Syllabus

For

B. Sc. (Program) with Botany

Choice Based Credit System

w.e.f. 2019-2020

Department of Botany and Microbiology

Gurukul Kangri Vishwavidyalaya, Haridwar

Details of Courses Under Undergraduate Program (B.Sc.)

Course	***Credits**	
	Theory+ Practical	Theory+ Tutorials
I. Core Course **(12 Papers)**	12X4= 48	12X5= 60
04 Courses from each of the 03 disciplines of choice		
Core Course Practical/ Tutorial* **(12 Practical/ Tutorials*)**	12X2= 24	12X1= 12
04 Courses from each of the 03 Disciplines of choice		
II. Elective Course **(6 Papers)**	6X4= 24	6X5= 30
Two papers from each discipline of choice including paper of interdisciplinary nature.		
Elective Course Practical / Tutorials* **(6 Practical / Tutorials*)**	6X2= 12	6X1= 6
Two papers from each discipline of choice including paper of interdisciplinary nature.		

- **Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester**

III. Ability Enhancement Courses

1.Ability Enhancement Compulsory **(2 papers of 2 credits each)** **Environmental Science** **English/MIL Communication**	2X4= 8	2X4= 8
2. Skill Enhancement Course **(Skill Based)** **(4 Papers of 2 credits each)**	4X4= 16	4X4= 16
	Total credit= 132	**Total credit= 132**

Institute Should evolve A system/policy about ECA/ General Interest/Hobby/Sports/NCC/NSS/related courses on its own.

***wherever there is practical there will be no tutorials and vice- versa.**

Proposed scheme for choice based credit system in B. Sc. Program with Botany

	DISCIPLINE CORE COURSE (12)	**Ability Enhancement** **Compulsory Course (AECC) (2)**	**Skill Enhancement Course (SEC) (2)**	**Discipline Specific Elective DSE (6)**
I	Discipine-1 Botany Paper I: Biodiversity (Microbes, Algae, Fungi and Archegoniate)	(English/MIL Communication)/ Environmental Science		
	DSC-2 Paper I			
	DSC-3 Paper I			
II	Discipine-1 Botany Paper II: Plant Ecology and Taxonomy	Environmental Science/ (English/MIL Communication)		
	DSC-2 Paper II			
	DSC-3 Paper II			
III	Discipine-1 Botany Paper III: Plant Anatomy and Embryology		**SEC-1**	
	DSC-2 Paper III			
	DSC-3 Paper III			
IV	Discipine-1 Botany Paper IV: Plant Physiology and Metabolism		**SEC-2**	
	DSC-2 Paper IV			
	DSC-3 Paper IV			
V			**SEC-3**	DSE-Botany Paper I
				DSE-Discipline Paper I
				DSE-Discipline Paper I
VI			**SEC-4**	DSE-Botany Paper II
				DSE-Discipline Paper II
				DSE-Discipline Paper II

SEMESTER	COURSE OPTED	COURSE NAME	Credits
I	Ability Enhancement Compulsory Course-I	English/MIL communications/ Environmental Science	4
	Core course - Botany Paper I	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4
	Core Course - Paper I Practical/Tutorial	Biodiversity (Microbes, Algae, Fungi and Archegoniate) Lab	2
	Discipline- 2 Paper I	DSC- 2 Paper I	4
	Discipline- 2 Paper I Practical	DSC- 2 Paper I Practical	2
	Discipline - 3 Paper I	DSC- 3 Paper I	4
	Discipline - 3 Paper I Practical	DSC- 2 Paper I Practical	2
II	Ability Enhancement Compulsory Course-II	English/MIL communications/ Environmental Science	4
	Core course-Botany Paper II	Plant Ecology and Taxonomy	4
	Core Course- Botany Paper II Practical/Tutorial	Plant Ecology and Taxonomy Lab	2
	Discipline - 2 Paper II	DSC- 2 Paper 2	4
	Discipline - 2 Paper II Practical	DSC- 2 Paper 2 Practical	2
	Discipline - 3 Paper II	DSC- 3 Paper 2	4
	Discipline - 3 Paper II Practical	DSC- 3 Paper 2 Practical	2
III	Core course- Botany Paper III	Plant Anatomy and Embryology	4
	Core Course- Botany Paper III Practical/Tutorial	Plant Anatomy and Embryology Practical	2
	Discipline - 2 Paper III	DSC- 2 Paper III	4
	Discipline - 2 Paper III Practical	DSC- 2 Paper III Practical	2
	Discipline - 3 Paper III	DSC- 3 Paper III	4
	Discipline - 3 Paper III Practical	DSC- 3 Paper III Practical	4
	Skill Enhancement Course -1	SEC- 1	4
IV	Core course- Botany Paper IV	Plant Physiology and Metabolism	4
	Course- Botany Paper IV Practical	Plant Physiology and Metabolism Practical	2
	Discipline - 2 Paper IV	DSC- 2 Paper IV Theory	4
	Discipline - 2 Paper IV Practical	DSC- 2 Paper IV Practical	2

