Mohanlal Sukhadia University
Udaipur, Rajasthan, India

Department of Botany

Syllabus

M.Sc. Botany- NEP 2020

Department of Botany
Mohanlal Sukhadia University, Udaipur (Rajasthan)

PROGRAM OUTCOMES FOR M.Sc. BOTANY

Plant sciences is now an amalgamation of basic and applied science. Plants besides being the unique capability of plants to trap solar energy and provide food to all cannot be replicated by any system. Conventional studies like plant identification is now being supplemented with molecular techniques like DNA Barcoding. The courses have been designed to benefit all Botany students to study various aspects of plant science including its practical applications. Keeping in mind that these students can take up teaching at different levels, research work in research institutes and or industry, doctoral work, environment impact assessment, biodiversity studies, entrepreneurship, scientific writing relevant topics have been included in the curriculum. Students would be benefited with knowledge of core subjects like plant diversity, physiology and biochemistry, molecular cytogenetics and application of statistics etc. which are offered in these subjects modules on analytical techniques, plant tissue culture and phytochemistry would make them obtain skills in doing research. All the courses in the programme are carefully designed to equip the students for competitive exams like CSIR NET, SET etc. and to write research proposals for grants.

PO1	Understanding the classification of plants from cryptogams to Spermatophyte. Identification of the flora in field. Study of biodiversity in relation to habitat correlate with climate change, land and forest degradation. Application of Botany in agriculture through study of plant pathology. Palaeobotany to trace the evolution of plants.
PO2	Understand the ultrastructure and function of cell membranes, cell communications, signaling, genetics, anatomy, taxonomy, ecology and plant physiology and biochemistry.
PO3	Molecular and Physiological adaptations in plants in response to biotic and abiotic stress. Genes responsible for stress tolerance genetic engineering of plants
PO4	To understand the multi functionality of plant cells in production of fine chemicals. There wide spread industrial applications.

Overall development

After completion of this course, it will educate students about plant science and inculcate strong fundamentals on modern and classical aspects of Botany, build life skills in Edible mushroom cultivation, Biofertilizer production, Greenhouse maintenance and Seed technology through value-added courses and create platform for higher studies in Botany and facilitate students to take-up successful career in Botany.Maintain a high level of scientific excellence in botanical research with specific emphasis on the role of plants. Create, select and apply appropriate techniques, resources and modern technology in multidisciplinary way. Practice of subject with knowledge to design experiments, analyse and interpret data to reach to an effective conclusion.

They would identify, formulate and analyse the complex problems with reaching a substantiated conclusion. Logical thinking with application of biological, physical and chemical sciences. Learning that develops analytical and integrative problem-solving approaches. Best problem-solving skills in students would encourage them to carry out innovative research projects thereby making them to use knowledge creation in depth.

Structural Framework of the Two Years Post Graduate Programme

Table 3: Structural framework of the two years M.A./M.Com./M.Sc. Program under NEP2020					
	SEM-1	SEM-II	PG Diploma	SEM-III	SEM-IV
Core Courses	DCC-1-Th (4 Cr) DCC-2 Th (4 Cr) DCC-3 Th (4 Cr) DCC-4 Th (4 Cr) DCC-1 Th/Lab (4 Cr) DCC-2 Th/Lab (4 Cr)	DCC-5-Th (4 Cr) DCC-6 Th (4 Cr) DCC-7 Th (4 Cr) DCC-3 Th//Lab (4 Cr) DCC-4 Th/Lab (4 Cr)	Student who opt to exit after completion of the I year securing 48 credits will be awarded a PG Diploma in the relevant subject.	DCC-8-Th (4 Cr) DCC-9 Th (4 Cr)	DCC-10-Th (4 Cr)
Discipline Specific Elective/ Generic Elective Courses	-	GEC-(1-4) Th (4 Cr)		DSE-(5-8) Th (4 Cr) DSE-(9-12) Th (4 Cr) DSE-(1-4) Th/Lab (4 Cr) GEC-(5-8) Th/Lab (4 Cr)	DSE-(13-16) Th (4 Cr) DSE-(17-20) Th (4 Cr) DSE-(21-24) Th (4 Cr) DSE-(9-12) Th/Lab (4 Cr) DSE-(13-16) Th/Lab (4 Cr)
	24+0=24	20+4=24		8+16=24	4+20=24
	56(DCC)+40(DSE/GEC)=96				

1. **Discipline Specific Elective (DSE):**In this table four electives are proposed for a given DSE/GEC course (in the parentheses note the 4 options of each elective i.e., 1-4, or 5-8 or 13-16 etc). Currently, at least two i.e., the first two are to be proposed in each of the ten DSE/GEC courses. Two additional numbers are reserved for two more electives which may be proposed in future.
2. A DSE course opted by a student from his/her parent Department, will be the DSE for him/her. Else the course will be the GEC.
3. A student can opt 2-3 GEC which are under the DSE courses of other faculty.
4. Wherever there are only theory papers the courses can be of either 6 or 4 credits only. . In case of 6 credit for each course the number of courses given in above table will reduce accordingly.
5. In some of the disciplines it can be (2L+2P+2T) or (2L+4P).

Course Structure

NEP based CBCS Scheme of Syllabus for M.Sc. Botany

Level	Sem	Course type	Course code	Title of the Course	Delivery Type			Total Hours	No. of credits	External exam	Internal assessment	Total
SEMESTER I												
8	I	DCC	BOT8000T	BIOLOGY AND DIVERSITY OF ALGAE AND BRYOPHYTES	L	T	-	60	4	80	20	100
			BOT8001T	MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY	L	T	-	60	4	80	20	100
			BOT8002T	PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY	L	T	-	60	4	80	20	100
			BOT8003T	CELL AND MOLECULAR BIOLOGY	L	T		60	4	80	20	100
			BOT8004P	BOT LAB I	-	-	P	120	4	80	20	100
			BOT8005P	BOT LAB II	-	-	P	120	4	80	20	100
										480	120	600
SEMESTER II												
8	II	DCC	BOT8006T	CYTOGENETICS, GENETICS AND PLANT BREEDING	L	T	-	60	4	80	20	100
			BOT8007T	PLANT DEVELOPMENTAL BIOLOGY AND RESOURCE UTILIZATION	L	T	-	60	4	80	20	100
			BOT8008T	PLANT GROWTH AND DEVELOPMENT	L	T	-	60	4	80	20	100
			BOT8009P	BOT LAB III	-	-	P	120	4	80	20	100
			BOT8010P	BOT LAB IV			P	120	4	80	20	100
		GEC	Given in list	From GEC Theory List- 1	L	T	-	60	4	80	20	100
										480	120	600

