SYLLABUS

OF

Three Year UG: Bachelor of Science Degree Program

IN

BOTANY
SEMESTER (I–VIII)

(As per National Education Policy-2020)

DEPARTMENT OF BOTANY
SCHOOL OF BIOLOGICAL SCIENCES

29/5/24

29/5/24

29-5-24

DR. HARISINGH GOUR VISHAWAVIDYALAYA
(A CENTRAL UNIVERSITY)
SAGAR, MADHYA PRADESH
(2022-2025)

29/5/24

29/5/24

29/5/24

About the Department

The Department of Botany was established with the inception of the university in 1946. The founder of the department was great Prof. R. Misra, FNA, known as the father of Ecology in India. Subsequently, it was nurtured under the leadership of Prof. S.B. Saksena, FNA, a renowned mycologist.

The Department of Botany has been in the forefront of teaching and research in plant sciences since its establishment in 1946. The Department stands today as a unique institution in the Central India with multidisciplinary and interdisciplinary teaching and research in plant sciences. The uniqueness of the Department essentially lies in the fact that within the Department's faculty, there are experts and active researchers representing almost all areas of plant sciences. We believe that to be effective, undergraduate, and postgraduate teaching must be done by teachers who are also actively involved in research in their respective areas of specialization. We have developed a teaching programme that stresses on the uniformity of principles of macro as well as micro molecular mechanisms in all living systems. The Department, serves as a catalyst in the vital scientific and educational activities of India and has a commitment to continue its service to the nation.

Quality teaching requires ongoing research activities, which needs a good deal of financial support. The research fellows of the Department constitute the core of its research activities. The Department has been operating several research projects funded by various National and International agencies; National funding agencies like Department of Biotechnology, Council of Scientific & Industrial Research, Department of Science & Technology, Ministry of Environment and Forests, University Grants Commission. The financial support received through these projects thus not only enables the faculty members in running their research programmes, but also enable the students to take challenging and modern research topics for their Ph.D. thesis. The faculty of the Department has produced quality research publications in reputed national and international journals e. g. *Nature, PNAS (USA), Nature Ecology & Evolution, Nature Plants, Journal of Ecology, Critical Review in Biotechnology, Total Science of Environment, Ecological Indicators, Biodiversity & Conservation* etc. The sustained efforts of the faculty have resulted in numerous awards, honours, and recognitions to the teachers as well as the students of the Department. In recognition to his contributions in the field of Biological Sciences, President of India has conferred 7th Visitor Award - 2021 on Professor Mohammed Latif Khan. In addition, we have the honour of having had two Fellows of the Indian National Science Academy (FNA) and one Fellow of the National Academy of Agricultural Sciences. In recognition of the excellent work carried out by the department, the University Grants Commission has extended its financial support to the Department under its DRS and SAP programmes. The non-teaching staff of the Department actively assists the faculty in carrying out its teaching and research programmes. Besides helping in the conducting the practical classes of B. Sc. and M. Sc. students, our technical staff and gardeners help in maintaining the herbarium and the botanical garden.

The level of expertise available with us and the infrastructure we have makes it imperative for us to think about the future activities of the Department in fulfilling its mandate of providing training of the highest quality to students of the region and the country at large. In this context, we have taken cognizance of the high richness of floristic wealth and diversity of ecosystems and gene pool in the region. Due to the mosaic nature of geo-climatic conditions in the region, the flora and vegetation of

Central India shows enormous variation. The region is also home to a large variety of traditional crops specially of millets that could form an important component of human diet in times to come. The rich biodiversity of the region can generate economic value in terms of extractable plant products, compounds, genes and species. In view of increasing human activities of various types in the region and the upcoming patenting regimes, there is a need for proper evaluation, characterization, documentation, and conservation of the plant genetic resources of the region for utilization and economic well-being of the people.

The Department is emphasizing research in following areas: microbial diversity and its conservation; survey of plant genetic resources of the region, their taxonomic characterization and establishment of physical and electronic herbaria; conservation of plant diversity using both *in vitro* as well as *in vivo* technologies; establishment of gene bank of the region; molecular characterization of rare, endangered and endemic plants of the region; ecological analysis of forest ecosystems of Central India including plant biodiversity inventory and conservation; ecology of agro-forestry ecosystem; documentation of plant genetic resources using molecular markers; molecular phylogeny and ecology. These studies may help generate economic value in terms of extractable plant products, compounds, genes and species, for conservation of ecosystems and plant genetic resources for utilization and economic well-being of the people.

Infrastructure

Over the years, the Department has been able to develop one of the best infrastructures for its teaching and research programmes. Four lecture halls and two laboratories provide exquisite environment to the students for their studies. One lecture hall, located in the Maharshi Kanada Bhavan, is equipped with audio visual facilities to impart quality teaching to the students. The laboratories are designed to provide students adequate working space, comfortable seating, personal cupboard and a supply of glassware, chemicals, and equipment. To aid further, students are having access to the Central Instrumentation Facility, Research Laboratories, Botanical Garden, Nursery, Library and Computers.

The research activities of the Department are spread over nine laboratories; each faculty supervising one laboratory. Doctoral and Post Doctoral students constitute the core group working in these laboratories. All the laboratories are replete with the requisite furniture, equipment, glassware, and chemicals. Most laboratories also have computers connected to Wi-Fi of the university. This has facilitated access to online databases and the UGC INFLIBNET service.

The seminar hall (named after Professor Saxena) is the most important venue for the Department's faculty, research scholars, and PG students to exchange ideas, discuss ongoing research and future perspectives. Lectures of visiting faculty, seminars of research scholars and degree students are organized in this hall. The hall is equipped with multimedia projection system. We are in the process to establish a fully airconditioned central instruments facility with the funds received from DBT-Builder Programme.

Since its establishment, the Department has maintained an herbarium to assist the faculty members, research scholars, students, and visitors from other institutions in identification and study of plant specimens. The herbarium has a collection of over 350 plant species and 1500 specimens predominantly from the Central India. The collection includes the specimens of rare, threatened, endangered

and medicinal plants. All specimens are arranged according to the Bentham and Hooker's system of classification. The herbarium continues to get richer by the contributions of teachers, research scholars and students regularly. The Herbarium is a miniature representation of plant diversity of the Central India. Currently, the herbarium is engaged in accessioning of specimens, creation of a database and digitization of the specimens. This facility is also manned by a STA.

The Department has established a Botanic Garden spreading over 15 acres and a Nursery located within the campus of the University. Botanic Garden of the department harbor over 600 species and is a treasure of rare, native, and exotic plants as an Ex-situ conservation management center. It is one of the prestigious botanic gardens of the country which is also a member of the Botanic Garden Conservation International, Kew, United Kingdom. The botanical garden is center for environmental awareness to school children, college students and public. Overall, it adds to the scenic beauty of the campus landscape. The Botanic Garden houses 2 green/net houses, 2 polyhouses, a glasshouse, a fern house wherein we maintain many of the rare and threatened plants of the region.

COURSE STRUCTURE

Academic Year: 2022-2025

Graduate Degree at the end of Three-year graduate Programme

S. No.	Degree	Credits
1	Certificate in Science: At the successful completion of the First Year (Two Semesters) of the Three-year Graduate Degree Programme.	40
2	Diploma in Science: At the successful completion of the Second Year (Four Semesters) of the Three-year Graduate Degree Programme.	40
3	Degree of Bachelor of Science: At the successful completion of the Third Year (Six Semesters) of the Three-year Graduate Degree Programme.	120
4	Degree of Bachelor with Honors in Botany: At the successful completion of the Fourth Year (Eight Semesters) of the Four-year Graduate Degree with Honors Programme.	160

L- 5 (I & II Semester)

Semester-I							
S. No.	Nature of the Course	Course Code	Course Title	Credits			
				L	T	P	C
1	Discipline Specific Major-1	BOT-DSM-111	Biodiversity Microbes Algae Fungi and Archegoniate (T)	3	1	0	4
		BOT-DSM-112	Biodiversity Microbes Algae Fungi and Archegoniate (P)	0	0	4	2
2	Multidisciplinary Major	BOT-MDM-111	Environment Studies (T)	3	1	0	4
		BOT-MDM-112	Environment Studies (P)	0	0	4	2
3	Ability Enhancement Course	BOT-AEC-111	Landscaping & Garden Management (T)	3	0	0	3
		BOT-AEC-112	Landscaping & Garden Management (P)	0	0	2	1
4	Skill Enhancement Course	BOT-SEC-111	Mushroom Culture Technology (T)	3	0	0	3
		BOT-SEC-112	Mushroom Culture Technology (P)	0	0	2	1
			Total				20
Semester-II							
S. No.	Nature of the Course	Course Code	Course Title	Credits			
				L	T	P	C
1	Discipline Specific Major-1	BOT-DSM-211	Plant Taxonomy (T)	3	1	0	4
		BOT-DSM-212	Plant Taxonomy (P)	0	0	4	2

29/5/24 29/5/24 29-5-24

2	Multidisciplinary Major	BOT-MDM-211	Plant Diversity and Human welfare (T)	3	1	0	4
		BOT-MDM-212	Plant Diversity and Human welfare (P)	0	0	4	2
3	Ability Enhancement Course	BOT-AEC-211	Nursery and Gardening (T)	3	0	0	3
		BOT-AEC-212	Nursery and Gardening (P)	0	0	2	1
4	Skill Enhancement Course	BOT-SEC-211	Biofertilizers (T)	3	0	0	3
		BOT-SEC-212	Biofertilizers (P)	0	0	2	1
			Total				**20**
Exit with Certificate in Science							

L- 6 (III & IV Semester)

Semester-III							
S. No.	**Nature of the Course**	**Course Code**	**Course Title**	**Credits**			
				L	**T**	**P**	**C**
1	Discipline Specific Major-1	BOT-DSM-311	Anatomy & Embryology of Spermatophytes (T)	3	1	0	4
		BOT-DSM-312	Anatomy & Embryology of Spermatophytes (P)	0	0	4	2
2	Multidisciplinary Major	BOT-MDM-311	Intellectual Property Rights (T)	3	1	0	4
		BOT-MDM-312	Intellectual Property Rights (P)	0	0	4	2
3	Ability Enhancement Course	BOT-AEC-311	Green Belt Development & Urban Management for Smart Cities (T)	3	1	0	3
		BOT-AEC-312	Green Belt Development & Urban Management for Smart Cities (P)	0	0	4	1
4	Skill Enhancement Course	BOT-SEC-311	Organic Farming (T)	3	0	0	3
		BOT-SEC-312	Organic Farming (P)	0	0	2	1
			Total				**20**
Semester-IV							
S. No.	**Nature of the Course**	**Course Code**	**Course Title**	**Credits**			
				L	**T**	**P**	**C**
1	Discipline Specific Major-1	BOT-DSM-411	Ecology & Conservation (T)	3	1	0	4
		BOT-DSM-412	Ecology & Conservation (P)	0	0	4	2
2	Multi Disciplinary Major	BOT-MDM-411	Ethnobotany (T)	3	1	0	4
		BOT-MDM-412	Ethnobotany (P)	0	0	4	2
3	Ability Enhancement Course	BOT-AEC-411	Environment Monitoring & Ecosystem Restoration (T)	3	1	0	3

		BOT-AEC-412	Environment Monitoring & Ecosystem Restoration (P)	0	0	4	1
4	Skill Enhancement Course	BOT-SEC-411	Waste Management (T)	3	0	0	3
		BOT-SEC-412	Waste Management (P)	0	0	2	1
			Total				**20**
Exit with Diploma in Science							

L- 7 (V & VI Semester)

Exit with Degree of Bachelor of Science

Semester-V							
S. No.	**Nature of the Course**	**Course Code**	**Course Title**	**Credits**			
				L	**T**	**P**	**C**
1	Discipline Specific Major-1	BOT-DSM-511	(T) Plant Physiology and Metabolism	3	1	0	4
		BOT-DSM-512	Plant Physiology and Metabolism (P)	0	0	4	2
2	Multidisciplinary Major	BOT-MDM-511	Economic Botany & Biotechnology(T)	3	1	0	4
		BOT-MDM-512	Economic Botany & Biotechnology (P)	0	0	4	2
3	Ability Enhancement Course	BOT-AEC-511	(T) Basic Laboratory and Field Skills in Plant Biology	3	1	0	3
		BOT-AEC-512	(P) Basic Laboratory and Field Skills in Plant Biology	0	0	4	1
4	Skill Enhancement Course	BOT-SEC-511	(T) Fundamentals of Molecular Biology	3	0	0	3
		BOT-SEC-512	(P) Fundamentals of Molecular Biology	0	0	2	1
			Total				**20**
Semester-VI							
S. No.	**Nature of the Course**	**Course Code**	**Course Title**	**Credits**			
				L	**T**	**P**	**C**
1	Discipline Specific Major-1	BOT-DSM-611	Cell and Molecular Biology (T)	3	1	0	4
		BOT-DSM-612	Cell and Molecular Biology (P)	0	0	4	2
2	Multi Disciplinary Major	BOT-MDM-611	Biomolecules (T)	3	1	0	4
		BOT-MDM-612	Biomolecules (P)	0	0	4	2
3	Ability Enhancement Course	BOT-AEC-611	(T) Microbiology and Plant-Microbe Interactions	3	1	0	3
		BOT-AEC-612	(P) Microbiology and Plant-Microbe Interactions	0	0	4	1