	Discipline - 3 Paper IV	DSC- 3 Paper IV Theory	4
	Discipline - 3 Paper IV Practical	DSC- 3 Paper IV	2
	Skill Enhancement Course -2	SEC -2	4
V	Skill Enhancement Course – 3	SEC -3	4
	Discipline Specific Elective –Botany Paper I	DSE-Botany Paper I	4
	Discipline Specific Elective –Botany Paper I Practical	DSE-Botany Paper I Practical	2
	Discipline Specific Elective – Discipline 2 Paper I	DSE-Discipline 2 Paper I	4
	Discipline Specific Elective – Discipline 2 Paper I Practical	DSE-Discipline 2 Paper I Practical	2
	Discipline Specific Elective – Discipline 3 Paper I	DSE- Discipline 3 Paper I	4
	Discipline Specific Elective – Discipline 3 Paper I Practical	DSE-Discipline 2 Paper I Practical	2
VI	Skill Enhancement Course – 4	SEC -4	4
	Discipline Specific Elective –Botany Paper II	DSE-Botany Paper II	4
	Discipline Specific Elective –Botany Paper II Practical	DSE-Botany Paper II Practical	2
	Discipline Specific Elective – Discipline 2 Paper II	DSE-Discipline 2 Paper II	6
	Discipline Specific Elective – Discipline 2 Paper II Practical	DSE-Discipline 3 Paper II Practical	6
	Discipline Specific Elective – Discipline 3 Paper II	DSE- Discipline 3 Paper II	6
	Discipline Specific Elective – Discipline 3 Paper II Practical	DSE- Discipline 3 Paper II Practical	6
Total Credits			132

Details of Courses

Core Courses –Botany

1. Biodiversity (Microbes, Algae, Fungi and Archegoniate)
2. Plant Ecology and Taxonomy
3. Plant Anatomy and Embryology
4. Plant Physiology and Metabolism

Skill Enhancement Courses (Any four)

Botany

1. Biofertilizers
2. Herbal Technology
3. Nursery and Gardening
4. Floriculture
5. Medicinal and Economic Botany
6. Plant Diversity and Human Welfare
7. Ethnobotany
8. Mushroom Culture Technology
9. Intellectual Property Right

Discipline Specific Electives-Botany (Any two)

1. Plant Biotechnology
2. Cell and Molecular Biology
3. Analytical Techniques in Plant Sciences
4. Bioinformatics
5. Research Methodology
6. Dissertation

Ability Enhancement Compulsory Courses

1. Environmental Science
2. English/MIL Communication

B.Sc. I Year **Semester – I**

BBO-C101
DSC-1 Biodiversity (Microbes, Algae, Fungi and Archegoniate)

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Vedic Plants and Microbes **(10 Lectures)**

Introduction to Veda, naming of plants in Veda, vedic classification of plants, medicinal plants in Rigveda and Atharvaveda and their medicinal properties and uses. Plants used in Yajna. Viruses– discovery, general structure, replication (general account), DNA virus (T-phage); lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); economic importance.

Unit 2: Algae **(12 Lectures)**

General characteristics,ecology and distribution,range of thallus organization and reproduction, Classification of algae,morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas,Oedogonium*,*Vaucheria, Fucus, Polysiphonia*. Economicimportance of algae

Unit 3: Fungi **(12 Lectures)**

General characteristics, ecology, range of thallus organization, cell wall composition, nutrition, reproduction and classification, life cycle of *Rhizopus*, *Penicillium, Alternaria*, *Puccinia,Agaricus*; Symbiotic associations-lichensGeneral account,reproduction and significance,mycorrhiza: ectomycorrhiza and endo-mycorrhiza and their significance.

Unit 4: Bryophytes and Pteridophytes **(18 Lectures)**

General characteristics, adaptations to land habit, classification, range of thallus organization of Bryophytes. Classification (up to family), morphology, anatomy and reproduction of *Riccia*, *Marchantia*and*Funaria*. Ecology and economic importance of Bryophytes. Pteridophytes:General characteristics, classification, early land plants (*Rhynia*), classification(up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included); heterospory and seed habit, ecological and economic importance of Pteridophytes.

Unit 5: Gymnosperms **(6 Lectures)**

General characteristics, classification. (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*, (developmental details not to be included), ecological and economical importance.

DSC-1 SEMESTER I BBO-C151(LAB COURSE-CC-01)

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs)*, Oedogonium, Vaucheria, Fucus* and Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides)
5. *Rhizopus and Penicillium*: Asexual stage from temporary mounts and sexual structures throughpermanent slides.
6. *Alternaria:* Specimens/photographs and tease mounts.
7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves;section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ectomycorrhiza and endomycorrhiza (Photographs)
11. ***Marchantia***- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemmacup,w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. ***Funaria***- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporaryslides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. ***Selaginella***- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyllandmegasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. ***Equisetum***- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m.spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
15. ***Pteris***- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporaryslides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
16. ***Cycas***- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. ***Pinus***- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarfshoot, t.s. needle, t.s. stem, ,l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. &r.l.s. stem (permanent slide).

