CBCS SYLLABUS

FOR

THREE YEARS UNDER-GRADUATE COURSE

IN

BOTANY (PROGRAMME)

(*w.e.f. 2022-2023*)

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN 722155

CONTENTS

1. Introduction

The syllabus for Botany at undergraduate level using the Choice Based Credit system has been framed in compliance with model syllabus given by UGC. While framing the syllabus as per the UGC guideline, the topics have been kept as generic as possible as per our own infrastructure, expertise and strength.

The main objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Botany.

Keeping in mind and in tune with the changing nature of the subject, adequate emphasis has been given on new techniques and understanding of the subject.

The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase.

1.1. Programme Outcome (PO)

PO	Summary	Description
PO 1	Sound Domain Knowledge	Students can acquire a strong, basic knowledge on origin, evolution and diversification in the basic and applied fields of Botany. They can develop relationship with the environments including their economic values.
PO 2	Laboratory Skill	The syllabus has the aim to develop good laboratory skills with latest advanced tools, sophisticated instruments and modern technologies to address emerging problems with scientific viewpoint.
PO 3	Overall Skill	Students will able to think logically and scientifically into structural outline, gather appropriate knowledge and skill for future career, planning and conducting independent project proposal and make appropriate report on it.
PO 4	Team Work	The syllabus will enhance the development of the spirit of team work; learn to harbor collaborative approach to explore new facts and facets of the subject.
PO 5	Academic and Scientific Endeavour	Students will gain cognitive development, innovative approach, technical maneuvering, entrepreneurship and managerial skills to set up a new start-up.
PO 6	Eco-friendly Approach	The course has a futuristic approach to develop eco-friendly management practices to make socio-economic upliftment.

PO 7	Ethical Awareness	Development of ethical awareness among students regarding research & publications is another outcome of the proposes course.
PO 8	Goal of life	The syllabus will help to inculcate visions in students so that they can play a vital role for the advancement of the discipline in the greater benefits of the society.

1.2. Programme Specific Outcome (PSO)

PSO	Summary	Description
PSO 1	Rational Analysis	Development of fundamental concepts, rational thinking & analytical skill.
PSO 2	Skill Development	Development of skill in some area like mushroom culture technology, Nursery & Gardening, Biofertilizer, Vermicomposting etc.
PSO 3	Soft Skill Proficiency	Development of communication skill, attitudes, leadership quality, ethical values and social awareness.
PSO 4	Ethical Awareness	Development of i) concept on ethical principles of education and research, i i) responsibility on environment and iii) knowledge of norms of the biodiversity conservation.
PSO 5	Environmental Consciousness	Increase in eco-friendly consciousness, waste-management practices to overcome environmental pollution and degradation of environment.
PSO 6	Hygiene Practices	Builds up good habit of hygienic practices.
PSO 7	Scientific Attitude	Inculcation of i) research mind and approach to develop eco-friendly products and ii) knowledge of basic sciences, life sciences and fundamental process of plants to study and analyze any related fact.
PSO 8	Resource Management	Development of knowledge & skill on natural & renewable resource management.
PSO 9	Dry-lab Practices	Development of ability of sequence analysis & structure prediction.
PSO 10	Awareness against Infectious Diseases	Development of awareness against infectious & fatal diseases.
PSO 11	Ecological Awareness	Understanding the valuable impact of the plant diversity in social and environmental aspects and demonstrate the knowledge and need of sustainable development.
PSO 12	Skill Development	Students will gain knowledge through different Hands-on-training program on agro-economic activities.
PSO 13	Social Interaction	Development of community link up through regular survey on Health & Nutritional parameters, Ethno-veterinary interests of local villagers.
PSO 14	Ethno-medicinal Practices	Development of knowledge on Ethno-medicinal Plants, their commercial usage & worldwide applications.
PSO 15	Compatible Agricultural	Development of concept about significance of crop improvement through genetic engineering in the present context of growing population.

2. Scheme for CBCS Curriculum

2.1. Credit Distribution across Courses

Course Type	Total Papers	Credits	
		Theory + Practical	Theory*
Core Courses	12	12×4= 48 12×2= 24	14×5= 70 14×1= 14
Discipline Specific Electives	6	6×4= 24 6×2= 12	4×5= 20 4×1= 4
Ability Enhancement Language Courses/ ENVS	2	1×2= 2 (ENG/MIL) 1×4= 4 (ENVS)	1×2= 2 (ENG/MIL) 1×4= 4 (ENVS)
Skill Enhancement Courses	4	4×2= 8	4×2=8
Totals	**24**	**122**	**122**

