SYLLABUS

OF

Two Year PG: Master of Science Degree Program

IN

BOTANY
SEMESTER (I–IV)

(As per National Education Policy-2020)

DEPARTMENT OF BOTANY

SCHOOL OF BIOLOGICAL SCIENCES

16/12/23

DR. HARISINGH GOUR VISHAWAVIDYALAYA
(A CENTRAL UNIVERSITY)
SAGAR - 470003, MADHYA PRADESH
(2022-2024 & 2023-2025)

16/12/23

16.12.23

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 Session: 2022-2024 (III-IV Semesters) & 2023-2025 (I-IV Semesters)

Post Graduate Degree at the end of Two-year Postgraduate Programme

S. No.	Degree	Credits
1	P. G. Diploma upon the successful completion of First year (Two Semesters) of the Two-year master's degree Programme	44
2	Master's Degree: At the successful completion of the Second Year (Four Semesters) of the Two-year Master's Degree Programme	88

Semester- I

S. No.	Nature of the Course	Course Code	Course Title	Credits			
				L	T	P	C
1	Discipline Specific Major-1	BOT-DSM-121	Biodiversity of Microbes & Lower Cryptogams (T)	3	1	0	4
		BOT-DSM-122	Biodiversity of Microbes & Lower Cryptogams (P)	0	0	4	2
2	Discipline Specific Major-2	BOT-DSM-123	Ecology and Environment (T)	3	1	0	4
		BOT-DSM-124	Ecology and Environment (P)	0	0	4	2
3	Multidisciplinary Major - 3	BOT-MDM-121	Cytogenetics (T)	3	1	0	4
		BOT-MDM-122	Cytogenetics (P)	0	0	4	2
4	Skill Enhancement Course	BOT-SEC-121	Mushroom Biology (T)	3	0	0	3
		BOT-SEC-122	Mushroom Biology (P)	0	0	2	1
			Total				22

Semester- II

S. No.	Nature of the Course	Course Code	Course Title	Credits			
				L	T	P	C
1	Discipline Specific Major-1	BOT-DSM-221	Plant Physiology and Biochemistry (T)	3	1	0	4
		BOT-DSM-222	Plant Physiology and Biochemistry (P)	0	0	4	2
2	Discipline Specific Major-2	BOT-DSM-223	Biology and Diversity of Spermatophytes (T)	3	1	0	4
		BOT-DSM-224	Biology and Diversity of Spermatophytes (P)	0	0	4	2
3	Multidisciplinary Major - 3	BOT-MDM-221	Forest Ecology (T)	3	1	0	4
		BOT-MDM-222	Forest Ecology (P)	0	0	4	2
4	Skill Enhancement	BOT-SEC-221	Biochemical and Molecular Techniques	3	0	0	3

	Course		(T)				
		BOT-SEC-222	Biochemical and Molecular Techniques (P)	0	0	2	1
			Total				**22**

Exit option with P.G. Diploma upon the successful completion of First year (Two Semesters) of the Two-year Master's Degree Program

Semester-III

S. No.	Nature of the Course	Course Code	Course Title	Credits			
				L	T	P	C
1	Discipline Specific Major-1	BOT-DSM-321	Genetic Engineering and Biotechnology (T)	3	1	0	**4**
		BOT-DSM-322	Genetic Engineering and Biotechnology (P)	0	0	4	**2**
2	Discipline Specific Major-2	BOT-DSM-323	Plant Anatomy and Embryology (T)	3	1	0	**4**
		BOT-DSM-324	Plant Anatomy and Embryology (P)	0	0	4	**2**
3	Multidisciplinary Major - 3	BOT-MDM-321	Biodiversity and Climate change (T)	3	1	0	**4**
		BOT-MDM-322	Biodiversity and Climate change (P)	0	0	4	**2**
4	Skill Enhancement Course	BOT-SEC-321	Landscaping and Garden Management (T)	3	0	0	**3**
		BOT-SEC-322	Landscaping and Garden Management (P)	0	0	2	**1**
			Total				**22**

Semester-IV

S. No.	Nature of the Course	Course Code	Course Title	Credits			
				L	T	P	C
1	Discipline Specific Major-1	BOT-DSM-421	Dissertation Project Work/Experimental Learning on any Botany Related Aspect	0	0	28	**14**

Exit: Postgraduate Degree M.Sc. Botany

Semester I

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	Botany	I	BOT-DSM-121	Biodiversity of Microbes & Lower Cryptogams (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: General account; ultra-structure, nutrition and reproduction; Biology and economic importance of Bacteria; Cyanobacteria: salient features and biological importance.

Unit 2 **10 hours**

Viruses: Characteristics and ultra-structure of virions; Isolation and purification of viruses; Chemical nature, replication, transmission of viruses; Economic importance.

Unit 3 **8 hours**

Mycology: General characters of fungi: substrate relationship in fungi, nutrition (saprobic, biotrophic, symbiotic), reproduction (vegetative, asexual, sexual), heterothallism; heterokaryosis, parasexuality; Recent trends in classification; General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; Fungi in industry, medicine and as food; Fungal diseases in plants and humans; Mycorrhizae fungi.

Unit 4 **17 hours**

Phycology: Algae in diversified habitats thallus organization; Reproduction; Classification of algae; Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta, Rhodophyta; Algal blooms; Algal biofertilizers; Algae as food, feed and uses in industries; Economic importance.

Unit 5 **15 hours**

Bryophyta: Morphology, structure, reproduction and life history, distribution, classification; General account of Marchantiales, Jungermanniales, Anthoceratales, Sphagnales, Funariales and Polytrichales; Economic and ecological importance; Pteridophyta: Morphology, anatomy and reproduction, classification; evolution of stele; heterospory and origin of seed habit; General account of fossil pteriodophyta, Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

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

- To understand the basic concept of microbes their structure and their economic importance.
- To understand the basic information about the viruses and their distribution. General characteristics and their economic importance
- To understand the basic information about the fungi, their classification, ecological significance and economic importance.
- To understand the basic characteristic of Algae and their classification, industrial and economics importance.
- To understand the basic characteristic Ecological and economic importance of Bryophytes, and Pteridophytes.