29-5-24

4	Skill Enhancement Course	BOT-SEC-611	(T) Plant Biotechnology	3	0	0	3
		BOT-SEC-612	(P) Plant Biotechnology	0	0	2	1
			Total				**20**
Exit with Degree in Science							

L- 8 (VII & VIII Semester)

Exit with Honors in Botany

Semester-VII							
S. No.	**Nature of the Course**	**Course Code**	**Course Title**	**Credits**			
				L	**T**	**P**	**C**
1	Discipline Specific Major-1	BOT-DSM-711	Biodiversity Informatics(T)	3	1	0	4
		BOT-DSM-712	Biodiversity Informatics(P)	0	0	4	2
2	Multidisciplinary Major	BOT-MDM-711	Plant Health and Disease diagnosis (T)	3	1	0	4
		BOT-MDM-712	Plant Health and Disease diagnosis (P)	0	0	4	2
3	Ability Enhancement Course	BOT-AEC-711	Medicinal Botany(T)	3	1	0	3
		BOT-AEC-712	Medicinal Botany (P)	0	0	4	1
4	Skill Enhancement Course	BOT-SEC-711	Instrumentation (T)	3	0	0	3
		BOT-SEC-712	Instrumentation (P)	0	0	2	1
			Total				**20**
Semester-VIII							
S. No.	**Nature of the Course**	**Course Code**	**Course Title**	**Credits**			
1	Discipline Specific Major-1	BOT-DSM-811	Dissertation	20			
			Total	**20**			
Exit with Honours in Botany							

Semester I

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**I**	**BOT-DSM-111**	**Biodiversity (Microbes, Algae, Fungi and Archegoniate) (Theory)**	**Mid Sem.- 40 End Sem.- 60**	**3-1-0=4**

Course objectives:

- The objective of the course is to understand the basic concept of lower plants such as Microbes Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperm.

Unit 1 **10 hours**

Microbes: 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 **12 hours**

Algae: 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;* Economic importance of algae.

Unit 3 **12 hours**

Fungi: Introduction: General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi-General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *Alternaria* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); Symbiotic Associations Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

Unit 4 **12 hours**

Bryophytes: Unifying features of archegoniates, Transition to land habit, Alternation of generations; General characteristics, adaptations to land habit, Classification, Range of thallus organization; Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria; (Developmental details not to be included); Ecology and economic importance of bryophytes with special mention of Sphagnum.

Unit 5 **14 hours**

Pteridophytes & Gymnosperms: General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*); Classification (up to family), morphology, anatomy and reproduction of *Selaginella, Equisetum* and *Pteris* (Developmental details not to be included); Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.
General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

Course outcome: Upon the completion of the course the students:

- Will be able to understand the basic concept of microbes their structure and their economic importance.
- Will be able to understand the basic information about the algae and their distribution. General characteristic and their economic importance.
- Will be able to understand the basic information about the fungi, their ecological significance.
- Will be able to understand the basic characteristic of bryophytes and their economic importance.
- Will be able to understand the basic characteristic Ecological and economic importance of Pteridophytes and Gymnosperms.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**I**	**BOT-DSM-112**	**Biodiversity (Microbes, Algae, Fungi and Archegoniate) (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and
2. Lysogenic Cycle.
3. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
4. Gram staining
5. 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)
6. Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides.
7. Alternaria: Specimens/photographs and tease mounts.
8. 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.
9. Agaricus: Specimens of button stage and full-grown mushroom; Sectioning of gills of Agaricus.
10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
11. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
12. Marchantia- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
13. Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
14. Selaginella- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
15. 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).
16. Pteris- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
17. Cycas- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s.
18. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
19. Pinus- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, 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).

Essential Readings

1. Kumar, H.D. (1999) Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996) Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
3. Vashishta, P.C., Sinha, A.K., Kumar, A. (2010) Pteridophyta, S. Chand. Delhi, India.
4. Bhatnagar, S.P. and Moitra, A. (1996) Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.

5. Parihar, N.S. (1991) An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

Additional Readings:

1. Tortora, G.J., Funke, B.R., Case, C.L. (2010) Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
2. Sethi, I.K. and Walia, S.K. (2011) Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
3. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005) Biology.Tata McGraw Hill, Delhi, India.
4. Lack and Evans (2014) Bios Instant Notes: Plant Biology. Taylor & Francis, New York.
5. Madigan (2008) Brock Biology of Microorganisms. Pearson International Edition, Benjamin Cummings, U.S.A.
6. Dwivedi, Lalit Kumar (2014) Handbook of Botany. DBS Imprints, New Delhi.
7. Bhattacharya (2016) Textbook of Botany. Medtech.
8. Mauseth (2011) Botany: An Introduction to Plant Biology. Jones & Barlett Publishers.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**I**	**BOT-MDM-111**	**Environment Studies (Theory)**	**Mid Sem. -40 End Sem. -60**	**3-1-0 = 4**

Course objectives:

- The course will be enabling students to understand importance of environment and waste management skills

Unit 1 **10 hours**

Environmental pollution: Air, Water and Soil: Kinds, sources quality parameters, effects and control.

Unit 2 **12 hours**

Biodiversity and conservation: Levels of biodiversity, Distribution and regional patterns; Hypotheses for global patterns of distribution; Hot Spots of Biodiversity, Biodiversity Conservation; IUCN categories, strategies for conservation.

Unit 3 **14 hours**

Climate change: Greenhouse gases, global warming; Ozone layer and Ozone hole consequences of climate change.

Unit 4 **12 hours**

Ecosystem stability: Concept (resistance and resilience), Ecosystem services, ecological perturbation and their impact on plants and ecosystems, Environmental Impact Assessment (EIA).

Unit 5 **12 hours**

Ecosystem Management: Concept, sustainable development, Sustainability indicators, ecosystem restoration.

Course outcomes: Upon the completion of the course the students:

- Will be able to understand about the cause of pollution and control measures
- Will be able to understand about the plant biodiversity and conservation studies
- Will be able to understand about the cause of climate change and its impacts
- Will be able to understand about the concept of ecosystems and environmental impact assessment
- Will be able to understand about the concept sustainable development sustainability indicators ecosystem restoration.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**I**	**BOT-MDM-112**	**Environment Studies (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Sampling methods for different communities.
2. Determination of concentration of dominance
3. Determination of species richness
4. Calculation of diversity indices
5. Listing of local birds and seasonal variations
6. Classifying plant species into IUCN Red List Categories
7. Collection and preparation of herbarium/museum of plants
8. Field visits to different biodiversity hotspots in India
9. Physico-chemical analysis of air, water and soil samples from polluted areas by standard methods.

Essential Readings:

1. Singh, J.S., Singh, S.P. and Gupta, S.R. (2008) Ecology, Environment and Resource conservation, Anamaya Pub, New Delhi.
2. Miller-Dombois, D. and Ellenberg, H. (1974) Aims and methods of vegetation ecology, Wiley N.Y.
3. Odum, E.P. (1983) Basic ecology W.B. Saunders, Philadelophia.
4. Smith, R.L. (1996) Ecology and Field Biology, Harper Collins College Pub. Inc. New York.
5. Curtis, J.T. and Cottom, G. (1956) Plant Ecology Work Book: Laboratory Field Reference Manual, Burgesss Publishing Com Minnesota.
6. Daubenmire, R.F. (1968) Plant Communities. A text book of Plant syencology. Harper and Row, New York.
7. Mishra, R. (1968) Ecology Work Book, Ozford and IBH Publishing Co. New Delhi.

Additional Readings:

1. Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. and Kent, J. (2000) Biodiversity hotspots for conservation priorities, Nature 403, 853–858.
2. Odum, E.P. (1971) Fundamental of Ecology, 3rd edition, Natraj Publisher, Dehradun.
3. Oosting, M.J. (1956) An Introduction to Plant Ecology, 2nd Edition, W.H. Freeman, San Fransisco. London.
4. Piper, C.S. (1966) Soil and Plant analysis, Han publisher, Bombay.
5. Weaver, J.E. and Clements, E.F. (1938) Plants Ecology, McGraw Hill Book Co, New York and London.
6. Whittaker, R.H. (1975) Communities and Ecosystems, 2nd edition MacMillan Publishing Co, New York.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**I**	**BOT-AEC-111**	**Landscaping and Garden Management (Theory)**	**Mid Sem - 40 End Sem - 60**	**3-0-0=3**

Course objectives:

- The important of the course is to develop skill, entrepreneurship and employ ability in the students.

Unit 1 **12 hours**

29-5-24

Landscaping: Principle of elements, Garden features and adornment, Garden designing, Bio-aesthetics planning, Role of plants and combating environmental pollution, types of gardens.
Unit 2 **10 hours**
Garden Management: Soil analysis, Physio-chemico properties, Soil nutrient management, Types of soil, role of soil for plant growth and plant disease management.
Unit 3 **18 hours**
Bio-fertilizers: Farm yard manure (FYM), Vermicompost, Organic manure, Green manure, Role of bacteria, role of AM fungi, Bio-pesticides.
Unit 4 **10 hours**
Garden tools (Falcon): 1. Pruning secateurs, 2. Hedge sheer with steel handle and PVC grip, 3. Pruning saw, 4. Sickle with wooden handle, 5. Budding grafting knife, 6. Weeding towel chrome coated small and large, 7. Cultivator head three prongs with wooden handle, 8.Weeder with wooden handle, 9.Weeding fork, 10.Plant lifter with wooden handle, 11. Garden rake with steel handle 12 and 16 teeth, 12. Hoe garden type and Dutch type, 13. Khurpa high carbon steel, steel handle with PVC grip (small, medium and long), 14.Tree pruner multi-angular long reach pruner, 15. Spade with wooden handle, 16. Lawn mower manual, 17.Lawn mower electric motor.and techniques:- Spacing, compartment (for different plant groups), seeding, budding, cutting, grafting, thickets, irrigation (Automated drip irrigation).
Unit 5 **10 hours**
Floriculture: History of Ornamental plants, Floriculture as carrier, Commercial floriculture, flowers & Industries, floriculture business competition, World scenario floriculture.
Course outcome: Upon the completion of the course the students: • Will be able to design landscape for various gardens and can give consultancy • Will be able understand soil quality according to landscape so that proper plants can be planted accordingly also, learn how to manage the plant diseases. This sill helped the student is various ways. • Will be able to develop various bio-fertilizer and later on establish entrepreneurship. • Will be able to use the modern tool of Garden management and learn now to do planting pruning, budding and designing of modern garden, it will generate employability. • Will be able to establish carrier as a floriculturist and can provide job to other also.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**I**	**BOT-AEC-112**	**Landscaping and Garden Management (Practical)**	**Mid Sem.-40 End Sem.-60**	**0-0-2=1**

Practical:

1. Analysis of physic- chemico properties of soil.
2. Isolation and Identification of bio-inoculants.
3. Nursery development & plant propagation.
   a) Important component of nursery.
   b) Important nursery operation.
   c) Use of Green House Nursery production.
   d) Propagation through seeds, Propagation through cutting, Propagation through layering, Propagation through budding, Propagation through grafting.

Essential Readings

1. Bose, T.K., Maiti, R.G., Phua, R. S. and Das, P. (2012) Floriculture and Landscaping Naya Udyog, Kolkata.
2. Misra, R.L. and Misra, S. (2012) Landscape and Gardening, Additional Westiville publishing house, New Delhi.

Additional Readings

1. Singh, S.A. and Singh, S.B. (2010) A to Z Horticulture at Glance – III, Intellects, New Delhi.
2. Patil, D.A. (2007) Origin of plant names, Daya publishing House, New Delhi.
3. Flora of Madhya Pradesh (1997) Vol. I & II Botanical Survey of India.
4. Marsha, W.G. (2017) Gardening in India. Bio Green Books, New Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**I**	**BOT SEC-111**	**Mushroom Culture Technology (Theory)**	**Mid Sem.- 40 End Sem.- 60**	**3-0-0 = 3**

Course objectives:

- The major objective of the course is to develop skills towards mushroom cultivation. It's learner become entrepreneur.

Unit 1 **12 hours**

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

Unit 2 **12 hours**

Cultivation Technology: Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low-cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag.

Unit 3 **12 hours**

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 4 **12 hours**

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

Unit 5 **12 hours**

Food Preparation: Types of foods prepared from mushroom. Research Centers - National level and regional level. Cost bene it ratio - Marketing in India and abroad, Export Value.

