DEPARTMENT OF BOTANY
DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR (M.P.)
(A CENTRAL UNIVERSITY)

M.Sc. Program in Botany

Introductory note :

The department offers M.Sc. program in Botany with minimum duration of 2 years (four semester) and maximum of 4 years. A student must appear in the mid semester as well as internal assessment exams. failing which he / she will not be allowed to appear in the End Sem exam. 75% attendance is mandatory for every student before appearing in the End Sem Exam.

Structure of Theory Course :

Name of Program	Duration of the Program	Structure of the Program with credits										Contact hours		
		Core Course			Elective Course			Open Elective Course			Field Study Core course		Core Course (each)	Elective Course (each)	Open Elective Course (each)
M.Sc. Botany	2 yrs. min. 4 yrs. max	No.	Credit	Total Credit	No.	Credit	Total Credit	No.	Credit	Total Credit	No.	Credit			
		12	04	48	04	03	12	02	02	04	01	02	60	45	30

Structure of Practical / Lab Course

Name of Program	Duration of the Program	Structure of the Program with credits						Contact hours	
		Core Course			Elective Course			Core Course (each)	Elective Course (each)
M.Sc. Botany	2 yrs. min. 4 yrs. max	No.	Credit	Total Credit	No.	Credit	Total Credit		
		12	02	24	04	01	04	60	45

Theory Examination Scheme :

Mid Sem. Marks	Internal Assessment (20 Marks)		End Sem Exam	Total	Field Study			
					Performance	End Sem		
	Assignment	Attendance				Evaluation report	Viva-Voce	Total
20	15	5	60	100	40	50	10	100

Practical / Lab Course Examination Scheme :

Mid Sem Marks	Internal Assessment		End Sem Examination	Total
	Performance and checking of practical record / suggestion regularly	Attendance		
20	15	05	60	100

The marks for attendance shall be awarded as follows :

(i)	75% and below	:	00 Mark
(ii)	>75% and upto 80%	:	01 Mark
(iii)	>80% and upto 85%	:	02 Marks
(iv)	>85% and upto 90%	:	03 Marks
(v)	>90% and upto 95%	:	04 Marks
(vi)	>95%	:	05 Marks

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SYLLABUS

M.Sc. (2020-21)
I Semester
(Three core courses, Field Study and One Elective Course from the deptt.)

Core Course			
S.No.	**Course Code**	**Name of the Course**	**Credit**
1.	BOT CC 121	Biology and Diversity of Viruses, Bacteria & Fungi	04
2.	BOT CC 122	Biology and Diversity of Viruses, Bacteria & Fungi **(Practical)**	02
3.	BOT CC 123	Biology and Diversity of Algae, Bryophytes & Pteridophytes	04
4.	BOT CC 124	Biology and Diversity of Algae, Bryophytes & Pteridophytes **(Practical)**	02
5.	BOT CC 125	Biology and Diversity of Spermatophytes	04
6.	BOT CC 126	Biology and Diversity of Spermatophytes **(Practical)**	02
7.	BOT CC 127	Field Study **(Project)**	02
Elective Course (I Semester)			
1.	BOT EC 121	Mushroom Biology	03
2.	BOT EC 122	Mushroom Biology **(Practical)**	01
3.	BOT EC 123	Ecosystem Services	03
4.	BOT EC 124	Ecosystem Services **(Practical)**	01

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Syllabus 2020-2021

Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	I	BOT-CC-121	Biology and Diversity of Viruses, Bacteria & Fungi	100	04

Unit	Contents	Hours
1	**Archaebacteria and Eubacteria**: General account; ultra structure, nutrition and reproduction; biology and economic importance; cyanobacteria - salient features and biological importance.	10
2	**Viruses**: Characteristics and ultra-structure of virions; isolation and purification of viruses; chemical nature, replication, transmission of viruses; economic importance.	10
3	**Phytoplasma**: General characteristics and role in causing plant diseases.	8
4	**Mycology**: General characters of fungi; substrate relationship in fungi; cell ultra-structure unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotrophic, symbiotic); reproduction (vegetative, asexual, sexual); heterothallism; heterokaryosis, parasexuality; recent trends in classification.	17
5	**Phylogeny of fungi**: general account of Mastigomycotina, Zygomycotina, Ascomycotina Basidiomycotina, Deuteromycotina; fungi in industry, medicine and as food; fungal diseases in plants and humans; Mycorrhizae; fungi as biocontrol agents.	15

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	Practical	BOT-CC-122	Biology and Diversity of Viruses, Bacteria & fungi	100	02

Suggested Laboratory Exercises

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.

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. Vivek Rastogi for 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. The text book of Microbiology - Ananthanarayan, R. Jayaram Paniker C.K., Orient Longman Limited, Hyderabad (A.P.) India

Additional 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

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	II	BOT-CC-123	Biology and Diversity of Algae, Bryophytes & Pteridophytes	100	04
1	**Phycology**: Algae in diversified habitats (terrestrial, freshwater, marine); thallus organization; reproduction (vegetative, asexual, sexual); criteria for classification: (algal pigments, reserve food, flagella); Classification of algae.						13
2	Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta. Bacillariophyta, Phaeophyta, Rhodophyta; algal blooms, algal biofertilizers; algae as food, feed and uses in industries; economic importance.						15
3	**Bryophyta**: Morphology, structure, reproduction and life history; distribution; classification; general account of Marchantiales, Jungermanniales, Anthoceratales, Sphagnales, Funariales and Polytrichales; economic and ecological importance.						12
4	**Pteridophyta**: Morphology, anatomy and reproduction; classification; evolution of stele; heterospory and origin of seed habit.						10
5	General account of fossil pteriodophyta; introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.						10

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	Practical	BOT-CC-124	Biology and Diversity of Algae, Bryophytes & Pteridophytes	100	02

Suggested Laboratory Exercises:

1. 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.*
2. Morphological study of representative member of Bryophytes and Pteridophytes: *Marchantia, Anthoceros, Polytrichum, Psilotum, Lycopodium, Selaginella, Equisetum, Ophioglossum, Isoetes, Lygodium, Regnellidium* and *Marsilia.*
3. Study of morphology, anatomy and reproductive structures of bryophytes.