SEMESTER III												
9	III	DCC	BOT9011T	PLANT BIOCHEMISTRY AND PHYSIOLOGY	L	T	-	60	4	80	20	100
			BOT9012T	PLANT SYSTEMATICS	L	T	-	60	4	80	20	100
		DSE	Given in list	From DSE-1 list	L	T	-	60	4	80	20	100
			Given in list	From DSE-2 list	L	T	-	60	4	80	20	100
			Given in list	From DSE Lab (List-1 and 2)	-	-	P	120	4	80	20	100
		GEC	Given in list	From GEC Theory List-2	L	T	-	60	4	80	20	100
										480	120	600
SEMESTER IV												
9	IV	DCC	BOT9013T	PLANT TISSUE CULTURE AND GENETIC ENGINEERING	L	T	-	60	4	80	20	100
		DSE	Given in list	From DSE-3 List	L	T	-	60	4	80	20	100
			Given in list	From DSE-4 List	L	T	-	60	4	80	20	100
			Given in list	From DSE-5 List	L	T	-	60	4	80	20	100
			Given in list	From DSE Lab (List-3, 4 and 5)			P	120	4	80	20	100
			Given in list	DSE Lab -RESEARCH ORIENTATION IN PLANT SCIENCES	-	-	P	120	4	80	20	100
										480	120	600

GEC Theory List- 1

SEMESTER II

Course Code	Title of the Course
BOT8100T	PLANT ECOLOGY, CONSERVATION AND EVOLUTION
BOT8101T	TOOLS AND TECHNIQUES IN PLANT SCIENCES

Discipline Specific Electives

DSE Theory List-1 (SEMESTER III)

Course Code	Title of the Course
BOT9100T	PLANT BIOENERGETICS AND APPLIED BIOCHEMISTRY
BOT9101T	PRINCIPLES OF PATHOLOGY AND PLANT DISEASES

DSE Theory List-2 (SEMESTER III)

Course Code	Title of the Course
BOT9102T	PRINCIPLES OF MICROBIAL TECHNOLOGY
BOT9103T	APPLIED PLANT SCIENCES
BOT9104T	BIOSYSTEMATICS-1

DSE Lab List-1 (SEMESTER III)

Course Code	Title of the Course
BOT9100P	PLANT BIOENERGETICS AND APPLIED BIOCHEMISTRY
BOT9101P	PRINCIPLES OF PATHOLOGY AND PLANT DISEASES

DSE Lab List-2 (SEMESTER III)

Course Code	Title of the Course
BOT9102P	PRINCIPLES OF MICROBIAL TECHNOLOGY
BOT9103P	APPLIED PLANT SCIENCES
BOT9104P	BIOSYSTEMATICS-1

GEC Theory List- 2 (SEMESTER III)

Course Code	Title of the Course
BOT9100T	Restoration Ecology
BOT9101T	Conservation Biology

DSE Theory List-3

(SEMESTER IV)

Course Code	Title of the Course
BOT9105T	SECONDARY METABOLITES AND BIOPROCESS ENGINEERING
BOT9106T	MOLECULAR PLANT PATHOLOGY AND DISEASE MANAGEMENT

DSE Theory List-4

(SEMESTER IV)

Course Code	Title of the Course
BOT9107T	APPLICATIONS OF MICROBIAL TECHNOLOGY
BOT9108T	BIOSYSTEMATICS-1I

DSE Theory List-5

(SEMESTER IV)

Course Code	Title of the Course
BOT9109T	APPLIED PHYCOLOGY
BOT9110T	COMMERCIALIZATION OF MICROPROPAGATION TECHNOLOGIES

DSE Lab List-3

Course Code	Title of the Course
BOT9105P	SECONDARY METABOLITES AND BIOPROCESS ENGINEERING
BOT9106P	MOLECULAR PLANT PATHOLOGY AND DISEASE MANAGEMENT

DSE Lab List-4

Course Code	Title of the Course
BOT9107P	APPLICATIONS OF MICROBIAL TECHNOLOGY
BOT9108P	BIOSYSTEMATICS-1I

DSE Lab List-5

Course Code	Title of the Course
BOT9109P	APPLIED PHYCOLOGY
BOT9110P	COMMERCIALIZATION OF MICROPROPAGATION TECHNOLOGIES

DSE LAB-Research Orientation in Plant Sciences

Class	Code	Description
SEMESTER - IV	BOT9111P	**Research Orientation in Plant Sciences:** Credit hours for Research Orientation in Plant Sciences and marking schemes is equivalent to other DSEs. Students have to submit a hardcopy of dissertation and give a presentation of Research Orientation in Plant Sciences for evaluation. Details of dissertation proforma and marking scheme is enclosed as Annexure I.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – I

Code of the course	**BOT8000T**
Title of the course	**BIOLOGY AND DIVERSITY OF ALGAE AND BRYOPHYTES**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Lectures and tutorial (40+20=60hours). The 40 hours lectures for content delivery and 20 hours on diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide fundamental and advance knowledge about the biology and biodiversity of various algae and bryophytes

Course Learning Outcomes

After completion of this course, students will be able to

CO1: Learn criteria of classification, diversity, life form, reproduction, phylogeny, nutritional and economic importance of the plants.

CO2: Develop critical understanding on morphology, anatomy and reproduction.

CO3: Develop proficiency in the experimental technique and methods of appropriate analysis of plant of these groups.

CO4: Explore many unexplored plants for the economic benefits of human like medicine, biofertilizers and other uses because Rajasthan have diversified climatic condition.

CO5: Understand plant origin, evolution and their transition to land habitat because algae and bryophytes are one of the basics of botany.

Syllabus

Unit-I Lecture hours: 12

Algae: General account, thallus organisation, cell structure, reproduction, life cycle pattern, trends of classification. Systematic position of Blue Green Algae. Economic and evolutionary importance of algae.

Unit-II Lecture hours: 12

Algae: Salient features, interrelationships and comparative account of Chlorophyta, Charophyta, Xanthophyta and Bacillariophyta.

Unit –III Lecture hours: 12

Algae: Salient features, interrelationships and comparative account of Phaeophyta, Rhodophyta, Prochlorophyceae, Glaucophyceae, Eustigmatophyceae.

Unit-IV Lecture hours: 12

Bryophytes:. General characters and classification. Origin, evolution of gametophyte and sporophyte. Economic, evolutionary and ecological importance of bryophytes.

Unit-V Lecture hours: 12

Bryophytes: Comparative study of structure, reproduction and life cycle and interrelationship with special reference to Sphaerocarpales, Marchantiales, Jungermanniales, Calobryales, Anthocerotales, Sphagnales, Bryales.

Suggested Books and References:

1. Bold H. C and Wynne M.J (1975). Introduction to the Algae: Structure and Reproduction Prentice Hall Biological Science Series.
2. Chapman V.J and Chapman D.J (1973). The Algae. Macmillan and company, New York.
3. Fritsch F.E (1945). The Structure and Reproduction of the Algae Volume I and II, Cambridge University Press.
4. Kumar H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.
5. Morries I. 1986. An Introduction to the Algae. Cambridge University Press, U.K.
6. Round F.E. 1986. The Biology of Algae. Cambridge University Press, Cambridge.
7. Vijayraghavan M.R and Bela Bhatia (1997), Brown Algae: Structure, Ultrastructure and Reproduction, APH publishing Corporations, New Delhi.
8. Vijayraghavan M.R and Bela Bhatia (1997), Red Algae: Structure,Ultrastructure and Reproduction, APH publishing Corporations, New Delhi.
9. Chandrakant, Pathak (2003). Bryophyta, Dominant Publishers and Distributors, New Delhi.
10. Parihar N.S. 1991. Bryophyta. Central Book Depot, Allahabad.
11. Puri P. 1980. Bryophytes. Atma Ram and Sons, Delhi.
12. Rashid A (1998). An introduction to Bryophyta. Vikas Publishing House Pvt. Ltd, New Delhi.