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Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	Botany	I	BOT-DSM -122	Biodiversity of Microbes & Lower Cryptogams (Practical)	Mid Sem- 40 End Sem- 60	0-0-4=2

Practical:

1. Gram's staining of bacteria.
2. Morphological study of locally available disease plant materials.
3. Identification of fungal cultures: *Rhizopus, Mucor, Aspergillus, Penicillium, Chaetomium, Helminthosporium, Curvularia, Fusarium, Colletotrichum, Alternaria, Phytopthora and Water Molds.*
4. Sterilization methods, preparation of media and stains.
5. Symptomology of some diseased specimens: White rust, downy mildew, powdery mildew, smuts, rusts. tikka disease of groundnut, ring rot of pan, red rot of sugarcane, whip smut of sugarcane, wilts, bacterial blight of paddy, citrus canker, tobacco mosaic virus, little leaf of brinjal, sesame phyllody, mango malformation.
6. Morphological study of representative member of Algae: *Microcystis, Chaetomorpha, Enteromorpha, Hydrodityon, Ulva, Pithophora, Stigeoclonium, Drapranaldiopsis, Microdictyon, Bryopsis, Ectocarpus, CaulerpaColeochaete, Cladophora, Zygnema, Iyengera, Sphacelariya, Dictyota, Nitella, Chara, Nostoc, Spirulina, Anabena.and etc.*
7. Morphological study of representative member of Bryophytes and Pteridophytes: *Marchantia, Anthoceros, Polytrichum, Psilotum, Lycopodium, Selaginella, Equisetum, Ophioglossum, Isoetes, Lygodium, Regnellidium* and *Marsilia.*
8. Study of morphology, anatomy and reproductive structures of bryophytes.

Essential readings:

1. Introductory Mycology, Alexopoulos, C.J., Mims, C.W. and Blackwell, M.; John Wiley & Sons. Inc. U.S.A. 2012.
2. An introduction to Fungi, Dubey, H.C., Vikas Publishing House, New Delhi. 2012.
3. Plant Pathology, Sharma, P.D., Rastogi & Co., Meerut. 1995.
4. The fungi, Mehrotra, B.S., Today and Tomorrow's Printers and Publishers, New Delhi. 1992.
5. An introduction to Mycology, Mehrotra, R.S., Aneja, K.R., Wiley Eastern Limited, New Delhi 1990.
6. Introductory Phycology, Kumar, H.D., East west press, New Delhi. 1992.
7. The Algae, Chapman, V. J. and Chapman, D.J. Macmillan publishers. 1973.
8. Phycolog, IVth edition, Lee, R.E., Cambridge University Press, London. 2013.
9. An Introduction to Embryophyta Vol-I & II, Bryophyta and Pteridophytes, Parihar, N.S., Central Book Depot. Allahabad. 1999.
10. An Introduction to Bryophyta, Rashid, A., Vikas publication House, Pvt, New Delhi. 1998.
11. Studies in Paleobotany, Andrews, H.N. John Wiley and Sons, New York. 1961.
12. The text book of Microbiology, Ananthanarayan, R. Jayaram Paniker, C.K., Orient Longman Limited, Hyderabad (A.P.) India.

Suggested readings:

1. Microbiology, Pelczar, M., Chan, E.C.S. and Krieg, N.R., Tata Mc Grew Hill Publishing Co. Ltd. New Delhi. 1996.
2. Introduction to Fungi, Webster, J., Cambridge University Press, London. 1970.

3. Morphology and Taxonomy of fungi, Bessy, E.A., Scientific Pub, Jodhpur. 2015.
4 Microbiology: Fundamentals and Applications, Purohit, S.S., Agro Bios, Jodhpur. 2002.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	Botany	I	BOT-DSM-123	**Ecology and Environment (Theory)**	**Mid Sem. -40 End Sem. -60**	**3-1-0 = 4**

Course objectives:

- The objective of the course is to understand the applied aspects of ecology. It includes the critical comprehension of environmental pollution, biodiversity conservation and climate change. An understanding of environmental impact assessment and ecosystem restoration methods.

Unit 1 **10 hours**

Ecology: Concept and definitions, kinds of ecosystem, Ecological pyramids, Food chain and Food web, Ecosystem processes.

Ecosystem functions: Energy flow, biogeochemical cycles, primary and secondary productivity.

Unit 2 **12 hours**

Vegetation organization and Development: Concept of community and continuum, analysis of community (analytical and synthetic characters) community coefficients, inter specific associations, concept of ecological niche. Temporal changes (cyclic and non-cyclic), Ecological succession.

Unit 3 **14 hours**

Ecosystem stability: Concept (resistance and resilience), ecological perturbation and their impact on plants and ecosystems.

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

Unit 4 **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 5 **12 hours**

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

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

- To understand the cause, impact and control of pollution.
- To learn the methods to assess the biodiversity of an ecosystem.
- To learn the concept of biodiversity levels, significance and conservation.
- To perceive the gamut of climate change, its impacts globally and its mitigation.
- To analyse the ecosystem stability, degradation and restoration.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**I**	**BOT-DSM -124**	**Ecology and Environment (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Study of minimal size of the quadrat by Species- Area Curve method for studying the forest and grassland vegetation.
2. To determine minimal number of quardats by Species –Area Curve method in forest and grassland.
3. Sampling of the grassland vegetation by quadrat method for determining the density, frequency and basal cover of different species.
4. To determine diversity indices (Shannon-Wiener, concentration of dominance, species richness, equitability and B-diversity) for protected and unprotected grassland stands.
5. To estimate IVI of the species in a woodland using point centred quarter method.
6. To determine gross and net phytoplankton productivity by light and dark bottle method.
7. To determine soil moisture content, porosity and bulk density of soils collected for varying depths at different locations.
8. To determine the water holding capacity of soils collected from different locations.
9. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
10. To estimate the dissolved oxygen content in fresh waters by azide modified of Winkler's method.