Essential Reading:

1. Kumar, H.D. 1992 Introductory Phycology - East west press New Delhi -
2. Chapman V. J. and . Chapman D.J. 1973 The Algae Macmillan publishers
3. Lee, R.E 2013 Phycology,. IV edition Cambridge University Press, London
4. Parihar, N.S. 1999: An Introduction to Embryophyta Vol-I & II, Bryophyta and Pteridophytes Central Book Depot. Allhabad
5. Rashid, A 1998 An Introduction to Bryophyta Vikas publication House, Pvt, New Delhi
6. Andrews H.N. 1961 Studies in Palaeobotany, John Wiley and Sons, New York

Additional Reading:

1 Sharma O.P Test book of Algae,. 1986 Tata Macgraw Hill New Delhi
2 Sundara Rajan, S. 1994: Introduction to Pteridophyta
3 Sporne, K.R. 1962: The Morphology of Pteridophyta

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Syllabus 2020-2021

Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	III	BOT-CC-125	Biology and Diversity of Spermatophytes	100	04

Unit	Contents	Hours
1	General characteristics of Gymnosperm; classification and distribution of Gymnosperm in India.	8
2	Economic Importance of Gymnosperms. General Account of pteridospermales, Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales. Life history of *Cycas, Pinus, , Ginkgo* and *Gnetum*.	14
3	Taxonomic hierarchy, species, genus, family and other categories; Salient features of the International Code of Botanical nomenclature.	10
4	Classification of angiosperm artificial and natural and phylogenetic systems merits and demerits Recent trends in Taxonomy, Herbarium, FLORA, Botanical Garden.	14
5	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.	14

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	Practical	BOT-CC-126	Biology and Diversity of Spermatophytes	100	02

Suggested Laboratory Exercises:

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 Taxonomy2 edition Tata McGraw Hill
2. Baruah, A Handbook of Angiosperm Taxonomy and Useful Plants, Aavishkar Publishers
3. Nairne A K. Scientific Classification of Flowering Plants, Discovery publication house New Delhi.
4. Grant W.F 1984 Plant Biosystematics –. Academic press London
5. Dikshit, A Siddiqui, MO and Pathak, A- 2016 Taxonomy of Angiosperm – Basic concept, Molecular aspects and Future Prospects by Studerra Press, New Delhi.
6. Bhatnagar, S.P and Moitra A.. 1996Gymnosperms., New Age International Pvt. Ltd., New Delhi
7. Sharma, O.P 1999 Gymnosperms. Pragati Prakashan, Meerut
8. Chamberlain, CJ.. 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 Naik V.N Taxonomy of Angiosperm –.
3 Sambamurty A.V.S.S Taxonomy of Angiosperms IK international Publishers New Delhi
4 Sporne, KR1974 The Morphology of Gymnosperms.. Hutchinson University Library, London
5 Singh, m.p. & Abb, S.G.(2016): Essentials of Plant Taxonomy and Ecology, Bio Green books, New Delhi.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	-	BOT-CC-127	**Field Study (Project)**	100	02

Unit	Contents
1	Collection of Plants identification and preservation (a) Sagar and its environs (b) from local excursion (short) (c) Major excursion (long)
2	Preparation of Herbarium.
3	Preservation of collected plant species.
4	Submission of report for every field study
5	Submission of Desertation at the time of End Sem. Exam.

Essential Reading:

1. Sharma O.P 2009 Plant Taxonomy2 edition Tata McGraw Hill
2. Baruah, A Handbook of Angiosperm Taxonomy and Useful Plants, Aavishkar Publishers
3. Nairne A K. Scientific Classification of Flowering Plants, Discovery publication house New Delhi.
4. Mugdal, V. Khanna, K.K. & Hazra P.K.(editors) 1997, Flora of Madhya Pradesh Vol-I,II, III Publication B.S.I.

Additional Reading:

1. Pullaiah,T, 2013 Text book of Biosystematics Theory and Practical Regency Publication New Delhi
2. Naik V.N Taxonomy of Angiosperm
3. .Pullaiah, T., Sandhya Rani S., Karuppaswamy, S. 2011, Flora of Eastern Ghat Vol-I,II,III, IV
4. Roy, G.P. 1998 Grasses of Madhya Pradesh Flora of India, Series -4 Publication Deptt. of Environment.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	-	BOT-EC-121	Mushroom Biology	100	03

Unit	Contents	Hours
1	Mushroom definition, Characteristics of mushrooms, Categories (edible,poisonous,medicinal) Biodiversity of wild mushrooms.	9
2	Ecological importance of Fungi in general and mushroom in particular, specially Locally growing Mushrooms	9
3	Classification, identification and cultivation methods of mushrooms.(*Pleurotus* , *Agaricus* and *Calocybe* and *Cordyceps* Species)	9
4	Diseases of mushrooms, use of spent mushroom compost as bio-control agent, secondary metabolites of mushrooms.	9
5	Mushroom by-products (pickle, soap, medicine) Agri-business-(concept of marketing, market channels, SWOT analysis)	9

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	Practical	BOT-EC-122	Mushroom Biology	100	01

Suggested Laboratory Exercises:

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 2010Textbook 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 processesing Technology. Agrobios Jhodhpur
5. Sharma B.C and Sharma N.P 2013 Mushroom cultivation and users. and. Agrobios Jhodhpur

Additional Readings:

1. Pegler D and Spooner B 1997 The mushroom Identifier Published by Grange Books London U.K.
2. Aneja 2005 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.& Patil, N. (2016). Mushroom: A Nutritive Food and its Cultivation. Bio Green Books, New Delhi.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	Theory	BOT-EC-123	Ecosystem Services	100	03

Unit	Contents	Hours
1.	Introduction to Ecosystem Services: Definition and Key concept; classification; ecosystem functions and services.	9
2.	The role of biodiversity in the provision of ecosystem services.	9
3.	Valuing ecosystem services.	9
4.	Paying for ecosystem services.	9
5.	Governing for ecosystem services	9

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	I	Practical	BOT-EC-124	Ecosystem Services	100	01

Laboratory/Field Exercises:

1. Identification and characterization of ecosystem services of a nearby forest/grassland/pond ecosystem.
2. To identify and characterize various drivers impacting ecosystem services in of an ecosystem.
3. To study the change in quantity and quality of ecosystem services due to varying degree of product extraction and other disturbances.
4. Quantification of various types of services as classified in the Millennium Assessment Goal of forest ecosystem

Essential Readings:

1. Ecosystem Services from concept to practice, by Jetske Bouma and Pieter Van Beukering, 2015. Cambridge University Press, UK.
2. Ecosystem Services - Concept, Methods and Case Studies, by Karsten Grunewald and Olaf Bastian, 2015, Springer.
3. Conserving and Valuing Ecosystem Services and Biodiversity – Economic, Institutional and Social Challenges, by K. N. Ninan, 2009. Earthscan, publishing for Sustainable future, London.
4. The law and policy of ecosystem services by Ruhl, J. B., Kraft, Steven E., and Lant C. L. Island Press, 2007, University of Michigan, ISBN: 1559630949
5. Payments for Ecosystem Services: Getting Started: a Primer. United States. Agency for International Development, Katoomba Group, Forest Trends, 2008, ISBN: 9789280729252

Additional Readings:

1. Ecosystem services certification: Opportunities and constraints by Meijaard, E., Sheil, D., Guariguata, M.R., Nasi, R., Sunderland, T.C.H., Putzel, L., Center for International Forestry Research (CIFOR) Bogor, Indonesia, 2011, ISBN: 978-602-8693-59-2
2. MA: Millennium Assessment, Ecosystem and Human Well-being. A frame work for Assessment. Washington, DC: Island Press; 2003
3. MA: Millennium Assessment, Ecosystem and Human Well-being. Current State and trends. Volume 1, Washington, DC: Island Press; 2005
4. MA: Millennium Assessment, Ecosystem and Human Well-being. Synthesis. Washington, DC: Island Press; 2005
5. MA: Millennium Assessment, Ecosystem and Human Well-being. Scenarios. Volume 2, Washington, DC: Island Press; 2005
6. MA: Millennium Assessment, Ecosystem and Human Well-being. Policy responses. Volume 3, Washington, DC: Island Press; 2005
7. MA: Millennium Assessment, Ecosystem and Human Well-being. Multiscale Assessments. Volume 4, Washington, DC: Island Press; 2005.

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M.Sc. II Semester

(Three core courses + One Elective course from the deptt.)

Core Course			
S.No.	**Course Code**	**Name of the Course**	**Credit**
1.	BOT CC 221	Cytogenetics	04
	BOT CC 222	Cytogenetics **(Practical)**	02
2.	BOT CC 223	Plant Physiology	04
	BOT CC 224	Plant Physiology **(Practical)**	02
3.	BOT CC 225	Plant Anatomy and Embryology of Angiosperm	04
	BOT CC 226	Plant Anatomy and Embryology of Angiosperm **(Practical)**	02
Elective Course (II Semester)			
1.	BOT EC 221	Forest Ecology	03
	BOT EC 222	Forest Ecology **(Practical)**	01
2.	BOT EC 223	Fungal Biosystematics	03
	BOT EC 224	Fungal Biosystematics **(Practical)**	01
3.	BOT OE 221	Basic Concepts of Botany	02
4.	Add on Course	Organic Farming	02

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	I	BOT-CC-221	Cytogenetics	100	04

Unit	Contents	Hours
1	**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,	12
2	**Cell Cycle:** Mitosis, Meiosis, role of cyclins in cell division, Apoptosis.	10
3	**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.	18
4	**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 polytene chromosme). DNA replication in prokaryotes, different proteins and enzymes involved.	10
5	**Mutation:** DNA damage and repair, Mutation, Type of Mutation, Mechanism of mutation, Polyploids and haploids in crop improvements, Transposable Genetic elements, Mechanism of Transposition.	10

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	Practical	BOT-CC-222	Cytogenetics	100	02

Suggested Laboratory Exercises:

1. Familiarizing students with lab equipments
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) Bruce Alberts, Alexender Johnson, Julian Lewis, Martin Raff, Keith Reberts, Peter Walter: Molecular biology of cell. Gerland Science, a member of the Taylor and Francis group – New York.
(3) Lewin B Genes (1997) Oxford University Press, New York, USA
(4) Karp, G (1996) Cell and Molecular Biology. Jhon Wileys and Sons London , U.K.
(5) Hartl, D.L. Jones, E.W (1998) Genetics Principles and Analysis IV edition Jones and Bartlett Publishers Boston, USA.

Additional Readings

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

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	II	BOT-CC-223	Plant Physiology	100	04

Unit	Contents	Hours
1	**Plant water relations:** Physical properties of water; diffusion, osmosis, translocation of water, concept of water potential, Transpiration, Physiology of stomata, plant-water relations, mechanism of water transport through xylem. Plants and inorganic nutrient: Essential nutrient, nutrient role and deficiency symptoms, Toxicity of micro nutrient, root-microbe interactions in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins.	12
2	**Light and pigment:** physical nature of light, natural radiation, photoreceptor. Photosynthesis: Bioenergetics, Photophosphorylation, light harvesting, Complexes, photosynthetic carbon reduction, (PCR) C4 syndrome, Crassulacean acid, metabolism (CAM) Translocation of xenobiotic chemical.	8
3	**Signal transduction:** Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascade. Sensory photobiology: History of discovery of phytochromes and cryptochromes, and their photochemical and biochemical properties, photophysiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.	15
4	**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.	15
5	**Stress physiology:** Plant responses to biotic and abiotic stress, mechanisms of biotic and abiotic stress tolerance, HR and SAR, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.	10

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	Practical	BOT-CC-224	Plant Physiology	100	02

Suggested Laboratory Exercises:

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. Bioassay of auxins and cytokinins using appropriate plant material
9. To determine the rate of transpiration under different environmental condition.
10. To study water and salt stress in herbaceous plant growth.

Essential Readings

1. Hopkins W.G 2008 Introduction to Plant Physiology IV Edition Jhon Wileys 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. Murphy A. 2015 Plant Physiology and Development sinaur anociates sunderland USA.