Suggested E-resources

- https://www.algaebase.org/
- https://www.e-algae.org/
- https://ag.arizona.edu/azaqua/algaeclass/algaeweb.html
- https://stri.si.edu/story/bryophytes
- https://www.britishbryologicalsociety.org.uk/

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – I

Code of the course	**BOT8001T**
Title of the course	**MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Lectures and tutorial (40+20=60hours). The 40 hours lectures for content delivery and 20 hours on diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide fundamental and advance knowledge about the microbiology, mycology and plant pathology.

Course Learning Outcomes

After completion of this course, students will be able to

CO1: Understand the general characteristic of archaebacteria and eubacteria

CO2: Develop a good knowledge of characteristics of different microorganisms and their significance.

CO3: Understand common characteristics of different classes of fungi with their economic and ecological importance.

CO4: Identify plant diseases ant their control measures.

CO5: Develop skill to perform basic experiments to grow and study vegetative and reproductive structure of microorganism in laboratory.

Syllabus

Unit –I Lecture hours: 12

Archaebacteria and Eubacteria: General characters, distribution, ultra-structure, nutrition, multiplication, biology, economic and evolutionary importance. Methods of genetic recombination and their significance. Isolation, culture and identification of bacteria.

Unit –II Lecture hours: 12

Viruses: Physical and chemical characteristics, ultra-structure, multiplication, isolation and purification and economic importance. Plant virus transmission.

Mycoplasma, phytoplasma, L-forms, viroids, rickettsias, spiroplasma and prions: A general account, economic and evolutionary importance.

Unit –III Lecture hours: 12

Fungi: General characters, life cycle patterns, ultra-structure, mycelial growth, cell composition, nutrition (necrotrophs, biotrophs and symbionts), methods of reproduction. Recent trends in classification and phylogenetic relationship among fungal groups.

Fungal associations: Mycorrhizae and Lichens; General account of morphology, reproduction, life cycle and significance.

Unit –IV Lecture hours: 12

Fungi: General account of morphology, reproduction, life cycle and economic importance of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Fungiimperfecti. Economic importance of fungi. Heterothallism, Heterokaryosis and Parasexuality in fungi.

Unit –V Lecture hours: 12

Plant disease management: Symptoms of plant diseases. Control methods. Integrated pest management. Study of etiology and management of following important plant diseases; Downy mildew and Green ear of bajra, Blight of maize, Tikka disease of groundnut, Leaf blight of rice, Grassy shoots of sugarcane, Sandal spike, Rice tungro, Bunchy top of banana. Diseases and Pests of Ornamental Plants.

Suggested Books and References:

1. Alexopoulus, C. J., Mims, C. W. and Blackwel, M., Introductory Mycology, John Wiley & Sons Inc.
2. Mandahar, C. L. Introduction to Plant Viruses. Chand & Co. Ltd., Delhi.
3. Mehrotra, R. S. and Aneja, R. S. An Introduction to Mycology. New Age Intermediate Press.
4. Manual of Microbiology: Tools and Techniques; Kanika Sharma. Ane books. New Delhi. 2007
5. Textbook of Microbiology; Kanika Sharma. Ane books. New Delhi. 2011.

Suggested E-resources

- https://plpa.cfans.umn.edu/
- https://www.springer.com/journal/42161
- https://www.ffungi.org/
- https://www.mycobank.org/

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – I

Code of the course	**BOT8002T**
Title of the course	**PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Lectures and tutorial (40+20=60hours). The 40 hours lectures for content delivery and 20 hours on diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide fundamental and advance knowledge about the Pteridophytes, Gymnosperms and Palaeobotany

Course Learning Outcomes

After completion of this course, students will be able to

CO1: Understand about the evolution of stellar system and heterospory.
CO2: Gain knowledge about the general character and classification of pteridophytes.
CO3: Understand about the general character of gymnosperms.
CO4: Learn about evolutionary relationship of Cycadopsida, Coniferopsida, Gnetopsida, Coniferales
CO5: Understand about the basic principle of paleobotany and know about prominent scientist.

Syllabus

Unit-I Lecture hours: 12

Pteridophyta: Evolution of stelar system; Evolution of Prothallus; soral evolution; Heterospory and seed habit; Cytological evolution of ferns; Apogamy and Apospory. Telome theory.

Unit-II Lecture hours: 12

Pteridophyta: General account of present and past distribution with special reference to India. Study of structure, reproduction, evolution, classification and inter-relationships of the Pteridophyta with special reference to Rhyniophytopsida, Psilotopsida, Lycopsida, Sphenopsida, Pteropsida.

Unit-III Lecture hours: 12

Gymnosperms: General account of present and past distribution of gymnosperms with special reference to India. Economic importance of gymnosperms, phylogeny and relationships of the main groups of gymnosperms.

Unit-IV Lecture hours: 12

Gymnosperms: Study of structure, reproduction, evolution, classification, life history with special reference to Cycadopsida, Coniferopsida, Gnetopsida. Evolution of the female strobilus in Coniferales.

Unit-V Lecture hours: 12

Palaeobotany: Geological time scale, types and nomenclature of fossils, fossilization, methods of study of fossils. Study of fossil archegoniates. Brief account of contributions of Eminent Scientists, Major National and International Institutions and recent advances.

Suggested Books and References:

1. Bhatnagar S.P and Moitra Alok 1996. Gymnosperms. New Age International Pvt. Ltd.Publishers, New Delhi, 470 pp.
2. Bierhorst D.W. 1971. Morphology of Vascular Plants. New York and London.
3. Biswas C and Johari B.M 2004. The Gymnosperms Narosa Publishing House, New Delhi.497 pp.
4. Parihar N.S. 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
5. Stewart W.N. and Rathwell G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press. Cambridge.

Suggested E-resources

- https://www.worldfloraonline.org/taxon/wfo-9949999998
- https://www.rbge.org.uk/science-and-conservation/herbarium/our-collections/gymnosperms/
- http://www.theplantlist.org/browse/G/
- https://www.pteridoportal.org/portal/index.php

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – I

Code of the course	**BOT8003T**
Title of the course	**CELL AND MOLECULAR BIOLOGY**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Lectures and tutorial (40+20=60hours). The 40 hours lectures for content delivery and 20 hours on diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide fundamental and advance knowledge about the cell biology and molecular biology of the plants.

Course Learning Outcomes

After completion of this course, students will be able to

CO1: Understand the structure and function of cell organelle at ultrastructure level
CO2: Explore molecular level regulation of cell cycle and cancer.
CO3: Understand the nucleic acid structure, replication and transcription mechanism
CO4: Develop the knowledge of functioning of protein synthesis machinery
CO5: Learn the gene regulation mechanism and basic techniques of genomics and proteomics

Syllabus

Unit-I Lecture hours: 12

Cell: Cell types and structure. Development of intracellular compartment, Structure and functions of cellular membranes, cell wall and cell organelles (nucleus, mitochondria, chloroplasts, Golgi apparatus, lysosomes, endoplasmic reticulum,vacuoles, ribosomes, and cytoskeleton). Synthetic cell and recent developments. Genome organization. Organization, diversity, evolution and function of mitochondrial and chloroplast genome.

