

Minutes of the Ad-hoc BoS Botany meeting

Minutes of the meeting of the Ad-hoc Board of Studies BOTANY in the faculty of Science and Technology was held on 26th June 2023 at 12:30 noon

THE FOLLOWING MEMBERS WERE PRESENT

1. Dr. Rajesh Raut
2. Prof. Abhay Salve
3. Prof. Sakshi Chaubal
4. Dr. Smt. Jaya Pawar
5. Dr. Rahul Zanan

Item No. 01: Consideration of the changes in the Syllabi as per the Credit Structure in Botany
As Per Government of Maharashtra Guidelines

- 1) Botany syllabus for BSc First Year all the titles and course code was presented by Prof. Sakshi Chaubal and Dr. Rahul Zanan.
- 2) M.Sc Botany syllabus all the titles and course code was presented by Prof. Abhay Salve Dr. Jaya Pawar and Dr. Rajesh Raut.

Raut
(Dr. R. W. Raut)
26/06/2023

Sakshi Chaubal Dr. Sakshi Chaubal

Rahul Zanan
Dr. Rahul Zanan
28/06/2023

Jaya Pawar
26/6/2023
Dr. Jaya Pawar

Abhay Salve
26/06/2023
Dr. Abhay Salve

**DR. HOMI BHABHA STATE UNIVERSITY,
MUMBAI**

Faculty of Science and Technology

**SYLLABUS FOR
UNDER GRADUATE COURSE IN BOTANY**

As Per NEP Guidelines

**BOTANY SEMESTER - WISE SYLLABUS
(Theory and Practicals)**

**To Be Implemented from Academic Year
2023 - 2024**

Courses for B. Sc. Botany

SEMESTER	Course Title	Course Code
SEMESTER I	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Biodiversity I and Ecology I	BSBODC101T
	Biodiversity I and Ecology I	BSBODC101P
	Plant Morphology & Ethnobotany	BSBODC102T
	Plant Morphology & Ethnobotany	BSBOCC102P
	DISCIPLINE SPECIFIC MINOR COURSE	
	Plant Diversity	BSBOMN101T
	Plant Organisation	BSBOMN102T
	VOCATIONAL SKILL COURSES (VSC)	
	Hands on Training Related to Plant Diversity	BSBOVS101P
	Hands on Training Related to Plant Organization	BSBOVS102P
	GENERIC/ OPEN ELECTIVES (OE)	
	Nursery management	BSBOOE101T
	Indian Knowledge System (IKS)	
	Ayurveda and Medicinal Plants	BSBOIK101T
SEMESTER II	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Biodiversity II and Plant Anatomy I	BSBODC201T
	Biodiversity II and Plant Anatomy I	BSBODC201P
	Plant Conservation and Mendelian Genetics	BSBODC202T
	Plant Conservation and Mendelian Genetics	BSBODC202P
	DISCIPLINE SPECIFIC MINOR COURSE	
	Cell Biology and Biomolecules	BSBOMN201T
	Plant Physiology	BSBOMN202T
	VOCATIONAL SKILL COURSES (VSC)	
	Hands on Training Related to Cell Biology	BSBOVS201P
	Hands on Training Related to Plant Physiology	BSBOVS202P
	GENERIC/ OPEN ELECTIVES (OE)	
	Gardening and Landscaping	BSBOOE201T
	Indian Knowledge System (IKS)	
	Ayurveda and Medicinal Plants	BSBOIK201T
SEMESTER III	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Biodiversity III and Plant Systematics	BSBODC301T
	Biodiversity III and Plant Systematics	BSBODC301P
	Cell Biology I and Ecology II	BSBODC302T
	Cell Biology I and Ecology II	BSBOCC302P
	DISCIPLINE SPECIFIC MINOR COURSE	
Reproduction in Plants	BSBOMN301T	

	Reproduction in Plants	BSBOMN301P
	Plant Genetics	BSBOMN302T
	Plant Genetics	BSBOMN302P
	GENERIC/ OPEN ELECTIVES (OE)	
	Plants and Human Welfare	BSBOOE301T
	Skill Enhancement Courses (SEC)	
	Mushroom Cultivation Technology	BSBOSE301T
	Mushroom Cultivation Technology	BSBOSE301P
SEMESTER IV	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Biodiversity IV and Embryology	BSBODC401T
	Biodiversity IV and Embryology	BSBODC401P
	Cell Biology II and Anatomy II	BSBODC402T
	Cell Biology II and Anatomy II	BSBOCC402P
	DISCIPLINE SPECIFIC MINOR COURSE	
	Plant Biotechnology	BSBOMN401T
	Plant Biotechnology	BSBOMN401P
	Plant Ecology	BSBOMN402T
	Plant Ecology	BSBOMN402P
	GENERIC/ OPEN ELECTIVES (OE)	
	Indian Forest	BSBOOE401T
	Skill Enhancement Courses (SEC)	
	Organic Farming and bio fertilizers	BSBOSE401T
	Organic Farming and bio fertilizers	BSBOSE401P
SEMESTER V	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Genetics and Plant Breeding	BSBODC501T
	Genetics and Plant Breeding	BSBODC501P
	Plant Physiology and Biochemistry	BSBODC502T
	Plant Physiology and Biochemistry	BSBODC502P
	Biostatistics and Bioinformatics	BSBODC503T
	Biostatistics and Bioinformatics	BSBODC503P
	DISCIPLINE SPECIFIC ELECTIVE COURSE	
	Analytical Techniques in Plant Science	BSBODE501T
	Pharmacognosy and Industrial Botany	BSBODE502T
	VOCATIONAL SKILL COURSES (VSC)	
	Hands on Training: Analytical Techniques in Plant Science	BSBOVS501P
	Hands on Training: Pharmacognosy and Industrial Botany	BSBOVS502P
	FIELD PROJECT / COMMUNITY ENGAGEMENT & SERVICES (FP/CEP)	
	Field Project / Community Engagement & Services related to Major	BSBOFP/CE501P

SEMESTER VI	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Molecular Biology	BSBODC601T
	Molecular Biology	BSBODC601P
	Plant Taxonomy and Horticulture	BSBODC602T
	Plant Taxonomy and Horticulture	BSBODC602P
	Environmental Botany and Environmental Impact Assessment	BSBODC603T
	Environmental Botany and Environmental Impact Assessment	BSBODC603P
	DISCIPLINE SPECIFIC ELECTIVE COURSE	
	Plant Biotechnology	BSBODE601T
	Conservation Biology and Seed Technology	BSBODE602T
	VOCATIONAL SKILL COURSES (VSC)	
	Hands on Training: Plant Biotechnology	BSBOVS601P
	Hands on Training: Conservation Biology and Seed Technology	BSBOVS602P
	FIELD PROJECT / COMMUNITY ENGAGEMENT & SERVICES (FP/CEP)	
Field Project / Community Engagement & Services related to Major	BSBOFP/CE601P	

FOUR YEAR UG HONOURS DEGREE IN MAJOR

SEMESTER	Course Title	Course Code
SEMESTER VII	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Plant Diversity I (Algae, Fungi, Bryophytes and Pteridophytes)	BSBODC701T
	Plant Diversity I (Algae, Fungi, Bryophytes and Pteridophytes)	BSBODC701P
	Plant Physiology and Ecology	BSBODC702T
	Plant Physiology and Ecology	BSBODC702P
	DISCIPLINE SPECIFIC ELECTIVE COURSE	
	Molecular Biology, Cytogenetics and Biotechnology I	BSBODE701T
	Molecular Biology, Cytogenetics and Biotechnology I	BSBODE701P
	Plant Physiology, Biochemistry and Phytochemistry I	BSBODE702T
	Plant Physiology, Biochemistry and Phytochemistry I	BSBODE702P
	Ecology, Environmental Botany and Biotechnology I	BSBODE703T
	Ecology, Environmental Botany and Biotechnology I	BSBODE703P
	RESEARCH METHODOLOGY	
	Research Methodology	BSBORM701T
SEMESTER VIII	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Plant Diversity II (Gymnosperm, Angiosperm, Paleobotany and Developmental Botany)	BSBODC801T
	Plant Diversity II (Gymnosperm, Angiosperm, Paleobotany and Developmental Botany)	BSBODC801P
	Cytology, Genetics, Cell Biology, and Plant Breeding	BSBODC802T
	Cytology, Genetics, Cell Biology, and Plant Breeding	BSBODC802P

	DISCIPLINE SPECIFIC ELECTIVE COURSE	
	Molecular Biology, Cytogenetics and Biotechnology II	BSBODE801T
	Molecular Biology, Cytogenetics and Biotechnology II	BSBODE801P
	Plant Physiology, Biochemistry and Phytochemistry II	BSBODE802T
	Plant Physiology, Biochemistry and Phytochemistry II	BSBODE802P
	Ecology Environmental Botany and Biotechnology II	BSBODE803T
	Ecology Environmental Botany and Biotechnology II	BSBODE803P
	ON JOB TRAINING: INTERNSHIP / APPRENTICESHIP	
	On Job Training: Internship / Field Project related to Major	BSB00J/FP80 1P

FOUR YEAR UG HONOURS WITH RESEARCH DEGREE IN MAJOR

SEMESTER	Course Title	Course Code
SEMESTER VII	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Plant Diversity I (Algae, Fungi, Bryophytes and Pteridophytes)	BSBODC701T
	Plant Diversity I (Algae, Fungi, Bryophytes and Pteridophytes)	BSBODC701P
	Plant Physiology and Ecology	BSBODC702T
	DISCIPLINE SPECIFIC ELECTIVE COURSE	
	Molecular Biology, Cytogenetics and Biotechnology I	BSBODE701T
	Plant Physiology, Biochemistry and Phytochemistry I	BSBODE702T
	Ecology Environmental Botany and Biotechnology I	BSBODE703T
	RESEARCH METHODOLOGY	
	Research Methodology	BSBORM701T
	RESEARCH PROJECT	
	Research Project related to Major	BSBORP701P
SEMESTER VIII	DISCIPLINE SPECIFIC COMPULSORY COURSE	
	Plant Diversity II (Gymnosperm, Angiosperm, Paleobotany and Developmental Botany)	BSBODC801T
	Plant Diversity II (Gymnosperm, Angiosperm, Paleobotany and Developmental Botany)	BSBODC801P
	Cytology, Genetics, Cell Biology, and Plant Breeding	BSBODC802T
	DISCIPLINE SPECIFIC ELECTIVE COURSE	
	Molecular Biology, Cytogenetics and Biotechnology II	BSBODE801T
	Plant Physiology, Biochemistry and Phytochemistry II	BSBODE802T
	Ecology Environmental Botany and Biotechnology II	BSBODE803T
	RESEARCH PROJECT	
	Research Project related to Major	BSBORP801P

Field Visits: At list one field visit (minimum one day) per semester is compulsory. During entire degree course minimum one visit beyond the limits of Maharashtra for habitat studies is compulsory. The record of visits should be duly certified and presented at the time semester end practical examination.