Additional Readings

1. Moore, T.C.1974. Research Experiences in Plant Physiology: A Laboratory Manual. Springer-Verlag, Berlin.
2. Roberts, J. and Tucker, G.A2000. 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. Jain, 2000: Fundamentals of Plant Physiology, S. Chand, New Delhi.
7. Chauhan,N. 2016: Development in Physiology, Biochemistry and Molecular Biology of Plants.Bio Green Books, New Delhi.
8. Sinha, Pushpa 2016: Plant anatomy and Physiology. Bio Green Books, New Delhi.
9. Pramila Pandey.2016: Textbook on Plant Physiology. Daya Publishing House, New Delhi.
10. Devlin,2017: Devlin's outline of Plant Physiology**.** Medtech
11. Trivedi, P.C.2016. Plant Stress Physiology.Bio Green Books, New Delhi.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	IV	BOT-CC-225	Plant Anatomy and Embryology of Angiosperm	100	04

Unit	Contents	Hours
1	**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)	12
2	**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.	8
3	**Flower:** Morphological nature of stamen and carpel. **Male gametophyte :** Structure of anthers; microsporogenesis, role of tapetum; pollen development, male sterility **Female gametophyte :** Ovule development; Types of ovule, megasporogenesis: organization of the embryo sac, types and structure of the embryo sac.	15
4	**Pollination, pollen-pistil interaction and fertilization**: Pollination mechanisms and vectors; structure of the pistil; pollen-stigma interactions, self-incompatibility; double fertilization; in vitro fertilization.	10
5	**Seed development and fruit growth:** Endosperm development; embryogenesis, polyembryony; apomixes; embryo culture; seed dormancy, fruit dehiscence.	15

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	Practical	BOT-CC-226	Plant Anatomy and Embryology of Angiosperm **(Practical)**	100	02

Suggested Laboratory Exercises:

1. Study of internal structure of anomalous stem and roots (*Boerhaavia, Nyctanthus, Salvadora Bougainvillea, Amaranthus, Achyranthes, Tinospora, Leptadenia, Beta vulgaris*).
2. Study of loving shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla.*
3. Microscopic examination of vertical sections of leaves such as Cannabis, Nerium, Maize and Wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the C3 and C4 leaf anatomy of plants.
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, Pistia, Jussieua etc.)
5. Field study of several types of flowers with different pollination mechanisms.
6. Types of ovule.
7. Study of seed dormancy and methods to break dormancy.

Essential Readings :

- Srivastav, L 2005 Plant GFrowth and Development Ist Edition Academic press
- Ranjan P 2010 Plant Anatomy 2010 New central book agency New Delhi
- Beck C.B. An Introduction to Plant Structure and Development Cambridge University Press London U.k.

Additional Readings :

- Singh,V, Pande P. C. Jain, D.K. 2010, Text Book of Botany Rastogi Publication Merrut
- Sinha, Pushpa.2016.Plant Anatomy and Physiology. Bio Green Books, New Delhi.
- Singh, M.P. & Abb, S.G.2016: Essentials of Plant Taxonomy and Ecology. Bio Green Books, New Delhi.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	-	BOT-EC-221	Forest Ecology	100	03

Unit	Contents	Hours
1	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.	9
2	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.	9
3	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.	9
4	Microclimate of forest, Forest soils of India, Forest Natural regeneration, Joint Forest management concept and practice.	9
5	Wildlife conservation and related legislation, Seed biology, Forest Influences, Organic matter dynamics and annual budget sheets.	9

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	Practical	BOT-EC-222	Forest Ecology	100	01

Suggested Laboratory Exercises:

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.G 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. 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

Additional 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 Trrees 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.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	-	BOT-EC-223	Fungal Biosystematics	100	03

Unit	Contents	Hours
1	An introduction to Fungal Biosystematics and its development in Indian sub-continent. General introduction to history of Mycology, fungal characteristics and their biological status.	9
2	Broad classification of fungi. An introduction to field mycology- survey, collection, conservation, nomenclature and identification.	9
3	Symptomatology- various types with examples. Broad categories of fungal diseases- leaf spots, powdery mildews, black mildews, damping off, cankers and root rots.	9
4	Recent terminologies used in the fungal biosystematics. Dried reference collection as important resources in fungal biosystematics.	9
5	Beneficial fungi and their utilization. Different fungal diseases found in the area.	9

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	Practical	BOT-EC-224	Fungal Biosystematics	100	01

Suggested Laboratory Exercises:

1. Field survey for the different types of fungal symptoms.
2. Collection of fungal diseases and their dry and wet preservation.
3. Study of slides and museum specimens of fungal diseases.
4. Study of the collected fungi by different methods.
5. Study of various fungal cultures.
6. Preparation of Camera Lucida drawings.

Essential Readings :

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 2012. Introductory Mycology. John Wiley & Sons. Inc. U.S.A.
2. Dubey, H.C. 2013 (reprint-2017). An introduction to Fungi. Vikas Publishing House, New Delhi.
3. Kamal and Singh, R.P. 1993. An introduction to fungi. Central Book Depot, Allahabad.
4. Mehrotra, B.S. 1992. The fungi. Today and Tomorrow's Printers and Publishers, New Delhi.
5. Webster, J. 1970. Introduction to Fungi. Cambridge University, Press, London.

Additional Readings :

1. Allsopp, D., Colwell, R.R. and Hawksworth, D.L. 1995. Microbial Diversity and Ecosystem Function. C.A.B. International, Wallingford, U.K.
2. Bessey, E.A. 2015. Morphology and Taxonomy of Fungi. Scientific Publishers, Jodhpur.
3. Arora, 2003. Handbook of Fungal Biotechnology. Taylor & Francis Group, New York.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II		BOT-OE-221	Basic Concept of Botany (Open Elective)	100	2

Unit – I : Introduction: Definition and scope; History of Botany; General characteristics of plants.

Unit – II : Plant World: Classifications, General characteristic of Thallophyta, Bryophyta, Pteridophyta, Spermatophyta. Life cycle of flowering plant.

Unit – III : Conservation of plants

Unit – IV : Plants and human welfare

Unit –V : Plant and Environment: Environmental awareness, Pollution, Global warming and climate change.

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
6. Dwivedi, Lalit Kumar (2014). Handbook of Botany. DBS Imprints, New Delhi.
7. Bhattacharya (2016).Textbook of Botany. Scientific International Publishers, New Delhi
8. Gangulee, Das and Dutta, College Botany, 2010, Central Book Depot Calcutta.

Additional Readings:

1. Sharma, O.P. Plant Taxonomy 2009 Tata Mc Graw Hill, New Delhi.
2. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
3. Singh, M.P. & Abb S.G.(2016). Essentials of Plant Taxonomy and Ecology, Bio Green Books, New Delhi

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	II	Practical	Add on course	**Organic Farming Practices and Certification**	100	02

Unit-I Comparative account of Organic vs Chemical farming System

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

Unit-II 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-III 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-IV Practical knowledge of the following

Preservation and storage of agric products, marketing of agric products

Unit-V Disease management of agric products

Bacterial and fungal diseases, quality assurance of agric products, crop health clime, plant quarantine

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Practicals

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
7. Project report

Essential Reading

1. S.N. Dehmukh, 2007. Organic Farming : Theory and Practice, Scientific Publishers, India
2. Chandra Prakash Shukl, 2010. Jaivik Kheti (Organic Farming), Scientific Publishers, India
3. Ranjan Kumar Biswas, 2012. Organic farming in India, Ajanta Books, Jodhpur, India.