Course outcomes: Upon the completion of the course the students will be able to:

- Will able to understand basic concept of mushroom diversity, history of cultivation. Types of edible mushroom of India.
- Will able to learn cultivation techniques, preparation of infrastructure for mushroom cultivation. Preparation mushroom begs.
- Will able to learn media preparation spawn preparation mushroom beg preparation composting technology.
- Will able to learn post harvest technologies. Storage production of by product and information regarding presence of bioactive compound.
- Will able to learn about preparation various food frase mushroom. Information regarding various centre sand potential of marketing in India and abroad.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**I**	**BOT-SEC-112**	**Mushroom Culture Technology (Practical)**	**Mid Sem.- 40 End Sem.- 60**	**0-0-2=1**

Practical:

1. Field survey for Mushrooms collection
2. Collection methods of Mushrooms
3. Identification for different types of mushrooms.
4. Spawn preparation.
5. Antioxidant activity of Mushroom.
6. Cultivation of *Pleurotus* species, *Agaricus* species and *Ganoderma*.
7. Antimicrobial activity of mushrooms.
8. Measurement of fungal growth by linear determination and by mycelia weight determination.
9. Enzyme activity (lignin degrading enzymes cellulase)
10. Solid state fermentation, liquid state fermentation.

Essential Readings

1. Pathak, V.N., Yadav, N. and Gour, M. (2004) Mushroom production and processing Technology, Agrobios Jodhpur.
2. Sharma, B.C. and Sharma, N.P. (2013) Mushroom cultivation and users, Agrobios Jodhpur.

Additional Readings

1. Tiwari, P. and Kapoor, S.C. (1988). Mushroom cultivation, Mittal Publications, Delhi.
2. Bahl, N. (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. I
3. Vyas, D, (2016) Mushroom krishikaranevamvyavasikaran, Krishna computer and Printer, Sagar.
4. Vyas, D. (2017). Mushroom utpadan ki Naveentam Takniki. Daya Publication New Delhi
5. Borkar, S.G. and Patil, N. (2016). Mushroom: A Nutritive Food and its Cultivation. Bio Green Books, New Delhi.

Semester II

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**II**	**BOT-DSM-211**	**Plant Taxonomy (Theory)**	**Mid Sem.- 40 End Sem.- 60**	**3-1-0= 4**

Course objectives:

- The objective of the course is to understand the basic concept of plant taxonomy.

Unit 1 **10 hours**

Introduction: History of taxonomy, taxonomic terminology, description of plants.

Unit 2 **10 hours**

Botanical Nomenclature: Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations. Taxonomic evidences from palynology, cytology, phytochemistry and molecular data

Unit 3 **14 hours**

Classification and Identification: Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series); Taxonomic hierarchy.

Unit 4 **10 hours**

Herbarium Techniques: Functions of herbarium, important herbaria and Botanical gardens of the India and world, flora and its importance, monograph.

Unit 5 **16 hours**

Morphological, Floral characters and Economics importance of following families:
Ranunculaceae, Brassicaceae, Malvaceae, Fabaceae, Asteraceae, Euphorbiaceae, Poaceae.

Course outcomes: Upon the completion of the course the students will be able to:

- Understand the terminology and history of taxonomy.
- Understand the principles and rules of ICN and understand the basic concept of palynology, cytology, phytochemistry in relation to taxonomy.
- Understand the basic principles of Classification and identification.
- Understand the herbarium techniques.
- Understand the morphological and floral characters of different families.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**II**	**BOT-DSM-212**	**Plant Taxonomy (Practical)**	**Mid Sem.- 40 End Sem.- 60**	**0-0-4=2**

Practical:

1. 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 & Hooker's system of classification): *Ranunulaceae, Brassicaceae, Malvaceae, Fabaceae, Asteraceae, Euphorbiaceae, Poaceae.*
2. Field studies and phenolgy of local flora. Visits of Botanical Garden.
3. Collection of plants species and herbarium techniques.
4. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Essential readings:

1. Hopkins, W.G. (2008) Introduction to Plant Physiology IV Edition, JhonWileys and Sons, London U.K.
2. Devi, P. (2000) Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics, Agrobios, Jodhpur, India.

3. Glick, B.R. and Thompson, J.E. (1993) Methods in Plant Molecular Biology and Biotechnology, CHC Press, Boxa Raton, Florida.
4. Bitar, L. Zeigen, E, Moller, I.M. and Murphy A. (2015) Plant Physiology and Development, Sinauranociates sunderland USA.
5. Nelson, D.L. and Cox, M.M. (2011) Lehninger principles of Biochemistry, 4th Edition, W H Freeman & Co.
6. Farrell, O. and Ranallo, R.T. (2005) Experiments in Biochemistry: A Hands on approach, Books Cole.

Additional Readings:

1. Moore, T.C. (1974) Research Experiences in Plant Physiology: A Laboratory Manual, Springer, Verlag, Berlin.
2. Roberts, J. and Tucker, G.A. (2000) Plant Hormone Protocols, Humana Press, New Jersey, USA.
3. Mc Donald, M. (2003) Photobiology of higher Plants, Jhon Wileys.
4. Wadte, S.S. and Baiy M.M.V. (2004) Plant Physiology Laboratory guide, SSBES Yeshwant Mahavidyalaya Nanded.
5. Sen N. (1984) Laboratory Exercises in Plant Physiology, Arun Prakashan Gwalior.
6. Conn, E.E., Stumpf, P.K., Bruening, G. and Doi, R.H. (1987) Outlines of Biochemistry, Jhon Wiley, USA.
7. Bucha. (2015) Biochemistry and Molecular Biology of Plants, JWO.
8. Chauhan, N. (2016) Development in Physiology, Biochemistry and Molecular Biology. Bio Green Book, New Delhi.
9. Sharma, S. (2016) Practical Manual of Biochemistry, Medtech.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**II**	**BOT-MDM-211**	**Plant Diversity and Human Welfare (Theory)**	**Mid Sem.- 40 End Sem.- 60**	**3-1-0 = 4**

Course objectives:

- Build awareness about the different groups of plants and their roles in supporting human life.

Unit 1	**12 hours**
Plant diversity and its scope: Genetic diversity, Species Diversity, Plant Diversity at the ecosystem level, agro-biodiversity and cultivated plant taxa. Values and uses of biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.	
Unit 2	**12 hours**
Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agro-biodiversity, Projected scenario for biodiversity loss.	
Unit 3	**12 hours**
Management of Plant Biodiversity: Organizations associated with biodiversity management - Methodology for execution - IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.	
Unit 4	**12 hours**
Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Biodiversity awareness programs, Sustainable Development.	
Unit 5	**12 hours**
Role of plants in relation to Human Welfare: a) Importance of forestry and its utilization and commercial aspects, b) Avenue trees, c) Ornamental plants of India, d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.	

Course outcome: On completion of the course, students are able to:

- Understand the morphological diversity among Bacteria, Viruses, Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
- Observe vegetative and reproductive parts of various life forms of Bacteria, Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
- Become aware of the status of Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms as a group in plant kingdom.
- Understand the life cycles of selected genera and learn about the economic and ecological importance these plant groups.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**II**	**BOT-MDM-212**	**Plant Diversity and Human Welfare (Practical)**	**Mid Sem.- 40 End Sem.- 60**	**0-0-4=2**
Practical: • Preparation of Project						

Essential Readings:

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity: Principles and Practices, Oxford and IBH Publications Co. Pvt. Ltd., New Delhi.
2. Bawa, K.S., Primack, R.B. and Oommen, M.A. (2011) Conservation Biology: A primer from South Asia, Universities Press (Ltd.), Hyderabad.
3. Primack, R.B. (2002) Essential of Conservation Biology, Third Edition. Sinauer Associates, Inc, Massachusetts USA.
4. Joshi, P.C. and Joshi, N. (2004) Biodiversity and Conservation, A. P. H. Publishing Corporation, New Delhi.
5. Menta, C. (2016) Biodiversity Vol. I. ISBN Publishers, New Delhi.
6. Pullaiah, T. (2016) Biodiversity in India (Vol. 8). Bio Green Books, New Delhi.

Additional Readings:

1. Biological diversity: The coexistence of species on changing landscapes by Michael A. Huston, 1994, Cambridge University Press.
2. Principles of Conservation Biology by Gary K Meffeand C. Ronald Carroll, 1994, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts USA.
3. Conservation Biology: The Science of Scarcity and Diversity, Edited by Michael E. Soule, 1986. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts USA.
4. Biodiversity: Social and Ecological Perspectives by Vandana Shiva, 1992. Natraj Publishers, Dehra Dun.
5. Levin (2013): Encyclopedia of Biodiversity (7 Vol. Set) Elsevier Publishers.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**II**	**BOT-AEC-211**	**Nursery and Gardening (Theory)**	**Mid Sem.- 40 End Sem.- 60**	**3-0-0=3**
Course objectives: • The major objective of the course is to develop skill related to nursery development and Gardening. This course help to develop entrepreneurship and generate employability						
Unit 1						**4 hours**
Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities, Planting, direct seeding and transplants.						

Unit 2	6 hours
Seed: Structure and types, Seed dormancy, causes and methods of breaking dormancy, Seed storage: Seed banks, factors affecting seed viability, genetic erosion, Seed production technology, seed testing and certification.	
Unit 3	**6 hours**
Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings, hardening of plants, green house, mist chamber, shed root, shade house and glass house.	
Unit 4	**8 hours**
Gardening: definition, objectives and scope; different types of gardening; landscape and home gardening; parks and its components; plant materials and design; computer applications in landscaping; Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	
Unit 5	**6 hours**
Sowing/raising of seeds and seedlings, Transplanting of seedlings, Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots, Storage and marketing procedures.	
Course outcomes: Upon the completion of the course the students: • Will able to understand and learning about planning, landscaping for developing nursery through seeding transplanting and maintenance of the plants. • Will able to learn about seed morphology texture, seed dormancy, seed storage, seed banking. Develop seed texting skills. • Will able to understand and learn various skill of vegetative propagations layering cutting, pruning, selection treatment developing green houses, mist chamber. • Will able to understand and develop gardening skill. Also learn how to develop various gardens landscape designing. Soil analysis disease management. • Will able to understand and learn processes of saving. It also provides cultivation vegetable crops and their marketing skills.	

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**II**	**BOT-AEC-212**	**Nursery and Gardening (Practical)**	**Mid Sem. - 40 End Sem.- 60**	**0-0-2=1**

Practical:

1. Nursery development & plant propagation.
2. Development of Important component of nursery.
3. Important nursery operation.
4. Use of Green House Nursery production.
5. Propagation through seeds, Propagation through cutting, Propagation through layering, Propagation through budding, Propagation through grafting.

Essential Readings

1. Saini, R.S., Kaushik, N., Kaushik, R.A. and Godara N.R. (2012) Practical: Nursery production, Publisher Agrobios, Jodhpur.
2. Marsha, W.G. (2017) Gardening in India, Bio Green Books, New Delhi.

Additional Readings

1. Misra, S. and Misra, R.L.– (2013) Commercial Ornamental bulb Science, West Villey Publishing House New Delhi.
2. Das, P.C. (2006) Manures and Fertilizers, Kalyani Publishers, New Delhi.
3. Krishnakumar, V. and Chowdapa, P. (2017) Organic Farming in Plantation Crops, Bio Green Books, New Delhi.
4. Swaminathan, C. (2017) Vrikshayurvedic Farming: The Traditional Indian Agriculture, Bio Green Books, New Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**II**	**BOT-SEC-211**	**Biofertilizers (Theory)**	**Mid Sem.-40 End Sem.-60**	**3-0-0=3**

Course objectives:

- The objective of the course is to develop skill about the understanding microbes and their role as biofertilizers and application in organic farming skills.

Unit 1 **9 hours**

General account about the microbes used as biofertilizer; Rhizobium: isolation, identification, mass multiplication, carrier-based inoculants, Actinorrhizal symbiosis.

Unit 2 **9 hours**

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

Unit 3 **9 hours**

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

Unit 4 **10 hours**

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 **10 hours**

Organic farming, Green manuring and organic fertilizers, Recycling of bio-degradable municipal, agricultural and Industrial wastes, biocompost making methods, types and method of vermicomposting, field Application.

Course outcome: Upon the completion of the course the students will be able to:

- Will be able to understand the learn techniques of microbial collection and their role as biofertilizers.
- Will be able to understand and learn isolation techniques of *Azospirillum* and *Azatobacter* and their responses and thereafter mass multiplication for application"
- Will be able to understand and learn about Cyanobacteria and Azolla and role as biofertilizers.
- Will be able understand and learn about Mycorrhizal association, type of Mycorrhiza and preparation of inoculum and its uses.
- Will be able to develop skill bout various type of manure and their application.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**II**	**BOT-SEC-212**	**Biofertilizers (Practical)**	**Mid Sem: 40 End Sem: 60**	**0-0-2=1**

Practical:

1. Isolation of Rhizobium from Leguminous Root Nodules
2. Azotobacter- Isolation, Identification and Mass Multiplication.
3. Azospirillum- Isolation, Mass Multiplication and Carrier Based Inoculant Preparations.
4. Isolation of Blue Green Algae from Water and Soil Samples.
5. Isolation of Arbuscular Mycorrhizal Fungal (AMF) Spores from Soil.