Suggested readings:

1. Dubey, R.C. A Text Book of Biotechnology. S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi-110 055.
2. Dubey, R.C. and Maheshwari, D.K. S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi-110 055
3. Kumar H.D. 1999. Introductory phycology.Affiliated East West Press, New Delhi.
4. Matthews, R.E. 2013 Fundamentals of Plant Virology ELSEVIER India.
5. Sethi I.K and Walia S.K. 2011. Text book of fungi and their allies. Mc MillianPublishers, New Delhi

6. Vashishta, B.R., Sinha A.K. 2012 Botany for degree students: Fungi. S.ChandNew Delhi.
7. Vashishta, B.R., Sinha A.K. and Singh, V.P 2012Botany for degree students: Algae, S.Chand New Delhi.
8. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata Mc Graw-Hill Co, New Delhi.
9. Presscott, L. Harley, J. and Klein, D. (2005) Microbiology, 6th edition, Tata Mc Graw- Hill Co. New Delhi.
10. Fritsch F.E. (1935 The Structure & Reproduction of Algae 1945): Cambridge University Press Cambridge, U.K. Vol. I, Vol. II.
11. Smith, G.M (1955) :Cryptogamic Botany(Vol. I Algae, Fungi, & Lichens) McGraw-Hill Book Co., New York .
12. Kumar, H.D. 1999. Introductory Phycology. Aff. East-west Press Pvt ltd., Delhi.

B.Sc. I Year **Semester – II**

BBO-C201
DSC-2 Plant Ecology and Taxonomy

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Introduction to Ecology and Ecological factors (12 Lectures)

Soil: origin, formation, composition, soil profile.Water: states of water in the environment, precipitation types. Light and temperature: variation optimal and limiting factors; Shelfordlaw of tolerance. Adaptationof hydrophytes and xerophytes.

Unit 2: Plant communities, Ecosystem and Phytogeography (19 Lectures)

Characters; Ecotone and edge effect; succession; processes and types.Structure; energyflow trophic organization; food chains and food webs, ecological pyramids production and productivity; biogeochemical cycling; cycling of carbon, nitrogen and phosphorous. Principle bio-geographical zones; endemism.

Unit 3: Introduction to plant taxonomy and Identification (5 Lectures)

Identification, classification, nomenclature.Functions of herbarium, important herbaria and botanical gardens of the world and India; documentation: flora

Unit 4: Taxonomic hierarchy and evidences

Ranks, categories and taxonomic groups. Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.

Unit 5: Botanical nomenclature and Classification (12 Lectures)

Principles and rules (ICBN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantal (upto series).

DSC-2 SEMESTER-II BBO-C251(LAB COURSE-CC-02)

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.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b)Study of biotic interactions of the following: Stem parasite (*Cuscuta)*, Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
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
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 - *Brassica,Alyssum / Iberis;* Asteraceae -*Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax;* Solanaceae -*Solanumnigrum, Withania;*Lamiaceae -*Salvia, Ocimum*; Liliaceae - *Asphodelus / Lilium / Allium.*
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested readings: Ecology

1. Singh, J.S., Singh, S.P. and Gupta, S. (2006) Ecology Environment and Resource Conservation.Anamaya Publications, New Delhi
2. Wilkinson, D.M. (2007). Fundamental Processes in Ecology. An Earth System Approach. Oxford.
3. Daubenmier, R.F. (1970). Plants and Environment: A text book of Plant Autoecology, WileyEastern Private Limited
4. Daubenmier, R.F. (1970), Plant Communities, Wiley Eastern Private Limited
5. Odum, E. (2008) Ecology. Oxford and IBH Publisher.
6. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.

Taxonomy

1. Porter, C.L. ( ): Taxonomy of flowering Plants, Eurasia Publishing House, New Delhi.
2. Lawrence, G.H.M. (1953): Taxonomy of Vascular Plants, Oxford & IBH Publishers, New Delhi, Calcutta.
3. Jefferey, C.(1968) : An Introduction to Plant Taxonomy J.A. Churchill, London.
4. Mathur, R.C.(1970) : Systematic Botany (Angiosperms) Agra Book Stores-Lucknow, Ajmer, Allahabad, Delhi.

B.Sc. II Year **Semester – III**

BBO-C301
DSC-3 Plant Anatomy and Embryology

MM : 100 Seasonal : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

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Unit 1: Tissue:Meristematic and permanent tissues (12 Lectures)

Structure of dicot and monocot root, stem and leaf.Root and shoot apical meristems; Simple and complex tissues.