Additional Reading

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

Placement opportunity :

Worldwide workers on Organic farms offer the opportunity to work on organic farms, gardens and smallholdings in India and abroad. Placement opportunity as Professional Volunteer in:

a) National Centre of Organic Farming (NCOF)

b) Nation Horticulture Mission (NHM)

c) Rashtriya Krishi Vikas Youjna (RKVY)

d) Paramparagat Krishi Vikas Yojana (PKVY)

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M.Sc. III Semester

(Three core course + one Elective Courses from the deptt.)

Core Course			
S.No.	**Course Code**	**Name of the Course**	**Credit**
1.	BOT CC 321	Molecular Biology	04
2.	BOT CC 322	Molecular Biology **(Practical)**	02
3.	BOT CC 323	Biochemistry	04
4.	BOT CC 324	Biochemistry **(Practical)**	02
5.	BOT CC 325	Plant Ecology	04
6.	BOT CC 326	Plant Ecology **(Practical)**	02
Elective Course (III Semester)			
1.	BOT EC 321	Plant Protection	03
2.	BOT EC 322	Plant Protection **(Practical)**	01
3.	BOT EC 323	Limnology	03
4.	BOT EC 324	Limnology **(Practical)**	01
5.	BOT EC 325	Software's Applications in Modern Biology	03
6.	BOT EC 326	Software's Applications in Modern Biology **(Practical)**	01
7.	BOT OE 321	Economic Botany	02

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	I	BOT-CC-321	Molecular Biology	100	04

Unit	Contents	Hours
1	Introduction, Overview, Origin of Molecular Biology and its impact on Biological Sciences. Nature of Gene: Bacterial and Viral Genetics, Pre-DNA concepts, Gene-Protein relationships.	12
2	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.	12
3	Gene Expression: Translation, Structure and function of Ribosomes, Adaptor Hypothesis, Messenger Hypothesis, Discovery and Structure of different RNAs involved in Protein Biosynthesis.	12
4	Genetic Code and its Elucidation, Central Dogma, Contributions of Francis Crick, Hargobind Khorana, Marshal Nierenberg, Sydney Brenner.	12
5	Gene Regulation: Overview. Gene regulation in Prokaryotes, Lac Operon, Tryptophan Operon, Lytic and Lysogenic Growth patterns in Phage λ. Gene regulation in Eukaryotes: Levels of Gene regulation, Role of Transcription factors, Role of DNA Methylation, Histone Code hypothesis, Regulatory RNAs, RNA interference.	12

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	Practical	BOT-CC-322	Molecular Biology	100	02

Suggested Laboratory Exercises:

1. Problem solving exercises based on syllabus.
2. Model building.

Project and its presentation.

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 Biology
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.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	II	BOT-CC-323	Biochemistry	100	04

Unit	Contents	Hours
1	**Thermodynamics of biological system:** Laws of thermodynamics; concept of free energy; energy transfer and redox potential. **Basics of enzymology:** classification and nomenclature of enzymes; enzymes as biocatalyst; physico-chemical properties of enzymes; cofactors and coenzymes; isozymes; kinetics of enzyme action; significance of Km; regulation of enzymes activity; factors affecting enzyme activity, e.g. Temperature; pH; allesteric modification and feedback regulation.	13
2	**Carbohydrates:** Mono, Di, Oligo and Poly saccharides**,** biosynthesis of Sucrose, Starch and Cellulose. **Respiration and lipid metabolism:** Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, altemative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids, and their catabolism.	13
3	**Nitrogen fixation, nitrogen and sulphur metabolism:** Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulfate uptake, transport and assimilation.	12
4	**Techniques in biochemistry:** Principles of light and electron microscopy; phase contrast and fluorescence microscopy; TEM and SEM; Cell fractionation producers; principles of various chromatography techniques- paper chromatography; TLC, GLC and HPLC; autoradiography and its applications.	12
5	**Amino acid and Proteins**: structure acid base properties optical and stereochemical properties. Primary, secondary, tertiary and quaternary structures.	10

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	Practical	BOT-CC-324	Biochemistry	100	02

Suggested Laboratory Exercises:

1. Preparation of standard curve for corbohydrade and protien
2. Carbohydrate estimation.
3. Protein estimation
4. Enzymology: activity of catalase, invertase, amylase and urease, and effect of pH and temperature on enzyme activity.
5. Acid and alkaline acid phosphatase activity
6. Isolation and identification of *Rhizobium* from different plants
7. Separation of amino acid through paper and column chromatography
8. Study of instruments and principle of TLC, HPLC and Centrifuge, Spectrophotometer.

Essential Readings

1. David, Nelson, L., Michael M. Lehninger principles of Biochemistry (2011) fourth Edition, Cox Publisher.
2. Farrell, O., Ryan T. Ranallo, Experiments in Biochemistry : A Hands on approach Publisher : Books Cole.
3. Garrett, R.H. and Grisham, C.M. (2010) Biochemistry : Publisher Book Cole.

Additional Readings

1. Eric, E. Conn Paul. K. Stumpf, Geerge Bruening, Roy Doi (1987) Out lines of Biochemistry : Jhon Wiley USA.
2. Bucha,(2015). Biochemistry and Molecular Biology of Plants. JWO.
3. Chauhan, N.(2016). Development in Physiology, Biochemistry and Molecular Biology. Bio Green Book, New Delhi.
4. Sharma,S. (2016). Practical Manual of Biochemistry. Medtech.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	III	BOT-CC-325	Plant Ecology	100	04

Unit	Contents	Hours
1	**Ecology :** History, development, definition and scope. **Ecosystem Organization:** Concept and definitions, kinds of ecosystem, Ecological pyramids, Food chain and Food web, Ecosystem processes.	12
2	**Ecosystem functions :** Energy flow, biogeochemical cycles. **Primary production** : Global pattern, Methods of measurements.	12
3	**Climate, soil and vegetation patterns of the world**: Major terrestrial biomes, climate types and soil types of the world.	12
4	**Vegetation organization :** Concept of community and continuum, analysis of community (analytical and synthetic characters) community coefficients, inter specific associations, concept of ecological niche.	12
5	**Vegetation development** : Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic, facilitation and tolerance models); changes in ecosystem properties during succession.	12

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	Practical	BOT-CC-326	Plant Ecology	100	02

Suggested Laboratory Exercises:

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.