Essential Readings:

1. J.S. Singh, S.P. Singh and S.R. Gupta. Ecology, Environment and Resource conservation, Anamaya Pub New Delhi (2008)
2. D. Miller-Dombois and H. Ellenberg. Aims and methods of vegetation ecology. Wiley N.Y. (1974)
3. E.P. Odum. Basic ecology W.B. Saunders, Philadelphia, (1983)
4. R.L. Smith. Ecology and Field Biology, Harper Collins College Pub. Inc. New York. (1996)
5. Curtis, J.T. and G. Cottom Plant Ecology Work Book: Laboratory Field Reference Manual Burgess Publishing Co. Minnesota. (1956).
6. Daubenmire, R.F. Plant Communities. A text book of Plant syencology. Harper and Row New York. 300p. (1968)
7. Mishra R. Ecology work Book. Oxford and IBH Publishing Co. New Delhi. Pp 235. (1968)

Additional Readings:

1. Oosting, M.J. An Introduction to Plant Ecology, end edition W.H. Freeman. San Franisco, London (1956)
2. Piper, C.S. Soil and Plant analysis (1966 reprint) Hans publisher, Bombay (1936)
3. Weaver, J.E. and E.F. Clements. Plants Ecology. McGraw Hill Book Co, New York and London (1938)
4. Whittaker, R.H. Communities and Ecosystems, 2nd edition Mac Millan Publishing Co. New York (1975)

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	Botany	I	BOT-MDM-121	Cytogenetics (Theory)	Mid Sem - 40 End Sem - 60	3-1-0=4

Course objectives:

- The objective of this course is to train students about the basic concept of cytology, genetics and its importance in studies of life sciences.
- It includes the basic understanding of cytoplasmic organelles, membrane transports, cell division, and Mendelian principles of heredity, gene interaction, DNA structure, replications and role of mutation in crop improvements.

Unit 1 **12 hours**

General Introduction: Historical background of cytology; Prokaryotic and Eukaryotic cell organization, structure and function of cell wall and plasma membrane; Membrane transport (Active and passive mechanism); Cell organelles; Cytoskeleton.

Unit 2 **10 hours**

Cell Cycle: Mitosis, Meiosis, role of cyclins in cell division, Apoptosis.

Unit 3 **18 hours**

Introduction of Genetics: Overview; Pre-Mendelian theory concerning Heredity and Evolution; Mendelian concept of Heredity; Extension of Mendelism: Gene Interactions, Multiple Allelism, Polygenic Inheritance; Chromosomal Theory of Inheritance, Sex-Linkage, Linkage, Crossing over, Chromosomal Mapping; Extra-chromosomal Inheritance; Population Genetics.

Unit 4 **10 hours**

DNA structure and Replication: DNA as genetic material, Structure and different types of DNA, Topology, Chromatin, Nucleosome model, Heterochromatin and Euchromatin, Special type of chromosomes (Lampbrush and polytenechromosme); DNA replication in prokaryotes, different proteins and enzymes involved.

Unit 5 **10 hours**

Mutation: DNA damage and repair, Mutation, Type of Mutation, Mechanism of mutation, Polyploids and haploids in crop improvements, Transposable Genetic elements, Mechanism of Transposition.

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

- To understand the basic concepts of prokaryotic and eukaryotic cell organisation, different cell organelles and membrane transport.
- To understand the process of cell division, different stages of meiosis and mitosis, apoptosis and role of cyclin in cell division.
- To understand the Mendelian concept of heredity, gene interactions, multiple allelism, polygenic inheritance, chromosomal theory of inheritance, linkage, crossing over, extra-chromosomal inheritance and population genetics.
- To understand the structure of DNA, its replications in prokaryotes and eukaryotes, special types of chromosomes.
- To understand the mechanism of mutation and its types, role of polyploids and haploids in crop improvements and mechanism of transposition.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**I**	**BOT-MDM-122**	**Cytogenetics (Practical)**	**Mid Sem.-40** **End Sem.-60**	**0-0-4=2**

Practical:

1. Familiarizing students with lab equipment.
2. Study of different type of chromosomes
3. Study of different stages of mitotic cell division in suitable material
4. Study of meiotic cell division in Pollen mother cells.
5. Studying pea plant as tool for investigating Law of Inheritance: i) Mendel's Law of segregation ii) Law of Independent Assortment.
6. Chi-square test.
7. Isolation of DNA from different sources.

Essential Readings:

1. P.K. Gupta. Cytology, Genetics and Molecular Biology. (2009) Rastogi Publications
2. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Reberts, P. Walter. Molecular biology of cell. Gerland Science, a member of the Taylor and Francis group – New York.
3. L.B. Genes. (1997) Oxford University Press, New York, USA
4. G. Karp. Cell and Molecular Biology. (1996) JhonWileys and Sons London, U.K.
5. D.L. Hartl, E.W. Jones. Genetics Principles and Analysis IV edition. (1998) Jones and Bartlett Publishers Boston, USA.

Additional Reading:

1. C.B. Pawar. Cell biology. Himalaya Publishing house, New Delhi.
2. W.S. Klug and M.R. Cummings. Essential of Genetics; 5th Edition (2004).
3. S.C. Rastogi. Cell Biology. (2015) New Age International Publisher, New Delhi.
4. V.K. Agarwal and Dr. P.S. Verma. Cell biology. (2015) S. Chand Publishing house, New Delhi.
5. P.S. Verma and V.K. Agarwal. Cell Biology, Genetics, Molecular biology, Evolution & Ecology. (2005) S. Chand and Company Ltd. New Delhi.
6. A.K. Rathoure, and M. Shrivastava. Cell Biology and Genetics. (2015) Daya Publishing House, New Delhi.
7. Hyde. Genetics and Molecular Biology: With Fundamentals of Biostatics. (2016) Mcgraw Hill, New Delhi.
8. R.J. Singh. Plant Cytogenetics. (2016) CRC Press, Taylor & Francis Group, New York.
9. B.S. Singh, and M.P. Singh. Cytogenetics. (2015) SSPH Publications, New Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**I**	**BOT-SEC-121**	**Mushroom Biology (Theory)**	**Mid Sem. -40** **End Sem. - 60**	**3-0-0 = 3**

Course objectives:

- The major objective of this paper to trained the students to become skilled entrepreneur.

Unit 1 **9 hours**

Mushroom definition, Characteristics of mushrooms, Categories (edible, poisonous, medicinal) Biodiversity of wild mushrooms.