Essential Readings:

1. Lakhsman, H.C. and Channabasara, A. (2014) Biofertilizers and Biopesticides, Pointer Publisher, Jaipur.
2. Deshmukh, A.M. (2003). Biofertilizer and Biopesticides, A B D Publisher, Jaipur.

Additional Readings:

1. Das, P.C. (2006) Manures and Fertilizers, Kalyani Publishers, New Delhi.
2. Alef, K. and Nannipieri, P. (1995) Methods in Applied Soil Microbiology and Biochemistry, Academic Press London.
3. Aggarwal, A.K. (2017) Mycorrhizal Fungi, Boi. Green Books, New Delhi.
4. Krishnakumar, V.P. (2017) Organic Farming in Plantation Crops, Bio Green Books, New Delhi.
5. Mohandas, S. (2016) Arbuscular Mycorrhizal Fungi in Fruit crop production, Bio Green Books, New Delhi.

Semester III

Department of Boatny						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	Botany	III	BOT-DSM-311	Anatomy & Embryology of Spermatophytes (Theory)	Mid Sem. - 40 End Sem. - 60	3-1-0 = 4

Course objectives:

- The objectives of the course is to understand the basic concepts of plant anatomical structures such as Root, Stem, Leaf, Secondary growth, Adaptive Anatomy and Embryology of Spermatophytes.

Unit 1 **12 hours**

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

Unit 2 **16 hours**

Secondary Growth: Secondary growth in root and stem, Wood (heartwood and sapwood).
Adaptive Anatomy: Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit 3 **8 hours**

Structural organization of flower: Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 4 **16 hours**

Pollination and fertilization: Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.
Embryo and endosperm: Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship.

Unit 5 **8 hours**

Apomixis and polyembryony: Definition, types and practical applications

Course outcome: This course will help students:

- To understand basic concept of Plant Anatomical structures of dicot and monocot Root, stem and leaf, root and shoot apical meristems and tissues.
- To understand the basic concept of secondary growth in Plants.
- To understand the concept of adaptive anatomical structure like epidermis, cuticle etc. and in xerophytes and hydrophytes.
- To understand the concept of structural organization of flower like anthers, pollen, ovules, embryo sac etc.
- To understand the concept of pollination and fertilization in plants like double fertilizations, seed dispersal mechanisms.
- To understand the concept of embryo and endosperms its types and relationship.
- To understand the basic concepts of apomixes and polyembryony its types and practical applications.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	Botany	III	BOT-DSM-312	Anatomy & Embryology of Spermatophytes (Practical)	Mid Sem- 40 End Sem- 60	0-0-4=2

Practical:

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.

Essential Readings

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011) Embryology of Angiosperms, 5th edition, Vikas Publication House Pvt. Ltd, New Delhi.
2. Tayal, M.S. (2010) Plant Anatomy, Rastogi Publication, Meerut.
3. Ranjan, P.K. (2015) Plant Anatomy, Bio-Green Books, New Delhi.

Additional Readings

1. Mauseth, J.D. (1988) Plant Anatomy, The Benjamin/Cummings Publisher, USA.
2. Ganguli, H.C., Das, K.S.K. and Dutta, C.T. (2010) College Botany, Vol. I, latest Ed., New Central Book Agency.
3. Sinha, P. (2016) Plant Anatomy and Embryology, Bio Green Books, New Delhi.
4. Singh, G.D. (2009) A to Z Botany, Bio Green Books, New Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**III**	**BOT-MDM-311**	**Intellectual Property Rights (Theory)**	**Mid Sem. - 40 End Sem. - 60**	**3-1-0 = 4**

Course objectives:

- To understand the basic concepts of intellectual property rights.
- To learn the procedure for obtaining the intellectual property rights.
- To understand the statutory provisions of different forms of IPRs in simple forms.

Unit 1 **12 hours**

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

Patents: Objectives, Rights, Patent Acts 1970 and its amendments. Procedure of obtaining patents, working of patent, Infringement, Industrial Application: Non-Patentable Subject Matter, Registration Procedure, Rights and duties of Patentees.

Copyrights: Introduction, works protected under copyright law, Rights, Transfer of Copyrights, Infringement, Remedies and Penalties.

Unit 2 **08 hours**

Trademarks: Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.

Geographical Indications: Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position.

Industrial Designs: Objectives, Rights, Assignments, Infringements, Defences of Design Infringement.

Information Technology Related Intellectual Property Rights: Computer Software and Intellectual Property, Database and Data Protection, Protection of Semi-conductor chips, Domain Name Protection.

Unit 3	15 hours
Protection of Traditional Knowledge: Objective, Concept of Traditional Knowledge, Holders, Issues concerning Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, need for a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.	
Unit 4	**10 hours**
Plant Varieties Protection: Objectives, Justification, International Position, Plant varieties protection in India. Rights of farmers, Breeders and Researchers. National gene bank, Benefit sharing. Protection of Plant Varieties and Farmers' Rights Act, 2001.	
Unit 5	**15 hours**
Biotechnology and Intellectual Property Rights: Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.	
Course outcome: On successful completion of this course the student should be able to: • Distinguish and explain various forms of IPRs. • Apply statutory provisions to protect particular form of IPRs. • Analyze rights and responsibilities of holder of Patent, Copyright, Trademark, Industrial Design etc. • Identify procedure to protect different forms of IPRs at national and international level.	

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**III**	**BOT-MDM-312**	**Intellectual Property Rights (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Discuss traditional knowledge with three controversial patent cases in the US related to neem, turmeric, and basmati.
2. Analyze the IPR issues associated with mobile apps and software.
3. Listing out different products in India that are identified by geographic tags.
4. Study how IPR can be used for protecting newly discovered plant verities.
5. How trademarks safeguard the names of plants-based products like seed and herbal medicine.
6. How IPR van be used for protecting Indian traditional knowledge.

Essential Readings:

1. Acharya N.K. (2001) Textbook on intellectual property rights, Asia Law House.
2. Guru M. and Rao M.B. (2003) Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications, New Delhi.
3. Ganguli P. (2001) Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill.
4. Miller A.P. and Davis M.H. 2000. Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers, London.
5. Watal J. (2001) Intellectual property rights in the WTO and developing countries. Oxford University Press, Oxford.

Additional Readings:

1. Saha R. (2006) Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies, Daya Publishing House, New Delhi.
2. Gopalakrishnan N.S. and Agitha T.G. (2009) Principles of Intellectual Property Eastern Book Company, Lucknow.
3. Parulekar A. and D' Souza S. (2006) Indian Patents Law – Legal & Business Implications; Macmillan India Ltd.
4. Wadehra B.L. (2000) Law Relating to Patents, Trade Marks, Copyright, Designs &

Geographical Indications; Universal law Publishing Pvt. Ltd., India.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**III**	**BOT-AEC-311**	**Green Belt development and urban management in smart cities (Theory)**	**Mid Sem.- 40 End Sem.- 60**	**3-0-0 = 3**

Course objectives:

- To introduce the fundamental concept of Green Belt and its importance in the control of environmental protection.
- To provide adequate knowledge of plant-pollutant interactions and their adverse impacts.
- To learn about the Green Belt development, design, and regulatory provisions in India.

Unit 1 **9 hours**

Introduction to Green Belts: Definition and characteristics of smart cities, Green Belt: Meaning, History and Green Belt Movement, Principle, Need and Importance, Purposes, Challenges and Scope, Advantages and Disadvantages, Green Belt control on Environment protection and Climate change, Role of green belts in smart city development.

Unit 2 **9 hours**

Plant- Pollutant Interactions: Types of pollutants, Primary and Secondary air pollutants, Source and sinks of pollutants, Absorption of gaseous pollutants and particulate matter by soils and vegetative surfaces, Toxic impacts on plant species, Role of green belts in mitigating urban pollution

Unit 3 **9 hours**

Green Belt Development: Guidelines & Techniques, Theoretical models for green belt development, Land analysis, Buffers and Corridors, Effectiveness and Optimization of a Green belt, Resilience and Disaster Management, Green belt integration in urban transportation systems, Factors affecting green belt development.

Unit 4 **9 hours**

Agro-Climatic Zones and Green Belt Design: Agro-Climatic Zones: Definition, Objectives and Classification of Agro-Climatic Zones. Green Belt Design: Plantation matrix in green belt, Selection of plant species, Seedling preparation, Plantation techniques, Roadside plantation & around periphery of reservoir, Plantation precaution.

Unit 5 **9 hours**

Green Belt Development: Policy and Regulations: Policy and regulatory provisions: Need, Importance, Current goal and Benefits; Environmental Guidelines, Environment Management Plan, Use of technology for monitoring and enforcing green belt rules, Case Studies.

Course outcomes: At the completion of this course students will

1. Get familiar with the basic concepts of green belt development, design and need in the urban setup.
2. Understand the basic guidelines and their effective role in environmental protection and combating climate change.
3. Apply principles of green belt development in smart city planning and management.
4. Evaluate the impact of urban pollutants on green belts and smart city ecosystems.
5. Identify and recommend technological solutions for smart city green belt development and monitoring.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**III**	**BOT-AEC-312**	**Green Belt development and**	**Mid Sem- 40 End Sem- 60**	**0-0-2=1**

				urban management in smart cities (Practical)		

Practical:

1. Methods of vegetation sampling and calculation of importance value index.
2. Estimation of Green Cover of an area by measuring tree basal area, height and canopy cover.
3. Estimation of Total Carbon stock of an area.
4. Understanding of meteorological variables (temperature, humidity, precipitation, solar radiation, wind etc.)
5. Understating of air pollutants and measurement of Air Quality Index (AQI) at any particular location.
6. Selection of air pollution tolerant plant species.
7. Assessment of Air pollution tolerance index (APTI) of plant species.

Essential Readings:

1. Amati, M. (2016). Urban green belts in the twenty-first century, Routledge.
2. Carter-Whitney, M. and Esakin, T.C. (2010) Ontario's greenbelt in an international context. Toronto, ON, Canada: Canadian Institute for Environmental Law and Policy.
3. Pōneke, M.H.K. (2019) Outer Green Belt Management Plan, New Zealand.
4. Masters, G.M. (2004) Introduction to environmental engineering and science, Prentice-Hall.
5. Santra, S.C. (2001) Environmental Science. New Central Book Agencies, Pvt., Ltd. Kolkata.

Suggested Readings:

1. Austin, G. (2014). Green infrastructure for landscape planning: integrating human and natural systems. Routledge.
2. Sturzaker, J. and Mell, I. (2016) Green Belts: Past; Present; Future?. United Kingdom, Taylor & Francis.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Boatny**	**III**	**BOT-SEC-311**	**Organic Farming (Theory)**	**Mid Sem: 40 End Sem: 60**	**3-0-0=3**

Course objectives:

- The objective of this course is to understand the basic concepts of organic farming, different methods of production of biofertilizer, biopesticides, disease management etc.

Unit 1 **9 hours**

Comparative account of Organic vs Chemical farming System: Historical back ground of agriculture in India. Comparative study of cost benefit ratio of Chemical farming vs Organic farming; Principles of organic farming; Global and Indian Scenario of their need and feasibility; Physical and chemical properties of soil and water; Integrated Nutrient Management and Integrated Pest Management; Microbial analyses.

Unit 2 **9 hours**

Method of production and use of various biofertilizers: Different type of compost and manure, *Rhizobium, Azotobacter, Azospirillum*, Cyanobacteria, *Azolla*, Phosphate solubilizing microorganisms (PSM), AM fungi, mushroom spent compost, Green manure. Plant Growth Promoting Rhizobacteria (PGPR)

Unit 3 **9 hours**

Method of production and use of various Biopesticides: Bio-insecticides, Bio-herbicides, Bio-nematicides, Neem based biopesticides and other indigenous biopesticides and practical

utilization.
Unit 4 **9 hours**
Practical knowledge of the following: Preservation and storage of agric products, marketing of agric products.
Unit 5 **9 hours**
Disease management of agric products: Bacterial and fungal diseases, quality assurance of agric products, crop health clime, plant quarantine.
Course outcomes: The students Studying the course • Will be able to understand organic farming and chemical farming system. • Will be able to understand method of production and use of various bio fertilizers. • Will be able to understand method of production and use of various Biopesticides • Will be able to understand preservation, marketing, storage of agric products. • Will be able to understand disease management of agric products.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**III**	**BOT-SEC-312**	**Organic Farming (Practical)**	**Mid Sem. - 40** **End Sem. - 60**	**0-0-2=1**

Practical:

1. Demonstration of composting techniques
2. Selection and identification of earthworm species for vermicomposting
3. Preparation of vermiwash
4. Preparation of Neem biopesticides
5. Visit and study of certified organic farms
6. E-browsing of selected websites of Organic Certification agencies

Essential Reading

1. Dehmukh, S.N. (2007) Organic Farming: Theory and Practice, Scientific Publishers, India.
2. Shukla, C.P. (2010). Jaivik Kheti (Organic Farming), Scientific Publishers, India.
3. Biswas, R.K. (2012) Organic farming in India, Ajanta Books, Jodhpur, India.