Unit-II Lecture hours: 12

Cell cycle: mitosis and meiosis. Cell cycle regulation, role of cyclins and cyclin-dependent kinases.
Cancer: Molecular genetics of Cancer: oncogenes, tumor suppressor genes, metastasis, therapeutic interventions of uncontrolled cell growth, apoptosis.

Unit-III Lecture hours: 12

DNA: DNA structure and types (A-, B-, Z-, DNA). DNA replication, enzymes of DNA replication,DNA repair mechanisms.
RNA: RNA synthesis and processing: Transcription factors and machinery, RNA polymerases, transcription initiation, elongation and termination, RNA processing: RNA editing, capping, polyadenylation, splicing, structure and function of different types of RNA, Reverse transcriptase.

Unit-IV Lecture hours: 12

Protein: Types, Properties, Structure, function, Cellular localization, Reverse turn.
Protein synthesis and processing: Genetic code, Ribosome, Translation: formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, translational proof-reading, translational inhibitors, post-translational modification of proteins. Signal hypothesis, protein sorting to mitochondria and chloroplasts. Ramchandran Plot. DNA-Protein interactions and Protein-protein interactions

Unit-V **Lecture hours: 12**

Gene regulation: Regulation of gene expression in pro- and eukaryotes, the control sequences (operator, promoter, terminator, attenuator, enhancer),Operon model - lac, trp, attenuation, role of chromatin in regulating gene expression and gene silencing.

Genomics and Proteomics: Introduction to Structural, functional genomics. Microarrays, Brief account of Proteomics. 2-D electrophoresis of proteins Concept of Transcriptomics: RNAi and Gene Silencing, Metabolomics and Metagenomics.

Suggested Books and References:

1. J.D. Watson, T.A. Baker, S.P. Bell etc., Molecular Biology of the Gene, Pearson Education, India.
2. J.W. Dale and Mv Schantz, From Genes to Genomes, John Wiley & Sons.
3. B.D. Singh, Biotechnology, Kalyani Publishers.
4. An Introduction to Molecular Biotechnology by M. Wink, Wiley-VCH.
5. Introduction to Molecular Biology, Genomics & Proteomics for Biomedical Engineers by M.R. Neuman, CRC Press.

Suggested E-resources

- https://onlinelibrary.wiley.com/journal/10958355
- https://bmcmolcellbiol.biomedcentral.com/
- https://www.embl.org/
- https://www.mbi.ucla.edu/

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – I

Code of the course	**BOT8004P**
Title of the course	**BOT LAB I**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Practical- 120 hours (Hands-on, demo, virtual, pictorial, video observations, with main emphasis on concept, principle)
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide practical knowledge based on theory papers (BIOLOGY AND DIVERSITY OF ALGAE AND BRYOPHYTES and MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY).

Course Learning Outcomes

After completion of this course, students will be able to

- Understand the internal and external structures algae and bryophytes
- Understand the structures various microorganisms
- Understand the structure and reproductive structures of fungi
- Understand the symptoms of various diseases in plants

Syllabus

Practicals:

1. Microscopicpreparationsandstudy of followingalgalmaterials:*Chlamydomonas, Volvox, Coleochaete, Hydrodictyon, Ulva, Cladophora, Pithophora, Oedogonium, Vaucheria, Chara, Ectocarpus, Sargassum, Batrachospermum*, *Polysiphonia*, Diatoms- Available genera.
2. Isolationand establishment of axenicalgalculture
3. Study of externalandinternalmorphologyandmicroscopicpreparations of followingBryophytes:*Marchantia, Plagiochasma, Asterella, Targionia, Pellia*, *Porella*, *Anthoceros, Notothylus, Sphagnum, Funaria, Rhodobryum*and*Polytrichum*.
4. Isolation culture and identification of bacteria from various sources.
5. Identification of cultured bacteria using Gram's stain.
6. Isolation culture and identification of blue green algae from various sources and study of heterocyst.
7. Study and identification of following fungal genera: *Synchytrium*, *Phytopthora*, *Peronospora*, *Mucor*, *Penicillium*, *Erysiphe*, *Claviceps*, *Agaricus*, *Puccinia*, *Uromyces*, *Melampsora*, *Sphacelotheca*.
8. Isolation and identification of mycorrhizae associated with various plant species.
9. Study of important plant diseases
10. Study of lichens/mycorrhiza
11. Local field trip

Any other experiment setup by the faculty covering the theme of the paper and learning outcomes may also be included.

Scheme of Examination
External examination- 80 Marks

- Major practical exercise (based on BOT8000T) – 16 Marks
- Minor practical exercise (based on BOT8000T) – 08 Marks
- Major practical exercise (based on BOT8001T) – 16 Marks
- Minor practical exercise (based on BOT8001T) – 08 Marks
- Identification and comments of spots – 12 Marks
- Record- 10 Marks
- Viva-Voce- 10 Marks

Suggested Books and References:

1. Chapman V.J and Chapman D.J (1973). The Algae. Macmillan and company, New York.
2. Fritsch F.E (1945). The Structure and Reproduction of the Algae Volume I and II, Cambridge University Press.
3. Kumar H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.
4. Morries I. 1986. An Introduction to the Algae. Cambridge University Press, U.K.
5. Round F.E. 1986. The Biology of Algae. Cambridge University Press, Cambridge.
6. Vijayraghavan M.R and Bela Bhatia (1997), Brown Algae: Structure, Ultrastructure and Reproduction, APH publishing Corporations, New Delhi.

6. Mandahar, C. L. Introduction to Plant Viruses. Chand & Co. Ltd., Delhi.
7. Mehrotra, R. S. and Aneja, R. S. An Introduction to Mycology. New Age Intermediate Press.

7. Manual of Microbiology: Tools and Techniques; Kanika Sharma. Ane books. New Delhi. 2007

Suggested E-resources

- https://www.algaebase.org/
- https://www.e-algae.org/
- https://ag.arizona.edu/azaqua/algaeclass/algaeweb.html
- https://stri.si.edu/story/bryophytes
- https://www.springer.com/journal/42161
- https://www.ffungi.org/
- https://www.mycobank.org/

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – I

Code of the course	**BOT8005P**
Title of the course	**BOT LAB II**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Practical- 120 hours (Hands-on, demo, virtual, pictorial, video observations, with main emphasis on concept, principle)
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide practical knowledge based on theory papers (PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY and CELL AND MOLECULAR BIOLOGY).