Unit 2 **9 hours**

Ecological importance of Fungi in general and mushroom in particular, Benefits of Mushrooms

Unit 3	**9 hours**
Classification, identification and cultivation methods of mushrooms: *Pleurotus*, *Agaricus* and *Calocybe* and *Cordyceps* Species	
Unit 4	**9 hours**
Diseases of mushrooms, use of spent mushroom compost as bio-control agent, secondary metabolites of mushrooms.	
Unit 5	**9 hours**
Mushroom by-products (pickle, soap, medicine), Agri-business: concept of marketing, market channels, SWOT analysis.	

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

- Will able to learn about mushrooms get knowledge and enhanced skill about biodiversity of mushroom.
- Will able to learn ecological importance of fungi, can became guide and consultant about locally occurring mushroom. This provides a employability.
- Will able to learn cultivation techniques for various edible and medicinally important mushrooms. This skill enables them gives an opportunity to become entrepreneur.
- Will able to get complete knowledge of diseases management of mushroom. This provide a good skill towards maintaining mushroom houses
- Will able to learn how to produce value added products and market them. This enables them not only to become entrepreneur but also provide tool for creation of starts up or employment to others.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**I**	**BOT SEC-122**	**Mushroom Biology (Practical)**	**Mid Sem.-40 End Sem.-60**	**0-0-2=1**

Practical:

1. Field survey for Mushrooms collection, Collection methods and their identification, preparation of e – herbarium.
2. Different media preparation for mushroom culture.
3. Spawn preparation.
4. Cultivation of *Pleurotus*species, *Agaricus*species and *Cordyceps*species and production of Mushroom compost.
5. Estimation of carbohydrate and protein in mushroom
6. Antimicrobial activity of mushrooms.
7. Use of SMC (spent mushroom compost) as a biofertilizer and Bio- control agent.

Essential Readings:

1. Miles, P.G and Chang, S.T. (1997) Mushroom Biology: Concise basics and current developments.
2. Kango, N. (2010) Textbook of microbiology, IK international publishers and distributors, New Delhi.
3. Gunasekaran, P. (1995) A laboratory manual of microbiology.
4. Pathak, V. N., Yadav, N. and Gour, M. Mushroom production and processing Technology, Agrobios, Jhodhpur
5. Sharma, B. C. and Sharma, N.P. (2013) Mushroom cultivation and users, Agrobios, Jhodhpur.

Additional Readings:

1. Pegler, D. and Spooner, B. (1997) The mushroom Identifier, Grange Books London U.K.

2. Aneja. (200)5 Experiments in microbiology, plant pathology and biotechnology.
3. Vyas, D., Khare, P. K., Paliwal, G.S., and Gupta, R.K. (2011) Microbial Biotechnology and Ecology, Daya publishing house New Delhi.
4. Borkar, S.G. and Patil, N. (2016) Mushroom: A Nutritive Food and its Cultivation, Bio Green Books, New Delhi.
5. Vyas, D. and Singh, C. (2023) Mycotalk, Akinik Publication, New Delhi.
6. Dehariya, P. (2021) Recent Trends in Mushroom Biology, Global Books Organization, New Delhi.

Semester II

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**II**	**BOT-DSM-221**	**Plant Physiology and Biochemistry (Theory)**	**Mid Sem. – 40 End Sem. – 60**	**3-1-0= 4**

Course objectives:

- The major objective of this paper is to develop understanding forwards vital function carried out by the plants. To understand the basic concept of Biochemistry. Structure of carbohydrates, respiration and lipid metabolism, Nitrogen fixation, amino acids and Proteins and techniques in Biochemistry.

Unit 1 **10 hours**

Plant water relations: Physical properties of water; diffusion, osmosis, Transpiration, Physiology of stomata, plant-water relations, mechanism of water transport through xylem. Phloem loading and unloading, passive and active solute transport, membrane transport proteins.

Unit 2 **10 hours**

Light and pigment: Photoreceptor, Photosynthesis: Bioenergetics, Photophosphorylation, light harvesting, Complexes, C4 syndrome, Crassulacean acid, metabolism (CAM) Translocation of xenobiotic chemical.

Unit 3 **8 hours**

Plant growth regulators and elicitors: Physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid, brassinosteroids, polyamines, jasmonic acid and salicylic acid. The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development - genetic and molecular analysis, role of vernalization.

Unit 4 **15 hours**

Thermodynamics of biological system: Laws of thermodynamics; concept of free energy; energy transfer and redox potential

Respiration and lipid metabolism: Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alterative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids.

Unit 5 **15 hours**

Nitrogen fixation, nitrogen and sulphur metabolism: Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulphate uptake, transport and assimilation.

Amino acid and Proteins: structure acid base properties optical and stereochemical properties. Primary, secondary, tertiary and quaternary structures.

Course outcomes: The students Studying of the course

- Will be able to get understanding regarding water and water relationship. Movements of water and Plant water relations, this skill helped them for plantation of plants.
- Will be able to understand role of light and light harvesting complexes. Photo synthetic response of C3, C4 plants and xenobiotic. This will provide skill enable them to understand metabolic pathways occurs in plants.
- Will be able to learn importance of plant growth hormones and their biosynthesis this provide a skill to students who wishes to establish entrepreneurship in floriculture and seed development.
- Understand the law of thermodynamics, Respiration and lipid metabolism.
- Understand the biological nitrogen fixation, mechanism of nitrate uptake and reduction, ammonium assimilation, amino acids and proteins.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**II**	**BOT-DSM-222**	**Plant Physiology and Biochemistry (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Preparation of standard curve of glucose and determination of glucose content in given plant material.
2. Extraction and estimation of starch from plant material.
3. Study of absorption spectra for chlorophyll-a and chlorophyll-b and calculate the ratio of chlorophyll-a and chlorophyll-b
4. Determination of osmotic potential of vacuolar sap by plasmolytic method.
5. Separation of chlorophyll pigment by paper and column chromatography.
6. To determine the rate of photosynthesis under different light qualities.
7. To determine the rate of photosynthesis under CO_2 effect.
8. To determine the rate of transpiration under different environmental condition.
9. To study water and salt stress in herbaceous plant growth.
10. Preparation of standard curve for carbohydrate and protein.
11. Separation of amino acid through paper and column chromatography.
12. Study of instruments and principle of TLC, HPLC and Centrifuge, Spectrophotometer.