SEMESTER I

DISCIPLINE SPECIFIC COMPULSORY COURSE	
Paper I	
Course Code: BSBODC101T	Course Title: Biodiversity I and Ecology I
Course Credit: 2	Total contact hours: 30 Hrs
Course Contents (Topics & subtopics)	Hours
Unit 1: Microbes and Algae Microbes <ul style="list-style-type: none"> • Viruses–General account and economic importance • Bacteria–General characteristics, cell structure and economic importance Algae <ul style="list-style-type: none"> • General characteristics; Ecology and distribution; Range of thallus, organization and reproduction; Classification of algae 	10
Unit 2: Algae and Plant Ecology <ul style="list-style-type: none"> • Morphology and life cycles of the following: <i>Nostoc</i>, <i>Chlamydomonas</i>, <i>Vaucheria</i>, <i>Polysiphonia</i>. • Economic importance of algae Ecological factors <ul style="list-style-type: none"> • Soil: Origin, formation, composition, soil profile. • Water: States of water in the environment, precipitation types. • Light and temperature: Variation Optimal and limiting factors. 	10
Unit 3: Ecosystem <ul style="list-style-type: none"> • Structure; energy flow trophic organization; • Food chains and food webs, • Ecological pyramids production and productivity; • Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous. 	10
Course Code: BSBODC101P	Course Title: Biodiversity I and Ecology I
Course Credit: 1	Total contact hours: 30 Hrs
Course Contents (Topics & subtopics)	30
<ol style="list-style-type: none"> 1. Gram staining. 2. Study of vegetative and reproductive structures of <i>Nostoc</i>, <i>Chlamydomonas</i>, <i>Vaucheria</i> and <i>Polysiphonia</i> through temporary preparations or permanent slides or electron micrographs. 3. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer / hygrometer, rain gauge and lux meter. 4. To study the quantitative characters of plant community by quadrat method (density, frequency and abundance) 5. Field visit to research institute / places of ecological / environmental interest. 	
Objectives: <ul style="list-style-type: none"> • To understand the general characteristics of microbes. 	

<ul style="list-style-type: none"> • To understand the general characters, ecology, morphology, reproduction and life cycle of algae. • To understand the concepts and principles of ecology, ecological factors and ecosystem. 		
Suggested Readings <ol style="list-style-type: none"> 1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition. 2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition. 3. Raven P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India. 4. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition. 5. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th Ed. 		
Paper II		
Course Code: BSBODC102T	Course Title: Plant Morphology and Ethnobotany	
Course Credit: 2	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		Hours
Unit 1: Plant Morphology Vegetative Morphology <ul style="list-style-type: none"> • Root: Types of roots • Leaf: Venation, types • Stem: Types of stem Floral Morphology <ul style="list-style-type: none"> • Types of inflorescence: Racemose, Cymose and Special type • Flower: Bracts, attachments, floral whorls, symmetry, position and arrangement of floral organs • Calyx: Cohesion, aestivation • Corolla: Cohesion, aestivation, shape, perianth 		10
Unit 2: Plant Morphology and Ethnobotany <ul style="list-style-type: none"> • Androecium: Cohesion, adhesion, attachment of filament to anther • Gynoecium: Number of carpels, cohesion of carpels, position of ovary, number of locule and ovule, placentation, style, stigma • Floral formula Ethnobotany <ul style="list-style-type: none"> • 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 <ol style="list-style-type: none"> a) Food plants b) Intoxicants and beverages c) Resins and oils and miscellaneous uses. 		10

Unit 3: Ethnobotany		10
Methodology of Ethnobotanical studies		
a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) Temples and sacred places.		
Ethnobotany and legal aspects		
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. Biopiracy, Intellectual Property Rights and Traditional Knowledge		
Course Code: BSBODC102P	Course Title: Plant Morphology and Ethnobotany	
Course Credit: 1	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		30
<ol style="list-style-type: none"> 1. Vegetative Morphology: Roots and Stem 2. Vegetative Morphology: Leaves 3. Floral morphology: inflorescence, flower 4. Floral morphology: Calyx and corolla 5. Floral morphology: Androecium and Gynoecium 6. Detailed morphological and anatomical study of medicinally important part(s) of locally available plants (Minimum 8 plants) used in traditional medicine. 7. Field visits to identify and collect ethno-medicinal plants used by local tribes/folklore. 		
Objectives:		
<ul style="list-style-type: none"> • To understand the vegetative characters of plants • To understand floral characters of plants • To understand ethnobotany concept, methods used in ethnobotany and its legal aspect. • To identify various plant parts used by tribal as medicines by ethnic groups 		
Suggested Readings		
<ol style="list-style-type: none"> 1. Simpson, M.G. (2006). <i>Plant Systematics</i>. Elsevier Academic Press, USA 2. Singh, G. (2012). <i>Plant Systematics: Theory and Practice</i>. Oxford & IBH. Pvt. Ltd., New Delhi. 3rd edition. 3. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995. 4. Glimpses of Indian. Ethnobotany, Oxford and I B H, New Delhi – 1981. 5. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta. 6. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today & Tomorrow's printers and publishers, New Delhi. 7. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India. 		

DISCIPLINE SPECIFIC MINOR COURSE		
Paper I		
Course Code: BSBOMN101T	Course Title: Plant Diversity	
Course Credit:2	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		Hours
Unit 1: Diversity In The Living Organism		10

Taxonomic Categories		
Species, Genus, Family, Order, Class, Phylum, Kingdom		
Unit 2: Biological Classification		10
Kingdom Monera, Protista, Fungi, Plantae and Animalia, Viruses, Viroids, Prions And Lichen		
Unit 3: Plant Kingdom		10
Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.		
Paper II		
Course Code: BSBOMN102T	Course Title: Plant Organisation	
Course Credit: 2	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		Hours
Unit 1: Morphology of Flowering Plants		
Root, Stem, Leaf, Inflorescence, Flower, Fruit, Seed, Floral formula and floral diagram.		10
Unit 2: Systematic study of Plant Families		
Technical description of flowering plant (Floral formula and Floral Diagram). Plant Family: Mavvaceae, Liliaceae, Asteraceae		10
Unit 3: Anatomy of Flowering Plants		
Dicotyledonous and Monocotyledonous Plants. Structure of xylem, phloem and cambium. Types of Stomata: Anomocytic, Anisocytic, Diacytic, Paracytic, and Gramineous.		10

VOCATIONAL SKILL COURSES (VSC)		
Hands on Training Related to Minor		
Paper I		
Course Code: BSBOVS101P	Course Title: Hands on Training Related to Plant Diversity	
Course Credit: 1	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		30
1. Morphology and Reproduction of Algae (Temporary slide/Photograph). 2. Morphology and Reproduction of Bryophytes (Temporary slide/Photograph). 3. Morphology and Reproduction of Pteridophytes (Temporary slide/Photograph).		
Paper II		
Course Code: BSBOVS102P	Course Title: Hands on Training Related to Plant Organization	
Course Credit: 1	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		30
1. Floral morphology: Inflorescence and Flower.		

2. To study of Monocot and Dicot leaf and stem.	
3. To study the stomata on the upper and lower surfaces of leaves.	
4. Study and describe selected flowering plants of families.	

GENERIC/ OPEN ELECTIVES (OE)	
Course Code: BSBOOE101T	Course Title: Nursery management
Course Credit: 2	Total contact hours: 30 Hrs
Course Contents (Topics & subtopics)	Hours
Unit 1: Nursery Definition, objectives and scope and general practices. Planning and seasonal activities. Planting of seeding, potting and transplants. Soil components, Synthetic growth mediums for pots and nursery.	10
Unit 2: Propagation Techniques Seed, Budding, Grafting, Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings. Hardening of plants. Green house and shade house.	10
Unit 3: Management of Nursery Building up of infrastructure for nursery, Maintenance nursery, Mother stock maintenance, Product Sale management.	10
Course Outcome: 1. To gain knowledge of Nursery management, cultivation, multiplication, raising and maintenance of nursery plants. 2. To get knowledge of new and modern techniques of plant propagation. 3. To develop interest in nature and plant life. 4. Students can find employment in plantations and nurseries.	
Suggested Reading: 1. Agrawal, P.K. (1993). Hand Book of Seed Technology. New Delhi, Delhi: Dept. of Agriculture and Cooperation, National Seed Corporation Ltd. 2. Bose T.K., Mukherjee, D. (1972). Gardening in India. New Delhi, Delhi: Oxford & IBH PublishingCo. 3. Jules, J. (1979). Horticultural Science, 3rd edition. San Francisco, California: W.H. Freeman and Co. 4. Kumar, N. (1997). Introduction to Horticulture. Nagercoil, Tamil Nadu: Rajalakshmi Publications. 5. Musser E., Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: McGraw Hill Book Co. 6. Sandhu, M.K. (1989). Plant Propagation. Madras, Bangalore: Wile Eastern L.	