*Tutorials of 1 Credit will be conducted in case there is no practical component

2.2. Scheme for CBCS Curriculum in Botany (Programme)

SEMESTER –I

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/BOT/101/C-1A	Plant Biodiversity: Microbes, Algae, Fungi and Archegoniate (Theory and Practical	6 (T 4+P2)	10	40 (T25+P15)	50	4	N.A.	4
SP/SC/102/C-2A	From another Discipline-2	6	10	40	50			
SP/SC/103/C-3A	From another Discipline-3	6	10	40	50			
SP/ 104/AECC-ENV	Environmental Studies	4	10	40	50	N.A	N.A.	N.A.
Total in Semester– I		22	40	160	200			

N.B. Theory: 1 Credit= 1 Hour/Week, Practical: 1 Credit= 2 Hours/Week, Tutorial: 1 Credit= 1 Hour/Week

SEMESTER –II

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/BOT/201/C-1B	Genetics and Plant Breeding (Theory and Practical)	6 (T4+P2)	10	40 (T25+P15)	50	4	NA.	4
SP/SC/202/ C-2B	From another Discipline – 2	6	10	40	50			
SP/SC/ 203/C- 3B	From another Discipline – 3	6	10	40	50			
SP/SC/204/ AECC-E/MIL	English/MIL	2	10	40	50	N.A	N.A.	N.A.
Total in Semester– II		20	40	160	200			

N.B. Theory: 1 Credit= 1 Hour/Week, Practical: - 1 Credit= 2 Hours/Week, Tutorial: 1 Credit= 1 Hour/Week

SEMESTER –III

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/BOT/ 301/C-1C	Plant Ecology, Morphology and Taxonomy (Theory and Practical)	6 (T4+P2)	10	40 (T25+P15)	50	4	N.A.	4
SP/SC/302/C-2C	From another Discipline - 2	6	10	40	50			
SP/SC/ 303/ C-3C	From another Discipline - 3	6	10	40	50			
SP/BOT/304/SEC-1	Any one from Botany: 1. Bio-fertilizer 2. Herbal Technology	2	10	40	50	2	N.A.	N.A.
Total in Semester – III		**20**	**40**	**160**	**200**			

N.B. Theory: 1 Credit= 1 Hour/Week, Practical: 1 Credit= 2 Hours/Week, Tutorial: 1 Credit= 1 Hour/Week

SEMESTER –IV

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/BOT/401/C-1D	Plant Physiology and Metabolism (Theory and Practical)	6 (T4+P2)	10	40 (T25+P15)	50	4	NA	4
SP/SC/ 402/C-2D	From another Discipline-2	6	10	40	50			
SP/SC/ 403/C-3D	From another Discipline-3	6	10	40	50			
SP/BOT/404/SEC-2	Any one from Botany: 1. Nursery & Gardening 2. Floriculture	2	10	40	50	2	NA	NA
Total in Semester – IV		**20**	**40**	**160**	**200**			

N.B. Theory: 1 Credit= 1 hour/Week, Practical: 1 Credit= 2 hours/Week, Tutorial: 1 Credit= 1 hour/Week

SEMESTER – V

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/BOT/501/DSE-1A	Any one from: 1. Cell & Molecular Biology 2. Plant Anatomy and Embryology	6 (T4+P2)	10	40 (T25+P15)	50	4	N.A.	4
SP/SC/ 502/DSE-2A	From another Discipline – 2	6	10	40	50			
SP/SC/ 503/DSE-3A	From another Discipline – 3	6	10	40	50			
SP/BOT/504/SEC-3	Any one from Botany: 1. Medicinal Botany 2. Ethnobotany	2	10	40	50	2	N.A	N.A
Total in Semester – V		**20**	**40**	**160**	**200**			

N.B. Theory: 1 Credit= 1 Hour/Week, Practical: 1 Credit= 2 Hours/Week, Tutorial:- 1 Credit= 1 Hour/Week

SEMESTER – VI

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/BOT/ 601/DSE-1B	Any one from: 1.Economic Botany & Biotechnology 2.Horticultural Practices and Post Harvest Technology	6 (T4+P2)	10	40 (T25+P15)	50	4	NA	4
SP/SC/ 602/DSE-2B	From another Discipline – 2	6	10	40	50			
SP/SC/ 603/DSE-3B	From another Discipline – 3	6	10	40	50			
SP/BOT/ 604/SEC-4	Any one from Botany: 1.Mushroom Culture Technology 2. Plant Diversity & Human Welfare	2	10	40	50	2	NA	NA
Total in Semester – VI		**20**	**40**	**160**	**200**			

N.B. Theory: 1 Credit= 1 hour/Week, Practical: 1 Credit= 2 hours/Week, Tutorial: 1 Credit= 1 hour/Week