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, Sinauer Associates, 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 Wiley.
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**
M.Sc.	**Botany**	**II**	**BOT-DSM-223**	**Biology and Diversity of Spermatophytes (Theory)**	**Mid Sem.-40 End Sem.- 60**	**3-1-0 = 4**

Course objectives:

- The objective of the course to develop understanding about the spermatophytes. The importance of the course is to enable students to learn about the distribution of gymnosperms and angiosperms as well as botanical nomenclature.

Unit 1 **10 hours**

General characteristics of Gymnosperm: Classification and distribution of Gymnosperm in India.

Unit 2 **10 hours**

Economic importance of gymnosperms: General account of *Pteridospermales, Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwischiales* and *Gnetales;* Life history of *Cycas, Pinus, Ginkgo* and *Gnetum.*

Unit 3 **8 hours**

Taxonomic hierarchy, species, genus, family and other catagories, Silent features of the International code of Botanical nomenclature.

Unit 4 **15 hours**

Classification of angiosperm: Artificial and natural and phylogenetic systems, merits and demerits; Recent trends in Taxonomy, Herbarium, FLORA, Botanical garden.

Unit 5 **15 hours**

Morphological nature of flower: Stamen & carpel. Range of floral variation and trends of evolution in order- Ranales, Amentiferae, Tubiflorales, Santales and Helobiales. Study of various families of local flora.

Course outcome: The students Studying of the course

- Will able to learn distribution pattern of Gymnosperms and Angiosperms.
- Will able to learn life history of gymnosperms and its importance.
- Will be able to learn systematic of angiosperm plants.
- Will be able to learn artificial and natural system of classification, herbarium preparation and plant identification.
- Will be able to learn details of morphological features of the flowering plants.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**II**	**BOT-DSM -224**	**Biology and Diversity of Spermatophytes (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Study of complex tissues viz. Xylem and Phloem, Tracheids, Vessels and Sieve tubes and Companion cells.
2. Comparative study of the wood anatomy and vegetative and reproductive parts of *Cycas, Pinus, Cupressus, Araucaria, Taxodium, Podocarpus, Agathis, and Ephedra.*
3. Study of important fossil gymnosperms from prepared slides.
4. Description of a specimen from representative, locally available families.
5. Herbarium techniques, Field trips within and around the campus; compilation of field notes and preparation of herbarium sheets and e-herbarium. Use of flora for identification of specimens. Comparison of different species of a genus and different genera of a family

Essential Reading:

1. Sharma, O.P. (2009). Plant Taxonomy, 2nd edition, Tata McGraw Hill.
2. Baruah, A. (2010) Handbook of Angiosperm Taxonomy and Useful Plants, Aavishkar Publishers.
3. Nairne, A.K. (2014) Scientific Classification of Flowering Plants, Discovery publication house, New Delhi.
4. Grant, W.F. (1984) Plant Biosystematics, Academic press London.
5. Dikshit, A. Siddiqui, M.O. and Pathak, A. (2016) Taxonomy of Angiosperm: Basic concept, Molecular aspects and Future Prospects, Studerra Press, New Delhi.
6. Bhatnagar, S.P. and Moitra, A. (1996) Gymnosperms, New Age International Pvt. Ltd., New Delhi.
7. Sharma, O.P. (1999) Gymnosperms, Pragati Prakashan, Meerut.
8. Chamberlain, C.J. (1971) Gymnosperms: Structure and Evolution, Chicago University Press.

Additional Reading:

1. Pullaiah, T. (2013) Text book of Biosystematics Theory and Practical, Regency Publication, New Delhi.
2. Sambamurty, A.V.S.S. (2005) Taxonomy of Angiosperms, IK International Publishers, New Delhi.
3. Sporne, K. R. (1974) The Morphology of Gymnosperms, Hutchinson University Library, London.
4. Singh, M.P. and Abb, S.G. (2016), Essentials of Plant Taxonomy and Ecology, Bio Green books, New Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**II**	**BOT-MDM-221**	**Forest Ecology (Theory)**	**Mid Sem: 40 End Sem: 60**	**3-1-0=4**

Course objectives:

- Principal objective of the course is to impart the details of global distribution of different types of forests in relation to climatic conditions. Dependency of humans on forests and needs for conservation. Ecological concepts pertaining to the management and growth and development of forests in general and Indian forests in particular.

Unit 1 — **10 hours**

Introduction, Importance of forest resources, forest communities of different climatic zones, Methods of studying structure and composition of forest communities. Forest types of India and M.P.

Unit 2 — **10 hours**

Classification of forest biomes, World distribution, Classification of forests of India, Tropical forest, Subtropical forests, Temperate forest, Alpine vegetation of Himalayas. Differences between true temperate and Indian temperate forests.

Unit 3 — **8 hours**

Phenomenon of succession in forest, Nature of climax, Role of grazing and anthropogenic factors, Forest environment, climatic factors governing forest distribution, Methods of studying environmental factors in forests.

Unit 4 — **17 hours**

Microclimate of forest, Forest soils of India, Forest Natural regeneration, Joint Forest management concept and practice.

Unit 5 — **15 hours**

Wildlife conservation and related legislation, Seed biology, Forest Influences, Organic matter dynamics and annual budget sheets

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

- Understand the importance of forest resources.

- Learn the structure and functions of forests as ecosystems
- Have the in-depth knowledge of distribution of forests globally and regionally.
- Understand the forest succession in relation to climate and soils.
- Learn the conservation policies for wildlife conservation in India.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**II**	**BOT-MDM-222**	**Forest Ecology (Practical)**	**Mid Sem: 40** **End Sem: 60**	**0-0-4=2**

Practical:

1. A survey and reconnaissance of a nearby forest to have an idea of various herb, shrub and tree species.
2. Sampling of the forest vegetation by quadrat method for determining density, frequency and basal area of different tree species.
3. Studying forest natural regeneration.
4. Study of climatic factors inside and outside a forest.
5. Visits to forest of different edapho-climatic zones.
6. Excursions to places of importance to forestry research, such as IIFM – Bhopal, SFRI and TFRI Jabalpur, FRI Dehra Dun etc.