Indian Knowledge System (IKS)	
Course Code: BSBOIK101T	Course Title: Ayurveda and Medicinal Plants
Course Credit: 2	Total contact hours: 30 Hrs
Course Contents (Topics & subtopics)	Hours

<p>Unit 1: Ayurveda Ayurveda: Introduction, History and current status. Practice, diagnosis, treatment and substances used. Disciplines: Ashtanga Ayurveda. Ayurveda in Veda: Rig Veda, Yajur Veda, Sama Veda, Atharvana Veda. Rasa Shastra in Vedas. Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: Introduction, Principles and Concepts, Prevention of Disease, Therapeutics</p>	10
<p>Unit 2: Ayurvedic Herbs and Spices with Health Benefits Plant part, uses and health benefits of Turmeric (Haldi), Cumin (Jeera), Carom seeds (Ajwain), Asafoetida (Heeng), Coriander (Dhaniya), Red Chilli (Lal mirch), Fenugreek (Methi dana), Small cardamon (Elaichi), Cloves (Laung), Black Pepper (Kali miri), Fennel (saunf), Dry Ginger (saunth), Cinnamon (dalchini).</p>	10
<p>Unit 3: Ayurvedic Formulations: Ayurvedic Formulations: Ark, Asava and Arishta, Avaleh, Bhasma, Churna, Ghrita, Guggulu, Kwath or Kashaya, Pak, Rasayan, Taila, Vati. Dashmoola: Plants part used, uses, dosage, benefits and side effects. Triphala: Plants part used, preparation, meditational property, uses, dosage, benefits and side effects. Chyavana Prasha: Introduction, uses, ingredients, preparation, dosage Sitopaladi Churna: Introduction, uses, ingredients, preparation, dosage</p>	10
<p>Course Outcome: 1. To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of garden plants. 2. To get knowledge of new and modern techniques of plant propagation. 3. To develop interest in nature and plant life.</p>	
<p>Suggested Reading: 1. Agrawal, P.K. (1993). Hand Book of Seed Technology. New Delhi, Delhi: Dept. of Agriculture and Cooperation, National Seed Corporation Ltd. 2. Bose T.K., Mukherjee, D. (1972). Gardening in India. New Delhi, Delhi: Oxford & IBH PublishingCo. 3. Jules, J. (1979). Horticultural Science, 3rd edition. San Francisco, California: W.H. Freeman and Co. 4. Kumar, N. (1997). Introduction to Horticulture. Nagercoil, Tamil Nadu: Rajalakshmi Publications. 5. Musser E., Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: McGraw Hill Book Co. 6. Sandhu, M.K. (1989). Plant Propagation. Madras, Bangalore: Wile Eastern L. 7. Home Remedies in Unani, Department of Ayush, New Delhi. 8. Myths and Interesting Facts about AYUSH, Department of Ayush, New Delhi.</p>	

SEMESTER II

DISCIPLINE SPECIFIC COMPULSORY COURSE		
Paper I		
Course Code: BSBODC201T	Course Title: Biodiversity II and Plant Anatomy I	
Course Credit: 2	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		Hours
Unit 1: Fungi <ul style="list-style-type: none"> • Introduction-General characteristics, ecology and significance, cell wall composition, nutrition, reproduction and classification. • True Fungi-General characteristics, life cycle of <i>Rhizopus</i> (Zygomycota) <i>Penicillium</i>, (Ascomycota), <i>Agaricus</i> (Basidiomycota). • Economic importance of fungi. 		10
Unit 2: Symbiotic Associations and Plant Anatomy Symbiotic Associations <ul style="list-style-type: none"> • Lichens: General account, types and significance. • Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance Introduction: Definition, scope of plant anatomy Simple and complex tissues. <ul style="list-style-type: none"> • Epidermal tissue system: Structure and function of epidermal tissue system, uniseriate and multiseriate epidermis. 		10
Unit 3: Plant Anatomy <ul style="list-style-type: none"> • Epidermal outgrowth: glandular and non-glandular. • Structure and function of xylem, phloem and cambium. Organs <ul style="list-style-type: none"> • Structure of dicot and monocot root stem and leaf. • Types of Stomata: Anomocytic, Anisocytic, Diacytic, Paracytic, and Graminaceous. 		10
Course Code: BSBODC201P	Course Title: Biodiversity II and Plant Anatomy I	
Course Credit: 1	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		30
<ol style="list-style-type: none"> 1. <i>Rhizopus</i> and <i>Penicillium</i>: Asexual stage from temporary mounts and sexual structures through permanent slides. 2. <i>Agaricus</i>: Specimens of button stage and full grown mushroom; Sectioning of gills of <i>Agaricus</i>. 3. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) 4. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs) 5. Study of types of Stomata: Anomocytic, Anisocytic, Diacytic, Paracytic, Graminaceous 6. Study of Leaf: Dicot and Monocot leaf. 7. Study of the following leaves with respect to leaf surface characters (cuticle, epidermis, epidermal outgrowths) 		
Objectives: <ul style="list-style-type: none"> • To understand the general characters, ecology, morphology, reproduction and life cycle of fungi. 		

<ul style="list-style-type: none"> • To understand the symbiotic association of fungi. • To understand the concepts and principles of plant anatomy. • To understand structure of different tissue and types of stomata. 		
Suggested Readings <ol style="list-style-type: none"> 1. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi. 2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition 3. Raven P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India. 4. Plant Anatomy, Chandurkar P J, Plant Anatomy Oxford and IBH publication Co. New Delhi 1971. 5. B P Pandey, Plant Anatomy, S Chand and Co. Ltd, New Delhi 1978. 6. Esau, Plant Anatomy, Wiley Toppan Co. California, USA. 7. Pijush Roy, Plant Anatomy, New Central Book Agency Ltd, Kolkata. 8. Eames and Mc Daniel, An Introduction to Plant Anatomy, McGraw –Hill Book Co. Ltd and Kogakusha Co, Tokyo, Japan. 		
Paper II		
Course Code: BSBODC202T	Course Title: Plant Conservation and Mendelian Genetics	
Course Credit: 2	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		Hours
Unit 1: Plant Conservation		10
Conservation biology <ul style="list-style-type: none"> • The environment and its pollution types: land, air and water. Effect on living organisms. • Environmental hazards: threats to the global environment, greenhouse effect, ozone depletion. • Problems of conservation: causes of threat to environment, human interference, habitat destruction, overexploitation of resources. • Deforestation, Afforestation, Social forestry and agroforestry 		
Unit 2: Plant Conservation and Mendelian Genetics Phytogeography <ul style="list-style-type: none"> • Principle biogeographical zones; Endemism Plant communities <ul style="list-style-type: none"> • Characters; Ecotone and edge effect; Succession; Processes and types. Mendelian genetics and its extension <ul style="list-style-type: none"> • Mendelism: Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Pedigree analysis. 		10
Unit 3: Mendelian Genetics Modified Mendelian Ratios: <ul style="list-style-type: none"> • 2:1- lethal Genes; 1:2:1; Co- dominance, incomplete dominance; 9:7; 9:4:3; 13:3; 12:3:1. Epistasis. 		10

Course Code: BSBODC202P	Course Title: Plant Conservation and Mendelian Genetics	
Course Credit: 1	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		30
<ol style="list-style-type: none"> 1. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates and organic matter. 2. Study of morphological and anatomical characteristics of plants under pollution stress. 3. Estimation of DO and free CO₂ 4. Field visit to research institute / places of ecological / environmental interest. 5. Meiosis through temporary squash preparation. 6. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4). 		
Objectives:		
<ul style="list-style-type: none"> • To understand the plant communities and phytogeography. • To understand the different factors and their control for conservation of biodiversity. • To understand the Mendelian ratio and other epistasis ratio. 		
Suggested Readings		
<ol style="list-style-type: none"> 1. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition. 2. Simpson, M.G. (2006). <i>Plant Systematics</i>. Elsevier Academic Press, San Diego, CA, U.S.A. 3. Singh, G. (2012). <i>Plant Systematics: Theory and Practice</i>. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition. 4. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th Ed. Strickberger, M.W. (1976): Genetics (2nd Edition) MacMillan Publishing Co., Inc., N.Y., London. 5. Mukherjee, B. (1996) Environmental Biology, 1st edition, Tata Mcgraw Hill. 6. Sinnott, E.W., L.C. Dunn & J. Dobshansky (1958): Principles of Genetics (5th Edition) McGraw Hill Publishing Co., N.Y. Toronto, London. 7. Singleton, R.(1963) : Elementary Genetics, D. Van Nostrand Co., Ltd., Inc., N.Y. & Affiliated East West Press (P) Ltd., New Delhi. 8. Gardner, E. J & Snusted, D.P.(1984): Principles of Genetics (7th edition) John Wiley & Sons, N.Y. Chichester, Brisbane, Toronto, Singapore. 		