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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. P;lant 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)

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	-	BOT-EC-321	Plant Protection	100	03

Unit	Contents	Hours
1	History of plant pathology. Classification of plant diseases. General characteristics of plant pathogenic bacteria, fungi, viruses, mycoplasma and nematodes. General idea of symptomatology.	9
2	General principles of plant disease control: (a) Cultural practices (b) Physical methods (c) Chemical methods (d) Biological methods Plant quarantine	9
3	Infection process, penetration and entry by plant pathogens. Dissemination of plant pathogens.	9
4	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.	9
5	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.	9

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	Practical	BOT-EC-322	Plant Protection	100	01

Suggested Laboratory Exercises:

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.

Drawing of the conidia of fungi with the help of Camera Lucida and to determine the scale of magnification.

Measurement of conidia of fungi with the help of occular micrometer.

Collection and study of the crop diseases listed below from the local and out station fields. Each student will submit a minimum of 25 permanent and 25 temporary prepared slides alongwith practical records. A Herbarium of local disease samples should also be submitted.

Various rusts of Wheat, Rust of Linseed, Pycnidial and Aecidial stages on Barbery, Smut of Wheat.

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.

Demonstration of the production of mycotoxins.

Culture and study of some common plant pathogenic fungi.

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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)
6. Heald, Frederick Defo.2016. Manual of Plant Diseases (Set of 2 Vols.).Bio Green Books, New Delhi

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	-	BOT-EC-323	Limnology	100	03

Unit	Contents	Hours
1	Introduction: Definition and Scope of Limnology; Water in the Biosphere; Classification and origin of Lakes.	9
2	Chemical properties: Hydrogen-ion concentration, Dissolved gases in freshwater- Nitrogen and Phosphorus cycles in freshwater lakes. Ecological classification of freshwater organisms: Nature and distribution of Phytoplankton, Macropyhytes and Zooplankton communities.	9
3	Concept of Productivity: Seasonal variation, Primary productivity in freshwater lakes, Estimation of Primary Productivity.	9
4	Food Chains, Food webs, Trophic levels and Energy flow in freshwater ecosystems.	9
5	Eutrophication : Causes, mechanism and significance, Management of freshwater bodies.	9

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	Practical	BOT-EC-324	Limnology	100	01

Suggested Laboratory Exercises:

1. Construction of morphometric maps of aquatic systems.
2. Measurement of transparency and temperature.
3. Analysis of different dissolved gases : Dissolved oxygen and Carbon dioxide.
4. Analysis of lake water for bicarbonates, carbonates, total alkalinity, chlorides etc.
5. Sampling of phytoplankton and their qualitative and quantitative analysis.
6. Sampling of periphytes and macrophytes, and their qualitative and quantitative analysis.
7. Sampling of Zooplankton and their qualitative and quantitative analysis.
8. Primary production: Experiment-in-situ by light and dark bottle method.
9. Short term productivity experiments for the understanding of diel variation in aquatic ecosystems.
10. Analysis of sediments for benthic fauna and flora.

Essential Readings

1. Welch, P.S. (1952) Limnology. 2nd ed. McGraw Hill Co., New York.
2. Wetzel, R.G. (1975) Limnology. W.B. Saunders Co., Philadelphia.
3. Ruttner, F. (1963) Fundamentals of Limnology. 3rd ed. University of Toronto Press, Canada.
4. Cole, G.A. (1979) Textbook of Limnology. 2nd ed. C.V. Mosby Co. Toronto.

Additional Readings

1. Goldman, C.R. and A.J. Horne (1983) Limnology. McGraw Hill, Inc. Tokyo.
2. Golterman, H.L. (1975) Physiological Limnology. Elsevier Scientific Pub. Oxford.
3. Moss, B. (1980) Ecology of Fresh Waters. Blackwell Scientific Pub., Oxford.
4. Barne, A.K. and K.H. Mann (1980) Fundamentals of Aquatic Ecosystems. Blackwell Scientific Pub., Oxford.
5. Hutchinson, G.E. (1957) A Treatirse on Limnology. Vol. I-II. John Wiley & Sons, New York.
6. Robinson, (2014). Ecological Principles of wastewater microbes. Auris.
7. Dey,(2014). Ecology of Aquatic Systems. Medtech Publishers.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	-	BOT-EC-325	Software's applications in Modern Biology	100	03

Unit	Contents	Hours
1	**Software's for biological research:** Computer handling, Free online software's, downloading installing and Troubleshooting.	9
2	**Designing of experiments:** Experimental design and optimization of media (Central Composite Design) using Design expert.	9
3	**Statistical Analysis of Biological Data:** Data collections, arrangement and management of data, One Way ANOVA, Two Way ANOVA, Correlation, Multiple correlations, Regression, by computer software.	9
4	**Data interpretation and report/article writing:** Preparing different type of graphs, designing flow charts.	9
5	**Referencing tool:** EndNote and other referencing tools for managing research references/bibliography.	9

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	Practical	BOT-EC-326	Software's applications in modern Biology	100	01

Suggested Laboratory Exercises:

1. Downloading and installing software's
2. Designing of experiments and its importance.
3. Statistical analysis and its requirements
4. To design experiments using CCD and prepare response surface methodology graph using laboratory and field data.
5. To determine significance of data using one way and two way ANOVA.
6. To calculate correlation and regression in biological data.
7. To prepare different type of graphs and design flow chart using experimental data.
8. To apply Cite while you write option in Microsoft word using End Note referencing software and importing references from the web.

Essential Reading:

1. Gupta V: SPSS for Beginners, Interpreting Regression Output, Comprehensive Excel, Excel for Beginners, Charting in Excel.
2. www.Endnote.com
3. Hill, T. &Lewicki, P. (2007).STATISTICS: Methods and Applications. StatSoft, Tulsa, OK

Additional Readings.