Essential readings:

1. Champion, H. and Seth, S.K. (1968) General Silviculture for India, Govt. of Indian Publication, Delhi.
2. Champion, H.G. and Seth. (1968) A revised survey of forest types of India Govt. of India Publication, Delhi
3. Puri, G.S., Mehar-Homeji, V.M., Gupta, R.K. and Puri, S. (1983) Forest Ecology, Oxford, IBH Pub. Co., New Delhi.
4. Kimmins, J.P. (1997) Forest Ecology, Printice Hall, New Jursey, USA.
5. Misra, R. (1968) Ecology work Book, Oxford, IBH Pub. Co. New Delhi.
6. Smith, R.L. (1996) Ecology and Field Biology, Harper Collins.
7. Odum, E.P. (1971) Fundamental of Ecology, Saunders's Pub. Athens. G.A.

Suggested readings:

1. UNESCO. (1978) Tropical Forest Ecosystems, UNESCO, UNEP/FAO, Paris.
2. Ovington, J.D. (1965) Woodlands, The English University, Press. London.
3. Troup, R.S. (1921) Silviculture of Indian Trees, Vol I-III, Clarendon Press, Oxford.
4. Burton, V.B., Donald, R.Z. and Stephen, H.S. (1998) Forest Ecology, J. Wiley and sons, NY.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M. Sc.	**Botany**	**II**	**BOT-SEC-221**	**Biochemical and Molecular Techniques (Theory)**	**Mid Sem.-40** **End Sem.-60**	**3-0-0=3**

Course objectives:

- To provide scientific understanding of instruments, their operation and applications
- Ability to perform analytical experiments and data interpretation

Unit1 **10 hours**

Fundamentals of basic laboratory instrumentations: Microscopy- basic principles and applications. **Centrifugation:** basic principles - instrumentation - centrifugation units - types of centrifuges-rotors-accessories. Buffer preparation, Electrical conductivities, pH estimation

Unit 2	10 hours
Fundamentals of basic laboratory instrumentations: Chromatography & Electrophoresis - types of chromatography, Blotting techniques - western- southern & northern- application methods in life sciences and biotechnology. Polymerase Chain Reaction.	
Unit 3	**8 hours**
Principles and techniques of colorimetry & spectrophotometry: Beer-Lamberts Law - instrumentation - qualitative and quantitative methods of analysis-protein, and carbohydrates.	
Unit 4	**17 hours**
Nomenclature and Classification of Enzymes: Properties of Enzymes, Enzyme Activity and Units, Specific Activity, Catalytic Power and Specificity, Lock and Key Theory, Induced Fit Model, Factors affecting enzyme activity- Michaelis-Menten equation, Enzymes estimation methods.	
Unit 5	**15 hours**
Basic Molecular Biology and techniques: DNA, RNA and proteins. DNA replications, Transcription and translation, Gel electrophoresis (Agarose gel electrophoresis, SDS-PAGE). Calculations in molecular biology.	

Course outcome: At the completion of this course, the students will be able to:

- Understand the fundamentals of underlying principles related to various instrumentation techniques
- Apply various analytical methods for quantitative and qualitative analysis of biological samples

Department of Botany

Class	Subject	Sem.	Course Code	Course Title	Marks	Credits
M.Sc.	Botany	II	BOT-SEC-222	Biochemical and Molecular Techniques (Practical)	Mid Sem: 40 End Sem: 60	0-0-2=1

Practical:

1. Laboratory safety guidelines.
2. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law.
3. To determine sugar concentration in plant samples.
4. To determine chlorophyll concentration in leaf samples
5. Enzyme activity; Cellulase, Lipase, Protease, Catalase
6. Effect of temperature on enzyme activity.
7. Polymerase Chain Reaction
8. Isolation & Purification of genomic DNA from bacteria
9. Isolation & Purification of plasmid DNA
10. Separation of proteins by native and SDS-PAGE.

Essential 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.

Suggested Readings:

1. Wilson, K. and Walker, J. (2000) Principles and Techniques in Practical Biochemistry, 5th Ed., Cambridge University Press.
2. Holtzhauer, M. (2006) Basic Methods for the Biochemical Lab, Springer.

Semester III

Department of Boatny						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**III**	**BOT-DSM-321**	**Genetic Engineering and Biotechnology (Theory)**	**Mid Sem. -40 End Sem. -60**	**3-1-0 = 4**

Course objectives:

- The major objective of this paper is to develop understanding forwards vital function carried out by the plants.
- To understand the basic concept of Biochemistry.
- Structure of carbohydrates, respiration and lipid metabolism, Nitrogen fixation, amino acids and Proteins and techniques in Biochemistry.

Unit 1 **10 hours**

Recombinant DNA technology: An overview, Gene cloning: tools and techniques; Vectors: Plasmids and Bacteriophages. Manipulation of DNA, DNA manipulative enzymes, Restriction mapping, Gel electrophoresis, blotting, DNA sequencing, DNA libraries, PCR, Expression vectors.

Unit 2 **12 hours**

Microbial genetic manipulation: Bacterial transformation, Selection of transformants and recombinants, Genetic improvement of microbes, Plant growth promoting bacteria: nitrogen fixation in plants, bio-control of pathogens, siderophores, Microbial insecticides.

Unit 3 **10 hours**

Genetic engineering of plants: Aims and strategies for development of transgenics, *Agrobacterium* – the natural genetic engineer, Ti-plasmid, Ri-plasmid, T-DNA, Chloroplast transformation; alternative DNA delivery methods and its role in plant transformation.

Uni4 **16 hours**

Biotechnology: Basic concepts, principles and scope, Plant Cell and Tissue Culture: General introduction, history, scope, concept of cellular differentiation, and totipotency. Organogenesis and adventives embryogenesis: Fundamental aspects of morphogenesis, somatic embryogenesis and production of haploid plants, androgenesis, mechanisms, techniques and utility.

Uni 5 **12 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.

Intellectual property rights, ecological and ethical concerns.