[UGP= Under Graduate programme, S.C.= Subject Code C= Core Course, E/H/MIL= English/ Hindi/ Modern Indian Language, H/MIL/E= Hindi/ Modern Indian Language/ English, AECC-E= Ability Enhancement Compulsory Course-English, AECC-ENV= Ability Enhancement Compulsory Course-Environmental studies, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.= Lecture, Tu.= Tutorial, and Pr.=Practical]

2.3. Choices for Discipline Specific Electives

SEMESTER	COURSE	CHOICE
SEM-V	DSE-1A	Any one from: 1. Cell & Molecular Biology 2. Plant Anatomy and Embryology
SEM-VI	DSE-1B	Any one from 3. Economic Botany & Biotechnology 4. Horticultural Practices and Post Harvest Technology

2.4. Choices of Skill Enhancement Courses

SEMESTER	COURSE	CHOICE
SEM-III	SEC-1	Any one from Botany: 1. Biofertilizers 2. Herbal Technology
SEM-IV	SEC-2	Any one from Botany: 3. Nursery & Gardening 4.Floriculture
SEM-V	SEC-3	Any one from Botany: 5.Medicinal Botany 6.Ethnobotany
SEM-VI	SEC-4	Any one from Botany: 7.Mushroom Culture Technology 8.Plant Diversity & Human Welfare

2.5. Question Pattern

Core and DSE papers (Theory and Practical)

Theory (F.M: 25)	Practical (F.M: 15)
UNIT-I 1. Any five out of eight **1×5=5**	1.Work out/Demonstration/Experiment and/or identification **10/9** 2.Laboratory Record and/or Field record **2/3** 3.Viva Voce **3**
UNIT-II 2. Any two out of four **5×2=10**	
UNIT-III 3. Any one out of two **10×1=10**	

SEC papers (Theory)

Theory (F.M: 40)
UNIT-I 1. Any five out of eight **2×5=10**
UNIT-II 2. Any four out of six **5×4=20**
UNIT-III 3. Any one out of two **10×1=10**

3. Core Courses

Semester- I

3.1. CC-1A T1: Plant Biodiversity (Microbes, Algae, Fungi, Archegoniate)
Course Code: SP/BOT/101/C-1A

(Theory: Lecture 60/Credits 4/Marks 25)

Course Learning Outcomes:

- Study the characteristics and economic importance of various groups of algae.
- Develop understanding on the concept of microbes their nutrition, growth, metabolism, reproduction and recombination process.
- Prepare microbial samples for microscopic observation and temporary and permanent slides for different algal samples.
- Understand the economic importance of microbes in human welfare.
- Understand the concept of extinct and extant primitive archegoniate (Bryophytes, Pteridophytes & Gymnosperms).
- Understand about the morphology, anatomy of different vegetative parts and reproductive organs with life cycle of different genus.
- Gather Knowledge about the evolution among the plants and evolution of land plants.

Unit 1: Microbes (10 lectures)
Viruses–General characters of virus; Structure of DNA virus (T-phage); Lytic and lysogenic cycle; Structure of RNA virus (TMV); Economic importance of viruses; General characteristics and cell structure of bacteria; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance of bacteria.

Unit 2: Algae (12 lectures)
General characteristics; Range of thallus organization and reproduction; Morphology and life-cycles of the following: *Oedogonium, Vaucheria, Fucus, Polysiphonia*. Economic importance of algae.

Unit 3: Fungi (12 lectures)
Introduction- General characteristics, life cycle of *Mucor* (Zygomycota), *Penicillium* (Ascomycota), *Agaricus* (Basidiomycota); General characters of Lichens; Mycorrhiza: ectomychorrhiza and endomycorrhiza and their significance.

Unit 4: Introduction to Archegoniate (2 lectures)
Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Unit 5: Bryophytes (10 lectures)
General characteristics, morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 6: Pteridophytes (8 lectures)
General characteristics, morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Ecological and economical importance of Pteridophytes.

Unit 7: Gymnosperms (6 lectures)
General characteristics; morphology, anatomy and reproduction of *Cycas* and *Pinus* (Developmental details not to be included). Ecological and economical importance.