Unit 2: Adaptive and protective systems,Secondary Growth (16 Lectures)

Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

Unit 3: Structural organization of flower: Pollination and fertilization (8 Lectures)

Structure of anther and pollen. Structure and types of ovules. Types of embryo sacs, organization and ultrastructure of mature embryo sac.Pollination mechanisms and adaptations; Double fertilization. Seed-structure appendages and dispersal mechanisms.

Unit 4: Embryo and endosperm (8 Lectures)

Endosperm types, structure and functions. Dicot and monocot embryo; Embryo-endosperm relationship.

Unit 5: Apomixis and polyembryony (8 Lectures)

Definition, types and practical applications.

DSC-3 SEMESTER-III BBO-C351(LAB COURSE-CC-03)

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).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Suggested readings: Anatomy

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
3. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.
4. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
5. Taiz, L. & Zeiger, E. 2006 Plant Physiology. (4th edition) Sinauer Associates, Inc. Sunderland,

Embryology

1. Maheswari,P(1963) :Recent Advances in the Embryology of Angiosperms(Ed.) International Society of Plant Morphologists- University of Delhi.
2. Swamy. B.G.L. & Krishnamoorthy. K.V.(1980):From flower to fruit. Tata McGraw Hill Publishing Co., Ltd., New Delhi.
3. Maheswari, P.(1985):An Introduction to the Embryology of Angiosperms Tata McGraw Hill Publishing Co.,Ltd., New Delhi.
4. Bhojwani, S.S. & Bhatnagar, S.P. (2000) : The Embryology of Angiosperms (4^{th} Edition) Vikas Publishing House(P)Ltd., UBS Publisher's Distributors, New Delhi.

B.Sc. II Year **Semester – III**

BBO-S301
SEC-1 Nursery and Gardening

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Nursery: Planning and Management (8 Lectures)

Definition, objectives and scope and building up of infrastructure fornursery, planning and seasonal activities - planting - direct seeding and transplants.

Unit 2: **Seed: Dormancy and Production Technology (12 Lectures)**

Structure and types - seed dormancy; causes and methods of breakingdormancy - seed storage: seed banks, factors affecting seed viability, genetic erosion - seed production technology - seed testing and certification.

Unit 3:Vegetative propagation: Techniques and Managements (12 Lectures)

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: Gardening: Design and Managements (16 Lectures)

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: Cultivation (12 Lectures)

Sowing of seeds, transplanting of seedlings, cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes and carrots, storage and marketing.

B.Sc. II Year **Semester – III**

BBO-S302
SEC-1 Floriculture

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1:Introduction **(20 Lectures)**

Importance and scope of floriculture and landscape gardening. Nursery management and routine garden operations: sexual and vegetativemethods of propagation; soil sterilization; seed sowing; pricking; planting and transplanting; shading; stopping or pinching; defoliation; wintering; mulching; topiary; role of plant growth regulators.

Unit 2: Ornamental plants: **(8 Lecturer)**

Flowering annuals; herbaceous perennials; divine vines; shadeand 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 3: Principles of garden designs: **(8 Lecturer)**

English, Italian, French, Persian, Mughal andJapanese gardens; features of a garden (garden wall, fencing, steps, hedge, edging, lawn, flower beds, shrubbery, borders, water garden;some famous gardens of India.

Unit 4: Landscaping and commercial floriculture: **(10 Lecturer)**

Landscaping places of public importance: landscaping highways and educationalinstitutions.
Factors affecting flower production; production andpackaging 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 5: **Diseases and pests of ornamental plants:** **(2 Lecturer)**

Diseases and pests of ornamental plants; leaf spot of Chrysanthemum, tulip mosaic.

B.Sc. II Year **Semester – IV**

BBO-C401
DSC-4 Plant Physiology and Metabolism

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Plant-water relations and mineral nutrition (16 Lectures)

Importance of water, water potential and its components; transpiration and its significance; factors affecting transpiration; root pressure and guttation.Essential elements, macro and micronutrients; criteria of essentiality of elements; role of essential elements; transport of ions across cell membrane, active and passive transport.

Unit 2: Translocation of metabolites (6 Lectures)

Phloem structure, function, composition of phloem sap, girdling experiment; pressure flow model; phloem loading and unloading.

Unit 3: Photosynthesis and respiration (18 Lectures)

Photosynthetic pigments (Chl. a, b, xanthophylls, carotene); photosystem I and II, reaction center, antenna molecules; electron transport and mechanism of ATP synthesis; C_3, C_4 and CAM pathways of carbon fixation; photorespiration.Glycolysis, anaerobic respiration, TCA cycle; oxidative phosphorylation, oxidative pentose phosphate pathway

Unit 4: Enzymes and nitrogen metabolism (8 Lectures)

Classification, structure and properties; mechanism of enzyme action and enzyme inhibition.Biological nitrogen fixation (process of nodule formation, *nif*genes, nitrogenase, mechanism of nitrogen fixation),nitrate and ammonia assimilation.