DISCIPLINE SPECIFIC MINOR COURSE		
Paper I		
Course Code: BSBOMN201T	Course Title: Cell Biology and Biomolecules	
Course Credit: 2	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		Hours
Unit 1: Structure and Functions of Cell		
Structure and Function of Prokaryotic and Eukaryotic Cell		10
Unit 2: Cell Division		
Cell Cycle, Significance of Mitosis and Significance of Meiosis		10
Unit 3: Biomolecules		10

Structure, function and types of Proteins, Polysaccharides, Nucleic Acids. Enzymes: Enzyme Reaction, Competitive and Non-competitive inhibition.		
Paper II		
Course Code: BSBOMN202T	Course Title: Plant Physiology	
Course Credit: 2	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		Hours
Unit 1: Photosynthesis Location, Pigments involved, Light Reaction, Electron Transport, C4 Pathway		10
Unit 2: Respiration Glycolysis, Aerobic Respiration, Anaerobic respiration		10
Unit 3: Plant Growth and Development Differentiation, Dedifferentiation and Redifferentiation of Plants. Plant Growth Regulators		10

VOCATIONAL SKILL COURSES (VSC) Hands on Training Related to Minor		
Paper I		
Course Code: BSBOVS201P	Course Title: Hands on Training Related to Cell Biology	
Course Credit: 1	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		30
1. To study of mitosis. 2. To detect or identify the carbohydrates. 3. To detect or identify the proteins. 4. Separation of plant pigments by paper chromatography.		
Paper II		
Course Code: BSBOVS202P	Course Title: Hands on Training Related to Plant Physiology	
Course Credit: 1	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		30
1. To demonstrate osmosis by osmometer. 2. Study of plasmolysis in epidermal peel of leaf. 3. To demonstrate the rate of transpiration of leaf. 4. To study the rate of respiration in flower buds/ germinating seeds.		

GENERIC/ OPEN ELECTIVES (OE)		
Course Code: BSBOOE201T	Course Title: Gardening and Landscaping	
Course Credit: 2	Total contact hours: 30 Hrs	
Course Contents (Topics & subtopics)		Hours

<p>Unit 1: Introduction to Gardening Definition, objectives and scope. Different types of gardening - landscape and home/terrace gardening and parks. Styles of gardens. Important garden features: paths, Avenues, Hedges, Edges, Lawns, Flower beds, Water bodies, Rock gardens, Arches and Pergolas. Plants suitable for different location and climates.</p>	10
<p>Unit 2: Maintenance of Garden Seed production technology. Seed testing and certification. Transplanting of seedlings. Study of cultivation of different vegetables and flowering plants: cabbage, brinjal, tomatoes, roses, geranium, and orchids. Developing and maintenance of different types of lawns.</p>	10
<p>Unit 3: Landscaping Introduction and scope of Landscaping, Gardening Areas: Roof Garden, Sunken Garden, Vertical Garden, Terrace Garden. Landscape design Principles: Balance, Proportion, Unity, Rhythm, Harmony, Movement or mobility, Surprise, Scale, Space. Gardening Areas: Water Garden, Shade Garden, Rock Garden, Terrarium, Bottle and dish Garden, Window Gardening. Computer applications in landscaping.</p>	10
<p>Course Outcome:</p> <ol style="list-style-type: none"> 1. To make the students familiar with different commercial garden plants and economic values. 2. To generate interest amongst the students on plants importance in day today life, conservation, ecosystem and sustainability. 3. Students can also find jobs as garden expert in NGOs, government organization, residential complexes, hotels and commercial gardens. 	
<p>Suggested Reading:</p> <ol style="list-style-type: none"> 1. A Naturalist's guide to Garden Flower of India, 2021, P. Sachdeva and V. Tonbram 2. Handbook of Gardening, Gopal Swami Aingar, 1975 3. Handbook of Horticulture, CPWD 4. Complete Gardener's manual, The Royal Horticultural Society. 5. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones & Bartlett - Publishers. 	

Indian Knowledge System (IKS)	
Course Code: BSBOIK201T	Course Title: Ayurveda and Medicinal Plants
Course Credit: 2	Total contact hours: 30 Hrs
Course Contents (Topics & subtopics)	Hours
<p>Unit 1: Ayurveda Ayurveda: Introduction, History and current status. Practice, diagnosis, treatment and substances used. Disciplines: Ashtanga Ayurveda. Ayurveda in Veda: Rig Veda, Yajur Veda, Sama Veda, Atharvana Veda. Rasa Shastra in Vedas.</p>	10

<p>Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine.</p> <p>Unani: Introduction, Principles and Concepts, Prevention of Disease, Therapeutics</p>	
<p>Unit 2: Ayurvedic Herbs and Spices with Health Benefits</p> <p>Plant part, uses and health benefits of Turmeric (Haldi), Cumin (Jeera), Carom seeds (Ajwain), Asafoetida (Heeng), Coriander (Dhaniya), Red Chilli (Lal mirch), Fenugreek (Methi dana), Small cardamon (Elaichi), Cloves (Laung), Black Pepper (Kali miri), Fennel (saunf), Dry Ginger (saunth), Cinnamon (dalchini).</p>	10
<p>Unit 3: Ayurvedic Formulations:</p> <p>Ayurvedic Formulations: Ark, Asava and Arishta, Avaleh, Bhasma, Churna, Ghrita, Guggulu, Kwath or Kashaya, Pak, Rasayan, Taila, Vati.</p> <p>Dashmoola: Plants part used, uses, dosage, benefits and side effects.</p> <p>Triphala: Plants part used, preparation, meditational property, uses, dosage, benefits and side effects.</p> <p>Chyavana Prasha: Introduction, uses, ingredients, preparation, dosage</p> <p>Sitopaladi Churna: Introduction, uses, ingredients, preparation, dosage</p>	10
<p>Course Outcome:</p> <ol style="list-style-type: none"> 1. To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of garden plants. 2. To get knowledge of new and modern techniques of plant propagation. 3. To develop interest in nature and plant life. 	
<p>Suggested Reading:</p> <ol style="list-style-type: none"> 1. Agrawal, P.K. (1993). Hand Book of Seed Technology. New Delhi, Delhi: Dept. of Agriculture and Cooperation, National Seed Corporation Ltd. 2. Bose T.K., Mukherjee, D. (1972). Gardening in India. New Delhi, Delhi: Oxford & IBH PublishingCo. 3. Jules, J. (1979). Horticultural Science, 3rd edition. San Francisco, California: W.H. Freeman and Co. 4. Kumar, N. (1997). Introduction to Horticulture. Nagercoil, Tamil Nadu: Rajalakshmi Publications. 5. Musser E., Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: McGraw Hill Book Co. 6. Sandhu, M.K. (1989). Plant Propagation. Madras, Bangalore: Wile Eastern L. 7. Home Remedies in Unani, Department of Ayush, New Delhi. 8. Myths and Interesting Facts about AYUSH, Department of Ayush, New Delhi. 	

**DR. HOMI BHABHA STATE UNIVERSITY,
MUMBAI**

**Faculty of Science and Technology
SYLLABUS FOR Two-Year PG Program
M.Sc. Degree**

CREDIT STRUCTURE IN BOTANY

**Based on
NEP Guidelines
BOTANY SEMESTER - WISE SYLLABUS
(Theory and Practicals)**

**To Be Implemented From Academic Year
2023 – 2024**

Dr. Homi Bhabha State University, Mumbai.
Proposed structure for Two Year PG Program (M.Sc.) Degree

SEM	Course Type	Course Code	Course Title	Credits
I	Discipline Specific Core I	MSBODC101T	Plant Diversity I (Algae)	4
		MSBODC101P		2
	Discipline Specific Core II	MSBODC102T	Plant Physiology and Ecology	4
		MSBODC102P		2
	Discipline Specific Elective I	MSBODE101T	Molecular Biology, Cytogenetics and Biotechnology-I	4
		MSBODE101P		2
	Discipline Specific Elective I	MSBODE102T	Plant Physiology, Biochemistry and Phytochemistry-I	4
MSBODE102P		2		
Discipline Specific Elective I	MSBODE103T	Ecology, Environmental Botany and Biotechnology-I	4	
	MSBODE103P		2	
Research Methodology	MSBORM101T	Research Methodology	4	
Total 22 Credits for Semester I				
II	Discipline Specific Core III	MSBODC201T	Plant Diversity II	4
		MSBODC201P		2
	Discipline Specific Core IV	MSBODC202T	Cytology, Genetics, Cell Biology & Plant Breeding	4
		MSBODC202P		2
	Discipline Specific Elective II	MSBODE201T	Molecular Biology, Cytogenetics and Biotechnology-II	4
		MSBODE201P		2
	Discipline Specific Elective II	MSBODE202T	Plant Physiology, Biochemistry and Phytochemistry-II	4
MSBODE202P		2		
Discipline Specific Elective II	MSBODE203T	Ecology, Environmental Botany and Biotechnology-II	4	
	MSBODE203P		2	
On Job Training/Field Project	MSBOOJ/FP201	On Job Training/Field Project	4	
Total 22 Credits for Semester II				
Exit Option: Award of PG Diploma in Discipline with 44 credits OR Continue with Discipline				
III	Discipline Specific Core V	MSBODC301T	Techniques and Instrumentation I	4
		MSBODC301P		2
	Discipline Specific Core VI	MSBODC302T	Cell and Molecular Biology-I	4
		MSBODC302P		2
	Discipline Specific Elective III	MSBODE301T	Molecular Biology, Cytogenetics and Biotechnology-III	4
		MSBODE301P		2
	Discipline Specific Elective III	MSBODE302T	Plant Physiology, Biochemistry and Phytochemistry-III	4
MSBODE302P		2		
Discipline Specific Elective III	MSBODE303T	Ecology, Environmental Botany and Biotechnology-III	4	
	MSBODE303P		2	
Research Project	MSBORP301P	Research Project	4	
Total 22 Credits for Semester III				
IV	Discipline Specific Core VII	MSBODC401T	Techniques and Instrumentation II	4
		MSBODC401P		2
	Discipline Specific Core VIII	MSBODC402T	Cell and Molecular Biology-II	4

		MSBODC402P		2
	Discipline Specific Elective IV	MSBODE401T	Molecular Biology, Cytogenetics and Biotechnology-IV	4
	Discipline Specific Elective IV	MSBODE402T	Plant Physiology, Biochemistry and Phytochemistry-IV	4
	Discipline Specific Elective IV	MSBODE403T	Ecology, Environmental Botany and Biotechnology-IV	4
	Research Project	MSBORP401P	Research Project	6
Total 22 Credits for Semester IV				
Two-year PG Degree in Discipline with 88 Credits.				