4. Fahrmeir, L., Kneib, Th., Lang, S., Marx, B. (2013). Regression Models, Methods and Applications
5. **Quirk**, Thomas J, **Quirk**, Meghan, **Horton**, Howard (2013).Excel 2010 for Biological and Life Sciences Statistics A Guide to Solving Practical Problems.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	III	Theory	BOT-OE-321	Economic Botany (Open Elective)	100	02

Unit – I

Cereals : Wheat, Rice, Maize

Unit – II

Pulses : Pigeon pea, Chick pea, Soybean

Unit – III

Spices and condiments : A general account

Unit – IV

Medicinal plants : Sarpagandha, Neem, Tulsi

Unit –V

Timber : Teak, Sal, Sisham

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.

Additional Readings:

1. Saxena, Rupali, (2015). Economic Botany of Angiosperms, Biogreen Books, New Delhi.

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M.Sc. IV Semester

(Three core course + Two Elective Courses (One Elec. from the dept.+ Second Elec. from other Dept.)

Core Course			
S.No.	**Course Code**	**Name of the Course**	**Credit**
1.	BOT CC 421	Genetic Engineering	04
2.	BOT CC 422	Genetic Engineering **(Practical)**	02
3.	BOT CC 423	Biotechnology	04
4.	BOT CC 424	Biotechnology **(Practical)**	02
5.	BOT CC 425	Ecology and Environment	04
6.	BOT CC 426	Ecology and Environment **(Practical)**	02
Elective Course (IV Semester)			
1.	BOT EC 421	Land scaping and Garden Management	03
2.	BOT EC 422	Land scaping and Garden Management **(Practical)**	01
3.	BOT EC 423	Biodiversity and Conservation	03
4.	BOT EC 424	Biodiversity and Conservation **(Practical)**	01
5.	BOT EC 425	Climate Change and Current Issues	03
6.	BOT EC 426	Climate Change and Current Issues **(Practical)**	01

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	I	BOT-CC-421	Genetic Engineering	100	04

Unit	Contents	Hours
1	**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.	12
2	**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.	12
3	**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.	12
4	**Genomics and proteomics**: Genetic and physical mapping of genes, Molecular markers for introgression of useful traits, Artificial chromosomes, High throughout sequencing, Genome projects, Bioinformatics, Functional genomics, Microarrays, Protein profiling and its significance.	12
5	**Applications**: Development of insect, herbicide, fungus and bacterial resistant plants, Genetic manipulation of flower pigmentation.	12

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	Practical	BOT-CC-422	Genetic Engineering	100	02

Suggested Laboratory Exercises:

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.

Essential Readings:

1. Glick and Pasternak (Latest ed.) Molecular biotechnology: Principles and Application of recombinant DNA technology.
2. Glick, B.R. and Thompson, J.E. 1993 Methods in Plant Molecular Biology and Biotechnology, CRC Press, Bocas Raton, Florida.
3. Sambrook and Russel (Latest ed.) Gene cloning.

Additional Readings

1. Brown, T.A. (Latest ed.) Gene cloning: An introduction
2. Gustofson J.P. 2000 (Latest ed.) 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. ISBN Publishers, New Delhi
5. Vidyashekharan, 2015. Genetic Engineering, Molecular Biology and Tissue culture from crop pest and Disease management. Daya Publishing House, New Delhi.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	II	BOT-CC-423	Biotechnology	100	04

Unit	Contents	Hours
1	**Biotechnology:** Basic concepts, principles and scope	10
2	**Plant Cell and Tissue Culture**: General introduction, history, scope, concept of cellular differentiation, and totipotency.	8
3	**Organogenesis and adventives embryogenesis**: Fundamental aspects of morphogenesis, somatic embryogenesis and production of haploid plants, androgenesis, mechanisms, techniques and utility.	12
4	**Somatic Hybridization:** Protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitation of protoplast research.	12
5	**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.	18

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	Practical	BOT-CC-424	Biotechnology	100	02

Suggested Laboratory Exercises:

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.
8. Somatic embryogenesis using appropriate explants.

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. Reddy (2017): Key Notes on Plant Biotechnology. Astral, Daya Publications, New Delhi.
7. Aneja (2014): Laboratory Manual of Microbiology and Biotechnology. Scientific International Publishers, New Delhi.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	III	BOT-CC-425	Ecology and Environment	100	04

Unit	Contents	Hours
1	**Environmental pollution:** Air, Water and Soil: Kinds, sources quality parameters, effects and control.	12
2	**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.	12
3	**Climate change**: Greenhouse gases, global warming; Ozone layer and Ozone hole consequences of climate change.	12
4	**Ecosystem stability:** concept (resistance and resilience), Ecosystem services, ecological perturbation and their impact on plants and ecosystems, Environmental Impact Assessment (EIA)	12
5	**Ecosystem Management**: Concept, sustainable development, Sustainability indicators, ecosystem restoration.	12

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	Practical	BOT-CC-426	Ecology and Environment	100	02

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. 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 vegetaion ecology, Wiley N.Y. (1974)
3. E.P. Odum : Basic ecology W.B. Saunders, Philadelophia. (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, Burgesss Publishing Com Minnesota. (1956)
6. Daubenmire, R.F. Plant Communities. A text book of Plant syencology. Harper and Row New York. 300 p. (1968)
7. Mishra R. Ecology Work Book , Ozford and IBH Publishing Co. New Delhi. Pp 235. (1968)

Additional Readings

1. Mayers, N. R. A. Mittrermeler, C.G. Mittermeler, G.A.B. da fonseca and J.Kednt, (2000). Biodiversioty hotspots for conservation priorities Nature.
2. Odum, E.P. : Fundamental of Ecology, Natraj Publisher, Dehradun, 3rd edition (1971)
3. Oosting, M.J. : An Introduction to Plant Ecology, 2nd Edition, W.H. Freeman, San Fransisco. London (1956)
4. Piper, C.S. Soil and Plant analysis (1966 reprint) Han publisher, Bombay (1936).
5. Weaver, J.E. and E.F. Clements, Plants Ecology, McGraw Hill Book Co, New York and London (1938).
6. Whittaker, R.H.: Communities and Ecosystems. 2nd edition MacMillan Publishing Co. New York (1975)

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	-	BOT-EC-421	Landscaping and Garden Management	100	03

Unit	Contents	Hours
1	**Landscaping:** – Principle of elements, Garden features and adornment, Garden designing, Bio-aesthetics planning, Role of plants and combatic environmental pollution, types of garden.	9
2	**Garden Management: -** Soil analysis, Physio-chemico properties, Soil nutrient management, Types of soil, role of soil for plant growth and plant disease management.	9
3	**Bio-fertilizers: -** Farm yard manure (FYM), Vermicompost, Organic manure, Green manure, Role of bacteria, role of AM fungi, Bio-pesticides.	9
4	**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).	9
5	**Floriculture: -** History of Ornamental plants, Floriculture as carrier, Commercial floriculture, flowers & Industries, floriculture business competition, World scenario floriculture.	9

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M.Sc.	Botany	IV	Practical	BOT-EC-422	Landscaping and Garden Management	100	01

Suggested Laboratory Exercises:

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, Sanyat (2012) Landscape and Gardening Additional Westiville publishing house New Delhi.