Course Learning Outcomes

After completion of this course, students will be able to

- Understand the internal and external structures pteridophytes
- Understand the internal and external structures gymnosperms
- Understand the structure of plant fossils
- Understand the cell division and structure of cell organelles
- Understand the molecular biology of plants and bioinformatics through various practicals

Syllabus

Practicals

1. Study of temporary, double stained microscopic preparations of Root/ stem/ rhizome/ petiole/ reproductiveparts of following pteridophytes:
2. *Psilotum, Lycopodium, Selaginella, Isoetes, Equisetum, Ophioglossum, Osmunda, Lygodium, Gleichenia, Cyathea, Dryopteris, Pteris, Actiniopteris, Adiantum, Marsilea, Salviniaand Azolla*.
3. Permanent doublestainedmicroscopicpreparations of T.S., T.L.S. and R.L.S. of stem of *Ginkgo, Pinus, Biota, Araucaria, Taxus, Taxodium, Agathis, Picea, Cephalotaxus, Cedrus, Podocarpus, Abies, Cupressus, Juniperus, Gnetum,Ephedra*
4. T.S. Leaflet and Rachis of *Cycas*and*Zamia*andneedle of *Pinus*.
5. T.S. of coralloid root of *Cycas*.
6. Microscopic preparations of male cone of *Pinus*and male andfemalecones of *Ephedra*.
7. Study of male coneandmegasporophyll of *Cycas*.
8. Study of fossil slides and specimens.
9. General study of chromosomes: Mitosis: Onion, Meiosis: Onion.
10. Ultrastructure of cells, cell organelles (study through microphotographs)
11. Isolation of genomic DNA and its visualization on Agarose gel.
12. Quantification of DNA.
13. Cot-curve preparation for given DNA sample.
14. Demonstration of function of thermal cycler and thermal program
15. Demonstration of preparation of reaction mixture for amplification of gene of interest from isolated genomic DNA
16. Horizontal gel electrophoresis for separation of amplified PCR products for marker studies
17. Demonstration of primer designing for amplification of gene of interest
18. Perform BLAST for given nucleotide sequence
19. Sequence retrieval from databases.

Any other experiment setup by the faculty covering the theme of the paper and learning outcomes may also be included.

Scheme of Examination
External examination- 80 Marks

- Major practical exercise (based on BOT8002T) – 16 Marks
- Minor practical exercise (based on BOT8002T) – 08 Marks
- Major practical exercise (based on BOT8003T) – 16 Marks
- Minor practical exercise (based on BOT8003T) – 08 Marks
- Identification and comments of spots – 12 Marks
- Record- 10 Marks
- Viva-Voce- 10 Marks

Suggested Books and References:

1. Bierhorst D.W. 1971. Morphology of Vascular Plants. New York and London.
2. Biswas C and Johari B.M 2004. The Gymnosperms Narosa Publishing House, New Delhi.497 pp.
3. Parihar N.S. 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
4. An Introduction to Molecular Biotechnology by M. Wink, Wiley-VCH.
5. Introduction to Molecular Biology, Genomics & Proteomics for Biomedical Engineers by M.R. Neuman, CRC Press.

Suggested E-resources

- https://www.worldfloraonline.org/taxon/wfo-9949999998
- https://www.rbge.org.uk/science-and-conservation/herbarium/our-collections/gymnosperms/
- http://www.theplantlist.org/browse/G/
- https://onlinelibrary.wiley.com/journal/10958355
- https://bmcmolcellbiol.biomedcentral.com/
- https://www.embl.org/
- https://www.mbi.ucla.edu/

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – II

Code of the course	**BOT8006T**
Title of the course	**CYTOGENETICS, GENETICS AND PLANT BREEDING**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Lectures and tutorial (40+20=60hours). The 40 hours lectures for content delivery and 20 hours on diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide the advance theoretical knowledge of Cytogenetics, Genetics and Plant Breeding

Course Learning Outcomes

After completion of this course, students will be able to

- **CO1:** To develop conceptual understanding of chromosomes, law of inheritance, genetic basis of loci, alleles and their linkage.
- **CO2:** Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders and study of chromosomal basis of inheritance.
- **CO3:** Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary level.
- **CO4:** Develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool.
- **CO5:** Learning the methods of crop improvement along with development of mapping population in plants, QTL mapping, and molecular marker assisted breeding.

Syllabus

Unit-I Lecture hours: 12

Chromosomes: Structure of chromatin and chromosomes, heterochromatin, euchromatin, Nucleosome structure, Karyotyping, DNA scaffolds and loops. Lampbrush and Polytene chromosomes, Supernumerary chromosomes, Structural and numerical alterations in chromosomes, C-value paradox, Cot curve and its significance, Unique and repetitive DNA, Gene families, transposable elements in eukaryotes and prokaryotes.

Unit-II Lecture hours: 12

Mendelismand Neo-Mendelism: Mendalian laws of inheritance, Modern concept of gene and alleles, Gene gene interactions, Multiple alleles and pleiotropy, pseudoalleles, complementation tests, lethal alleles, penetrance and expressivity.

Unit-III Lecture hours: 12

Chromosomal basis of inheritance: Sex determination; Sex linked, sex influenced and sex limited traits; Linkage and crossing over, Linkage analysis and linkage map.

Extra chromosomal inheritance: Extra-nuclear inheritance in *Neurospora*, *Chlamydomonas*, *Paramecium*, Yeast, *Drosophila* and Man, Mitochondrial genomes, Chloroplast genomes, Cytoplasmic male sterility. Somatic cell genetics.

Unit-IV Lecture hours 12

Pedigree: Pedigree analysis, lod score for linkage testing, genetic disorders. Quantitative genetics: Polygenic inheritance.

Mutations: Spontaneous and induced mutations, physical and chemical mutagens. molecular basis of gene mutations,.

Genetic recombination: Recombination and genetic mapping, Homologous and non-homologous recombination, site-specific recombination. Physical mapping of genes,

Unit-V Lecture hours: 12

Plant breeding; Introduction and objectives. Methods of crop improvement, advantages and limitations; Hybridization, mass selection, pure line selection; inbreeding depression, heterosis. Green revolution.

Molecular plant breeding: Development of mapping population in plants, QTL mapping, Importance of molecular marker assisted breeding.

Suggested Books and References:

1. G. Karp, 2015. Cell and Molecular Biology, John Wiley & Sans, Inc.
2. EDP De Robertis, 1987. Cell and Molecular Biology, Zea and Febiger.
3. H. Lodish, A. Berk, P. Matsudaira, C.A. Kaiser etc., 2009. Molecular Cell Biology, Scientific American Books.
4. Khush G. S. Cytogenetics of aneuploides. Academic Press New York USA.
5. Burnham C. R. Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.
6. Hartl D. L. and Jones E. W. Genetics: Principles and Analysis Jones and Barew Publishers Massachusetts USA.
7. Karp G. 2015. Cell and Molecular Biology : Concepts and Experiments, John Wiley and Sons Inc USA.
8. Fikui K. and Nakayama S. Plant chromosomes; Laboratory Methods CRC Press Boca Ration Florida.
9. Gupta P. K. Cytogenetics. Rastogi Publication Meerut.
10. Prasad G. Introduction to Cytogenetics. Kalyani Publishers, New Delhi.
11. Sinha U. and Sinha S. Cytogenetics, Plant Breeding and Evolution. Vikas Publishing house Pvt. Ltd. New Delhi
12. Sumner A.T. Chromosome and organization. Blackwell publishing
13. Swanson C. P., Merz T. and Young J. Cytogenetics. Prentice Hill of India Private Ltd. New Delhi.