OJT/FP: Student has to earned the requisite 04 credits of on-the-job training (OJT) / Field Project (FP) during summer break, after completion of the second semester of the first year in the respective Major Subject.
There will be capping of 8 students for each Discipline Specific Elective as per the student's preference and merit

SEMESTER-I

DISCIPLINE SPECIFIC COMPULSORY COURSE	
Paper I	
Course Code: MSBODC101T	Course Title: Plant Diversity I: Algae, Fungi, Bryophytes and Pteridophytes
Course Credit: 4	Total Contact Hours: 60Hrs
Course Contents(Topics & subtopics)	Hours
<p>Unit I: Algae</p> <ul style="list-style-type: none"> ● Classification of Algae up to orders, according to system proposed by G.M. Smith. ● Thallus organization, types of reproduction and evolution of sexual reproduction in algae ● Habitat, thallus organization, cell structure, pigments and reproduction with reference to different classes of algae. ● Microalgae in Human welfare: Nutraceuticals; Biofertilizers; Bio-fuel; CO₂ sequestration and pollution control. Bioactive compounds of algae. 	15
<p>Unit II: Fungi</p> <ul style="list-style-type: none"> ● Classification of fungi: An outline of latest classification up to orders, according to the system proposed by C J. Alexopoulos. ● General account of spore bearing organs and their arrangements in various groups of fungi; spore release and dispersal. ● Industrial and non-industrial Fungal Metabolites (Antibiotics, Enzymes, Organic acids, Phytoalexins and Mycotoxins). ● Mycorrhiza: types, distribution and significance with reference to agriculture and forestry. 	15
<p>Unit III: Bryophyta</p> <ul style="list-style-type: none"> ● Introduction, general features of Bryophytes and adaptation to land habit. ● Regeneration in bryophytes. Economic uses. ● Affinities with Algae and Pteridophytes. ● Comparative structural organization of gametophyte and sporophyte among major orders of Liverworts Hornworts and Mosses. 	15

<p>Unit IV: Pteridophyta</p> <ul style="list-style-type: none"> ● Introduction and general features of Pteridophytes. Affinities with Bryophytes and Gymnosperms. Classification of Pteridophytes as proposed by G.M. Smith. ● Stomatal structures in pteridophytes, Spores of pteridophytes. ● Apogamy, Apospory and Parthenogenesis in Pteridophytes. ● Ecology of pteridophytes, endangered pteridophytes and their conservation, Economic importance of the pteridophytes. 	15
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DISCIPLINE SPECIFIC COMPULSORY COURSE	
Paper I	
Course Code: MSBODC101P	Course Title: Plant Diversity I: Algae, Fungi, Bryophytes and Pteridophytes
Course Credit: 2	Total Contact Hours: 60 hours
Practical training on the basic experiments related to Plant Diversity I: Algae, Fungi, Bryophytes and Pteridophytes	Hours
<ol style="list-style-type: none"> 1. Study of at least one (Algae) genus from each class with respect to vegetative, reproductive structures and classification with reasons. 2. Study of at least one (Fungi) genus from each class with respect to vegetative, reproductive structures and classification with reasons. 3. Study of at least one (Bryophyte) genus from each class with respect to vegetative and reproductive structures. 4. Study of at least one (Pteridophyte) genus from each class vegetative and reproductive structures. 5. A mini field project to study algae, fungi and bryophytic specimens (only Identification). 	60

DISCIPLINE SPECIFIC COMPULSORY COURSE	
Paper II	
Course Code: MSBODC102T	Course Title: Plant Physiology and Ecology
Course Credit: 4	Total Contact Hours: 60Hrs
Course Contents(Topics & subtopics)	Hours
<p>Unit I: Respiration and Lipid Metabolism</p> <ul style="list-style-type: none"> ● Metabolic regulation of glycolysis, Kreb’s cycle. Pentose Phosphate Pathway, Electron transport and ATP synthesis, Bioenergetics principles. ● Gluconeogenesis; Glyoxylate cycle. Alternate oxidase system. ● Structure and function of Lipids, Fatty acid biosynthesis, and Lipid catabolism. 	15
<p>Unit II: Plant growth substances and signal molecules</p> <ul style="list-style-type: none"> ● Plant growth regulating substances (PGRS), Chemical structure, physiological effects and mechanism of action. Gibberellins, Cytokinesis, Abscisic acid, Ethylene, the role of PGRs. ● Growth regularly nature of Polyamines, Jasmonic acid Salicylic acid and Brassinosteroids, systemin, secondary metabolite and plant defence. ● Physiology of flowering, Phytochrome, flower induction, Seed germination and dormancy, senescence and ageing, stress physiology, vernalization and abscission. 	15
<p>Unit III: Structure and Functions of Ecosystem</p> <ul style="list-style-type: none"> ● An introduction to plant ecology and its scope. ● Structure of ecosystem: Abiotic components (climatic factors, Topographic/factors, Edaphic factors); Biotic components (Interactions among organisms, Autotrophs and Heterotrophs) Ecological Pyramids (Pyramid of numbers, Biomass and energy) ● Functions of the ecosystem: Productivity (Primary and secondary productivity, food chains, Grazing and detritus food chains) food webs. Biogeochemical cycles: C, N, P and S. 	15
<p>Unit IV. Community & Population ecology:</p> <ul style="list-style-type: none"> ● Classification, Analysis of communities, characteristics of communities, species diversity, Growth form and structure, origin, development and composition ● Competition and coexistence, intra-specific interactions, interspecific interactions, scramble and contest competition model, mutualism and commensalism, prey-predator interactions. ● Population Ecology: Characteristics of a population; population growth curves; life history strategies (r and K selection); Concept of metapopulation – demes and dispersal, intergenic extinctions. ● Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. 	15

DISCIPLINE SPECIFIC COMPULSORY COURSE	
Paper II	
Course Code: MSBODC102P	Course Title: Plant Physiology and Ecology
Course Credit: 2	Total Contact Hours: 60 hours
Practical	Hours
<ol style="list-style-type: none"> 1. Isolation of plant pigments / B – carotene/ by Column Chromatography 2. To study the physiological effects of auxins, gibberellins and cytokinins. 3. Estimation of proteins /lipids/ carbohydrates from a suitable material (Leaves/Seeds/roots/ tubers etc. 4. Estimation of proline in normal plant and that under stress 5. To Study the Quantitative Characters of Plant Community by Quadrat Method (Frequency, Density, 6. Abundance) 7. To estimate IVI of the species in a woodland using the point centre quadrat method. 8. To calculate the coefficient of variation and use a t-test for comparing two means related to ecological 9. data. 10. To find out the association between important grassland species using the chi-square test. 	60

Course Type: Discipline Specific Elective

Course Code: MSBODE101T

Course Title: Molecular Biology, Cytogenetics and Biotechnology-I

Credits-4

Course Objectives:

The objective of the present course content is to provide a foundation and background in cellular transport and cell communication, development at the molecular level in the plant and animals and cancer biology

Course Learning Outcomes:

The students will be learning

1. The current state of knowledge about the plant cell membrane transport of the molecules within and outside the cells. Communication of the cells
2. What are the components of signalling systems and mechanisms governing signalling pathways in biological systems?
3. How are cells tightly regulated and once the regulation is disturbed because of physical, chemical or biological means how the fate of the cell is?
4. How the body plan is determined at the early stage of development in plants and animals?

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Elective Paper SEM I	
Course Code: MSBODE101T	Course Title: Molecular Biology, Cytogenetics & Biotechnology-I
Course Credit: 4	Total Contact Hours: 60 hours
Course Contents(Topics & subtopics)	Hours
Unit I Membrane Transport and Cell Communication Molecular mechanisms of membrane transport, nuclear transport, transport across mitochondria and chloroplasts; intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to lysosomes/cell exterior. Cellular communication: general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins.	15

<p>Unit II Cell Signaling Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, and regulation of signaling pathways, plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.</p>	15
<p>Unit III Cancer Biology Cancer cells: Characteristics, division, spread, treatment. Course of cancer cell formation, Carcinogens: radiations, chemicals, oncogenic virus. Cancer and mutations, reproductive properties of transformed animal cell in culture, oncogenes, protooncogenes and their conversion. Oncogenes and growth factors.</p>	15
<p>Unit IV Early Development Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum. Genetic regulation of development in Drosophila Developmental stages in Drosophila – embryonic development, imaginal discs, homeotic genes</p>	15
<p>Suggested readings:</p> <ol style="list-style-type: none"> 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. Lodish, H., Berk, A. and 6 more. (2007) Molecular Cell Biology 6th edition. W. H. Freeman. 5. I-Genetics A Molecular Approach Third Edition by Peter J. Russell Benjamin Cummings San Francisco Boston New York 6. Freifelder D (2012). Molecular Biology, 5th edition. Narosa Publishing House, India 7. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York. 8. Allison A. Lizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken, New Jersey. 9. Freifelder D and Malacinski GM (2005) Essentials of Molecular Biology, 4th Edition, John and Bartlett Publishing, UK 10. Krebs JE., Kilpatrick ST and Goldstein ES. (2013). Lewin' GENES XI, Jones & Bartlett Learning. Burlington, MA. 	

