicides, mycoinsecticides, myconematicides; Fungi as biofertilizers; Genetic Engineering of Fungi; Fungi as bio-control agent.

Unit 3: Applied Bryology

Resource potential and commercial utility of bryophytes: Horticultural uses, Moss garden; Ecological importance of bryophytes Medicinal uses of bryophytes. Concept of Moss bioreactor.

Unit 4: Applied Pteridology

Traditional uses of ferns in pharmaceuticals; secondary metabolites of ferns: types, composition and their therapeutic role; Ferns in horticultures: significance and different practices; role of climate and other factors; Role of ferns in environmental restoration.

Unit 5: Applied aspects of Phanerogams

Phytochemistry of gymnosperms: secondary metabolites, medicinal value and drugs; Gymnosperms in horticulture: significance and different practices; Ecological role of gymnosperms in regional climate, soil and vegetation; Angiosperms in medicine: general account, significance and therapeutical potential; Commercial utility of angiosperms as timbre, fibres, rubber, and dyes.

Course Outcome: *This course will provide a detailed understanding on Algae, fungi, bryophytes and phanerogams.*

Suggested readings:

1. Kocchar, S. L. 1998 : Economic Botany in Tropics, 2nd Edition, MacMillan India Ltd., New Delhi
2. Simpson, B.B and Conner-Ogorzaly, M 1986: Economic Botany- Plants in our World, McGraw Hill, New York.
3. Mehrotra, R.S., 2003: Plant Pathology, Tata McGraw Hill Publishing co. Ltd.
4. Bhatnagar, S.P. and Moitra, A, 1996. Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India
5. Campbell, N.A., Reece J.B., Urry, L.A., Cain, M. L., Wassermann, S.A Minorsky, P.V., and Jackson, R.B. (2008). Biology, Pearson Benjamin Cummings, USA, 8th edition.