Suggested E-resources

- https://learn.genetics.utah.edu/
- https://medlineplus.gov/genetics/
- https://www.frontiersin.org/journals/genetics
- https://cals.ncsu.edu/horticultural-science/research/global-plant-breeding/
- https://www.fibl.org/en/themes/plant-breeding

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – II

Code of the course	**BOT8007T**
Title of the course	**PLANT DEVELOPMENTAL BIOLOGY AND RESOURCE UTILIZATION**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Lectures and tutorial (40+20=60hours). The 40 hours lectures for content delivery and 20 hours on diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide the advance theoretical knowledge of plant developmental biology and resource utilization

Course Learning Outcomes

After completion of this course, students will be able to

- **CO1:** Learn about the organization of meristem and vascular tissue differentiation
- **CO2:** Understand about the anatomical structure of stem and roots and learn the genetic and molecular aspects of flower development.
- **CO3:** Understand the structure of anther and pollen wall because ultrastructure of pollen grain plays an important role in taxonomy. Evaluate the special structures and types of male and female gametophyte and learn the reproductive process in angiospermic plants.
- **CO4:** Understand the mechanism of pollination and fertilization and can relate between embryo, endosperm and seed. Comprehend the causes of polyembryony and apomixis with its classification.
- **CO5:** Learn about the ethnobotanical practices and economic importance of plants. Increase an awareness and appreciation of plants and plant products encountered in everyday life of human use

Syllabus

Unit-I Lecture hours: 12

Meristems: Introduction, organization of meristems, shoot development– organization of the shoot apical meristems (SAM), Cytological and molecular analysis of SAM; Control of tissue differentiation, especially xylem and phloem, wood development in relation to environmental factors. Root development -Organization of root apical meristem (RAM), Vascular tissue differentiation, lateral roots; root hairs. Root-microbe interaction.

Unit –II Lecture hours: 12

Plant anatomy: Primary and secondary structure of root and stem of angiosperms. Anomalous secondary growth in stem and roots of angiosperms. Leaf anatomy. Leaf development and phyllotaxy.
Flower: Evolution of flower, genetics of floral organ differentiation; foliar stamens; open carpels; primitive living angiosperms, floral anatomy, inferior ovary, placentation and its evolution.

Unit –III Lecture hours: 12

Male gametophyte: Structure of anthers, microsporogenesis, role of tapetum, pollen germination, pollen tube growth and guidance, pollen embryos.

Female gametophyte: Ovule development and types, placentation types and its evolution. Megasporogenesis.
Embryo sacs: organization of the embryo sac, types of embryo sacs.

Unit –IV Lecture hours: 12

Pollination and Fertilization: pollen-pistil interaction; pollination mechanisms and vectors; sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspect). Double fertilization, *in vitro* fertilization.
Endosperm: Types, ultrastructure, endosperm haustoria, their extension, persistence and function.
Embryo-Polarisation of Zygote, embryogenic types, organogenesis of mono and dicot embryos. Structure and function of suspensor. Polyembryony (types and significance). Apomixis.

Unit –V Lecture hours: 12

Ethnobotany: Introduction, History and development of ethnobotanical study; scope and potential applications; methods in ethnobotanical study. Applied Ethnobotany and intellectual property rights.
Economic Botany: Origin, evolution, Botany, cultivation and uses of fibre yielding plants, cereal crops, sugar yielding plants, pulses, dye plants, gum yielding plants, oil yielding plants fruits and nuts, vegetables, spices, condiments, beverages, medicinal plant, rubber yielding plants and petrocrops, Centres of origin.

Suggested Books and References:

- Bhojwani, S.S. and Bhatnagar, S.P. Embryology of Angiosperms (4th Revised and enlarged edition), 2000.
- Burgess, J. 1985. An Introduction to Plant Cell Development, Cambridge University Press, Oxford.
- Fahn, A. 1982. Plant Anatomy (3rd Ed.), Pergamon Press, Oxford.
- Johri, B.M., Ambegaokar, K.B. and Srivastava, P.S. Comparative Embryology of Angiosperms, Vol. I & II, SpringerVerlag.
- Lyndon, R.F. 1990. Plant Development – The Cellular basis, Unnin Hyman, London.
- Maheshwari, P. An Introduction to Embryology of Angiosperms, 1950.
- Raghavan, V. 1999. Developmental Biology of Flowering Plants, SpringerVerlag, NewYork.
- Shivanna, K.R. and Johri, B.M. The Angiosperm Pollen structure and Function, Wiley Eastern Ltd., Publications, 1989.

Suggested E-resources

- https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/plant-development
- https://onlinecourses.nptel.ac.in/noc20_bt36/preview
- https://www.plantdev.wzw.tum.de/home.html
- https://plantae.org/
- https://www.kew.org/science/collections-and-resources/collections/economic-botany-collection
- https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/economic-botany

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – II

Code of the course	**BOT8008T**
Title of the course	**PLANT GROWTH AND DEVELOPMENT**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Lectures and tutorial (40+20=60hours). The 40 hours lectures for content delivery and 20 hours on diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide the advance theoretical knowledge of plant hormones, photoreceptors, signal transduction and morphogenesis in plants.

Course Learning Outcomes

CO1: Students will be able to understand the plant-water relationship and various mechanisms of active and passive transportation of molecules across the living membranes.

CO2: Students will be able to understand the importance of micro and macro-nutrients on plant growth and development. They will also understand the various factors controlling seed development and germination.

CO3: Students will be skilled theoretically about the biosynthesis and physiological effects of various plant growth regulators.

CO4: Students will learn about the importance of photoperiods and role of various photoreceptprs in flowering.

CO5: Students will learn various mechanisms of signal transduction in plants.

Syllabus

Unit-I Lecture hours: 12

Water relations: Chemical and Water potential. Absorption of water. Ascent of Sap, Transpiration, Factors affecting the rate of transpiration, Physiology of stomatal movement and regulation of transpiration. Guttation. Membrane transport: transport proteins, passive and active mechanisms.

Unit-II Lecture hours: 12

Plant nutrition: Nutrient requirement of plants. Essential nutrients: macro and micronutrients, Chelating agents, Nutrient deficiency (Symptoms and disorders).

Seed: Seed development, germination and dormancy, bud dormancy, Ageing, Senescence and death.

Unit –III Lecture hours: 12

Plant growth and Regulation: Over view, Historical account, Measurement of growth and growth kinetics. Plant growth regulators: Biosynthesis, chemical nature, physiological effects and mode of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, jasmonic acid and salicylic acid.

Unit –IV Lecture hours: 12

Photomorphogenesis: Over view, Historical account, Photoreceptors: structure, function, properties (Phytochrome and cryptochrome), molecular mechanism of action and role in photomorphogenesis. Photoperiodism:significance, Florigen, floral induction and development, Vernalization.

Unit –V Lecture hours: 12

Signal transduction: Basic concept and principles,Receptors and Second messengers (types, function),

Signal transduction and gene expression, Signaling involving calcium, inositol phospholipids and G proteins, Two component sensor regulator system. Plant movements and taxis; Types, role of signal transduction.

Suggested Books and References:

1. Introductory Plant Physiology, 2nd Edition G. Ray Noggle (Emeritus),George J. Fritz. Prentice Hall of India. 2002.
2. Plant Physiology; Sebanek J. Sebanek. Elsevier Science & Technology. 1992.
3. Plants Under Stress: Biochemistry, Physiology and Ecology and Their Application to Plant Improvement; Hamlyn G. Jones, T. J. Flowers, M. B. Jones. Cambridge University Press. 2008.
4. Biochemistry & Molecular Biology of Plants; Eds: Bob Buchanan, Wilhelm Gruissem, Russell Jones (Editor) Wiley; 1st. edition. 2002.
5. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants. M. N. V. Prasad, Kazimierz Strzalka, M. N. V. Prasad. Springer. 2002.
6. Plant Hormones: Physiology, Biochemistry and Molecular Biology: P. J. Davies Peter J. Davies. Kluwer Academic Publishers. 1995.
7. The Physiology of Flowering Plants; Opik, Helgi. Cambridge University Press.
8. Text book of Plant Physiology. V. Verma. Ane Books. New Delhi. 2007.
9. Plant Physiology; R.M. Devlin & Witham. Reinhold publications. 1969.