DISCIPLINE SPECIFIC ELECTIVE COURSE		
Practical of Elective Paper		
Course Code: MSBODE101P	Course Title: Molecular Biology, Cytogenetics & Biotechnology-I	
Course Credit: 2	Total Contact Hours: 60 hours	
Practical training on the basic experiments related to Cytology, Molecular biology and Plant Biotechnology		Hours
<ol style="list-style-type: none"> 1. Mitosis and Meiosis in plant 2. Preparation of Solutions: Molar, Normal and Percentage solutions and calculations. 3. Calibration of pH meter and determination of pH of solutions. 4. Preparation of Buffers: Phosphate buffer, Tris- HCl buffer, Citrate buffer, Acetate buffer. 5. Plant tissue culture: preparation of the Stock solution and culture media, Callus culture – leaf or internode. 6. Cell suspension culture and Encapsulation of zygotes. 7. Determination of soluble constituents in the callus system by TLC. 8. Purification of enzyme proteins by salt precipitation. 		60

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Elective Paper SEM I	
Course Code: MSBODSE102T	Course Title: Plant Physiology, Biochemistry and Phytochemistry-I
Course Credit: 4	Total Contact Hours: 60Hrs
Course Contents(Topics & subtopics)	Hours
Unit I: Unit I: Bioenergetics and Enzymes <ul style="list-style-type: none"> ● Bioenergetics: The Laws of Thermodynamics, Concept of Entropy, Free Energy ● Enzymes as Biological Catalysts: The Properties of Enzymes, The Active Site, Mechanisms of Enzyme Catalysis, Enzyme Kinetics 	15
Unit II: Vitamins and Coenzymes <ul style="list-style-type: none"> ● Vitamins: Structure, Properties, Source and Deficiency of water and fat soluble Vitamins ● Role of Vitamins as Coenzyme 	15
Unit III: Nucleotide Metabolism <ul style="list-style-type: none"> ● Purine and Pyrimidine: Biosynthesis and Regulation. ● Recycling of Purine and Pyrimidine nucleotides by salvage pathways 	15
Unit IV: Biochemistry of Membrane and Cell Wall <ul style="list-style-type: none"> ● Structure and function of membranes: Chemical composition, ● Functions of Membranes, Membrane carbohydrates, Membrane proteins and Membrane lipids ● Biochemistry of plant cell wall: Cellulose, Hemicelluloses, Lignin, Pectin, Suberin and Cutin. 	15
Suggested Readings <ul style="list-style-type: none"> ● Goodwin and Mercer Plant Biochemistry ● Lehninger and Nelson D.L. Principles of Biochemistry ● Gerald Karp (2010) Cell & Molecular Biology: Concepts & Experiments Taiz and Zeiger Plant Physiology ● Gerald F. Combs & James P. McClung (2017) The Vitamins: Fundamental Aspects in Nutrition and Health ● Rajan Katoch (2011) Analytical Techniques in Biochemistry & Molecular Biology Stryer L. Biochemistry ● Lodish H. and Darneu J. Molecular Cell Biology ● Dey PM and Harborne JB Plant Biochemistry ● Buchanan (2015) Biochemistry & Molecular Biology of Plants 	

DISCIPLINE SPECIFIC COMPULSORY COURSE		
Practical of Elective Paper		
Course Code: MSBODE102P	Course Title: Plant Physiology, Biochemistry and Phytochemistry-I	
Course Credit: 2	Total Contact Hours: 60 hours	
Practical Elective Paper SEM I		Hours
<ol style="list-style-type: none"> 1. Enzyme kinetics: Effect of substrate variation on the activity of enzyme. 2. Preparation of Acetone powder 3. Preliminary Phytochemical screening of the above prepared extracts and their comparative study 4. Estimation of polyphenols. 5. Extraction and estimation of pectin 6. Estimation of cellulose 7. Protein Extraction and estimation 		60

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Elective Paper SEM I	
Course Code: MSBODSE103T	Course Title: Ecology, Environmental Botany and Biotechnology-I Fundamentals of Ecology and Environmental Botany
Course Credit: 4	Total Contact Hours: 60Hrs
Course Contents(Topics & subtopics)	Hours
Unit I: Earth & Ecosystems <ul style="list-style-type: none"> ● An introduction to plant ecology ● Our Environment: Geological Consideration; Atmosphere; Hydrosphere; Lithosphere; Biosphere and Functions ● Type of Ecosystems on the globe ● Scope of Ecological studies. 	15
Unit II: Structure and Functions of Ecosystem <ul style="list-style-type: none"> ● Structure of ecosystem: Abiotic, Biotic components, Ecological Pyramids. ● Functions of ecosystem: Productivity (Primary and secondary productivity), ● Food chains, Grazing and detritus food chains and food webs. ● Ecosystem stability: concepts, natural and anthropogenic disturbances. 	15
Unit III: Niche and Population Ecology <ul style="list-style-type: none"> ● Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. ● Characteristics of a population; population growth curves; life history strategies (r and K selection); ● Concept of metapopulation; demes and dispersal, interdemec extinctions, age structured population. 	15
Unit IV: Ecological Habitats <ul style="list-style-type: none"> ● Types of Habitats: Marine, Freshwater, Estuarine ● Ecological Succession; Causes, Types, Steps, Hydrosere, Xerosere ● Climax, Dis-climax, Sub Climax ● Plant and Plant Communities as Indicators: Forests as Indicators Grassland, Soil types, Salinity, Grazing. 	15

DISCIPLINE SPECIFIC COMPULSORY COURSE	
Practical of Elective Paper	
Course Code: MSBODE103P	Course Title: Ecology, Environmental Botany and Biotechnology-I Fundamentals of Ecology and Environmental Botany
Course Credit: 2	Total Contact Hours: 60 hours
Practical	Hours
<ol style="list-style-type: none"> 1. To Study the Quantitative Characters of Plant Community by Quadrat Method (Frequency, Density, Abundance). 2. To calculate mean, mode median related to ecological data. 3. Variance, Standard Deviation, Standard Error related to ecological data. 4. To calculate coefficient of variation and use t-test for comparing two means related to ecological data. 5. To estimate chlorophyll content in plants growing in polluted and non-polluted areas /SO₂ fumigated and non-fumigated plant leaves. 6. Interpretation of satellite images and aerial photographs with respect to major vegetation/ landforms/ land use patterns. 7. Field visit: students should be taken for field visits to places of ecological/environmental interest or Research Institutes working in conservation of plants. They should submit detailed report of the visit in the form of project report during the practical examination for evaluation. The report shall carry marks. 	60

RESEARCH METHODOLOGY	
Research Methodology Paper	
Course Code: MSBORM101T	Course Title: Research Methodology
Course Credit: 4	Total Contact Hours: 60Hrs
Course Contents(Topics & subtopics)	Hours
Unit I: <ul style="list-style-type: none"> ● Research-Definition, Characteristics, Objectives, Research and Scientific method Types of Research; Descriptive vs. Analytical Research; Applied vs. Fundamental Research; Quantitative vs. Qualitative Research; Conceptual vs. Empirical Research; Research Methodology: An Introduction. Research Process: Basic Overview, Formulating the Research Problem. Defining the Research Problem, Research Questions ● Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Criteria of Good Research. Problems Encountered by Researchers in India ● Defining the Research Problem; What is a Research Problem? Selecting the Problem; The Necessity of Defining the Problem; Technique Involved in Defining a Problem ● Research Design; Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Different Research Designs; Basic Principles of Experimental Designs 	15
Unit II: <ul style="list-style-type: none"> ● Research Design, Formulation of Hypothesis, Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis, Tests of Hypothesis ● Sampling Design, Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample, Random Sample from an Infinite Universe, Complex Random Sampling Designs ● Methods of Data Collection, Collection of Primary Data, Observation Method , Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules ● Some Other Methods of Data Collection, Collection of Secondary Data 	15

<p>Unit III:</p> <ul style="list-style-type: none"> ● DESCRIPTIVE DATA ANALYSIS (a) Measures of central tendency. (b) Variability (c) Measures of Divergence from Normality • Skewness • Kurtosis (d) Estimation of Population Parameters of Mean and SD. (e) Graphical Presentation of Data. Regression analysis. Parametric Techniques (a) Conditions to be satisfied for using parametric techniques (b) Pearson's Coefficient of Correlation (c) t-test for comparison of Mean Scores. (d) z-test for comparison of r's. (e) ANOVA (f) Hotelling's t-test (g) Biserial and Point-Biserial r ● Interpretation and Report Writing. Meaning of Interpretation; Why Interpretation? The technique of Interpretation: Precaution in Interpretation Significance of Report Writing; Different Steps in Writing Report; Layout of the Research Report; Types of Reports; ;Oral Presentation Mechanics of Writing a Research Report 	15
<p>Unit IV: Scientific Communications</p> <ul style="list-style-type: none"> ● Concept of information organization and dissemination (IOD), Need For IOD, Role Of IOD, Definition Of Documentation, IOD Activities, and Information Sources. ● Discovering scientific information, Chemical Abstracts Service (CAS), Introduction to Chemical Abstracts and Beilstein, Subject Index, Author Index, Formula Index, citation indices Indices with examples. ● Web sources, E-journals, E-books, open access, Internet Search engines, Scirus, Google Scholar, ChemIndustry, Wiki-databases, Sci Finder, Scopus, Plagiarism UGC Infonet, Shodhganga ● Publications of scientific work- Scholarly article, Research Paper, Research Project, Legislation Drafting, Judgment Writing, Thesis, Dissertation, Book, Citation Methods- Foot Note, Text Note, End Note, Bibliography, Citation Rules, Blue Book, OSCOLA, MLA, APA, Chicago; writing ethics, plagiarism 	15

Course Outcomes-

1. Familiarisation and building competence with the Concept of Research, its importance and its role in advancing society.
2. Ability to select an appropriate research method, experimental design.
3. Ability to collect, analyse and interpret the data, prepare the research project report, and make Conclusions.
4. Effective dissemination of scientific information through scientific writing in different filed, such as scholarly articles, reviews, and technical reports.
5. Understand the importance of ethical writing.