Unit 5: Plant growth regulators and photoperiodism (8 Lectures)

Discovery and physiological roles of Auxins, Gibberellins, Cytokinins, ABA and Ethylene.Photoperiodism (SDP, LDP, day neutral plants); vernalization.

DSC-4 SEMESTER-IV BBO-C451(LAB COURSE-CC-04)

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

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. Steward. F.C (1964): Plants at Work (A summary of Plant Physiology) Addison-Wesley Publishing Co., Inc. Reading, Massachusetts, Palo alto, London.
2. Devlin, R.M. (1969) : Plant Physiology, Holt, Rinehart & Winston & Affiliated East West Press (P) Ltd., New Delhi.

3. Noggle, R.& Fritz (1989):Introductory Plant Physiology Prentice Hall of India.
4. Lawlor.D.W. (1989): Photosynthesis, metabolism, Control & PhysiologyELBS/Longmans-London.
5. Mayer, Anderson & Bonning(1965): Introduction to Plant PhysiologyD.Van Nostrand . Publishing Co., N.Y.
6. Mukherjee, S. A.K. Ghosh(1998) Plant Physiology ,Tata McGraw Hill Publishers(P)Ltd., New Delhi.
7. Salisbury, F.B & C.W. Ross (1999): Plant Physiology CBS Publishers and Printers,New Delhi.
8. Plummer, D.(1989) Biochemistry–the Chemistry of life,McGraw Hill Book Co., London, N.Y. New Delhi, Paris, Singapore, Tokyo.
9. Day, P.M.& Harborne, J.B. (Eds.,) (2000): Plant Biochemistry.Harcourt Asia (P) Ltd., India & Academic Press, Singapore.

B.Sc. II Year **Semester – IV**

BBO-S401
SEC-2 Biofertilizers

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Introduction: **(8 Lectures)**

General account about the microbes used as biofertilizer; *Rhizobium*, isolation,identification, mass multiplication, carrier based inoculants, actinorrhizalsymbiosis.

Unit 2: Inoculum preparation, maintenance and multiplication **(16 Lectures)**

Azospirillum:isolation and mass multiplication – carrier based inoculant, associativeeffect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication.

Unit 3: Cyanobacteria **(8 Lectures)**

Cyanobacteria (blue green algae), *Azolla*and *Anabaena* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

Unit 4: Mycorrhizal and VAM Fungi **(16 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: Organic farming and vermicomposting **(12 Lectures)**

Green manuring and organic fertilizers, agricultural and industrial wastes:bio-compost making methods, types and method of vermicomposting – field Application.

B.Sc. II Year **Semester – IV**

BBO-S402
SEC-2 Ethno-botany

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Ethno-botany **(12 Lectures)**

Introduction, concept, scope and objectives; ethnobotanyas an interdisciplinary science; 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: **(12 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: **(20 Lectures)**

Medico-ethnobotanical sources in India; significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiracthaindica* b) *Ocimum sanctum* c)*Vitexnegundo*. d) *Gloriosasuperba*e) *Tribulusterrestris*f) *Pongamiapinnata*g) *Cassia auriculata*h) *Indigoferatinctoria*; role of ethnobotany in modernmedicine with special example *Rauvolfiasepentina, Trichopuszeylanicus, Artemisia, Withania*.

Unit 4: IPR and Traditional knowledge: **(16 Lectures)**

Role of ethnic groups in conservation of plant genetic resources; endangered taxa and forest management (participatory forest management).Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India;Biopiracy, Intellectual Property Rights (IPR) and traditional knowledge.

B.Sc. III Year **Semester – V**

BBO-E501

DSE-1 Cell and Molecular Biology

MM : 100 Sessional : 30

Time : 3 hrs ESE : 70

Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Techniques in biology: (8 Lectures)

Principles of microscopy; light microscopy; phase contrast microscopy; fluorescence microscopy; confocal microscopy; sample preparation for light microscopy; electron microscopy (EM)- scanning EM and scanning Transmission EM (STEM); sample Preparation for electron microscopy; X-ray diffraction analysis.

Unit 2:Cell and cell cycle: (8 Lectures)

The cell theory; prokaryotic and eukaryotic cells; cell size and shape; eukaryotic cell components.Overview of cell cycle, mitosis and meiosis.

Unit 3: Cell organelles: (20 Lectures)

Mitochondria: structure, marker enzymes, composition; semiautonomous nature; symbionthypothesis; proteins synthesized within mitochondria; mitochondrial DNA.Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA.Endoplasmic reticulum, Golgi body &Lysosomes: structures and role.Peroxisomes and Glyoxisomes: 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 genetic material: (12 Lectures)

Functions of membranes; models of membrane structure; the fluidity of membranes; membrane proteins and their functions; carbohydrates in the membrane;faces of the membranes; selective permeability of the membranes; cell wall.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 and eukaryotes): bidirectional replication, semi-conservative.