3.1. CC-1A P1: Plant Biodiversity (Microbes, Algae, Fungi, Archegoniate)

(Practical: Marks 15/ Credits2)

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Simple staining process by carbol fuchsin to show bacterial cells.
3. Study of vegetative and reproductive structures of ***Nostoc***, ***Oedogonium***, ***Oscillatoria***, through temporary preparations and ***Fucus*** & ***Polysiphonia*** - Specimen and permanent slides
4. ***Mucor and Penicillium***: Asexual stage from temporary mounts and sexual Structures through permanent slides.
5. ***Puccinia*****:** Herbarium specimens of Black Stem Rust of Wheat and infected Justicia leaves; section/tease mounts of spores on Justicia leaf and permanent slides of different spore forms.
6. ***Agaricus*****:** Specimens of button stage and full-grown mushroom; Sectioning of gills of *Agaricus*.
7. ***Marchantia***: morphology of thallus, V.S. of thallus through gemma cup, L.S of sporophyte (Permanent slides).
8. ***Funaria***- morphology, permanent slides showing antheridial and archegonial heads, L.S of capsule from permanent slide.
9. ***Selaginella***- morphology, T.S. of stem, L.S of strobilus (from permanent slide).
10. ***Pteris***- morphology, V.S. of sporophyll.
11. ***Cycas***- morphology T.S. of rachis, V.S. of leaflet, L.S of ovule (permanent slide).
12. ***Pinus***- morphology T.S. of needle, T.S. of stem, L.S./T.S. of male cone, L.S. of female cone.

Suggested Readings

1. J.N.Mitra, D.Mitra, S.K.Chowdhuri . Studies in Botany Vol 1. Moulik Library
2. Bhattacharya, Hait,Ghosh. A Text Book of Botany. Vol 2. NCBA.
3. Hait, Bhattacharya,Ghosh. A Text Book of Botany. Vol 1. NCBA.
4. Bijaya Kumar Mishra, Nirupama Dash. Microbiology and Phycology 2019. Kalyani Publishers.
5. B.R.Vashishta, A.K.Sinha. Botany for Degree students FUNGI/ALGAE/Pteridophytes/Gymnosperms. S.Chand & Company.
6. Baman Chandra Acharya. Archegoniates (2020). Kalyani Publishers
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.

Semester– II

3.2. CC-1B T2: Genetics and Plant breeding
Course Code: SP/BOT/201/C-1B

(Theory: Lecture 60/Credits 4/Marks 25)

Course Learning Outcomes:

- Have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
- Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.
- Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.
- Analyze the effect of mutations on gene functions and dosage.

Unit 1: Heredity (20 Lectures)

1. Brief life history of Mendel.
2. Terminologies.
3. Laws of Inheritance.
4. Modified Mandelian Ratios: 1:2:1- Co- dominance, incomplete dominance; 9:7; 12:3:1.
5. Chi Square.
6. Multiple allelism.
7. Chromosome theory of Inheritance.

Unit 2: Sex-determination and Sex-linked Inheritance (4 Lectures)

Unit 3: **Linkage and Crossing over (8 Lectures)**
Linkage: concept & history, complete & incomplete linkage, bridges experiment, coupling & repulsion, recombination frequency, linkage maps based on two and three factor crosses. Crossing over: concept and significance, cytological proof of crossing over.

Unit 4: Mutations and Chromosomal Aberrations (6 Lectures)
Types of mutations, effects of physical & chemical mutagens. Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy; Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.

Unit 5: Plant Breeding (4 lectures)
Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

Unit 6: Methods of crop improvement (10 lectures)
Introduction: Centres of origin and domestication of crop plants, plant genetic resources;

Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants– Procedure, advantages and limitations.

Unit 7: Inbreeding depression and heterosis (4 lectures)
History, genetic basis of inbreeding depression and heterosis; Applications.

Unit 8: Crop improvement and breeding (4 lectures)
Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

3.2. CC-1B P2: Genetics and Plant breeding

(Practical: Marks 15/Credits 2)

1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi- square.
2. Incomplete dominance and gene interaction through seed ratios (9:7, 12:3:1).
3. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs.
4. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
5. Hybridization techniques - Emasculation, Bagging (For demonstration only).

Suggested Readings

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, 5th edition, John Wiley & Sons Inc., India,
3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
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. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning.
6. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7thedition.
7. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
8. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

Semester- III

3.3 CC-1C T3: Plant Ecology, Morphology and Taxonomy
Course Code: SP/BOT/301/C-1C

(Theory: Lectures: 60/Credits 4/Marks 25)

Course Learning Outcomes:

- Classify Plant systematics and recognize the importance of herbarium.
- Evaluate the Important herbaria and botanical gardens.
- Interpret the rules of ICN in botanical nomenclature.
- Generalize the characters of the families according to artificial, natural and phylogenetic classification.

Plant Ecology (30 Lectures, Marks-10)

Unit 1: Introduction (2 lectures)

Unit 2: Ecological factors (10 lectures)
Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 3: Plant communities (6 lectures)
Characters; Ecotone and edge effect; Succession; Processes and types.

Unit 4: Ecosystem (8 lectures)
Structure; energy flow trophic organization; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous.

Unit 5: Phytogeography (4 lectures)
Principle biogeographical zones; Endemism.