Reference books

1. Research Methodology, Methods and Techniques, By C. R. Kothari, New Age International (P) Limited
2. Elements of Information Organization and Dissemination. Amitabha Chatterjee, Chandos Publishing.
3. Managing Scientific Information and Research Data, Svetla Baykoucheva, Elsevier Publisher
4. Driving Science Information Discovery in the Digital Age, Svetla Baykoucheva, Elsevier publisher
5. Scientists Must Write, A Guide to better writing for Scientists, engineers and Students
6. Second edition, Robert Barrass, Routledge-Taylor & Francis Group
7. Guide to Publishing a Scientific Paper, Ann M. Körner, Routledge- Taylor & Francis Group
8. McGraw Hill's concise guide to Writing Research Papers, Carol Ellison McGraw Hill Publisher

SEMESTER-II

DISCIPLINE SPECIFIC COMPULSORY COURSE	
Paper I	
Course Code: MSBODC201T	Course Title: Plant Diversity II: Gymnosperms, Angiosperms, Paleobotany and Developmental Botany
Course Credit: 4	Total Contact Hours: 60Hrs
Course Contents(Topics & subtopics)	Hours
<p>Unit I: Gymnosperms</p> <ul style="list-style-type: none"> ● General introduction of gymnosperms with special reference to its salient features, similarities and dissimilarities with other groups like pteridophytes and angiosperms. ● Classifications of gymnosperms according to system proposed by C.J. Chamberlain. ● Endangered gymnosperms, their conservation and present status. Economic importance. 	15
<p>Unit III: Angiosperms</p> <ul style="list-style-type: none"> ● Systematics: Introduction to systematics; Plant identification, Classification, Nomenclature. Evidence from palynology, cytology, phytochemistry [Alkaloids, Phenolics, Glucosides & terpenes (in brief)] and molecular data (cp.DNA, mt-DNA, nuclear DNA, PCR amplification, sequence data analysis). ● Outline of classification of Angiosperms; Hutchinson's system of classification, Principles of Angiosperm Phylogeny Group (APG IV), merits and demerits. ● Botanical gardens, Herbarium techniques, digital herbarium and their significance. ● Palynology: Definition Pollen morphology: Polarity, symmetry, apertures, sporoderm Application of palynology. 	15
<p>Unit III: Paleobotany</p> <ul style="list-style-type: none"> ● Paleobotanical records, plant fossils. ● Geological time scale and dominant fossil flora of different ages, ● Fossil formation and Preservation of plant fossils - impressions, compressions, petrification's, moulds and casts, pith casts. ● Radiocarbon dating. Exploration of fossil fuels. ● Birbal Sahni Institute of Paleosciences. 	15

Unit IV: Developmental Botany <ul style="list-style-type: none"> • Development of flower: Transition to flowering - vegetative to reproductive evocation, floral homeotic mutations (MAD box genes) in <i>Arabidopsis</i>. • ABC model of flower development. • Developmental biology of male and female gametophytes: microsporogenesis and microgametogenesis, megasporogenesis and megagametogenesis. 	15
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DISCIPLINE SPECIFIC COMPULSORY COURSE	
Paper I	
Course Code: MSBODC201P	Course Title: Plant Diversity II: Gymnosperms, Angiosperms, Paleobotany and Developmental Botany
Course Credit: 2	Total Contact Hours: 60 hours
Practical	Hours
<ol style="list-style-type: none"> 1. Study of at least one (Gymnosperms) genus from each class with respect to vegetative and reproductive structures. 2. Study of vegetative and floral characters of the following families (Description, V.S. of flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham and Hooker's system of classification) Magnoliaceae, Asteraceae, Asclepiadaceae, Convolvulaceae, Acanthaceae, Umbelliferae, Lamiaceae, Euphorbiaceae, Orchideae, and Poaceae. 3. Study of pollen in vitro germination methods: Sitting drop culture and suspension culture. 4. Study of pollen in viability (TTC staining). 5. Study of post-fertilization stage with the help of permanent slides and electron micrographs. 6. Field excursion for familiarization with and study of vegetation type(s) and flora(s) of areas of different bioclimatic zones of India. 7. Mounting of a properly dried and pressed specimen of any wild plant on herbarium sheet (to be submitted with the record book). 	60

DISCIPLINE SPECIFIC COMPULSORY COURSE	
Paper II	
Course Code: MSBODC202T	Course Title: Genetics, Cell Biology & Plant Breeding
Course Credit: 4	Total Contact Hours: 60Hrs
Course Contents(Topics & subtopics)	Hours
Unit I: Cytogenetics Cell Regulation Cell cycle-Eukaryotic cell cycle, checkpoints and regulations of cell cycle Cell interaction-Cellular adhesions, junctions and junction proteins	15
Unit II: Molecular Biology Microbial Genetics: Molecular basis of transformation, transduction, Conjugation; fine structure of the gene, T4 Phage, complementation analysis, deletion mapping, cis-trans tests.	15
Unit III: Recombinant DNA Technology Vectors in gene cloning: pUC19, phage, cosmid, BAC and YAC vectors. High and low copy number plasmids and their regulation. Application of recombinant DNA technology for the production of herbicide-resistant plants, insect-resistant plants, improving seed storage proteins and Golden rice.	15
Unit IV: Plant Breeding Genetic systems and breeding methods - Selection and breeding strategies for self-pollinated, cross-pollinated and clonally propagated plants. Self-incompatibility, male sterility, apomixis. Genetics and molecular basis of heterosis - Types of heterosis, the genetic and molecular basis of inbreeding and heterosis, utilization in crop improvement.	15
Suggested Reading: Molecular Genetics of Plant Development, Howell SP (1998) Cambridge University Press The physical and chemical basis of molecular biology-Creighton Principles of Biochemistry-Nelson et al Lewin's Cell- Plopper, George (edtd) Principles of Mol. Biology-Tropp, Burton Cell Biology-Pollard The Cell: a molecular approach-Cooper Molecular Biology-Clarke, David Molecular Biology-Weaver	

DISCIPLINE SPECIFIC COMPULSORY COURSE	
Paper II	
Course Code: MSBODSC202P	Course Title: Genetics, Cell Biology & Plant Breeding
Course Credit: 2	Total Contact Hours: 60 hours
Practical	Hours
<ol style="list-style-type: none"> 1. Preparation of cytological stains, fixatives and pretreatment agents. 2. Squash preparation from pre-treated root tips (colchicines/ Paradichlorobenzene/ Aesculin. 3. Squash preparation from mutagen treated root tips for the study of aberrations. 4. Smear preparation from any suitable plant material. 5. Problems based on: Restriction map analysis and construction of restriction maps, Tetrad analysis in Neurospora – two genes and centromere. Deletion mapping in Bacteriophage. 	60

Course Type: Discipline Specific Elective

Course Code: MSBODE201T

Course Title: Molecular Biology, Cytogenetics and Biotechnology-II (rDNA Technology)

Credits-4

Course Objectives:

The objective of the present course content is to provide a foundation and background in recombinant DNA technology, cloning and expression vectors and their applications, DNA sequencing and amplification techniques, DNA libraries, genomic arrays and protein-DNA interactions

Course Learning Outcomes:

The students will be learning

1. Current state of knowledge about the basic tools used in the recombinant DNA technology.
2. What are different types of cloning and expression vectors, inclusion bodies and plant based vectors?
3. Different types of PCR, How primers are design? Applications of PCR. How DNA sequencing is achieved. Different types of DNA sequencing techniques.
4. How DNA libraries are constructed? What is the role of DNA libraries in molecular biology?
5. How genomic arrays are constructed? DNA foot printing and study of protein-protein interactions.

Course Objectives:

The objective of the present course content is to provide a foundation and background in recombinant DNA technology, cloning and expression vectors and their applications, DNA sequencing and amplification techniques, DNA libraries, genomic arrays and protein-DNA interactions

Course Learning Outcomes:

The students will be learning

1. Current state of knowledge about the basic tools used in the recombinant DNA technology.
2. What are different types of cloning and expression vectors, inclusion bodies and plant based vectors?
3. Different types of PCR, How primers are design? Applications of PCR. How DNA sequencing is achieved. Different types of DNA sequencing techniques.
4. How DNA libraries are constructed? What is the role of DNA libraries in molecular biology?
5. How genomic arrays are constructed? DNA foot printing and study of protein-protein interactions.