Course outcome: The students Studying of the course

- Will be able to get understanding regarding DNA Recombinant Technology, blotting techniques, gel electrophoresis etc.
- Will be able to understand microbial genetic manipulation.
- Will be able to understand transgenic, plasmids, DNA delivery methods and its role in plant transformation.
- Will be able to understand basic concepts of Biotechnology, plant cell and tissue culture.
- Will be able to understand applications of plant tissue culture.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**III**	**BOT-DSM-322**	**Genetic Engineering and Biotechnology (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Familiarizing students with lab set up and instrumentation.
2. Growth characteristics of *E. coli* using plating and turbidi-metric methods.
3. Isolation of plasmid from *E. coli* by alkaline lysis method and its quantification

spectrophotometrically
4. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
5. Cloning of a DNA fragments in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
6. PGPR characterization assay: Phosphate solubilization and siderophore production.
7. Isolation of protoplasts from various plant tissues and testing their viability.
8. Effect of physical (temperature) and chemical (osmoticum) factors on protoplast yield.
9. Demonstration of protoplast fusion employing PEG.
10. Study of Organogenesis.
11. Somatic embryogenesis using appropriate explants.

Essential Readings:

1. Glick, R.B. and Pasternak, J.J. (2002.) Molecular biotechnology: Principles and Application of recombinant DNA technology, American Society for Microbiology.
2. Glick, B.R. and Thompson, J.E. (1993) Methods in Plant Molecular Biology and Biotechnology, CRC Press, Bocas Raton, Florida.
3. Sambrook, J. and Russel, D.W. (2000) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, U.S.
4. Singh, B.D. (2016), Biotechnology: Expanding Horizons, Kalyani Publisher, New Delhi.
5. Purohit, S.S. (1998) Biotechnology: Fundamentals & Applications, 3rd Edition, Agrobios Publisher.

Additional Readings

1. Brown, T.A. (2020) Gene cloning: An introduction, Wiley-Blackwell.
2. Gustofson, J.P. (2000) Genomes, Kluwer Academic Pub. NY, USA.
3. Old, R.W. and Primrose, S.B. (1989) Principal of gene manipulation, Blackwell pub. Oxford, U.K.
4. Stoye, J. (2016) Genomics and Proteomics, Vol. I & II, INTECH, New Delhi.
5. Vidyashekharan, P. (2015) Genetic Engineering: Molecular Biology and Tissue culture from crop pest and Disease management, Daya Publishing House, New Delhi.
6. Kumar, P. and Mina, U. (2015) Biotechnology: A problem approach, Pathfinder Academy, New Delhi.
7. Bilgrami, K.S. and Pandey, A.K. Introduction to Biotechnology CBS Publisher & Distributor, New Delhi.
8. Ratledge, C. and Kristiansen, B. (2001) Basic Biotechnology, Cambridge University Press.
9. Glick, B.R., Pasternak, J.J. and Patten, C.L. (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA, ASM Press Washington, D.C.
10. Rastogi, S.C. and Rastogi, S. (2008). Introduction to Biotechnology, CBS Publisher, New Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**III**	**BOT-DSM-323**	**Plant Anatomy and Embryology (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 SAM, RAM, Cambium, Periderm, Anomalous Secondary Growth and Embryology.

Unit 1 **12 hours**

Meristematic Tissue: Classification based on stage or methods of development, position in plant body. Theories of SAM and RAM.
Permanent Tissue: Simple (Parenchyma, Collenchyma, Sclerenchyma); The complex tissue (Xylem, Phloem).

Unit 2 **08 hours**

Cambium: origin of cambium fascicular and interfascicular cambium, structure and function of cambium.
Periderm: structure and function, phellogen, phellem, phelloderm, commercial cork. Anomalous anatomical structure in Angiosperm.

Unit 3 **15 hours**

Male gametophyte: Structure of anthers; microsporogenesis, role of tapetum; pollen development, male sterility
Female gametophyte: Ovule development; Types of ovules, megasporogenesis: organization of the embryo sac, types and structure of the embryo sac.

Unit 4 **10 hours**

Pollination, pollen-pistil interaction and fertilization: Pollination mechanisms and vectors; structure of the pistil; pollen-stigma interactions, self-incompatibility; double fertilization; in vitro fertilization.

Unit 5 **15 hours**

Seed development and fruit growth: Endosperm development; embryogenesis, polyembryony; apomixes; embryo culture; seed dormancy, fruit dehiscence.

Course outcome:

- To understand the basic concepts of meristematic tissue, theories of SAM and RAM, Permanent tissue.
- To understand the basic structure of Cambium and Periderm, anomalous anatomical structure in angiosperms.
- To understand the structure and development of male and female gametophyte.
- To understand pollination and pollen pistil interaction and fertilization etc.
- To understand the concept of embryogenesis, seed development, polyembryony fruit dehiscence etc.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**III**	**BOT-DSM-324**	**Plant Anatomy and Embryology (Practical)**	**Mid Sem- 40 End Sem- 60**	**0-0-4=2**

Practical:

1. Study of internal structure of anomalous stem and roots (*Salvadora Bougainvillea, Tinospora, Leptadenia,*).
2. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla*.
3. Microscopic examination of vertical sections of leaves such as *Nerium, Maize* to understand the internal structure of leaf tissues and trichrome, glands etc.
4. Study of shoot and roots in monocots and dicots. Examination of L.S. of root from slides permanent preparation to understand the organization of root apical meristem and its derivatives. (maize, aerial roots of banyan etc.)
5. Field study of several types of flowers with different pollination mechanisms.
6. Types of ovules.
7. Study of seed dormancy and methods to break dormancy.

Essential Readings:

1. Srivastav, L. (2005) Plant Growth and Development, I[st] Edition, Academic press.

2. Ranjan, P. (2010) Plant Anatomy, New central book agency, New Delhi.
3. Beck, C.B. (2005) An Introduction to Plant Structure and Development, Cambridge University Press, London U.K.

Additional Readings

1. Singh, V., Pande, P. C. and Jain, D.K. (2010) Text Book of Botany, Rastogi Publication, Meerut.
2. Sinha, P. (2016). Plant Anatomy and Physiology, Bio Green Books, New Delhi.
3. Singh, M.P. and Abb, S.G. (2016) Essentials of Plant Taxonomy and Ecology, Bio Green Books, New Delhi.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**III**	**BOT-MDM-321**	**Biodiversity and Climate change (Theory)**	**Mid Sem.-40 End Sem.- 60**	**3-1-0 = 4**

Course objectives:

- The course aims to make students understand biodiversity in the context of ecosystem dynamics, ecosystem functioning and provision of ecosystem services.
- They will develop knowhow for assess biodiversity and measures to manage biodiversity. They will also develop an understanding of climate change and assessment, adaptation and mitigation strategies.