Additional Reading

1. Planiappan, S.N. (2016). Organic Farming Practices and Problems, Scientific Publishers, India
2. Swaminathan, C., Vijayalakshmi, K., and Swaminathan, V. (2007) Panchgavya: Boon to Organic Farming, CBS Publishers & Distributors Pvt. Ltd, India.
3. Yadav, S. (2016) Vermicomposting and Jaavik Krishi Prabandhan, Ajanta Books, Jodhpur, India.

Semester IV

Department of Boatny						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**IV**	**BOT-DSM-411**	**Ecology & Conservation (Theory)**	**Mid Sem. -40 End Sem. -60**	**3-1-0 = 4**

Course objectives:

- Remember important ecological principles.
- Explain the relationship between biodiversity and ecosystem stability.
- Summarize the main factors contributing to species endangerment.

Unit1 **14 hours**

Introduction to Ecology and Conservation: Definition and scope and historical development of ecology; Importance of conservation biology; Conservation ethics and principles; Ecological levels of organization; Ecosystem structure and function; Biodiversity and its significance; Threats to biodiversity and extinction processes; Red List categories; Conservation organizations and initiatives.

Unit 2 **12 hours**

Population Ecology: Population dynamics and growth models; Population distribution and dispersion; Population density and factors affecting it; Life history strategies and reproductive ecology; Population regulation mechanisms.

Unit 3 **12 hours**

Community Ecology: Community structure and organization; Species interactions; Trophic levels and food webs; disturbance ecology; Keystone species and ecosystem engineers; Biotic and abiotic factors shaping communities.

Unit 4 **12 hours**

Ecosystem Ecology: Ecosystem energy flow and nutrient cycling; Net primary productivity; Biogeochemical cycles; Ecological succession and ecosystem development.; Human impacts on ecosystems; Conservation of terrestrial and aquatic ecosystems.

Unit 5 **10 hours**

Conservation Strategies: Habitat conservation and restoration; Conservation genetics and genetic diversity; In-situ and ex-situ conservation approaches; Successful conservation projects; Ethical and socio-economic aspects of conservation; Future challenges and opportunities in conservation.

Course outcome: At the end of the course the learner will be able to

- Describe the principles of ecology and their application in understanding the relationships between living organisms and their environment.
- Analyze the dynamics of populations and communities, identifying factors influencing their distribution, abundance, and interactions.
- Understand the structure and functioning of ecosystems, recognizing the importance of biodiversity and ecological processes in maintaining ecosystem health and resilience.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**IV**	**BOT-DSM-412**	**Ecology & Conservation (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Conduct a plant identification survey in the university campus or a nearby natural area. Record plant names, characteristics, and locations.
2. Use quadrats to estimate the population density of a specific plant species in a chosen location.
3. Study the adaptations of local plant species to environmental conditions. Record observations and explanations.
4. Collect, press, and prepare plant specimens for a herbarium, complete with proper labelling.

5. Identify invasive plant species in a local ecosystem. Discuss their impacts.
6. Examine plant specimens for signs of diseases, pests, and pathogens, and suggest remedies.

Essential readings:

1. Molles Jr., M. C. (2015) Ecology: Concepts and Applications.
2. Magurran, A.E., and McGill, B.J. (2011) Biological Diversity: Frontiers in Measurement and Assessment, Oxford University Press.
3. Gurevitch, J., Scheiner, S.M., and Gittleman, J.L. (2006) Design and Analysis of Ecological Experiments (2nd ed.), Oxford University Press.
4. Odum, E. P. (2004) Fundamentals of Ecology, Oxford and IBH Publishing Co. Pvt. Ltd.
5. Molles Jr., M. C. (2019) Ecology: Concepts and Applications (8th ed.), McGraw-Hill Education.
6. Smith, R.L., and Smith, T.M. (2015) Elements of Ecology (9th ed.), Pearson.
7. Sharma, P.D. (2019) Ecology and Environment, Rastogi Publications.
8. Cunningham, W.P., and Cunningham, M.A. (2019) Environmental Science: A Global.

Additional Readings:

1. Lindenmayer, D., and Fischer, J. (2006) Habitat Fragmentation and Landscape Change: An Ecological and Conservation Synthesis, Island Press.
2. Hobbs, R. J. and Harris, J.A. (2001) Restoration Ecology: Repairing the Ecological Fabric, Island Press.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**IV**	**BOT-MDM-411**	**Ethnobotany (Theory)**	**Mid Sem. - 40 End Sem. - 60**	**3-1-0 = 4**

Course objectives:

- The present objective of the course is to acquaint the students with the ethno-biological significance of plants and help them develop their skills for plant identification and value addition.

Unit 1 — **12 hours**

Ethnobotany: Its scope, interdisciplinary approach; Role of ethnomedicine and its scope in modern times.

Unit 2 — **12 hours**

History and principles: Ayurveda, Unani and Siddha systems of medicines; Indigenous knowledge and its importance.

Unit 3 — **12 hours**

Ethnic groups of India: Major and minor tribes with special reference to Madhya Pradesh, life styles of ethnic tribes, conservation practices of biodiversity.

Unit 4 — **12 hours**

Plants used by ethnic groups as food, medicines: (*Adhatodavasica, Aegle marmelos, Asparagus racemosus, Azadirachta indica, Phyllanthus emblica, Rauwolfea serpentine, Tinospora cordifolia Terminalia arjuna, Tridaxprocumbens* and *Withania somnifera*), beverages, vegetables, fodder, fibre, resins and other uses. NWFP (Non Wood Forest Produces).

Unit 5 — **12 hours**

Ethnobotany and Ethnopharmacology as a tool to protect interests of ethnic groups and rural development. Impact of Ethnobotany in herbal-medicine industry, land-use development, agriculture, forestry, betterment of rural livelihoods and education.

Course outcome: The students studying the course

- Will be able to understand the need to conserve floristic and cultural diversity of the region.
- Will be able to understand rescue and document Ethnobotanicals for sustainable use of plant resources.
- Will be able to understand the need for development of new drugs for safe and more rational use of herbal preparations.

- Will be able to understand recognition of intellectual property rights and its benefit to people and society who share their knowledge and wisdom.
- Will be able to understand develop skill in collection of data about ethnomedicinal plants.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**IV**	**BOT-MDM-412**	**Ethnobotany**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Study about status of ethnic community present in Madhya Pradesh (Through previous survey data).
2. Preparation of questionnaire for ethnobotanical field study.
3. Local Field study for identification of locally available ethnomedicinal plants.
4. Study about NWFP (Non wood forest products).
5. Study of ethnomedicinal Plants (*Adhatoda vasica, Aegle marmelos, Asparagus racemosus, Azadirachta indica, Phyllanthus emblica, Rauwolfea serpentina, Tinospora cordifolia Terminalia arjuna, Tridax procumbens* and *Withania somnifera*).
6. Study about the ethnic beverages.

Essential readings:

1 Jain, S.K. (1989). Methods and approaches in Ethnobotany. Society of Ethnobotanists, Lucknow

2 Jain, S.K. (1995). A manual of Ethnobotany. Scientific Publishers, Jodhpur

3 Jain, S.K., Mudgal, V., Banerjee, D.K., Guha, A., Pal, D.C. and Das, D. (1984). Bibliography of Ethnobotany. Botanical Survey of India, Howrah

Additional readings:

1 Jain S.K. (1997). Contribution to Indian Ethnobotany, Sci. Publ. Jodhpur

2 Snehalatha and Jain, S. K. (1998). Historical Archive in Ethnobotany. Institute of Ethnobotany, NBRI, Lucknow.

3 Ethnobotany-Principles and application. John Wiley& Sons Ltd., West Sussex, England

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**IV**	**BOT-AEC-411**	**Environment Monitoring & Ecosystem Restoration (Theory)**	**Mid Sem.- 40 End Sem.- 60**	**3-0-0 = 0**

Course objectives:

- Define environmental monitoring and ecosystem restoration.
- Describe the different types of environmental monitoring.
- Explain the principles of ecosystem restoration.
- Identify the different techniques used in ecosystem restoration.

Unit 1 **10 hours**

Principles of Environmental Monitoring: Definition and scope of environmental monitoring; Significance of environmental monitoring; Types of monitoring: continuous, periodic, and episodic; Selection of monitoring parameters; Monitoring tools and equipment; Data collection and analysis methods.

Unit 2 **10 hours**

Ecosystem Assessment and Health Monitoring: Ecosystem structure and function; Indicator species and biodiversity assessments; Air and water quality monitoring; Soil health assessment; Remote sensing and GIS in ecosystem monitoring.

Unit 3 **10 hours**

Impact of Human Activities on Ecosystems: Deforestation and habitat destruction; Pollution and its effects on ecosystems; Climate change impacts; Invasive species and their ecological

consequences; Overexploitation of natural resources.
Unit 4 **10 hours**
Ecosystem Restoration Techniques: Principles of ecosystem restoration; Habitat restoration and rehabilitation; Reforestation and afforestation; Wetland restoration; Soil and water conservation measures; Succession and monitoring in restoration projects.
Unit 5 **10 hours**
Case Studies and Restoration Projects: Review of successful ecosystem restoration projects; Analyzing restoration failures and lessons learned; Role of community participation in restoration efforts.
Course outcomes: At the completion of this course students will • Get familiar with the basic concepts of green belt development, design and need in the urban setup. • Understand the basic guidelines and their effective role in environmental protection and combating climate change. • Apply principles of green belt development in smart city planning and management. • Evaluate the impact of urban pollutants on green belts and smart city ecosystems. • Identify and recommend technological solutions for smart city green belt development and monitoring.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**IV**	**BOT-AEC-412**	**Environment Monitoring & Ecosystem Restoration (Practical)**	**Mid Sem. - 40 End Sem. - 60**	**0-0-2=1**

Practical:

1. Collect basic environmental data (e.g., temperature, humidity, wind speed) on the university campus.
2. Collect water samples from a local stream and test for parameters like pH, turbidity, and dissolved oxygen.
3. Examine the leaves of local plants for signs of pollution damage and discuss findings.
4. Observe and document signs of soil erosion in a nearby landscape.
5. In groups, create a restoration plan for a local degraded area.

Essential Reading

1. Pepper, I.L., Artiola, J.F. and Brusseau, M.L. (2004) Environmental Monitoring and Characterization, Netherlands: Elsevier Science.
2. Allison, S.K., and Murphy, S.D. (2017) Routledge handbook of ecological and environmental restoration, Taylor & Francis.
3. Allison, S.K. (2012) Ecological restoration and environmental change: renewing damaged ecosystems, Routledge.

Additional Reading:

1. Cale, P., and Allen-Diaz, B.H. (2013) New models for ecosystem dynamics and restoration, Island Press.
2. Kim, Y., Platt, U., Gu, M. B., and Iwahashi, H. (2009) Atmospheric and biological environmental monitoring, Springer Science & Business Media.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	Boatny	IV	BOT-SEC-411	Waste Management (Theory)	Mid Sem: 40 End Sem: 60	3-0-0=3

Course objectives:

- Understand the basics of Waste and its management.
- Provide fundamental knowledge on the handling, processing and disposal of waste.
- Introduce the basic techniques involved in the management of wastes.
- Knowledge on waste management for sustainable future and environmental hygiene

Unit 1 — **12 hours**

Introduction to Waste: Definition and Types of Waste: Domestic waste; Commercial Waste; Industrial Waste; Agriculture Waste; Biomedical Waste; E-waste; Effects of Waste on human and plants.

Unit 2 — **12 hours**

Waste Characteristics and Reduction Strategies: Physical and Chemical characteristics of the waste; Waste reduction at Producer Level, Individual Level and Community Level; Economic benefits of waste reduction.

Unit 3 — **12 hours**

Solid Waste Management: Different techniques used in Collection; Storage; Transportation and Disposal of Municipal solid waste: Landfill (traditional and sanitary landfills); Thermal treatment (pyrolysis and incineration); Composting and Vermicomposting; Drawbacks in waste management techniques.

Unit 4 — **12 hours**

Resource Recovery: 6R Principle- Reduce, Reuse, Recycle, Recover, Repair and Refuse; Biological processing (composting, anaerobic digestion, aerobic treatment); Reductive Dehalogenation; Green techniques for waste treatment.