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Elective Paper SEM II	
Course Code: MSBODE201T	Course Title: Molecular Biology, Cytogenetics & Biotechnology-II
Course Credit: 4	Total Contact Hours: 60Hrs
Course Contents(Topics & subtopics)	Hours
Unit I Recombinant DNA Technology Restriction endonucleases and methylases; DNA ligase, Klenow enzyme, T4 DNA polymerase, polynucleotide kinase, alkaline phosphatase; cohesive and blunt end ligation; linkers; adaptors; homopolymeric tailing; labeling of DNA: nick translation, random priming, radioactive and non-radioactive probes.	15
Unit II Cloning and Expression Vectors M13mp vectors; Bluescript vectors, Lambda vectors; Principles for maximizing gene expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Inclusion bodies; methodologies to reduce formation of inclusion bodies; mammalian expression and replicating vectors; Baculovirus and Pichia vectors system.	15
Unit III DNA Amplification and Sequencing Principles of PCR: primer design; fidelity of thermostable enzymes; DNA polymerases; types of PCR – multiplex, nested; reverse-transcription PCR, real time PCR, touchdown PCR, hot start PCR, colony PCR, asymmetric PCR, cloning of PCR products; PCR in molecular diagnostics; viral and bacterial detection; sequencing methods; enzymatic DNA sequencing; chemical sequencing of DNA; automated DNA sequencing; RNA sequencing.	15
UNIT IV DNA Libraries, Genomic Arrays and Protein-DNA-Interactions Insertion of foreign DNA into host cells; transformation, electroporation, transfection; construction of libraries; isolation of mRNA and total RNA; reverse transcriptase and cDNA synthesis; cDNA and genomic libraries; construction of microarrays – genomic arrays, cDNA arrays and oligo arrays; study of protein-DNA interactions: electrophoretic mobility shift assay; DNase footprinting; methyl interference assay, chromatin immunoprecipitation.	15

<p>Suggested readings</p> <ol style="list-style-type: none"> 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. Lodish, H., Berk, A. and 6 more. (2007) Molecular Cell Biology 6th edition. W. H. Freeman. 5. I-Genetics A Molecular Approach Third Edition by Peter J. Russell Benjamin Cummings San Francisco Boston New York 6. Freifelder D (2012). Molecular Biology, 5th edition. Narosa Publishing House, India 7. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York. 8. Allison A. Lizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken, New Jersey. 9. Freifelder D and Malacinski GM (2005) Essentials of Molecular Biology, 4th Edition, John and Bartlett Publishing, UK 10. Krebs JE., Kilpatrick ST and Goldstein ES. (2013). Lewin' GENES XI, Jones & Bartlett Learning. Burlington, MA. 	
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DISCIPLINE SPECIFIC COMPULSORY COURSE	
Practical of Elective Paper	
Course Code: MSBODE201P	Course Title: Molecular Biology, Cytogenetics & Biotechnology-II
Course Credit: 2	Total Contact Hours: 60Hrs
Practical	Hours
<ol style="list-style-type: none"> 1. Preparation of C- metaphase / G- banding in suitable material 2. Karyotype studies of any 2 plants and preparation of ideogram 3. Genetics of development in Arabidopsis – ABC model Homeotic gene expression (Slide/Chart) 4. Mounting of Giant polytene chromosomes from <i>Chironomus</i> larva. 5. Detection of polymorphism from any DNA gel photograph or suitable material. 6. Demonstration of protoplast fusion employing PEG. 7. Organogenesis and somatic embryogenesis using appropriate explants. 	60

DISCIPLINE SPECIFIC ELECTIVE COURSE	
Elective Paper SEM II	
Course Code: MSBODSE202T	Course Title: Plant Physiology, Biochemistry and Phytochemistry-II
Course Credit: 4	Total Contact Hours: 60Hrs
Course Contents(Topics & subtopics)	Hours
Unit I: Secondary Metabolism <ul style="list-style-type: none"> ● General biosynthetic pathways in the formation of secondary metabolites ● Biosynthesis and role of following class of compounds <ul style="list-style-type: none"> ○ Phenols, ○ Phenylpropanes, ○ Coumarinns, ○ Lignins, ○ Flavonoids, ○ Alkaloids, ○ Tannins, ○ Terpenes. 	15
Unit II: Extraction Techniques for Phytochemicals <ul style="list-style-type: none"> ● Conventional Extraction Methods: Maceration, Percolation, Decoction, Reflux, Distillation and Soxhlet extraction ● Modern Extraction Methods: Pressurized liquid extraction (PLE), Supercritical Fluid Extraction (SFE), Ultrasound assisted extraction (UAE), Microwave Assisted Extraction (MAE), Pulse Electric Field (PEF), Enzyme assisted extraction (EAE) 	15
Unit III: Separation Techniques for Phytochemicals <ul style="list-style-type: none"> ● Separation methods: Separation based on Adsorption properties <ul style="list-style-type: none"> ○ Partition coefficient ○ Molecular size ○ Ionic strength ● Modern techniques: <ul style="list-style-type: none"> ○ Preparative GC ○ SFC ○ Molecular imprinted technology ○ Simulated moving bed chromatography 	15

<p>Unit IV: Phytochemicals as Nutraceuticals</p> <p>Occurrence, Chemical nature, medicinal and health benefits of following.</p> <ul style="list-style-type: none"> ● Carotenoids – i) α & β - Carotene ii) Lycopene iii) Xanthophyll (Lutein) ● Limonoids – d-Limonene ● Saponins – i) Glycyrrhizin ii) Shatavarins ● Flavonoids – i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin ● Anthocyanins ● Phenolic acids:- Ellagic acid 	15
<p>Suggested readings</p> <ol style="list-style-type: none"> 1. Goodwin and Mercer Plant Biochemistry Taiz and Zeiger Plant Physiology 2. Dey PM and Harborne JB Plant Biochemistry 3. Lehninger and Nelson D.L. Principles of Biochemistry 4. Gerald Karp (2010) Cell & Molecular Biology: Concepts & Experiments Taiz and Zeiger Plant Physiology 5. Gerald F. Combs & James P. McClung (2017) The Vitamins: Fundamental Aspects in Nutrition and Health 6. Rajan Katoch (2011) Analytical Techniques in Biochemistry & Molecular Biology 7. Pharmacognosy Phytochemistry – Medicinal Plants – Jean Brunetton, 8. Medicinal Plant – Their Bioactivity, Screening and Evaluation – Published by CSIR 9. Textbook of Pharmacognosy – Trease and Evans – 14th edition 	

DISCIPLINE SPECIFIC COMPULSORY COURSE	
Elective Paper SEM II	
Course Code: MSBODE202P	Course Title: Plant Physiology, Biochemistry and Phytochemistry-II
Course Credit: 2	Total Contact Hours: 60 hours
Practical	Hours
<ol style="list-style-type: none"> 1. Estimation of Saponification & Iodine Value of Fats and Oil 2. Estimation of Tryptophan. 3. Study of enzymes SDH and effect of inhibitors on its activity. 4. Extraction & separation of Glucosinolates from Mustard 5. Extraction & separation of Piperine from Piper 6. Extraction & separation of lycopene from Lycopersicum 7. Estimation of Isoelectric Point of Protein 	60

DISCIPLINE SPECIFIC ELECTIVE COURSE		
Elective Paper SEM II		
Course Code: MSBODE203T	Course Title: Ecology, Environmental Botany and Biotechnology-II Fundamentals of Ecology	
Course Credit: 4	Total Contact Hours: 60Hrs	
Course Contents(Topics & subtopics)		Hours
Unit I: Ecological Concepts <ul style="list-style-type: none"> ● Ecological Principles, Natural Interactions, Biological Rarity Phenomena ● Concept of Productivity. ● Ecosystem Energetics, Laws of Thermodynamics, Energy Flow Models in Terrestrial Ecosystem. ● Principles of Limiting Factor, Liebig’s Law, Shelford’s Law of Tolerance. 		15
Unit II: Threats to ecosystems, Biodiversity and human interventions <ul style="list-style-type: none"> ● Causes for extinction: habitat loss, industrialization, hunting and bio invasions; invasive species: wiser use & management. ● Current extinction trends. ● Habitat loss, deforestation rate- extinction crises Habitat fragmentation & degradation, Overexploitation, Invasive alien species, Overexploitation, Disease, Climate change ● Poaching of wildlife, man-wildlife conflicts. 		15
Unit III: Biodiversity: <ul style="list-style-type: none"> ● Basic concepts of biodiversity, Biodiversity- definition, levels and types. Global and Indian biodiversity. ● Biodiversity prospecting and indigenous knowledge systems, ● India as a mega diversity nation. Floristic diversity of India and adjacent regions. ● Biodiversity as bio resources – use and values (consumptive and productive use values) of biodiversity as sources of food, fodder, timber, medicinal and ornamental plants. 		15

<p>Unit IV: Biogeochemical cycles and Human interventions</p> <ul style="list-style-type: none"> ● Nitrogen Cycle: Role of Nitrogen in Plant Metabolism and Biosphere. Nitrogen Cycle changes due to human activities. ● Carbon Cycle: Forms and places of occurrence of Carbon. Cycling of Carbon in Biosphere. ● Sedimentary Cycle: Sulphur Cycle: Forms of Sulphur in biosphere and geosphere, in fossil fuels and its release with industrialization, Sulphur cycling in Soil Bacterial Metabolism. ● Phosphorus Cycle: Ecological Function, Biological Function and Process of the Cycle. 	15
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DISCIPLINE SPECIFIC COMPULSORY COURSE	
Elective Paper SEM II	
Course Code: MSBODE203P	Course Title: Ecology, Environmental Botany and Biotechnology-II Fundamentals of Ecology
Course Credit: 2	Total Contact Hours: 60 hours
Practicals	Hours
<ol style="list-style-type: none"> 1. Determination of water holding capacity, moisture content, color and pH of different soils 2. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method. 3. To determine gross and net phytoplankton productivity by light and dark bottle method. 4. Comparative study of Biological Oxygen Demand Value For Industrial Waste effluent collected from any two sites. 5. Comparative study of Chemical Oxygen Demand Value For Industrial Waste effluent collected from any two sites. 6. Field visit: students should be taken for field visits to places of ecological/environmental interest or Research Institutes working in conservation of plants. They should submit detailed report of the visit in the form of project report in the final practical examination for evaluation. 	60