Unit 1 **9 hours**

Basic concepts of biodiversity: Definition, levels; Values: Instrumental, Intrinsic, social, aesthetic, cultural and spiritual; Measurement of biodiversity: species richness & abundances, diversity indices (Shannon diversity index, Simpson's index, Lincolin index); Biodiversity hotspots and their characteristic flora and fauna.

Unit 2 **9 hours**

Threats to biodiversity: Factors responsible for biodiversity loss: Habitat destruction, degradation and fragmentation; Invasive Species; Pollution; Overexploitation; Extinction: types, causes, current and future extinction rates, sixth extinction; IUCN Threatened Categories.

Unit 3 **9 hours**

Biodiversity conservation strategies: In situ conservation: Biosphere reserve, sanctuaries, and national parks; Ex situ conservation: Botanical Garden, zoological garden; in vitro conservation: Gene bank, tissue culture; Indigenous and Global approaches to biodiversity conservation.

Unit 4 **9 hours**

Basic concepts of climate: Definition of weather and climate; Elements of climate; Climate classifications.

Greenhouse effect: Greenhouse gases; Sources and sinks of greenhouse gases; Global and regional trends in greenhouse gas emissions; Green house effect; Global warming and its impact.

Climate change: Definition; Drivers of climate change; Evidences of climate change; Impact of climate change on: Weather pattern, ecosystem and its productivity, oceans, glaciers, agriculture, natural vegetation, wildlife, and humans.

Unit 5 **9 hours**

Climate change assessment, adaptation and mitigation: Vulnerability to climate change; International legal and policy frameworks to address climate change: United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol; Concept of climate change adaptation; Adaptation measures; Linkages between climate change adaptation and development; International and national adaptation initiatives and programmes; Climate Change Mitigation measures.

Course outcomes: At the completion of this course students will

- Understand the basics of science of biodiversity and Learn tools and techniques of monitoring

of biological diversity
- Cite the scientific evidence for biodiversity change in the modern era and detail the contemporary causes of diversity loss
- Understand and convey the ecological, social, and economic impacts of diversity loss.
- Apply management principles and tools that are used to conserve diversity at levels from genes to landscapes.
- Understand the status of global climate change and their mitigation and adaptation measures.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Botany**	**III**	**BOT-MDM-322**	**Biodiversity and Climate Change (Practical)**	**Mid Sem- 40** **End Sem- 60**	**0-0-4=2**

Practical:

1. Sampling methods for different plant communities
2. Calculation of species richness index in different areas of University
3. Vegetation analysis of different plant communities of University.
4. Classifying plant species into IUCN Red List Categories in India
5. Field visit to nearby protected area.
6. Measurements of climatic factors: Temperature, humidity, rainfall, light intensity etc.
7. Comparative accounts of global status of greenhouse gases by secondary data.
8. Determination of carbon content in soil and biomass.
9. Acquaintance with instrumentation involved in discipline i.e. GPS, Clinometer etc.

Essential Readings:

1. Conservation Biology: A primer from South Asia by Kamaljit S. Bawa, Richard B. Primack and Meera Anna Oommen, 2011. Universities Press (Ltd.),Hyderabad.
2. Essential of Conservation Biology by Richard B. Primack, 2002. Third Edition. Sinauer Associates, Inc, Massachusetts USA.
3. Measuring Biological Diversity by Anne E. Magurran, 2013, Published by John Wiley & Sons Inc., Hoboken, New Jersey.
4. Biodiversity and Conservation by P. C. Joshi and Namita Joshi, 2004. A. P. H. Publishing Corporation, New Delhi.
5. Introduction to Modern climate change by A. Desseler, 2011. Cambridge University Press, Cambridge.
6. Global climate change by J. B. Arnold, 2010. Sinauer Associates Inc., Sunderland, Massachusetts, USA.
7. IPCC (Intergovernmental Panel on climate change (2001) Climate change: The Scientific Basis. Cambridge University Press,Cambridge.
8. The Inconvenient Truth, AlGore, 2006. Rodale Inc., Emmaus, Pennsylvania, USA.

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. Meffe and C. Ronald Carroll, 1994. Sinauer Associates, Inc. Publishers, Sunderland, MassachusettsUSA.
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. Conserving the sacred for Biodiversity Management by P. S. Ramakrishnan, K. G. Saxena and U. M. Chandrashekara, 1998. Oxford & IBH PublishingCo. PVT. LTD., New Delhi.
6. Biodiversity in India (Vol. 8), T. Pullaiah, 2016. Bio Green Books, New Delhi.

7. The Discovery of Global warming by R.W. Spencer, 2009. Harvard Univ. Press, USA.
8. Climate Change. Picturing the Science by G. Schmidt, 2009. W.W. Norton & Co., New York.
9. The Science of Global warming and our Energy future by E. Malthez, 2009. Columbia University Press, New York.
10. Climate change from science to sustainability by Smith, 2009. Oxford University Press, London.
11. Climate change energy sustainability and pavements by Gopalkrishnan, 2014. Springer.

Department of Botany						
Class	**Subject**	**Sem.**	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	**Boatny**	**III**	**BOT-SEC-321**	**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 employability in the students.

Unit 1 **9 hours**

Landscaping: Principle of elements, Garden features and adornment, Garden designing, Bio-aesthetics planning, Role of plants and combating environmental pollution, types of garden

Unit 2 **9 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 **9 hours**

Bio-fertilizers: Farm yard manure (FYM), Vermicompost, Organic manure, Green manure, Role of bacteria, role of AM fungi, Bio-pesticides.

Unit 4 **9 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 **9 hours**

Floriculture: History of Ornamental plants, Floriculture as carrier, Commercial floriculture, flowers & Industries, floriculture business competition, World scenario floriculture.

Course outcomes: The students Studying the course

- 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 now 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
M.Sc.	Botany	III	BOT-SEC -322	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 Publisher 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.

Semester IV

Department of Botany						
Class	Subject	Sem.	**Course Code**	**Course Title**	**Marks**	**Credits**
M.Sc.	Botany	IV	BOT-DSM-421	Dissertation	Report **Submission : 75** **Viva-Voce/ presentation : 25**	**0-0-28=14**
Dissertation Project Work/Experimental Learning on any Botany related aspect						