Unit 5: Transcription and Regulation of gene expression: (6 Lectures)

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerases; translation (prokaryotes and eukaryotes), genetic code.Prokaryotes: lac operon and tryptophan (trp) peron.

DSE-1 SEMESTER-V BBO-E551(LAB COURSE-05)

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. 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).
5. Study the effect of temperature, organic solvent on semi permeable membrane.
6. Demonstration of dialysis of starch and simple sugar.
7. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
8. Measure the cell size (either length or breadth/diameter) by micrometry.
9. Study the structure of nuclear pore complex by photograph (from Gerald Karp)
10. Study of special chromosomes (polytene&lampbrush) either by slides or photographs.
11. Study DNA packaging by micrographs.
12. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

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. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
5. Dubey,R.C.A Text Book of Biotechnology. S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi-110 055.

B.Sc. III Year **Semester – V**

BBO-E502
DSE-1 Bioinformatics

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Introduction: **(5 Lectures)**

Introduction, branches of bioinformatics, aim, scope and research areas of bioinformatics.

Unit 2: Databases: **(5 Lectures)**

Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

Unit 3: Biological Sequence Databases: **(25 Lectures)**

National Center for Biotechnology Information (NCBI): tools and databases of NCBI, database retrieval tool, sequence submission to NCBI, Basic Local Alignment Search Tool (BLAST), nucleotide database, protein database, gene expression database. EMBL nucleotide sequence database (EMBL-Bank): introduction, sequence retrieval, sequence submission to EMBL, sequence analysis tools. DNA Data Bank of Japan (DDBJ): introduction, resources at DDBJ, data submission at DDBJ. Protein Information Resource (PIR): About PIR, resources of PIR, databases of PIR, data retrieval in PIR. Swiss-Prot: introduction and salient features.

Unit 4: Sequence Alignments: **(10 Lectures)**

Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, scoring matrices, Percent Accepted Mutation (PAM);Blocks of Amino Acid Substitution Matrix (BLOSUM).

Unit 5: Molecular Phylogeny and Applications: **(8 Lectures)**

Methods of phylogeny, software for phylogenetic analyses, consistency of molecular phylogenetic prediction.Structural bioinformatics in drug discovery, quantitative structure-activity relationship (QSAR) techniques in drug design, microbial genome applications, crop improvement.

Practical

11. Nucleic acid and protein databases.
12. Sequence retrieval from databases.
13. Sequence alignment.
14. Sequence homology and Gene annotation.
15. Construction of phylogenetic tree.

Suggested readings:

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

B.Sc. III Year **Semester – V**

BBO-E503

DSE-1 Analytical Techniques in Plant Sciences

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Imaging and related techniques: (15 Lectures)

Principles of microscopy; light microscopy; fluorescence microscopy; confocal microscopy; use of fluorochromes: (a) flow cytometry (FACS); (b) Applications of fluorescence microscopy: 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: (8 Lectures)

Centrifugation: differential and density gradient centrifugation, sucrose density gradient, CsCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3: Radioisotopes and spectrophotometry: (6 Lectures)

Use in biological research, auto-radiography, pulse chase experiment.Principle (Beer & Lambert's law). Application in biological research.

Unit 4: Chromatography: (8 Lectures)

Principle; paper chromatography; column chromatography, TLC, GLC, HPLC, ion-exchange chromatography; molecular sieve chromatography; affinity chromatography.

Unit 5: Characterization of proteins and nucleic acids, Biostatistics: (20 Lectures)

Mass spectrometry; X-ray diffraction; X-ray crystallography; characterization of proteins and nucleic acids; electrophoresis: AGE, PAGE, SDS-PAGE.Statistics, data, population, samples, parameters; representation of data: tabular, graphical; measures of central tendency: arithmetic mean, mode, median; measures of dispersion: range, mean deviation, variation, standard

deviation; Chi-square test for goodness of fit.

Practical's

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by chromatographic method.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).
12. Calculation (numerical) of central tendencies (mean, mode & median), standard deviation, standard error.

Suggested readings:

1. Dubey, R.C. A Text Book of Biotechnology. S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi-110 055.
2. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.
3. Smith, R. 2000 Plant Tissue Culture: Techniques and Experiments, 2nd edition, Academic.

B.Sc. III Year **Semester – V**

BBO-S501
SEC-3 Plant Diversity and Human Welfare

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Plant diversity and its scope: **(16 Lectures)**

Genetic diversity, species diversity, plant diversity atthe ecosystem level, agro-biodiversity 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 and its management: **(16 Lectures)**

Loss of genetic diversity, loss of species diversity, loss of ecosystem diversity, loss of agro-biodiversity, projected scenario for biodiversity loss, Management of Plant Biodiversity:Organizations associated with biodiversitymanagement-methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

Unit 3: Conservation of biodiversity: **(16 Lectures)**

Conservation of genetic diversity, species diversityand 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: **(12 Lectures)**

Importance of forestry their utilization and commercial aspects, avenue trees, ornamental plants of India. Alcoholic beverages through ages; fruits and nuts: Important fruit crops their commercial importance.