Taxonomy (30 Lectures, Marks-15)

Unit 6: Morphology (4 Lectures)
Leaves- Types, Phyllotaxy; Inflorescence – Defition and types; Flower – Different parts; Fruits - Defition and types.

U nit 7: Introduction to plant taxonomy (2 lectures)
Identification, Classification, Nomenclature.

Unit 8: Identification (4 lectures)
Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access.

Unit 9: (5 lectures)
Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.

Unit 10: Taxonomic hierarchy (2 lectures)
Ranks, categories and taxonomic groups.

U nit 11: Botanical nomenclature (5 lectures)
Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Unit 12: Classification (4 lectures)
Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (up to series), Engler and Prantl (up to series).

Unit 13: (4 Lectures)
General characters and economic importance of the following families (range of floral structure excluded): Magnoliaceae, Brassicaceae, Malvaceae, Euphorbiaceae, Fabaceae, Apocynaceae, Lamiaceae, Solanaceae, Rubiaceae, Asteraceae, Poaceae, Orchidaceae.

3.3. CC-1C P3: Plant Ecology and Taxonomy

(Practical: Credits 2/Marks 15)

Plant Ecology (Marks-6)

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.

2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.

4. Ecological adaptations of some species: *Ipomoea aquatica* stem, Nerium leaf and *Vanda* root.

5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (Species to be listed).

6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.

Taxonomy (Marks-9)

7. 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): Brassicaceae, Asteraceae, Solanaceae, Lamiaceae , Malvaceae, Rubiaceae, Fabaceae, Apocynaceae. Acanthaceae, Verbenaceae.

8. Field visit (local) – Excursion/Field trips are to be organized in Botanically rich areas. A field report with photographic document of plants (at least 10) and corresponding field record to be submitted during practical examination.

9. Submission of a properly dried and pressed herbarium specimen of any one wild plant.

Suggested Readings

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

Semester– IV

3.4. CC-1D T4: Plant Physiology & Metabolism
Course Code: SP/BOT/401/C-1D

(Theory: Lecture 60 /Credits 4/Marks 25)

Course Learning Outcomes:

- Understand Water relation of plants with respect to various physiological processes.
- Explain chemical properties and deficiency symptoms in plants
- Classify aerobic and anaerobic respiration
- Explain the significance of Photosynthesis and respiration
- Assess dormancy and germination of seeds
- To acquire adequate knowledge about translocation in plants, carbon dioxide concentrating mechanisms, growth regulators and flowering of plants.

Unit 1: Plant-water relations (8 lectures)
Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

Unit 2: Mineral nutrition (8 lectures)
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.

Unit 3: Translocation in phloem. (6 lectures)
Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 4: Photosynthesis (12 lectures)
Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

Unit 5: Respiration (6 lectures)
Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Unit 6: Enzymes (4 lectures)
Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

Unit 7: Nitrogen metabolism (4 lectures)
Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit 8: Plant growth regulators (6 lectures)
Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

Unit 9: Plant response to light and temperature (6 lectures)
Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far-red light responses on photomorphogenesis; Vernalization.

3.4. CC-1D P4: Plant Physiology & Metabolism

(Practical: Marks 15/Credits 2)

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and humidity) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
5. Comparison of the rate of respiration in any two parts of a plant.

Demonstration experiments (any four)
1. Bolting. 2. Effect of auxins on rooting. 3. Suction due to transpiration. 4. R.Q. 5. Respiration in roots.

Suggested Readings

1. Taiz, L., Zeiger, E., MØller, 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.

4. Discipline Specific Elective Courses

Semester- V

4.1. DSE-1A T1: Cell and Molecular Biology

Course Code: SP/BOT/501/DSE-1A

(Theory: Lectures 60/Credits 4/Marks 25)

Course Learning Outcomes:

- Develop a solid foundation in cell biology, molecular biology, microbiology, biochemistry, and molecular genetics.
- To make meaningful contributions to global medical and environmental issues.
- Reach research laboratory or administrative positions in the biotechnology and biomedical /Pharmaceutical industries.
- Understand DNA replication, transcription, gene expression.
- To enter into advance courses and into research laboratory.
- Understand Basic concept of bio molecules and cell biology.
- Develop knowledge about cell and its different bio molecules, cell cycle, cell division and multiplications.
- Gather knowledge about the biochemical analysis of different bio-molecules, Chromosome study, different physical processes involve in cell.

Unit 1: Techniques in Biology (8 Lectures)
Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM).

Unit 2: Cell as a unit of Life (2 Lectures)
The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.

Unit 3: Cell Organelles (20 Lectures)
Mitochondria: Structure, composition; Semiautonomous nature; Symbiont hypothesis; mitochondrial DNA. Chloroplast: Structure, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes: Structures and roles. Peroxisomes and Glyoxysomes: Structures, composition, functions in animals and plants and biogenesis. Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

Unit 4: Cell Membrane and Cell Wall (6 Lectures)
The functions of membranes; Fluid Mosaic Model of membrane structure; Selective permeability of the membranes; Structure of Cell wall.