Unit 5 — **12 hours**

Waste-to-Energy: Concept of energy recovery from waste; Refuse derived fuel; Different WTE processes: Combustion, Pyrolysis, Landfill gas recovery; Gasification.

Course outcomes: On completion of the course, student would be able to:

- In-depth understanding of waste management practices starting from its generation, processing and disposal.
- Plan effective strategies for minimizing waste generation and their impacts on human health and environment.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	Botany	IV	BOT-SEC-412	Waste Management (Practical)	Mid Sem- 40 End Sem- 60	0-0-2=1

Practical:

1. Preparation of charts showing the waste production in the university.
2. Preparation of compost using decomposable waste in the university.
3. Preparation of vermicompost from kitchen waste using earthworms in the university.
4. Preparation of chart describing the types of biomedical waste produce at university health centre.

Essential readings:

1. Rao, M.N., Razia, S. and Kota, H.S. (2017) Solid and Hazardous Waste Management, BS Publications.
2. Singh, J. and Ramnath, A. (2019) Solid Waste Management, Dream-tech Press.
3. Vesilind, P.A. and Worrell, W.A. (2016) Solid Waste Engineering, Cengage India.

4. John, P. (2014) Waste Management Practices: Municipal, Hazardous and Industrial, CRC Press, USA.

Additional readings:

1. CPHEEO (2016). Manual on Municipal Solid Waste Management, Ministry of Urban Development, India.
2. Tchobanoglous. G., Theisen, H., and Vigil, S.A. (2014) Integrated Solid Waste Management, Engineering Principles and Management Issues, McGraw-Hill, USA.
3. Anonymous (2014). Waste to resources- A waste management Handbook. The Energy and Resources Institute (TERI) New Delhi.www.teriin.org.

Semester V

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	Botany	V	BOT-DSM-511	Plant Physiology and Metabolism (Theory)	Mid Sem. -40 End Sem. -60	3-1-0 = 4

Course objectives:

- The objective of this course is to understand the basic concept of Plant water relations, Photosynthesis, respiration.
- To understand the basic concepts of enzymes, nitrogen metabolism, Plant growth regulators etc.

Unit1 **14 hours**

(a) Plant-water relations
Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.
(b) Mineral nutrition
Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

Unit 2 **12 hours**

Translocation in phloem **(6 Lectures)**
Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 3 **12 hours**

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

Unit 4 **12 hours**

(a) Enzymes
Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition
(b) Nitrogen metabolism
Biological nitrogen fixation; Nitrate and ammonia assimilation

Unit 5 **10 hours**

(a)Plant growth regulators
Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.
(b) Plant response to light and temperature
Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

Course outcome: At the end of the course the learner will be able to

- Understand the concept of plant water relations and mineral nutrition.
- Understand the concept of translocation in phloem.
- Understand the basic theories of photosynthesis and respiration.
- Understand the structure and properties of enzymes, nitrogen metabolism.
- Understand the plant growth regulators, Photoperiodism, Phytochrome, Vernalization.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**V**	**BOT-DSM-512**	**Plant Physiology and Metabolism (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

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.

Essential Readings

1. Verma, V. Plant Physiology, 2015 Ane Books Pvt. Ltd. New Delhi.
2. Yadav, Seema, 2010, Plant Physiology Bio-Green Books, New Delhi.

Additional Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Jain (2000). Fundamentals of Plant Physiology. S. Chand Publisher, New Delhi.
5. Pandey, Parmila (2016): Textbook of Plant Physiology. Daya Publishers, New Delhi.
6. Pessarakli (2016): Handbook of Photosynthesis. 3/Ed. Taylor & Francis.
7. Sinha, Pushpa (2016). Plant Anatomy and Physiology. Bio Green Books, New Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**V**	**BOT-MDM-511**	Economic Botany & Biotechnology **(Theory)**	**Mid Sem. - 40 End Sem. - 60**	**3-1-0 = 4**

Course objectives:

- The major objective of this paper is to develop knowledge about origin of cultivated plants, cereals and legumes, spices, beverages etc.
- The objective of this paper is to understand the basic concept of Biotechnology and plant tissue culture.

Unit 1 **12 hours**

Origin of Cultivated Plants: Concept of centers of origin, their importance with reference to Vavilov's work

Cereals & Legumes: Wheat -Origin, morphology, uses, General account with special reference to Gram and soybean

Unit 2 **12 hours**

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

Beverages Tea (morphology, processing, uses)
Unit 3 **12 hours**
Oils and Fats General description with special reference to groundnut **Fibre Yielding Plans:** General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)
Unit 4 **12 hours**
Introduction to biotechnology & Plant tissue culture Micropropagation; haploid production through androgenesis and gynogenesis; brief account of embryo & endo sperm culture with their applications
Unit 5 **12 hours**
Recombinant DNA Technique Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i. e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.
Course outcome: The students studying the course • Will be understand the concept of center of origin, vavilov work and basic knowledge of cereals and legumes. • Will be able to understand the general account of spices and beverages. • Will be able to understand the general description of oils, fats and fiber yielding plants. • Will be able to understand the micropopagation, embryo and endosperm culture. • Will be able to understand the blotting techniques, PCR, Markers, ELISA and Immunodetection etc.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**V**	**BOT-MDM-512**	**Economic Botany & Biotechnology**	**Mid Sem- 40** **End Sem- 60**	**0-0-4=2**

Practical:

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 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.

Essential Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Singh, Sadhana, Economic Botany of Angiosperms 2015, Biogreen Books, New Delhi.
4. Rastogi (2016): Principles of Molecular Biology. Scientific International Publishers, New Delhi.

Additional Readings

1. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. Saxena, Rupali, (2015). Economic Botany of Angiosperms, Biogreen Books, New Delhi.
3. Aneja (2014): Laboratory Manual of Microbiology and Biotechnology. Scientific International Publishers, New Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**V**	**BOT-AEC-511**	Basic Laboratory and Field Skills in Plant Biology **(Theory)**	**Mid Sem.- 40** **End Sem.- 60**	**3-0-0 = 0**

Course objectives:

- The major objective of this paper is to learn fundamental laboratory skills important for performing laboratory and field experiments. Basic concepts and handling of instruments.

Unit 1 **10 hours**

Use and maintenance of Laboratory equipment

Weighing balance (Top loading and Analytical), pH meter (calibration and use), magnetic stirrer, pipettes and micropipettes, autoclave, laminar airflow, BOD incubator, incubator shaker, micrometer, haemocytometer, spectrophotometer, Agarose gel electrophoresis unit, SDS PAGE unit, centrifuge, distillation unit.

Unit 2 **10 hours**

Microscopy, sample and slide preparation

Microscopes (Dissecting, Compound and Electron microscopes), Fixation and Preservation (for light and electron microscopy); staining, mounting; basic introduction to other types of microscopes (Confocal, Fluorescence)

Unit 3 **10 hours**

Measurements and calculations

Units of measurements and conversion from one unit to another, measurement of volumesof liquids, Weighing, calculations: scientific notations, powers, logarithm and fractions.

Unit 4 **10 hours**

Solutions and Buffers

Molarity, Molality, Normality, percent solution, stock solution, standard solution, dilution, dilution series, pH, acids and bases, buffers - phosphate, Tris- acetate, Tris- Cl and Citrate buffer.

Unit 5 **10 hours**

Basic culturing techniques

Basic culture media (LB, YEB, MS)- liquid and solid, Culture techniques: plating (streak, spread & pour), replica plating, serial dilution.

Course outcomes: At the completion of this course students will

- Able to understand Good Lab Practices, handling of instruments.
- Able to understand the basic concept of Microscopy.
- Able to understand the basics of measurements, units and common mathematical calculations.
- Able to understand the solutions and Buffers.
- Able to understand the Basic culture media.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**V**	**BOT-AEC-512**	Basic Laboratory and Field Skills in Plant Biology **(Practical)**	**Mid Sem. - 40 End Sem. - 60**	**0-0-2=1**

Practical:

1. Preparation of solutions- molar, molal, normal, percentage, stock, standard and serial dilution
2. Determining pH of solutions (pH paper, Universal indicator, pH meter) and preparation of buffers (Phosphate, Tris-Cl, Electrophoresis buffers - TBE/TAE)
3. Working of instruments -light microscope, autoclave, laminar air flow, spectrophotometer, centrifuge, gel electrophoresis unit (Agarose & Poly acrylamide).
4. Temporary peel mount slide preparation and staining (safranin and acetocarmine).
5. Preparation of LB medium, growth and maintenance of bacterial cultures (liquid - serial dilution method; and semi-solid cultures - streak, spread and pour plates)
6. Isolation of genomic DNA from E. coli and plant leaf material, Agarose gel electrophoresis

Essential Readings:

1. Evert, R. F., Eichhorn, S. E., Perry, J.B. (2012). Laboratory Topics in Botany. W.H. Freeman and Company.
2. Mesh, M.S., Kebede-Westhead, E. (2012). Essential Laboratory Skills for Biosciences. John Wiley & Sons, Ltd.
3. Mu, P., Plummer, D. T. (2001). Introduction to practical biochemistry. Tata McGraw-Hill Education.
4. Mann, S. P. (2016). Introductory Statistics, 9th edition. Hoboken, NJ, John Wileyand Sons Inc.
5. Danniel, W.W. (1987). Biostatistics. New York, NY: John Wiley Sons.
6. Jones, A.M., Reed, R., Weyers, J. (2016). Practical Skills in Biology, 6th Edition, Pearson
7. Bisen, P.S. (2014). Laboratory Protocols in Applied Life Sciences, 1st edition.CRC Press.

Additional resources:

1. Zar, Z. H. (2010). Biostatistical Analysis, 5th edition, Pearson Prentice Hall, New Jersey, USA.

29-5-24 29-5-24

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**V**	**BOT-SEC-511**	Fundamentals of Molecular Biology **(Theory)**	**Mid Sem: 40 End Sem: 60**	**3-0-0=3**

Course objectives:
To gain the knowledge of structure and functions of DNA and RNA, Replication of DNA, Gene expression, Genetic code.

Unit 1 **10 hours**

Experiments establishing DNA as the genetic material
Experiments by Griffith, Hershey and Chase, Avery, McLeod and McCarty andFraenkel Conrat (for RNA in plant viruses).

Unit 2 **10 hours**

Structure of DNA and RNA
DNA types (A, B, Z type), Organization of DNA and proteins in chromosomes(Nucleosome structure). RNA structure and types (t RNA, mRNA and rRNA).

Unit 3 **10 hours**

Replication of DNA
Experiment by Meselson and Stahl establishing semi conservative mode of DNA replication. Theta model and Rolling circle model of replication. Mechanism of replication.

Unit 4 **10 hours**

Gene Expression: Transcription, Mechanism of Transcription in Prokaryotes and Eukaryotes, General Transcription factors, Types of genes, RNA processing, Capping, Splicing, Polyadenylation and Termination, RNA as Enzyme.

Unit 5 **10 hours**

Genetic Code and its Elucidation
Central Dogma, Contributions of Francis Crick, Hargobind Khorana, Marshal Nierenberg, Sydney Brenner.

Course outcomes: On completion of the course, student would be able to:

- Understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes.
- Understand the DNA replication mechanism, genetic code and transcription process.
- Processing and modification of RNA and translation process, function and regulation of Gene expression.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**V**	**BOT-SEC-512**	Fundamentals of Molecular Biology **(Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-2=1**

Practical:

1. DNA isolation from E. coli.
2. Preparation of LB medium for E. coli culturing
3. Agarose gel electrophoresis of isolated DNA
4. Study experiments establishing nucleic acid as genetic material: Griffith's, Avery et al, Hershey & Chase's and Fraenkel Conrat's experiments (through photographs).
5. Study modes of DNA replication: Meselson and Stahl's experiment, Rolling circle and Theta model of replication and semi-discontinuous, semi conservative replication (through digital resources).

Essential Readings:

1. M.W. Stickberger: Genetics
2. Clug and Cummings: Essentials of Genetics
3. J.D. Watson: Molecular Biology of Gene

Additional Readings

1. B. Lewin: Genes VIII
2. Malacinski: Molecular Biolog
3. J.D. Watson: Double Helix
4. Mclennan (2013): Bio Instant Notes: Molecular Biology, 4E (PB)
5. Hyde, 2016: Genetics and Molecular Biology: With fundamentals of Biostatics (Pb). Mcgraw Hill, New Delhi.
6. Alberts, 2014: Molecular Biology of the Cell. Garland Science. Taylor & Francis Group, New York.
7. Rastogi,2016. Principles of Molecular Biology. Scientific International Publishers, New Delhi.

29/5/24

29-5-24

Semester VI

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VI**	**BOT-DSM-611**	**Cell and Molecular Biology (Theory)**	**Mid Sem. -40 End Sem. -60**	**3-1-0 = 4**

Course objectives:

- The major objective of this paper is to understand the theory of Cell Biology, Cell organelles, Cell Cycle, Genetic material and Gene expression.