Additional Readings

1. Singh Solaria Ajeet and Singh Salaria Babita (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. Woodrow G. Marsha (2017): Gardening in India. Bio Green Books, New Delhi.

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	Theory	BOT-EC-423	Biodiversity and Conservation	100	03

Unit	Contents	Hours
1.	Biodiversity: basic concepts, levels of biodiversity, biodiversity distribution, biodiversity assessment, inventory and sampling strategies, biodiversity hotspots.	9
2.	Biodiversity as resource, direct and indirect values, ecological benefits and services provided by biodiversity.	9
3.	Threat to biodiversity, losses of biodiversity, endemism, species loss, Invasive Alien species, biodiversity and rarity, IUCN classification of threatened category of species, extinction of species.	9
4.	Biodiversity conservation, *Ex-situ* and *in-situ* conservation measures, Conservation measures taken in India, International efforts for biodiversity conservation, Habitat and ecosystem management, Ecological restoration.	9
5.	Conservation of natural resources (hotspot areas, WLS, NPs, BRs), Sustainable development, Role of Institutions and policy making in conservation, International conservation laws, Intellectual property rights, CBD / National Biodiversity Authority etc.	9

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	Practical	BOT-EC-424	Biodiversity and Conservation	100	01

Laboratory/Field Exercises:

1. Sampling methods for different communities
2. Determination of concentration of dominance
3. Determination of species richness
4. Classifying plant species into IUCN Red List Categories
5. Study of plant diversity of university campus
6. Field visit to nearby national park/wildlife sanctuary 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. A Primer of Conservation Biology by Richard B. Primack, 2000, Second Edition. Sinauer Associates, Inc, Massachusetts USA.
3. Essential of Conservation Biology by Richard B. Primack, 2002, Third Edition. Sinauer Associates, Inc, Massachusetts USA.
4. Measuring Biological Diversity by Anne E. Magurran, 2013, Published by John Wiley & Sons Inc., Hoboken, New Jersey.
5. Biodiversity and Conservation by P. C. Joshi and Namita Joshi, 2004, A. P. H. Publishing Corporation, 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 Meffe and 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. Conserving the sacred for Biodiversity Management by P. S. Ramakrishnan, K. G. Saxena and U. M. Chandrashekara, 1998, Oxford & IBH Publishing Co. PVT. LTD., New Delhi.
6. Maxted: Agrobiodiversity and Conservation
7. Pullaiah, T.(2016): Biodiversity in India (Vol. 8). Bio Green Books, New Delhi.
8. Menta (2016): Biodiversity Vol. I. ISBN Publishers, New Delhi.
9. Levin: (2013): Encyclopedia of Biodiversity (7 Vol. Set) Elsevier Publisher

DEPARTMENT OF BOTANY
DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR (M.P.)
(A CENTRAL UNIVERSITY)

Syllabus 2020-2021

Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	-	BOT-EC-425	Climate Change and Current Issues	100	03

Unit	Contents	Hours
1	**Climate Change** : Origin and evolution of the earth's atmosphere, Overview of key concepts- weather and climate;	5
2	Climatic classification – Koppen's climatic classification; Climatic varioability – temperature, rainfall, wind speed & direction El-Nino, La Nino and their impacts. Effect of various anthropogenic activities on earth's atmosphere.	10
3	**Greenhouse Effect** : Global warming and greenhouse effect – major greenhouse gases, sources and sinks of greenhouse gases; Urban Heat Islands; Ozone layer depletion, issues and advance research to protect the Ozone layer and consequences; sea level rise and its impact ; Heat and cold waves; global dimming; Implication of climate change, monitoring and assessment.	10
4	**Climate change and policy framworks** – History of international climate change policies, United Nation Frameworks Convention of climate change (UNFCCC)- Key Provisions of the UNFCCC, its structure, and different party groups the convention. The Kyoto protocol and its associated bodies, Overview of Conference of Parties (CoP). Main climate change negotiations evoloved over the past years and highlights of some key issues relevant to future climate change regime.	10
5	**Climate change adaptation and mitigation**: The concept of climate change adaptation ; Linkage between climate change adaptation and development , International adaptation initiatives and programs. Integrated mitigation for development and planning through low Emission development strategics.	10

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Class	Subject	Semester	Paper	Course Code	Course Title	Marks	Credit
M.Sc.	Botany	IV	Practical	BOT-EC-426	Climate Change and Current Issues	100	01

Contents

1. Measurements of climatic factors : Temperature, humidity, rainfall, light intensity etc.
2. Comparative accounts of global status of greenhouse gases by secondary data.
3. Determination of carbon content in soil and biomass.
4. Estimation of carbon in vegetation by non destructive methods.
5. Acquaintance with instrumentation involved in discipline i.e. GPS, Clinometer etc.

Essential Readings

1. Desseler, A. (2011) Introduction to Modern climate change. Cambridge University Press, Cambridge.
2. Arnold, J.B. (2010) Global climate change. Sinauer Associates Inc., Sunderland, Massachusetts, USA.
3. IPCC (Intergovernmental Panel on climate change (2001) Climate change : The Scientific Basis. Cambridge University Press, Cambridge.
4. AlGore (2006) The Inconvenient Truth. Rodale Inc., Emmaus, Pennsylvania, USA.

Additional Readings

1. Spencer, R.W. (2009) The Discovery of Global warming. Harvard Univ. Press, USA.
2. Schmidt, G. (2009) Climate Change. Picturing the Science. W.W. Norton & Co., New York.
3. Malthez, E. (2009) The Science of Global warming and our Energy future. Columbia University Press, New York.
4. I P C C (1990) Climate change : The IPCC Assessment. Cambridge Univ. Press, Cambridge.
5. Smith (2009): Climate change from science to sustainability. Oxford University Press, London.
6. Gopalkrishnan (2014): Climate change energy sustainability and pavements, Springer.