Unit 5: Cell Cycle (6 Lectures)
Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.

Unit 6: Genetic material (6 Lectures)
DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.

DNA replication (Prokaryotes): bidirectional replication, semi–conservative, semi discontinuous, RNA priming, Ø (theta) mode of replication, replication of linear, ds- DNA, replicating the 5′ end of linear chromosome including replication enzymes.

Unit 7: Transcription (Prokaryotes and Eukaryotes) (6 Lectures)
Types of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes), genetic code.

Unit 8: Regulation of gene expression (6 Lectures)
Prokaryotes: Lac operon and Tryptophan operon.

4.1. DSE-1A P1: Cell and Molecular Biology

(Practical: Credits 2 / Marks 15)

1. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. Study of mitosis and meiosis (temporary mounts and permanent slides).
7. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
8. Measure the cell size (either length or breadth/diameter) by micrometry.
9. Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
10. Study DNA packaging by micrographs.
11. Study of Semi–conservative, semi discontinuous, Ø (theta) mode of replication by photograph.

Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
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.

4.2. DSE-1A T2: Plant Anatomy & Embryology

Course Code: SP/BOT/501/DSE-1A

(Theory: Lecture 60 /Credits 4/Marks 25)

Course Learning Outcomes:

- Learn about various plants parts, embryonic development, breeding activity and conservation techniques.
- Develop an understanding of concepts and fundamentals of plant anatomy
- Examine the internal anatomy of plant systems and organs
- Develop critical understanding on the evolution of concept of organization of shoot and root apex.
- Analyze the composition of different parts of plants and their relationships
- Evaluate the adaptive and protective systems of plants
- Generating in students an interest in plant structure and wood for having a wise approach in timber use, one of the most economically useful resources.
- Evaluate and understand structure and functions of different reproductive structures.

Plant Anatomy

Unit 1: Meristematic and permanent tissues (8 lectures)
Root and shoot apical meristems; Simple and complex tissues, Tissue Systems.

Unit 2: Organs (4 lectures)
Structure of dicot and monocot root stem and leaf.

Unit 3: Secondary Growth (8 lectures)
Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

Unit 4: Adaptive and protective systems (8 lectures)
Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Embryology

Unit 5: Structural organization of flower (8 lectures)
Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 6: Pollination and fertilization (8 lectures)
Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 7: Embryo and endosperm (8 lectures)
Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm Relationship.

Unit 8: Apomixis and polyembryony (8 lectures)-Definition, types and Practical applications.

4.2. DSE-1A P2: Plant Anatomy & Embryology

(Practical: Marks 15/Credits 2)

Plant Anatomy

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).

Embryology

7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ Campylotropous (from permanent slide).
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Pollen morphology: Impatiens, Hibiscus (from permanent slide)
11. Dissection of embryo/endosperm from developing seeds.

Suggested Readings

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

Semester- VI

4.3. DSE-1B T3: Economic Botany and Biotechnology
Course Code: SP/BOT/601/DSE-1B

(Theory: - Lectures: 60 / Credits 4/ Marks 25)

Unit 1: Origin of Cultivated Plants (4 Lectures)
Concept of centres of origin, their importance with reference to Vavilov's work.

Unit 2: Cereals (4 Lectures)
Wheat -Origin, morphology, uses.

Unit 3: Legumes (6 Lectures)
General account with special reference to Gram and soybean

Unit 4: Spices (6 Lectures)
General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

Unit 5: Beverages (4 Lectures)
Tea (morphology, processing, uses)

Unit 6: Oils and Fats (4 Lectures)
General description with special reference to groundnut

Unit 7: Fibre Yielding Plants (4 Lectures)
General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Unit 8: Introduction to biotechnology (2 lecture)

Unit 9: Plant tissue culture (8 Lectures)
Micropropagation; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

Unit 10: Recombinant DNA Techniques (18 Lectures)
Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e., RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

4.3. DSE-1B P3: Economic Botany and Biotechnology

(Practical: Credits 2/Marks 15)

1. Study of economically important plants: Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques through photographs: PCR, Blotting techniques, AGE and PAGE.

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

4.4. DSE-1B T4: Horticultural practices & Post Harvest Technology

Course Code: SP/BOT/601/DSE-1B

(Theory: Lecture 60 /Credits 6/Marks 40)

Course learning Outcome:

- Understanding the horticultural practices as a livelihood occupation
- Establishment of the knowledge of using plants as ornamental and aesthetic values
- Knowledge of keeping the plant materials in storage and to visualize the post-harvest problems.
- To know the tricks of the trade of the horticultural products.