Unit1 **12 hours**

Techniques in Biology: Principles of microscopy; Different types of microscope
Cell as a unit of Life: Cell Theory, Prokaryotic and Eukaryotic cell organization.
Cell Wall and Cell Membrane: The Structure and function, Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Selective permeability of the membranes.

Unit 2 **12 hours**

Chloroplast and Mitochondria: Ultra structure, genome organization and biogenesis
Oth**er cell organelles**: Structure and function of, Golgi apparatus, Endoplasmic reticulum, Centrosome, Lysosomes, Ribosome etc.
Nucleus: Nuclear Envelope, Nucleolus - structure and function, nucleosome model.

Unit 3 **12 hours**

Cell Cycle: Overview of Cell cycle, Mitosis and Meiosis; role of cyclins in cell division, Apoptosis.

Unit 4 **12 hours**

Genetic material: DNA as genetic material: Experiment of Griffith, O. T. Avery, Hershey and Chase. DNA : Discovery of double helix, structure of DNA, Different types, Topology, DNA as part of Chromosomes.
DNA Replication Different types of Protein and Enzyme involve

Unit 5 **12 hours**

Gene Expression: Transcription and Translation in Prokaryotes, Types of RNA, genetic code. regulation of gene expression in Prokaryotes: Lac operon and Tryptophan operon.

Course outcome: At the end of the course the students will be able to

- Understand the Cell theory, Cell wall and Cell membrane.
- Understand the structure and functions of Cell organelles.
- Understand the Mitosis and Meiosis.
- Understand the DNA structure and Replication, Gene expression.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VI**	**BOT-DSM-612**	**Cell and Molecular Biology (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Study of the photomicrographs of cell organelles
2. To study the structure of plant cell through temporary mounts.
3. Study of mitosis and meiosis (temporary mounts and permanent slides).
4. Study of plasmolysis and deplasmolysis on Rhoeo leaf.
5. Demonstration of DNA extraction from bacteria and its visualization in gel electrophoresis

D. 29/5/24 29.5.24

Essential Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. Khanna, Pragya Cell and Molecular Biology, 2008. I.K. International Publishing House Pvt. Ltd. New Delhi.
3. Verma, P.S. & Agrawal, V.K., 2016 Cell Biology (Cytology,Biomolecules and Molecular Botany), S.Chand Publishing New Delhi.

Additional Readings

1. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
2. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th
3. 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
5. Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VI**	**BOT-MDM-611**	Biomolecules **(Theory)**	**Mid Sem. - 40 End Sem. - 60**	**3-1-0 = 4**

Course objectives:

- The main objective of this paper to understand the structure and functions of basic biomolecules, basic principle of bioenergetics, Nucleic acid structure and fuction.

Unit 1 **12 hours**

Biomolecules: Types and significance of chemical bonds; Structure and properties of water; pH and buffers. Carbohydrates: Nomenclature and classification; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides.

Unit 2 **12 hours**

Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties; Phosphoglycerides.

Unit 3 **12 hours**

Proteins: Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins.
Amino acid structure acid base properties optical and stereochemical properties.

Unit 4 **12 hours**

Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit 5 **12 hours**

Bioenergetics: Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.

Course outcome: The students studying the course

- Will be able to understand the basic concept of biomolecules.
- Will be able to understand the structure and functions of lipids.
- Will be able to understand the structure of proteins and amino acids.
- Will be able to understand the structure and functions of Nucleic acids.
- Will be able to understand the basic concept of Bioenergetics.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VI**	**BOT-MDM-612**	**Biomolecules (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Protein estimation.
2. Carbohydrate estimation.
3. Nitrogenase activity.
4. Acid and alkaline acid phosphatase activity
5. Isolation and identification of Rhizobium from different plants.
6. Separation of amino acid through paper and column chromatography.

Essential Readings:

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
2. Conservation Biology: A primer from South Asia by Kamaljit S. Bawa, Richard B. Primack and Meera Anna Oommen, 2011. Universities Press (Ltd.), Hyderabad.
3. Essential of Conservation Biology by Richard B. Primack, 2002, Third Edition. Sinauer Associates, Inc, Massachusetts USA.
4. Biodiversity and Conservation by P. C. Joshi and Namita Joshi, 2004, A. P. H. Publishing Corporation, New Delhi.
5. Menta, C. (2016): Biodiversity Vol. I. ISBN Publishers, New Delhi.
6. Pullaiah, T. (2016): Biodiversity in India (Vol. 8). Bio Green Books, New Delhi.

Additional Readings:

1. Biological diversity: The coexistence of species on changing landscapes by Michael A. Huston, 1994, Cambridge University Press.
2. Principles of Conservation Biology by Gary K Meffeand C. Ronald Carroll, 1994, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts USA.
3. Conservation Biology: The Science of Scarcity and Diversity, Edited by Michael E. Soule, 1986. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts USA.
4. Biodiversity: Social and Ecological Perspectives by Vandana Shiva, 1992. Natraj Publishers, Dehra Dun.
5. Levin (2013): Encyclopedia of Biodiversity (7 Vol. Set) Elsevier Publishers.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VI**	**BOT-AEC-611**	Microbiology and Plant-Microbe Interactions **(Theory)**	**Mid Sem.- 40 End Sem.- 60**	**3-0-0 = 0**

Course objectives:

- To impart basic understanding about microbial world and their interactions with plants.

Unit 1 **10 hours**

Introduction

Microbial world, Growth and nutrition of microbes with reference to nutritional media.

Unit 2 **10 hours**

Viruses

Discovery; Physicochemical and biological characteristics; Classification (Baltimore); General structure with special reference to viroids and prions, DNA and RNA viruses; General account and mechanism of replication, lytic and lysogenic cycle; General account

of viral diseases of plants (mosaic and vein clearing disease).
Unit 3 **10 hours**
Discovery, General characteristics; Types - Archaebacteria, Eubacteria, Wall less forms (Mycoplasma, Phytoplasma and Spheroplasts); Cell structure; Nutritional types; Reproduction - vegetative, asexual and recombination (conjugation, transformation and transduction); General account of bacterial diseases of plants (Citrus canker, Angular leaf spots of cotton).
Unit 4 **10 hours**
Applied Microbiology: Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics and agriculture. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).
Unit 5 **10 hours**
Plant-Microbe interactions: General account of Plant-microbe interactions; Plant growth promoting rhizobacteria (PGPR); Mechanism of nitrogen fixation by Cyanobacteria and Rhizobia; Types of mycorrhizal association with plants; Ectomycorrhiza and Endomycorrhiza and their effects on plant growth.
Course outcomes: At the completion of this course students will • Understand microbes and their roles and applications. • Understand about modes of reproduction of Viruses, Archaebacteria, Eubacteria. • Understand the economic importance of microorganisms. • Understand plant-microbe interaction.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VI**	**BOT-AEC-612**	Microbiology and Plant-Microbe Interactions **(Practical)**	**Mid Sem. - 40** **End Sem. - 60**	**0-0-2=1**

Practical:

1. Study of Viruses: Electron micrographs / Model - T-Bacteriophage and TMV; specimens/digital resources/ Line drawings of Lytic and Lysogenic Cycle.
2. Study of Bacteria: Electron micrographs of bacteria; Types of Bacteria from temporary/permanent slides. Endospore, Binary fission, Conjugation, Root nodule through specimens/digital resources.
3. Study of Plant Growth Promoting Rhizobacteria (PGPR) through specimens/digital resources (at least three).
4. Gram staining to differentiate between Gram-positive and Gram-negative bacteria.
5. Study of Rhizobium from root nodules of a Leguminous plant.
6. Isolation of Anabaena from Azolla leaves.

Essential Readings:

1. Pelczar, M.J. (2001) Microbiology, 5th edition. New Delhi, Delhi: Tata Mc-Graw-Hill Co.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2016) Microbiology: An Introduction, Indian edition, Pearson India Education Services Pvt. Limited, Noida, India
3. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, 6th edition:McGraw Hill, New Delhi.

Additional Resources:

1. Talaro, K.P., Talaro, A. (2006). Foundations in Microbiology. Mc-Graw Hill, New Delhi
2. Gupta, R., Chugh, G. (2022) Plants, Microbes and Diseases 1st Edition, I.K. International Pvt. Ltd., Delhi
3. Subba Rao, N.S. (2000) Soil Microbiology, Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VI**	**BOT-SEC-611**	Plant Biotechnology **(Theory)**	**Mid Sem: 40 End Sem: 60**	**3-0-0=3**
Course objectives: To give students knowledge of techniques used in plant biotechnology and its applications.						
Unit 1						**10 hours**
Plant Tissue Culture General introduction, history, scope, concept of cellular differentiation, and totipotency.						
Unit 2						**10 hours**
Methods of gene Transfer Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment. Selection of transgenics- selectable marker and reporter genes						
Unit 3						**10 hours**
Organogenesis and adventives embryogenesis Fundamental aspects of morphogenesis, somatic embryogenesis and production of haploid plants, androgenesis, mechanisms, techniques and utility.						
Unit 4						**10 hours**
Micropropagation Selection of plant material, methodology, plant regeneration pathways-somatic embryogenesis, organogenesis, difference between somatic and zygotic embryos.						
Unit 5						**10 hours**
Applications of plant tissue culture: Clonal propagation, artificial seed, production of hybrids and somaclones, production of secondary metabolites/natural products, cryopreservation and germplasm storage.						
Course outcomes: On completion of the course, student would be able to: • Understand the basic concept of Plant tissue culture. • Understand the methods of gene transfer. • Understand the organogenesis and embryogenesis. • Understand the basic concept of Micropopagation. • Understand the applications of plant tissue culture.						

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VI**	**BOT-SEC-612**	Plant Biotechnology **(Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-2=1**

Practical:

1. Introduction and awareness of lab safety measures.
2. Study of sterilization of explants and working place.
3. Demonstration of androgenesis in Datura.
4. Isolation of protoplasts from various plant tissues and testing their viability.
5. Effect of physical (temperature) and chemical (osmoticum) factors on protoplast yield.
6. Demonstration of protoplast fusion employing PEG.
7. Study of Organogenesis.

Essential Reading

1. Singh, B.D. (2016), Biotechnology – Expanding Horizons, Kalyani Publisher: New Delhi
2. Purohit, S.S. Biotechnology (1998) Fundamentals & Applications, 3rd Edition Agrobios (Jodhpur) Publisher

Additional Reading

1. Kumar Pranav, Mina Urba. Biotechnology, A problem approach. Pathfinder Academy, New Delhi.
2. Bilgrami, K.S. and Pandey, A.K. Introduction to Biotechnology CBS Publisher & Distributor 485, Jain Bhawan Bhola Nath Nagar Shadhara, New Delhi.
3. Colin Ratledge and Bjorn Kristiansen, (2001), Basic Biotechnology, Cambridge University Press.
4. Bernard R. Glick and Jack J. Pasternak. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press Washington, D.C. (Printed in India by Gopsons Papers Ltd., Noida
5. Rastogi, S.C. & Rastogi Shivani (2008). Introduction to Biotechnology. CBS Publisher – New Delhi.
6. Aneja (2014): Laboratory Manual of Microbiology and Biotechnology. Scientific International Publishers, New Delhi.

Semester VII

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VII**	**BOT-DSM-711**	**Biodiversity Informatics (Theory)**	**Mid Sem.- 40 End Sem.- 60**	**3-1-0=4**

Course objectives:

- The objective of the course is to understand the basic concept

Unit 1 **12 hours**

History of Biodiversity Informatics

Introduction to Global & National movements for conservation, institutions (including National Biodiversity Authority of India, NBPGR and others) and other non-Governmental organizations (NGOs) and networks involved in biodiversity informatics

Unit 2 **12 hours**

Understanding Biodiversity

Recapitulating Basic principles of Ecology & Biodiversity - Geological Time scale and evolution of life forms, Five major extinctions, Ecosystems & Ecosystems diversity: biomes, mangroves, coral reefs, wetlands and terrestrial diversity. Biodiversity hotspots & factors of endemism; Levels of Biodiversity: Community diversity (alpha, beta and gamma biodiversity), Gradients of Biodiversity (latitudinal, insular (island biogeography).

Unit 3 **12 hours**

Measuring/Estimating Biodiversity

Magnitude of biodiversity (Global and Indian), Global Environmental changes, land and water use changes; Impacts of Climate Change on Biological systems, Introduction to Diversity Indices (Simpson, Shannon) and estimation of Species diversity: richness and evenness, loss of species; Genetic diversity: subspecies, breeds, race, varieties and forms; variation in genes and alleles at DNA sequence levels (selected case studies). Microbial diversity and useful prokaryotic genes. Speciation (amount of genetic variation is the basis of speciation)

Unit 4 **12 hours**

Informatics Resources

National & International efforts in Conservation, databases GBIF, IUCN categorized-endangered, threatened, vulnerable species; Red data book and related documentation; Design of Databases for Biodiversity, (Introduction to use of R).