B.Sc. III Year **Semester – V**

BBO-S502

SEC-3 Medicinal and Economic Botany

MM : 100 Sessional : 30

Time : 3 hrs ESE : 70

Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Introduction and history of Ayurveda: (20 Lectures)

History, scope and Importance of medicinal plants; indigenous medicinal sciences;definition and scope-Ayurveda: history, origin, saptadhatu and tridosha concepts, Ramayana, plants used in Ayurveda 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: Conservation of endangered and endemic medicinal plants: (20 Lectures)

Definition: endemic andendangered medicinal plants, red list criteria; in situ conservation: Biosphere reserves, sacred groves, national parks; *Ex situ* conservation: botanic gardens, ethno-medicinal 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: Ethno-botany and folk medicines: (20 Lectures)

Definition;ethnobotanyin India: methods tostudy ethno botany; applications of ethno botany: national interacts, palaeo-ethnobotany. folk medicines of ethno botany, ethno-medicine, ethno ecology, ethnic communities of India;application of natural products to certain diseases-Jaundice, cardiac, infertility, diabetics, blood pressure and skin diseases.

Unit 4: Origin of cultivated plants: (10 Lectures)

Concept of centers of origin, their importance with reference to Vavilov's work.Wheat - origin, morphology, uses.General description with special reference to cotton (botanical name, family, part used, morphology and uses).

Unit 5: Beverages, oils, legumes and spices (14 Lectures)

Tea (morphology, processing, uses).General description with special reference togroundnut. General account with special reference to Chick-pea and soybean. General account with special reference to clove and black pepper (botanical name, family, part used morphology and uses).

B.Sc. III Year **Semester – VI**

BBO-E601
DSE-2 Plant Biotechnology

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Scope and importance (4 Lectures)

Historical back ground and recent advance in plant biotechnology: emergence of modern biotechnology as an interdisciplinary area. Global impact and current excitement of plant biotechnology;Global scenario and recent trends in plant biotechnology; Potential of modern biotechnology for future and sustainable development. Plant biotechnology techniques for conservation of plant genetic resources.

Unit 2: Application of Plant cell, tissues and organ culture (8 Lectures)

Application in agriculture, improvement of hybrid, production of encapsulated seed/artificial seeds, Production of disease and stress free plants. Production of transgenic plants for crop improvements, virus resistant transgenic plants, insect resistant transgenic plants, Herbicide resistant transgenic plants, Molecular farming from transgenic plants, nutritional quality and immunotherapeutic drugs (edible vaccines, edible antibodies and edible interferon); Bioethics in plant genetic engineering.

Unit 3: Cryopreservation (12 Lectures)

Introduction and Difficulties in Cryopreservation; Methods for Cryopreservation, Selection of material, addition of cyoprotectors, Storeg in liquid nitrogen, thawing, washing and recuturing regeneration of plantlets; Plant cell bank; Pollen bank. Stage of cryopreservation and standardization of culture, Achievement through cryopreservation.

Unit 4: Plant tissue culture(10 lecture)

Totipotency, method of tissue culture.Micro-propagation; haploid production through androgenesis and glycogenesis; brief account of embryo & endosperm culture with their applications.

Unit 5: Recombinant DNA Techniques (18 Lectures)

Blotting techniques: Southern and Western Blotting, Northern, DNA fingerprinting; molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and reverse transcriptase-PCR;hybridoma and monoclonal antibodies, ELISA and immune detection;gene therapy.

DSE-2 SEMESTER-VI BBO-E651(LAB COURSE-06)

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 equipment's in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Suggested readings:

1. Dubey,R.C.A Text Book of Biotechnology. S. Chand & Company Pvt. Ltd. Ram Nagar, New Delhi-110 055.
2. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.
3. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
4. Chrispeel, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones and BarlettPublishers.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue andOrgan Culture. Narosa Publishing House.
6. Smith, R. 2000 Plant Tissue Culture: Techniques and Experiments, 2nd edition, Academic
7. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
8.
9. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rd edition. Benjamin Co.
10. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
11. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
12. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)

B.Sc. III Year **Semester – VI**

BBO-E602

DSE-2 Research Methodology

MM : 100 Sessional : 30

Time : 3 hrs ESE : 70

Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Basic concepts: **(22 Lectures)**

Research-definition and types of research (descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vsempirical). Research methods vs methodology;literature-review and its consolidation; Library research; field research; laboratory research. Common calculations in botany laboratories;understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases; preparation of solutions. Dilutions. Percentage solutions; molar and normal solutions; technique of handling micropipettes; knowledge about common toxic chemicals and safety measures in their handling.