Unit 1: Introduction (4 lectures)

Definition and Scope of horticulture, Branches of horticulture; Role in economy.

Unit 2: Ornamental plants (4 lectures)

Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental annuals - marigold, carnations, Petunias, Impatiens, Identification and salient features of some ornamental perennials - Rose, Gladiolus, Orchids, Gerberas, Tuberose, Chrysanthemum, Cacti and Succulents (Opuntia, Agave), *Croton*. Identification and salient

features of some ornamental flowering climbers – *Ipomoeas, Quisqualis indica, Pyrostegia venusta, Aganosma caryophyllata, Bignonias.*
Identification and salient features of some ornamental flowering trees - *Indian Laburnum (Cassia fistula*), Gulmohar (*Delonix regia*), Jacaranda, Lagerstroemia, Fishtail (*Caryota urens*) and areca palms, Semul (*Bombax ceiba*), Palash (*Butea monosperma*).

Unit 3: Fruit and vegetable crops (4 lectures)
Production, origin and distribution of major fruits and distribution of major vegetables. Management and marketing of vegetable and fruit crops; Identification of some fruits and vegetable varieties (citrus, banana, mango, Oranges, Chillies, Crucifers, Beans and Cucurbits).

Unit 4: Horticultural techniques (8 lectures)
Application of manure, fertilizers, nutrients and PGRs; Weed control; Biofertilizers, biopesticides; Irrigation methods (drip irrigation, surface irrigation, furrow and border irrigation); Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Scope and limitations.

Unit 5: Landscaping and garden design (6 lectures)
Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Urban forestry; policies and practices.

Unit 6: Floriculture (6 lectures)
Cut flowers, bonsai, commerce (market demand and supply); Importance of flower shows and exhibitions.

Unit 7: Post-harvest technology (10 lectures)
Importance of post harvest technology in horticultural crops; Evaluation of quality traits; Harvesting and handling of fruits, vegetables and cut flowers; Principles, methods of preservation and processing; Methods of minimizing loses during storage and transportation; Food irradiation - advantages and disadvantages; food safety.

Unit 8: Disease control and management (8 lectures)
Field and post-harvest diseases; Identification of deficiency symptoms; remedial measures and nutritional management practices; Crop sanitation; IPM strategies (genetic, biological and chemical methods for pest control); Quarantine practices; Identification of common diseases and pests of ornamentals, fruits and vegetable crops.

Unit 9: Horticultural crops - conservation and management (10 lectures)
Documentation and conservation of germplasm; Role of micropropagation and tissue culture techniques; Varieties and cultivars of various horticultural crops; IPR issues; National, international and professional societies and sources of information on horticulture.

4.4. DSE-1B P4: Horticultural practices & Post Harvest Technology

1. Bonsai preparation demonstration.
2. Propagation methods: cutting, layering, grafting.
3. Identification of some fruits and vegetable varieties (citrus, banana, mango, Oranges, Chillies, Crucifers, Beans and Cucurbits).
4. Field visits to gardens, standing crop sites, nurseries, vegetable gardens and horticultural fields at IARI or other suitable locations.

Suggested Readings

1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
2. Swaminathan, M.S. and Kochhar, S.L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.
3. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
4. Kader, A.A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, USA.
5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.

5. Skill Enhancement Courses

Semester- III

5.1. SEC-1 T1: Biofertilizers
Course Code: SP/BOT/304/SEC-1

(Theory: Credits 2/Lectures 30/Marks 40)

Unit 1: (4 Lectures)
General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

Unit 2: (8 Lectures)
Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication.

Unit 3: (4 Lectures)
Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

Unit 4: (8 Lectures)
Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

Unit 5: (6 Lectures)
Organic farming green manuring and organic fertilizers, Recycling of bio- degradable municipal, agricultural and Industrial wastes biocompost making methods, types and method of vermicomposting – field Application.

Suggested Readings

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas, S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.

5.2. SEC-1 T2: Herbal Technology
Course Code: SP/BOT/304/SEC-1

(Theory: - Credits 2/Lectures 30/Marks 40)

Unit 1 (6 Lectures)

Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

Unit 2 (6 Lectures)

Pharmacognosy - systematic position medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.

Unit 3 (6 Lectures)

Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).

Unit 4 (8 Lectures)

Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

Unit 5 (4 Lectures)

Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy).

Suggested Readings

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International BookDistributors.
3. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
4. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH publishing Co.
5. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
6. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
7. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

Semester- IV

5.3. SEC-2 T3 Nursery and Gardening
Course Code: SP/BOT/404/SEC-2

(Theory: Credits 2/Lectures 30/Marks 40)

Unit 1 (4 Lectures)
Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.