Suggested E-resources

- http://www.phytohormones.info/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4242202/
- https://organismalbio.biosci.gatech.edu/chemical-and-electrical-signals/plant-hormones-and-sensory-systems/
- https://study.com/academy/lesson/signal-transduction-in-plants-from-reception-to-response.html
- https://plantae.org/
- https://www.kew.org/science/collections-and-resources/collections/economic-botany-collection

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – II

Code of the course	**BOT8009P**
Title of the course	**BOT LAB III**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Practical- 120 hours (Hands-on, demo, virtual, pictorial, video observations, with main emphasis on concept, principle)
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide the advance knowledge of practicals based on theory papers (CYTOGENETICS, GENETICS AND PLANT BREEDING, and PLANT DEVELOPMENTAL BIOLOGY AND RESOURCE UTILIZATION).

Course Learning Outcomes

CO1: Students will learn to perform various practicals of cytogenetics.
CO2: Students will learn to perform various practicals of genetics.
CO3: Students will learn to perform various practicals of plant breeding.
CO4: Students will learn to perform various practicals of plant developmental biology
CO5: Students will understand the practical aspects of economic botany.

Scheme of Examination

External examination- 80 Marks

- Major practical exercise (based on BOT8006T) – 16 Marks
- Minor practical exercise (based on BOT8006T) – 08 Marks
- Major practical exercise (based on BOT8007T) – 16 Marks
- Minor practical exercise (based on BOT8007T) – 08 Marks
- Identification and comments of spots – 12 Marks
- Record- 10 Marks
- Viva-Voce- 10 Marks

Syllabus

Practicals

1. Meiotic irregularity in *Rhoeo discolor*.
2. Study of Salivary gland chromosome in *Chironomas*.
3. Emasculation, crossing and bagging in crop plants.
4. Problem of genetics.
5. Karyotype determination in onion.
6. Barr body analysis.
7. Pedigree analysis.
8. Genetic exercises and test of goodness of fit using Chi-square
9. Training in paraffin wax method for preparation of serial sections from fixation to mounting of permanent slides
10. Staining of slides using single and double stains
11. Demonstration of slides showing embryological peculiarities (male and female gametophytes, endosperm, embryo)
12. Anatomical study of the following materials:

Stem: *Boerhaavia, Achyranthes, Bignonia, Chenopodium, Leptadaenia, Nyctanthes, Salvadora, Dracaena, Triticum, Mirabilis, Aristolochia, Amaranthus, Chenopodium.*

Root: *Tinospora, Ficus.*

Floralanatomy: Buds of *Opuntia, Rosa, Calotropis, Hibiscus*and*Nerium*.
NodalAnatomy: *Calotropis, Nerium*

13. Knowledge of at least 25 plant species of economically and traditionally important plants.

Any other experiment setup by the faculty covering the theme of the paper and learning outcomes may also be included.

Suggested Books and References:

- Burnham C. R. Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.
- Hartl D. L. and Jones E. W. Genetics: Principles and Analysis Jones and Barew Publishers Massachusetts USA.
- Karp G. 2015. Cell and Molecular Biology : Concepts and Experiments, John Wiley and Sons Inc USA.
- Fahn, A. 1982. Plant Anatomy (3rd Ed.), Pergamon Press, Oxford.
- Johri, B.M., Ambegaokar, K.B. and Srivastava, P.S. Comparative Embryology of Angiosperms, Vol. I & II, SpringerVerlag.
- Biochemistry & Molecular Biology of Plants; Eds: Bob Buchanan, Wilhelm Gruissem, Russell Jones (Editor) Wiley; 1st. edition. 2002.
- Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants. M. N. V. Prasad, Kazimierz Strzalka, M. N. V. Prasad. Springer. 2002.

Suggested E-resources

- https://web.mnstate.edu/chastain/assets/pp-lab-manual-2012.pdf
- https://www.rlbcau.ac.in/pdf/Forestry/FBT-111%20%20Plant%20Physiology.pdf
- https://www.biologydiscussion.com/plant-physiology-2/experiments-plant-physiology-2/top-45-experiments-on-plant-physiology/34628
- https://medlineplus.gov/genetics/
- https://www.frontiersin.org/journals/genetics
- https://www.fibl.org/en/themes/plant-breeding

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – II

Code of the course	**BOT8010P**
Title of the course	**BOT LAB IV**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	DCC
Delivery Type of the Course	Practical- 120 hours (Hands-on, demo, virtual, pictorial, video observations, with main emphasis on concept, principle)
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide the advance knowledge of practicals based on theory papers (Plant Growth and Develppmwnt)

Course Learning Outcomes

CO1: Students will learn to perform practical to evaluate the effects of radiation on seed germination.
CO2: Students will learn to perform seed viability test,
CO3: Students will understand the effects of ABA on stomata opening and closing.
CO4: Students will learn to perform the effect of IAA on rooting.
CO5: Students will understand the effect of various hormones on seed germination and senescence.

Syllabus

Practicals

1. Study the effects of radiation on seed germination.
2. Seed viability test.
3. Study the the effects of ABA on stomata opening and closing.
4. Study the effect of IAA on rooting.
5. Study the effect of various hormones on seed germination and senescence.

Any other experiment setup by the faculty covering the theme of the paper and learning outcomes may also be included.

Scheme of Examination

External examination- 80 Marks

- Major practical exercise (based on BOT8008T) – 24 Marks
- Minor practical exercise (based on BOT8008T) – 10 Marks
- Minor practical exercise (based on BOT8008T) – 10 Marks
- Identification and comments of spots (8) – 16 Marks
- Record- 10 Marks
- Viva-Voce- 10 Marks

Suggested Books and References:

1. Biochemistry & Molecular Biology of Plants; Eds: Bob Buchanan, Wilhelm Gruissem, Russell Jones (Editor) Wiley; 1st. edition. 2002.
2. Introductory Plant Physiology, 2nd Edition G. Ray Noggle (Emeritus),George J. Fritz. Prentice Hall of India. 2002.
3. Plant Physiology; Sebanek J. Sebanek. Elsevier Science & Technology. 1992.
4. Plants Under Stress: Biochemistry, Physiology and Ecology and Their Application to Plant Improvement; Hamlyn G. Jones, T. J. Flowers, M. B. Jones. Cambridge University Press. 2008.

5. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants. M. N. V. Prasad, Kazimierz Strzalka, M. N. V. Prasad. Springer. 2002.

Suggested E-resources

- http://www.phytohormones.info/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4242202/
- https://study.com/academy/lesson/signal-transduction-in-plants-from-reception-to-response.html
- https://plantae.org/

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – II

Code of the course	**BOT8100T**
Title of the course	PLANT ECOLOGY, CONSERVATION AND EVOLUTION
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	GEC
Delivery Type of the Course	Lectures and tutorial (40+20=60hours). The 40 hours lectures for content delivery and 20 hours on diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide the advance theoretical knowledge of ecosystem, ecology, conservation of threatened plants and plant evolutionary biology.