Unit 3: Data collection and documentation: **(6 Lectures)**

Maintaining a laboratory record; tabulation and generation of graphs;imaging of tissuespecimens and application of scale bars; art of field photography.

Unit 3: Biological Problems **(6 Lectures)**

History; key biology research areas, model organisms in biology (brief overview): genetics, physiology, biochemistry, molecular biology, cell biology, genomics, proteomics-transcriptional regulatory network.

Unit 4: **Methods to study plant cell and plant microtechniques:** **(18 Lectures)**

Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; paraffin and plastic infiltration; preparation of thin and ultrathin sections.Staining procedures, classification and chemistry of stains. staining equipment. Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags). Cytogenetic techniques with squashed plant materials.

Unit 5: Scientific writing and presentation: **(8 Lectures)**

Numbers, units, abbreviations and nomenclature used in scientific writing; writing references; power point presentation; poster presentation; scientific writing and ethics, introduction to

copyright-academic misconduct/plagiarism.

Practical

1. Experiments based on chemical calculations.
2. Plant micro-technique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.
5. Technical writing on topics assigned.

BBO-E603
DSE-2 Dissertation

B.Sc. III Year **Semester – VI**

BBO-S601
SEC-4 Mushroom Culture Technology

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

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NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Introduction: **(10 Lectures)**

History; nutritional and medicinal value of edible mushrooms; Poisonous mushrooms; types of edible mushrooms available in India –*Volvariellavolvacea,Pleurotuscitrinopileatus, Agaricusbisporus*.

Unit 2: Cultivation technology: **(24 Lectures)**

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.

Unit 3: Storage and nutrition: **(16 Lectures)**

Short-term storage (refrigeration – upto 24 hours) long term storage (canning, pickels, papads), drying, storage in saltsolutions; nutrition – proteins - amino acids, mineral elements nutrition - carbohydrates, crude fiber content - vitamins.

Unit 4: Food preparation: (10 Lectures)

Types of foods prepared from mushroom; research centers -national level and regional level; cost benefit ratio - marketing in India and abroad,
export value.

BBO-S602
SEC-4 Intellectual Property Rights

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Introduction: (4 lectures)

Concept and kinds. Economic importance. IPR in India and world: genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO).

Unit 2: Patents, copyrights and trademarks: (18 Lectures)

Objectives, rights, patent act 1970 and its amendments. Procedure of obtaining patents, working of patents. Introduction, works protected under copyright law, rights, transfer of copyright, infringement. Objectives, types, rights, protection of goodwill, infringement, passing off, defenses, and domain name.

Unit 3: Geographical indications and protection of traditional knowledge: (14 Lectures)

Objectives, justification, international position, multilateral treaties, national level, Indian Position. Objective, concept of traditional knowledge, holders, issues concerning, bio-prospecting and bio-piracy, alternative ways, protect ability, needfor a sui-generis regime, traditional knowledge on the international arena, at WTO and at national level, traditional knowledge digital library.

Unit 4: Industrial designs: (4 Lectures)

Objectives, rights, assignments, infringements, defences of design infringement.

Unit 5: Protection of plant varieties: (20 Lectures)

Plant varieties protection-objectives, justification, international position, plant varietiesprotection in India; rights of farmers, breeders and researchers; national gene bank, benefit sharing; protection of plant varieties and farmers' rights act, 2001.Computer software and intellectual property, database and data protection, protection of semi-conductor chips, domain name protection.Patenting biotech inventions: objective, applications, concept of novelty, concept of inventive step, microorganisms, moral issues in patenting biotechnological inventions.

B.Sc. III Year **Semester – VI**

BBO-S603
SEC-4 Herbal Technology

MM : 100 Sessional : 30
Time : 3 hrs ESE : 70
Pass Marks : 40

NOTE: Questions of theory paper are to be set under three sections i.e., A, B, and C. Ten **objective/multiple choice questions** (MCQs) uniformly distributed from the entire syllabus are to be set for section A. In Section B, the student has to answer any five questions out of ten **short answer questions** (100 words) uniformly distributed from the entire syllabus. Eight **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section C and the student has to answer any four questions. Section A, B, and C will be of 10, 20, and 40 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit 1: Herbal medicines: **(12 Lectures)**

History and scope - definition of medical terms - role of medicinalplants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

Unit 2: Pharmacognosy: **(12 Lecturers)**

Systematic position medicinal uses of the following herbs in curing various ailments; tulsi, ginger, fenugreek, Indian Goose berry and ashoka.

Unit 3: Phytochemistry: **(12 Lecturers)**

Active principles and methods of their testing - identification andutilization of the medicinal herbs; *Catharanthusroseus* (cardiotonic), *Withaniasomnifera* (drugs acting on nervous system), *Clerodendronphlomoides* (anti-rheumatic) and *Centellaasiatica*(memory booster)

Unit 4: Analytical pharmacognosy: **(16 Lectures)**

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: Tissue culture and micro propagation **(8 Lectures)**

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