Unit 2 (6 Lectures)
Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification.

Unit 3 (6 Lectures)
Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glass house.

Unit 4 (8 Lectures)
Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

Unit 5 (6 Lectures)
Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

Suggested Readings

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5.Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

5.4. SEC-2 T4: Floriculture
Course Code: SP/BOT/404/SEC-2

(Theory: Credits 2/Lectures 30/Marks 40)

Unit 1 (2 Lectures)
Introduction: History of gardening; Importance and scope of floriculture and landscape gardening.

Unit 2 (8 Lectures)
Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

Unit 3 (4 Lectures)
Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

Unit 4 (4 Lectures)
Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water Garden. Some Famous gardens of India.

Unit 5 (4 Lectures)
Landscaping Places of Public Importance: Landscaping highways and Educational institutions.

Unit 6 (6 Lectures)
Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold,Rose, Lilium, Orchids).

Unit 7 (2 Lectures)
Diseases and Pests of Ornamental Plants.

Suggested Readings

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

Semester- V

5.5. SEC-3 T5: Medicinal Botany
Course Code: SP/BOT/504/SEC-3

(Theory: Credits 2/Lectures 30/Marks 40)

Course Learning Outcome:

- Establishment of knowledge about the medicinal plants though past and involvement of ethnic concept in interdisciplinary science.
- Establishment of methodology of ethnobotany studies.
- Knowledge of local medicinal plants and increase in interest on them.

Unit 1 (8 Lectures)

History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope.

Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments,

Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine.

Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.

Unit 2 (8 Lectures)

Definition: endemic and endangered medicinal plants, Red list criteria; Conservation of endangered and endemic medicinal plants. In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens.

Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.

Unit 3 (8 Lectures)

Definition; Ethnobotany and Folk medicines. Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany.Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India.

Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

Unit 4 (6 Lectures)

Study of local medicinal plants with proven medicinal properties: (Parts used and uses only)

1. Neem 2. Tulasi 3. Drumstick (Sojney-Moringa) 4. Fenugreek (Methi) 5. Periwinkle (Vinca) 6. Gooseberry (Amla) 7. Bael (Aegle) 8.Centella (Thankuni) 9. Sweet flag (Bach) 10. Gymnema

11. Cynodon (Durba ghas) 12. Aloe vera 13. Tinospora (Gulancha lata) 14. Ashwagandha 15. Kalmegh 16. Bahera 17. Haritaki.

Suggested Readings

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

5.6. SEC-3 T6: Ethnobotany
Course Code: SP/BOT/504/SEC-3

(Theory: Credits 2/Lectures 30/Marks 40)

Unit 1: Ethnobotany (6 Lectures)
Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit 2: Methodology of Ethnobotanical studies (6 Lectures)
a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit 3: Role of ethnobotany in modern Medicine (10 Lectures)
Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

Unit 4: Ethnobotany and legal aspects (8 Lectures)
Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

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.Lone et al,. Palaeoethnobotany
4. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.

5. S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
6. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
7. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah. 8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996 9).

Semester- VI

5.7. SEC-4 T7: Mushroom Culture Technology
Course Code: SP/BOT/604/SEC-4

(Theory: Credits 2/Lectures: 30/Marks 40)

Course Learning Outcome:

- Idea about various types and categories of mushrooms as edible staff.
- Demonstrate various types of mushroom cultivating technologies.
- Value the economic factors associated with mushroom cultivation.

Unit 1 (5 Lectures)

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 (12 Lectures)

Cultivation Technology: 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. 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. Mushroom weeds and pest and its control.

Unit 3 (8 Lectures)

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

Unit 4 (5 Lectures)

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

Suggested Readings

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printingand Publishing Co.Ltd., No.88, Mysore Road, Bangalore-560018.
3. Tewari, Pankaj Kapoor, S.C.,(1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Handbook of Mushrooms, II Edition, Vol.I & Vol.II.
5. B. C. Suman and V. P. Sharma (2011): Mushroom cultivation and Uses (Agrobios)
6. V. N. Pathak, N. Yadav and M. Gaur. (2011):Mushroom Production and Processing Technology (Agrobios)
7. Reeti Singh and U. C. Singh (2011): Modern Mushroom cultivation (Agrobios).

5.8. SEC T8: Plant Diversity and Human Welfare
Course Code: SP/BOT/604/SEC-4

(Theory: Credits 2/Lectures 30/Marks 40)

Unit 1 (8 Lectures)
Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at theecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

Unit 2: Loss of Biodiversity: (8 Lectures)
Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss,
Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

Unit 3: Conservation of Biodiversity: (8 Lectures)
Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.

Unit 4: Role of plants in relation to Human Welfare: **(6 Lectures)**
a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.

Suggested Readings

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.