Unit 5 **12 hours**

Methods in Biodiversity Informatics

Remote Sensing and Geographical Information Systems, Data capture – citizen science, uploading information on portals (e.g. www.indiabiodiversityportal.org) ; .Ecologically relevant parameters (minimum viable population, minimum dynamic area, effective population size, metapopulations); reproductive parameters in conservation (breeding habitats, mating systems, inbreeding depression, genetic bottlenecks, genetic constraints); Essential management practices in in-situ and ex- situ Biodiversity Management - Management of Biosphere reserves, National Parks, Sanctuaries and Sacred groves , Management of Botanical gardens, Zoological gardens, Gene banks, Pollen, seed and seedling banks, tissue culture and DNA banks.

Course outcome: Upon the completion of the course the students:

- Understand the use of Geographical Information System (GIS), Remote Sensing (RS) as wellas Informatics in relation to Biodiversity (particularly plant diversity).
- Understand principles of Data Capture systems, basic elements of digitisation of biological data, some key elements of Information Science along with creation/curation of Biological Databases (collection, storage & retrieval)
- Understand the importance of field collection, maintenance of herbaria & specimen

collections.
- Understand the relevant National and International Biodiversity Laws

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VII**	**BOT-DSM-712**	**Biodiversity Informatics (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1) Measurement of species diversity calculation of Diversity Indices - from data collected on plant species in different areas of the campus.
2) Measurement of biodiversity at molecular level by DNA (RFLP, RAPD, AFLP) analyses.
3) Blast analyses of selected DNA sequences from the International Gene Banks.
4) Introduction to simulations based on various environmental models.
5) Applications of RS and GIS techniques for species distribution models.
6) Experiential Learning Module: Visit to Biodiversity Parks, study the management and species diversity, based on that prepare a proposal for enhancement/ creation of local Biodiversity Park/Community outreach activities and other attributes.

Essential Readings:

1. Groom, M.J, Meffe, G.K, Carroll, C.R. (2006). Principles of ConservationBiology, 3rd edition, Sinauer Associates.
2. Carson, R. (1962). A Silent Spring, Houghton Mifflin Company.
3. Tandon, U., Parasaran, M., Luthra, S. (2018). Biodiversity: Law, Policy andGovernance, Routledge, India
4. Wilson, E. O. (1993). Diversity of Life. Harvard University Press, Cambridge, MA.
5. Wheater C.P., Bell J.R., Cook P.A. (2011). Practical field Ecology: A Projectguide, Wiley-Blackwell

Additional Readings:

1. Saha, G.K., Mazumdar, S. (2017). Wildlife Biology: An Indian Perspective. PHIlearning Pvt. Ltd.
2. Sinclair, A.R.E., Fryxell, J.M., Caughley,G. (2006). Wildlife Ecology,Conservation and Management. Wiley-Blackwell, Oxford, UK.
3. Singh, S.K. (2005). Text Book of Wildlife Management. IBDC, Lucknow.
4. Banerjee, K. (2002). Biodiversity Conservation in Managed and Protected Areas.Agrobios, India.
5. Sharma, B.D. (1999). Indian Wildlife Resources Ecology and Development. DayaPublishing House, Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VII**	**BOT-MDM-711**	**Plant Health and Disease diagnosis (Theory)**	**Mid Sem. -40 End Sem. -60**	**3-1-0 = 4**

Course objectives:

- To introduce students with various pathogenic fungi, bacteria, and viruses.
- To introduce students with the phytopathology, its concepts and principles.
- To acquaint with various plant diseases, casual organisms, and their control

Unit 1	10 hours
History of plant pathology. Classification of plant diseases. General characteristics of plant pathogenic bacteria, fungi, viruses, mycoplasma and nematodes. General idea of symptomatology.	
Unit 2	**12 hours**
Plant Disease Diagnosis Koch's Postulates; Plant disease symptoms and types (Necrosis, Hypertrophyand Hyperplasia, Hypoplasia); General symptoms of viral, bacterial and fungal plant diseases; Methods of plant disease diagnosis- Histochemical, Serological and PCR techniques	
Unit 3	**14 hours**
General principles of plant disease control: Cultural practices, Physical methods, Chemical methods, Biological methods, Plant quarantine Infection process, penetration and entry by plant pathogens. Dissemination of plant pathogens.	
Unit 4	**12 hours**
Defense mechanism in plants & structural and biochemical defense role of phenolics and phyto-alexins in disease resistance. Cell wall degrading enzymes and their involvement in pathogenesis. Microbial toxins and their role in plant diseases.	
Unit 5	**12 hours**
A detailed study of the following diseases and their control measures: Red rot of sugarcane, Fusarial wilt, Black stem rust of wheat, Citrus canker, Tundu disease of wheat, Leaf curl of papaya, Yellow vein mosaic of bhindi, Little leaf of brinjal, Root rot of vegetables.	
Course outcomes: Upon the completion of the course the students: • Will understand the history of plant Pathology. • Will understand the plant disease diagnosis. • Will understand the plant didease control. • Will understand the defence mechanism in plants.	

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VII**	**BOT-MDM-712**	**Plant Health and Disease diagnosis (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1) Preparation of different media for the isolation and culture of fungi from soil and diseased materials. Isolation of bacteria. Single spore isolation and other mycological techniques.
2) Collection and study of the crop diseases listed below from the local and out station fields. A Herbarium of local disease samples should also be submitted.
3) Various rusts of Wheat, Rust of Linseed, Pycnidial and Aecidial stages on Barbery, Smut of Wheat.
4) Diseases of Rice and Millets; Foot rot and leaf rot of Piper beetle; Early and late blights of Potato; Red rot and Whip smut of Sugarcane; Tikka disease of Groundnut, Powdery mildews; Other important diseases of vegetable crops and fruits including diseases caused by Viruses, Bacteria, Mycoplasma and Nematodes. Demonstration of the production of cell wall degrading enzymes.

Essential Reading

1. Sharma, P.D. Plant Pathology – Rastogi Publications "Gangori" Shivaji Road, Meerut – 250007

2. Aggarwal, Ashok, & Mehrotra, R.S. (2003) – Plant Pathology McGraw Hill Education, Book Vistas, New Delhi

Additional Reading

1. Ranichandra N.G. – Fundamentals of Plant Pathology (2013). Prentice Hall India learning private Limited. – New Delhi.
2. Agrios George N. – Plant Pathology (2005) Elsevier Academic Press Pulisher. – New Delhi
3. Dube, H.C.: An Introduction to Fungi. Vikas Publishing House Pvt. Ltd. 576, Masjid Road, Jangpura, New Delhi – 110 014.
4. Rangaswami, G. (1972) Diseases of crop plants in India. Prentice-Hall of India Private Limited New Delhi. (Latest Publication required)
5. Butler, E.J. (1987). Fungi and Disease in Plants. Bishen Singh Mahendra Pal Singh 23-A, Connaught Place Dehra-Dun – 248001 (India). (Latest Publication required)

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VII**	**BOT-AEC-711**	**Medicinal Botany (Theory)**	**Mid Sem - 40 End Sem - 60**	**3-0-0=3**

Course objectives:

- The objective of this course is to build awareness of students about medicinal plants and their conservation and promotion of medicinal plant sector at National level.

Unit 1 **10 hours**

History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.

Unit 2 **10 hours**

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

Unit 3 **10 hours**

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 4 **10 hours**

Ethnobotany and Folk medicines: Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

Unit 5 **10 hours**

Promotion of medicinal plant sector at national level: National Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions. Other organizational initiatives for promotion of MAPs at National and International levels. Demand and supply of medicinal plants. Herbal industries

Course outcome: Upon the completion of the course the students:

- Will understand History, Scope and Importance of Medicinal Plants.
- Will understand about Conservation of endangered and endemic medicinal plants.
- Will understand of Propagation of Medicinal Plants.
- Will understand Ethnobotany and Folk medicines.
- Will understand the promotion of medicinal plant sector at national level.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VII**	**BOT-AEC-712**	**Medicinal Botany (Practical)**	**Mid Sem.-40 End Sem.-60**	**0-0-2=1**

Practical:

1. Taxonomic descriptions and uses of important aromatic plants - clove, cinnamon, nutmeg, ajwain, dill, celery, tamarind, garcinia, curryleaf and saffron
2. Mounting of a properly dried and pressed specimen of any medicinal plant with herbarium label (to be submitted in the record book).
3. Systematics of some important medicinal plants: Adhatoda vasica, Abrus precatorius Aloe vera, Phyllanthus amarus, Stevia rebaudiana, Belladona and Cinchona
4. Field studies and phenolgy of local flora. Visits of Botanical Garden.

Essential Readings:

1. Medicinal Plants of Uttarakhand by C.P. Kala (2010)
2. Indian Medicinal Plants by P.C. Trivedi (2009).
3. Medicinal Plants of Indian Himalaya by S.S. Samant and U. Dhar.
4. Hand Book of Aromatic Plants by S.K. Bhattacharjee (2004).
5. Handbook of MAPs by S.K. Bhattacharjee (2009).

Additional Readings:

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

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VII**	**BOT-SEC-711**	**Instrumentation (Theory)**	**Mid Sem.-40 End Sem.-60**	**3-0-0=3**

Course objectives:

- To understand the principles and practical knowledge of spectroscopy and chromatography.
- To understand the principles and applications of electrophoresis, microscopy, centrifugation and blotting techniques
- To understand the types of research and ethics relevant to research and publications.

Unit 1 **9 hours**

Microscopy: Principles of light and electron microscopy; phase contrast and fluorescence microscopy; TEM and SEM; Cell fractionation producers;

Unit 2 **9 hours**

Chromatography and Centrifugation: principles of various chromatography techniques-paper chromatography; TLC, GLC and HPLC, Centrifugation principles; types: lowspeed, High speed, Micro and Ultra centrifuges. Sedimentation coefficient, Svedberg (S) unit, RPM, RCF, g; rotor types (fixed angle, swinging bucket, vertical, zonal), Preparative centrifugation: differential &density gradient centrifugations

Unit 3 **9 hours**

Colorimetry & spectrophotometry: Spectrophotometry: Beer's Lambert law and its application, UV- visible spectrophotometer, AAS, GC-MS, IR, NMR and Raman spectroscopy

Unit 4 **10 hours**

Electrophoresis: principles and applications, support media and buffers, electrophoresis of proteins and nucleic acids, and capillary electrophoresis. Blotting Techniques: Southern,

Western and Northern blots. Gel documentation systems. Radioactive and Non-Radioactive probes and uses.
Unit 5 **10 hours**
Research Methodology: Types of research, scientific research: hypothesis, experimentation, theory. Preparation of research articles: review article, research papers, online publications, thesis writing, editorial process, proof-reading symbols, Science communication, popular writing in magazines and newspapers. Presentation of research papers in seminar, symposia and conferences. Research ethics
Course outcome: Upon the completion of the course the students will be able to: • Understand the principle and application of Microscopy. • Understand the principle and application of Centrifuge and chromatography. • Understand the principle and application of Colorimetry & spectrophotometry • Understand the principle and application of Electrophoresis. • Understand the basic concept of Research methodology.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
B.Sc.	**Botany**	**VII**	**BOT-SEC-712**	**Instrumentation (Practical)**	**Mid Sem.- 40 End Sem.- 60**	**0-0-2=1**

Practical:

1) To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law.
2) Polymerase Chain Reaction
3) Isolation & Purification of genomic DNA from bacteria
4) Isolation & Purification of plasmid DNA 10. Separation of proteins by native and SDS-PAGE
5) To separate the amino acids by paper chromatography.
6) To separate the chlorophyll pigments by TLC

Essential Readings:

1. Boyer, R.F. 2000. Modern Experimental Biochemistry.
2. Jordedn. Prentice Hall Publ. ISBN 0 8053 31115. 2. Gurumani, N.2014. Research Methodology for Biological Sciences. MJP publishers, Chennai.
3. Kothari, C.R. and Garg, G. 2019. Research Methodology: Methods and Techniques. New Age International Publications, New Delhi.
4. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi

Additional Readings:

1. Michel, R.G. and Sambrook, J. (2012) Molecular Coning: A laboratory manual, Cold spring harbor laboratory press.
2. Nelson, D.L., Cox. M.M. (2009) Lehninger's Principle of Biochemistry. 6th ed. Freeman.
3. Prescott, H. (2002) Laboratory Exercises in Microbiology, 5th Edition, McGraw-Hill Companies

Semester-VIII

Department of Botany						
Class	Subject	Sem.	Course Code	Course Title	Marks	Credit
B.Sc.	Botany	VIII	BOT-DSM-811	Dissertation	Report Submission : 75 Viva-Voce/ presentation : 25	20
Dissertation Project Work/Experimental Learning on any Botany related aspect						