Course Learning Outcomes

After completion of this course, students will be able to

CO1: Understand the concept of population ecology and population genetics.
CO2: Learn about community structure and interaction**.**
CO3: Have knowledge of ecosystem functioning and global pollution phenomenon.
CO4: Understand concept of biodiversity and conservation strategies.
CO5: Conceptualize the phenomenon of evolution and speciation.

Syllabus

Unit-I Lecture hours: 12

Population: Concept of Metapopulation, Properties of populations (birth rate, death rate, age pyramids, survivorship curves, logistic model, carrying capacity), r- and k- strategies, life history pattern, Concept of Population Genetics (Hardy–Weinberg principle), Concept of Niche and Habitat; types of niche, niche width and overlap, character displacement, Homeostasis.

Unit-II Lecture hours: 12

Community Ecology: Biological and physical structure, Raunkiaer's Life form, organismal and individualistic model of community, Edges and ecotones, Succession; Concept, models and mechanisms.

Community interaction: Intraspecific population regulation, interspecific competition models; Lotka-Volterra model, type of interactions.

Unit-III Lecture hours: 12

Ecosystem: Ecosystem **s**tructure and function, Ecosystem stability; concept of resistance and resilience, Ecological energetic; energy flow through ecosystem. Global biogeochemical cycles of C, N, P and S.

Pollution: Global environmental changes; green house gases, O_3 depletion, eutrophication, International protocols and Acts related with environmental awareness and conservation, carbon foot print, carbon credits, carbon sequestration, Phytoremediation, Plant indicator.

Unit-IV Lecture hours: 12

Plant Biodiversity: Concept of Biodiversity, types of biodiversity, measurement of biodiversity (Simpson and Shannon diversity index), IUCN categories of threat. Strategies for conservation – *In situ* (Concept of Hotspots, Sanctuaries, National parks, Biosphere reserves) and *Ex situ* (Seed bank, gene

bank, botanical garden, in vitro etc.). Important conservation projects in India. International efforts and peoples participation for conservation. Important terms like Key stone species, Umbrella species, and flagship species, rivet popper hypothesis.

Unit-V Lecture hours: 12

Evolution: Origin of cells and unicellular evolution: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiment of Miller; the first cell: origin and evolution in prokaryotes and eukaryotes. Natural selection and Genetic Drift, concepts of neutral evolution. The Mechanisms of evolution, Speciation; allopatricity and sympatricity; convergent and divergent evolution.

Suggested Books and References:

- Aery, N.C. 2010. Manual of Environmental Analysis, Ane Books Pvt. Ltd., New Delhi.
- Kormondy, E.J. 1996. Concepts of Ecology. PrenticeHall India Pvt.Ltd., New Delhi.
- Odum, E.P. 1983. Basic Ecology. Saunders, Philadelphia.
- Smith, R.L. and Smith T.M. 1998. Elements of Ecolgy. Benjamin/Cummings Publication.
- Townsend, C.R., Begon, M., Harper, J.L. 2007. Essentials of Ecology. Blackwell Publishing.
- Heywood, V. (ed) 1995. Global Biodiversity Assessment. United Nations Environment Programme. Cambridge University Press, Cambridge, U.K.
- Katewa, S.S. & Jain Anita. Ethnobotany, Phytogeography, Plant Resources Utilization and conservation. Apex Publishing House, Jaipur. 2007.
- Swaminathan, M.N. & Jain, R.S. Biodiversity: Implications for global security, Macmillan, India. 1982.

Suggested E-resources

- https://www.iucn.org/
- https://www.unep.org/
- https://www.plant-ecology.info/
- https://ecology.uni-hohenheim.de/en/110619
- https://vtputkal.odisha.gov.in/subjectwise/plant-ecology-and-phytogeography/
- https://sustainability-innovation.asu.edu/ecologyexplorers/teacher-toolbox/lesson-plans/

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
Department of Botany
MSc Botany
Semester – II

Code of the course	**BOT8101T**
Title of the course	**TOOLS AND TECHNIQUES IN PLANT SCIENCES**
Level of the Course	NHEQF Level 6.0
Credit of the Course	4
Type of the Course	GEC
Delivery Type of the Course	Lectures and tutorial (40+20=60hours). The 40 hours lectures for content delivery and 20 hours on diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Prerequisites	Botany as one of the subjects in B.Sc.

Objectives of the Course

This course is designed to provide the advance theoretical knowledge the various tools and techniques used in plant biology research.

Course Learning Outcomes

After completion of this course, students will be able to

CO1: Understand the basic principle of microscopy, centrifugation and electrophoresis
CO2: Explore chromatography and spectrophotometry techniques.
CO3: Understand the basic principle of bioinformatics.
CO4: Develop the knowledge of central tendency and dispersion.
CO5: Learn the application of correlation, regression and analysis of variance.

Syllabus

Unit-I Lecture hours: 12

Microscopy: Optical, phase contrast, Fluorescence and electron microscopy (TEM and SEM), Confocal microscopy.
Centrifugation-Principle; Ultra centrifugation.
Electrophoretic techniques: Principle, types – Agarose Gel Electrophoresis, Native PAGE, SDS-PAGE, 2-D Gel Electrophoresis.

Unit-II Lecture hours: 12

Chromatography:Principle and methodology of chromatographic techniques: (a) Paper (b) Thin Layer (c) Column (d) Gel (e) Gas and (f) HPLC.
Spectrophotometry-Principle, and applications, Atomic Absorption Spectrometer, NMR.

Unit-III Lecture hours: 12

Bioinformatics: Introduction, BLAST, Biological Sequence Databases; nucleic acid and protein databases, Applications of Bioinformatics. Introduction to phylogenetics.
***In situ* hybridization:** FISH, McFISH and GISH.
Introduction to Nanobiotechnology

Unit-IV Lecture hours: 12

Biostatistics: Concept of treatment, replicates, sample and experimental design, Measures of central tendency – Mean (arithmetic), Median and Mode. Standard deviation and standard errors; skewness and kurtosis.

Unit-V Lecture hours: 12

Biostatistics: Basics of Correlation and Regression. Analysis of variance (single factor analysis), chi-square test.

Suggested Books and References:

1. Instrumental methods of chemical analysis: Chatwal and Anand, Himalaya Publishing House.
2. Instrumental Methods of Chemical Analysis: B.K. Sharma, Goel Publishing House.
3. S. C. Gupta. Fundamentals of Statistics. Himalaya Pub. House.
4. J. Medhi. Statistical Methods an introductory text. New Age International (P) Ltd. Publishers.
5. P. S. S. Sudar Rao & J. Richard. An introduction to biostatistics. Prentice Hall of India. N. Delhi.
6. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
7. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell

Suggested E-resources

- https://www.ausetute.com.au/chromato.html
- https://zeiss-campus.magnet.fsu.edu/articles/basics/index.html
- https://www.embl.org/
- https://www.ncbi.nlm.nih.gov/
- https://www.hsph.harvard.edu/wp-content/uploads/sites/565/2019/09/HST190_Lecture_1.pdf